An Analysis of the Dynamics of Multi-Disciplinary Medical Team Meetings and the Use of Communication Technology

A thesis submitted to the University of Dublin, Trinity College

in fulfillment of the requirements for the degree of

Doctor of Philosophy

May 2008

Bridget T. Kane

Declaration

I, the undersigned, declare that this work has not previously been submitted to this or any other University, and that unless otherwise stated, it is entirely my own work. This thesis may be borrowed or copied upon request with the permission of the Librarian, University of Dublin, Trinity College.

Bridget T. Kane

Dated: 1st May 2008

Acknowledgements

It would not have been possible to undertake this study without considerable help and support and I wish to sincerely thank those people and organizations who were instrumental in this achievement.

Dr. Saturnino Luz, my supervisor and mentor, challenged my assumptions and beliefs on many occasions, and always in an unbiased and logical manner. In providing prompt, detailed and constructive feedback he helped me see the weaknesses in my work and demonstrated how I might clarify and develop my ideas. The clarity of thought, wisdom and understanding he brings to his work is gratefully appreciated. His guidance and encouragement in helping me find my research feet is acknowledged and I am thankful for his continuing support.

The consultant staff, multidisciplinary team members and support staff at St. James's hospital co-operated fully and tolerated my persistent questions. I especially thank the members of the respiratory multidisciplinary team, in particular, Dr. Finbarr O'Connell, Prof. Luke Clancy, Dr. Ronan McDermott, Dr. Jim Meaney, Mr. Vincent Young, Ms. Eilis McGovern, Dr. Siobhain Nicholson, Dr. Rory O'Donnell, Dr. Joe Keane, Dr. Ruairi Fahy, Dr. Ken O'Byrne, Dr. Catriona O'Sullivan, Karl Doyle, Mary Devlin, Ann Hughes and Dr. Sardar Ali for their generous attitude, co-operation and support in this work. I learned that the work of clinical staff at the 'coal-face' is highly challenging, over the past few years in particular, and I have gained enormous respect for the individual team members who give generously of themselves and their skills in helping those less fortunate.

My thanks also to Prof. Eamon Sweeney, Prof. D. Sean O'Briain, Dr. Cian Muldoon, Dr. Eoin Gaffney, Dr. Mary Toner, Prof. John O'Leary and all of the pathologists and staff in the Central Pathology Department, St. James's hospital for their comments, co-operation and friendship at all times.

Dr. Kyran Bulger, in Tullamore, Dr. Aidan O'Brien, in Mullingar, and all the staff on the remote sides of the teleconference interface were very accommodating. I appreciated being able to visit Tullamore and Mullingar and experience the MDTM from the remote perspective. Thank you is also due to Noel Callaghan in Letterkenny, Eileen Byrne in Mullingar and Marie Barrett in Tullamore who were most obliging and provided the photographs, which are very much appreciated.

I appreciate the support of Prof. Peter Daly, Prof. Donal Hollywood, Prof. Con Timon, Prof.

Leo Stassen, Mr. Terry Boyle, Mr. Tom D'Arcy, Mr. Tom Lynch and Prof. John Reynolds and the lymphoma, head and neck, breast, gynae, urology and GI multidisciplinary teams who helped me gain insight into the work of multidisciplinary teams and their meetings.

The professional advice of Dr. Myra O'Regan, Department of Statistics, Trinity College Dublin is gratefully acknowledged.

I am sincerely grateful to Kirsten Bratke for having the patience and interest to proof-read draft documents and contribute to making the final version more readable. Edsko de Vries gave generously of his time in showing me the basics of Latex and helping me fix formatting issues.

Prof. Colm O'Morain, Vice-Chairman of the SJH / AMANCH Research Ethics Committee approved the research proposal on behalf of the Committee. The Irish Research Council for the Humanities and Social Sciences awarded the Government of Ireland research scholarship and provided financial support through the period of study.

The Health Informatics Society of Ireland were generous in their student award which allowed me to visit the Centre for Information Technology, National Institutes for Health, Bethesda, U.S.A., where the Telesynergy® system was developed. Mr. Kenneth M. Kempner, Centre for Information Technology, was very generous with his time and explained the intricacy of the Telesynergy® system, which I valued both on his visit to Ireland and during my visit to the Centre of Information Technology in November 2006.

Mr. Mike Dixon, surgeon, and the breast multidisciplinary team at the Western General Hospital, Edinburgh were very accommodating and welcomed me to their unit in December 2006. I am deeply grateful for the experience and insights gained through my visit there. Dr. Wilma Jack, Michael Hogg, Dr. Melanie Smith, Mr. Udi Chetty and Dr. Jeremy Thomas gave me the benefit of their insights and perspectives, for which I am grateful.

The comments from Dr. David W. Randall, Manchester Metropolitan University, Dr. Gavin Doherty and Prof. Khurshid Ahmad, Trinity College, following examination of this work are sincerely appreciated.

Finally, I wish to thank my family and friends for their continued support and encouragement.

Bridget T. Kane

University of Dublin, Trinity College

May 2008

Abstract

Multidisciplinary medical team meetings (MDTM)s are collaborative fora where healthcare specialists come together to discuss patient cases, establish a definitive diagnosis and determine the best treatment strategy for the patient. The practice of MDTMs is growing in importance as regulatory agencies advocate their adoption into routine practice.

This analysis of multi-disciplinary medical team meetings (MDTMs) identifies elements, or mechanics, of collaboration among team members and proposes measures to enhance the proceedings and make the MDTM more effective. The work of MDTMs is analysed both in its overall context of patient care and at the level of person-to-person interaction during a patient case discussion.

In this longitudinal study, the development of a multidisciplinary medical team was followed through a series of changes that incorporated the use of teleconferencing technology and a picture archive and communication system (PACS) into the proceedings. Analysis, based on qualitative and quantitative data, identifies the MDTM as a system that adds dependability to overall service delivery processes. Detailed analysis of screen displays and speech interactions, combined with observation data, are used to elucidate structures and analyse the dynamics of the MDTM.

System boundaries are defined that extend beyond the actual duration of the meeting. Stable work routines, timing and rhythms, are shown to be critical for MDTM success. Changes in organisation structures associated with MDTMs, both positive and negative, are demonstrated as a result of the adoption of teleconferencing. Although the discussion structure is relatively stable in teleconference, the dynamics of speech interactions are affected and patient case discussions take more time as a result.

Cases discussed in teleconference are less satisfactory from the users' perspective. However, there is a perceptible improvement in the quality of information exchanged at teleconferencing sessions compared to co-located meetings. Case controlled study reveals a doubling effect observed for participants who describe features in artefacts and for those who describe their professional approach (surgeons and radiation oncologist) in teleconference. Discussion around objects (artefacts) is most affected in teleconference. Examination of the use of video reveals an important requirement for the visual display of remote participants, that is not articulated in user surveys. The importance of increasing visual support for participants especially when the discussion involves

image assessment and the exchange of professional opinion is highlighted.

Visual needs are identified for both sides of the teleconference interface at MDTMs. Providing more control over audio, video and PACS would enhance teleconferences and image review. More control through personal devices is proposed to support interaction and increase participation. Furthermore, results suggest that having separate channels for tasks (pathology and radiology images) and person-to-person communication, by providing multiple displays, would make communication easier and save time. The display of radiological images is given special attention. With increasing complexity of imaging modalities, facilitating multiple views simultaneously is needed for satisfactory assessment.

The internal temporal structure identified in patient case discussions (PCD)s prompts the investigation of novel technologies for the development of an MDTM record. These results have implications for the design of future systems and the implementation of new channels of communication within the health service.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

Why do hospital clinicians have meetings? Might the need for meetings reflect a problem with information flow in the hospital? Are decisions made and how are they made? How do these meetings work in practice? If teleconferencing technology is used, does it affect the proceedings? These are the questions forefront in mind in undertaking this investigation of multidisciplinary medical team meetings (MDTMs). The goal of the study is to identify the elements and mechanics of operation that enhance or threaten the operation of the MDTM, and examine how technologies, or measures, might be applied to make this system more reliable, efficient and effective.

The MDTM is a relatively new, and rapidly growing, work practice and is an important junction in the patient management process. In this extended ethnographic study, the work of a multidisciplinary medical team (MDT) is analysed, both in its overall context in health service delivery and also in fine grained detail at the level of interaction among team members during individual patient case discussions (PCDs) at MDTMs.

The MDTM is identified as a *system*, that adds dependability to the overall patient management process. It is shown to have a predictable structure defined through its parts and processes that are integrated into the patient care pathway that involve work outside of the actual meeting. Advances in teleconferencing technology have facilitated the development of the MDTM over multiple hospitals and the effect of introducing teleconferencing into the MDTM proceedings is investigated as part of the study. Through the interaction of specialists at the MDTM, new knowledge is generated that is unavailable elsewhere and its value as a forum for professional education, training and development, as well as organizational learning, is demonstrated.

Research on computer support in healthcare has tended to focus on developing the concept of electronic healthcare record (EHR) systems that would maintain details on the biologic events and interventions in an individual's lifetime. Although it is now recognised that earlier efforts to develop the EHR have not taken account of the high levels of interaction and mobility among healthcare professionals (Hartswood et al. 2003, Bossen 2002) the MDTM is an area that has not

attracted the attention of research up to now.

In conducting this field study the opportunity was afforded to investigate the use of teleconference in a depth hitherto unreported. Results of a case-controlled study contribute to the debate on video mediated communication and help to reconcile some differences in previously reported work (e.g. Whittaker & O'Conaill 1997, Sellen 1995). The detailed results presented here on speech interactions at MDTM, with and without teleconference, add to the debate on the complex mechanisms employed in interpersonal communication, and interaction in teleconference, and the findings are predicted to re-open the controversy. Results in this study both agree, and conflict, with some of the reported work. For example, while these results agree with Sellen's (1995) finding that participation and vocalisation patterns are generally unaffected in teleconference, they fundamentally disagree that the duration of a vocalisation is unaffected. Although they agree with others (e.g. Whittaker & O'Conaill 1997), that the vocalisation duration is longer in teleconference, they do not agree that this is due to half-duplex audio and poor quality video. While the results here help explain why reported results may be at variance with one another, because of study protocols and methods of analysis, they prompt that other aspects of video-mediated communication, such as supporting the coupling of eye movements, remain to be further explored and highlight shortcomings in current understanding on interpersonal communication.

Poltrock & Grudin (2005) report on a 'torrent' of experimental studies conducted in the late 1980's and early 1990's on video-conferencing that failed to show significant benefits of video technology. Conflicting results with respect to the use of teleconferencing are reported in Kathleen E. Finn & Wilbur (1997), and some say that video-mediated communication does not make any difference to productivity (Carles 2001). There is general agreement in literature that teleconferencing is not as good as face-to-face communication, but is preferred over audio-only in group communication (Carles 2001, Olson, Olson & Meader 2000), without an explanation being proposed for the reasons underlying this finding. Poltrock & Grudin (2005) explain that when experiments on using video to mediate conversation did not realise expectations, researchers grew discouraged and interest waned. The question on why video communication has not been able to achieve full acceptance, remains unresolved. People prefer face-to-face communication over video (Olson & Olson 2003) and while Poltrock & Grudin (2005) identify some technical improvements that might be made to enhance video systems, they suggest that psychological and social issues are involved. Poltrock & Grudin also suggest that the current generation of camcorder and cell phone users are likely to have a different attitude to early users of video technology and that video communications (including teleconferencing) will be adopted more readily in the future. Much of the research reports that lack of a satisfying experience for participants lies at the root of the non-acceptance of video but the difficulties for participants have not been clearly elucidated.

Results here suggest that social issues are not entirely responsible for observed differences in teleconference and identify issues when using the technology that cause the MDTM to be

less productive in teleconference. In this study of a team in its natural setting, the nature of the conversation task is highly structured, consistent, and allows for relatively easy comparison between co-located and teleconferencing scenarios. It is shown that participants lose flexibility in conversation across the teleconference interface and demonstrate greater difficulty in achieving common ground (Clark & Brennan 1991). The illustration of features within image artefacts by participants is consistently associated with a 'doubling effect' in the duration of a vocalisation. This doubling effect is also in evidence for those roles who need to explain the rationale behind their treatment approach in teleconference, even though those roles may not be making any greater *proportional* contribution to the discussion, (or even less in some cases).

Proposed technological solutions for the MDTM event include enhanced technological support for pre- and post-MDTM work and the extension of the concept of common information spaces to include activities of team members outside of the time and space constraints of the MDTM. Enhanced support for interaction among team members, and interaction with shared displays, during meetings is suggested as well as improved audio and vision to fully support speech interaction across a teleconference interface.

1.1 Main findings

Many of the results in this study serve to verify findings of other researchers and are reported within the following chapters when appropriate. The substantial results that add new knowledge to existing bodies of work are summarised in this section.

(A) The multi-disciplinary medical team meeting (MDTM) is identified as a *system* that adds dependability to the overall patient management process. The review of patient investigative procedures, and the treatment planning decision, at the MDTM, amounts to a 'peer review' of the procedures employed in the independent work processes involved and serves to reduce system error.

(B) The patient case discussions (PCDs) are highly structured events. A predictable structure is demonstrated in Chapter 10 that has the potential to be harnessed to facilitate the application of novel technologies. PCDs are shown to have a recognisable structure, with four sub-sections, that is relatively unaffected in teleconference.

(C) A MDTM record is essential for hospital and patient files. This need for a formal record poses challenges for current models of electronic patient record-keeping.

(D) In patient case discussions, such as those that take place at MDTMs, it is imperative that clinicians have access to see radiology and pathology images, whether or not the discussion is held in teleconference. Being able to review the image detail is a critical part of the peer review, is essential for the understanding and learning that takes place during discussion, and helps in achieving common ground.

(E) Clinicians are shown to gain benefit from being able to see one another across the teleconference interface when discussing patient cases. Previous work on video suggests that video serves to enhance user satisfaction rather than deliver material benefit. In Chapter 6, MDTM participants demonstrate a need to see the remote interlocutors when discussing image artefacts, (verified in a questionnaire), and an articulated need for the simultaneous display of image artefacts and interlocutors in teleconference.

(F) Current standards and protocols for radiological imaging do not fully support sharing and the exchange of image data sets. In Chapter 7, it is discussed how the exchange of radiology images from different centres can cause MDTM system errors and two types of originating faults are noted: a) the processing protocol faults, b) lack of interoperable standards and protocols.

(G) Active vocal participation in patient case discussions reinforces learning and facilitates the acquisition of new knowledge. Chapter 8 reports on the experienced benefits of information sharing at MDTM. The vocal articulation of patient findings when making contributions to the patient case discussion is shown to benefit the provider of the information, as well as benefiting the addressees.

(H) It is shown to be difficult for non-vocal observer participants in a patient case discussion to assimilate information from the vocal interactions among the active participants in Chapter 9. This phenomenon is also reported for remote non-vocal participants in Chapter 4. When the ability of co-located non-vocal observer participants is examined for their ability to capture information from the discussion in the co-located setting and compared with their performance in teleconference, they perform better in teleconference. Thus, while it is shown that individuals have difficulty in comprehending the discussion in both scenarios, they demonstrate improved performance in teleconference.

(I) This study shows the MDTM to be more productive in face-to-face settings. There are a number of findings that relate to the use of teleconferencing technology that contribute to the debate on the nature of teleconference vs. face-to-face settings in interpersonal communication. Results of comparison on the two scenarios are mostly reported in Chapter 10, and some of the points are identified in the other chapters. The most important finding is that discussions in teleconference take considerably more time and the case-controlled study reported in Chapter 10 finds that **in teleconference:**:

1. The mean duration of patient case discussion is 56% longer;
2. The mean duration of a vocalisation is 64% longer;
3. There is a loss of flexibility of conversation;
4. There is no loss of overall predicted structure of the case discussion;
5. The use of artefacts is associated with a ‘doubling effect’ in the duration of vocalisation;

6. The act of *explaining* exhibits the 'doubling effect' ;
7. It is easier for observers to get information from the dynamics of conversation;
8. A need is demonstrated for two simultaneous data channels in teleconference; one for images and the second to see the remote participants;
9. There is a bias towards the audio source for information;
10. Remote clinicians exhibit greater need to connect to the large centre, than vice versa;
11. Co-ordination of the physical artefacts needed for case discussion is more difficult;
12. There is greater difficulty in achieving common ground in conversation.

Publications associated with this thesis are listed in Appendix K.

1.2 Research Setting

Multidisciplinary team working in patient management, especially cancer patient management (NCCAC 2005) is advocated in clinical practice guidelines in many countries. As part of that process, it is common practice to hold MDTMs to agree the patient's disease stage and plan appropriate treatment (Alberts et al. 2003). The cancer multidisciplinary team is now an established part of hospital practice in the United Kingdom (Nicholls 2007) and the development of multidisciplinary models of patient care (which include meetings) is being advocated as a standard of care for a wider range of illnesses (Windsor & Forbes 2007, Jefford et al. 2007). The practice of multidisciplinary medical team meetings is expected to grow in coming years as the demand for more meetings, where more patient cases can be discussed in greater depth, is realised.

Despite its importance in patient management, and recent technological advances that support mobility and interaction, the MDTM utilizes relatively little technology in its proceedings. In order to design appropriate technology to enhance the MDTM activity, the function and tasks of the team at its meetings must be understood. This work contributes towards understanding of both the MDT and its meetings, and of human behaviour in interaction with existing teleconferencing technology.

Specific studies of MDTMs (such as Bauman, Winqiust & Chin 2005) have tended to examine participation, attitudes (Macaskill et al. 2006, Fielding et al. 2005), decision-making and acceptance levels among clinicians (Kee, Owen & Leathem 2004). Although difficult to undertake and establish with certainty, several studies have attempted to demonstrate benefit in patient treatment and survival outcomes (Houssami & Sainsbury 2006, Birchall, Bailey & King 2004) and long term survival (Forrest et al. 2005). Others have demonstrated service benefits (Fleissig et al. 2006, Jack 2005, Corrie, Shaw & Harris 2003). A couple of studies have examined MDTM

in teleconference (Kunkler et al. 2006, Delaney et al. 2004). Kunkler et al. found slightly lower levels of positive attitudes to telemedicine-delivered care compared to face-to-face MDTMs but conclude, nonetheless, that videoconferencing facilitates multidisciplinary team working within a managed cancer clinical network. Delaney et al. (2004) compared attendance and the number of patient cases discussed and report that although more people attended the videoconferences than the face-to-face meetings, most participants preferred the face-to-face MDTMs. The mean number of cases discussed at Delaney et al.'s (2004) videoconferences was significantly less than the mean number of cases presented at the face-to-face MDTMs on which Delaney et al. reported. Similar to findings in this study, Delaney et al. found face-to-face MDTMs to be more informal and more conducive to open discussion than those held in teleconference. In acknowledging the potential benefits of teleconference, but reporting both success and failure in their teleconferencing initiative, Delaney et al. advise that it is important not to overestimate the capacities of this communication system to compensate for individuals geographical absence.

This study adopts a different approach to the study of MDTMs than those reported in literature. Here, the MDTM is identified as a system through which services are delivered. General measures of structures and participants' ability to capture information are explored as well as a detailed, but content-free, examination of vocalisation among active participants during PCDs. In examining the use of teleconferencing at MDTMs, the impact on those parameters is examined.

The *services* provided by the MDTM clearly fulfil its roles and functions as a system to enhance patient care (Newman et al. 2006) and facilitate learning (Jefford et al. 2007). The functions encompass patient management, education, organization and social roles of the MDTM. The education of under-graduates, post-graduates as well as professional development of medical and other staff is a concurrent secondary function. Audit is facilitated and information managed through MDTM activities. The social function of the MDTM, while secondary, is significant in its contribution to staff morale and teambuilding.

This study of the MDTM includes how the MDTM interacts with related work processes. While impact of MDTM practices on external processes is acknowledged, the main focus is on issues for the MDTM in maintaining integrity in the services it provides and supporting its further development. It is shown that, with respect to work associated with MDTMs, temporal rhythms of execution of pre-meeting and post-meeting activities are critical for MDTM success.

How the meeting serves as a forum for collaboration, interaction and the generation of new knowledge is examined through analysis of the role and behaviours of a typical MDT. Examination of information flow among members of the team demonstrates the MDTM to be a valuable forum for the exchange of information and the generation of new knowledge. All active participants are shown to benefit from interactive discussion in PCDs. The MDTM is a social organization that relies on high levels of individual co-operation and complex group dynamics to achieve the interpersonal and inter-role communication level necessary for its success. Having a clear understanding of

the information flows at the MDTM and interactions among team members is necessary when considering appropriate technological support to improve the processes.

Elements that serve to enhance the effectiveness of the MDTM are examined as well as points of vulnerability that threaten its dependability. The strengths and vulnerabilities in the MDTM system are identified so that technological solutions can be proposed to enhance the strengths and reduce frailty in the system. The effect of teleconferencing on the MDTM is explored and through the identification of additional strengths and vulnerabilities introduced by use of the system, contributes to knowledge of the work, the technology and human behaviour when interacting with it. Identification of the temporal structure within a PCD, its stages and phases, provides a context for the analysis of role interaction.

The co-ordination of pre-MDTM work with the extension of the MDTM to wider geographic locations is shown to be made more difficult with teleconferencing and the disruption of rhythms poses potential threats to dependability. An analysis of vocalisation patterns in PCDs demonstrates difficulties related to coordination and awareness in teleconferencing, evidenced by increased time spent in case discussion, longer vocalisation duration, some decrease in turn frequency and near lack of informal exchanges. There is greater difficulty in achieving common ground and a more collaborative effort needed in teleconference that poses challenges for CSCW system designers. The effect is particularly pronounced for those roles who use artefacts to illustrate their findings and have a need to *explain* or *describe* the basis for their opinion in teleconference. Despite the difficulties, the overall case discussion structure is relatively unaffected by the addition of teleconferencing technology into proceedings.

Although this study is confined to one hospital, a 963 bed facility where over 2,000 new cancers are treated every year, these results will have significance for others, particularly tertiary referral centres and teaching hospitals, which are likely experiencing similar changes. Furthermore, the dynamics of interaction between hospital structures, organizational roles and work practices, represented in the MDTM, serves as an ideal setting to examine dependability in cooperative work, especially for tasks that are executed through talk between different professional roles within a group. Workplace studies such as this have the potential to shape the development of novel technologies to support activities in the organizations of the future.

In undertaking this extended ethnographic study, the work of a single respiratory multidisciplinary team meeting was followed, over the period October 2004 to September 2007, in a tertiary referral, and teaching, hospital. Other teams and their meetings, both internal and external to the hospital, were observed for verification of common processes and comparison in their detail. Observation of the team at work and at their weekly meetings, the review of documents and image artefacts, as well as interviews, questionnaires and exercises with members of the team were used to gather data. Associated work processes were examined to put the meeting work in a larger context. Detailed analysis of vocalisations at the meeting through the use of video recordings

allowed for the identification of an internal structure to the discussion. A case controlled study was used to investigate the impact of teleconferencing on the meeting proceedings. Working with the team over the extended period of time provided a unique opportunity to study work processes, team development within that timeframe, and valuable material that allowed the investigation of the impact of teleconferencing on the meeting proceedings.

Team developments witnessed in the course of this work are documented. Trends in the wider health care environment were examined that might affect MDTs and their meetings in the future. Pressure to improve structures in healthcare service delivery and gain efficiency through the adoption of communication technologies are escalating. There are some issues emerging with respect to record keeping, developing group responsibility and medico-legal implications that will affect MDTs (Sidhom & Poulsen 2006). Trends towards greater transparency in the conduct of tasks and involving patients in decisions that affect them, are predicted to become topics for debate and real issues. Given the potential that information and communication technologies afford change in work practices, the adoption of appropriate technologies is not a simple matter. While the technology itself may be 'neutral', the application of solutions will reflect fundamental values and attitudes, including prejudices, and have the potential to cause disruption of service unless carefully managed. It will be demonstrated in this work that the use of technology, organization processes and human behaviour is closely intertwined.

1.2.1 Research domain

This study overlaps the areas of interaction analysis, human-computer interaction, collaboration, healthcare management and organization theory, medical informatics, decision-making and the application of information technology. The approach to the study, however, is mainly from a Computer Supported Collaborative Work (CSCW) perspective because this approach allows for the analysis and a synthesis that is considered most appropriate to satisfy the goals of the work, i.e. the identification of technological support that would enable the MDTM services to become more effective. The area of CSCW, where this work is being situated, is a multidisciplinary field that values understanding how people co-operate to achieve common objectives, and in developing computer technologies to support and enhance those people in their work. Rather than designing systems that require people to adapt their behaviour in order to use the technology, CSCW approaches aim to understand the activities of the user in their psychological, social and organizational setting to design acceptable technological solutions and is concerned with the support requirements of co-operative work arrangements (Schmidt & Bannon 1992). The study method adopted here is one of ethnographic enquiry, a method popular in CSCW research, which strives for participatory, non-intrusive, observation when conducting fieldwork.

Interaction analysts and ethnographers have considered a heterogenous range of technologies, systems and devices (Luff, Hindmarsh & Heath 2000), including video-mediated communication.

There is a substantial body of work already undertaken on the use of video technology (Kathleen E. Finn & Wilbur 1997) with which this investigation of the multidisciplinary team meeting can be compared. Furthermore, contributions in the area of workflow technologies and media spaces, for example 'Common Information Spaces' (Bannon & Bødker 1997) are believed to provide potential solutions to support the MDTM.

1.2.2 Structure of document

The methodology used in this study is described in Chapter 3 following the Introduction here and Background to the project in Chapter 2. The equipment used at meetings is given in the Methodology Chapter 3, Section 3.7, and the framework used in the analysis is presented in Section 3.9. Ethnographic analysis, which describes the roles and structures of MDTM, provide the material for the early chapters. Quantitative data gathered through exercises, questionnaires and video recordings provides the basis for the detailed analysis presented in the latter part of this work. The combination of qualitative and quantitative data serves a dual purpose: 1) to understand the mechanics and function from the MDT members' perspective and 2) to measure the impact of the introduction of technology (teleconferencing) into the setting.

Chapter 4 presents the MDTM as a *'System'* that adds dependability to the patient diagnostic and management processes. The professional roles involved, the meeting functions and the context of the MDTM in overall patient management is explained, together with the temporal organization of activities. The conduct of the proceedings is described and some implications for dependability of the MDTM system following the introduction of teleconferencing are introduced.

Chapter 5 describes a patient case discussion (PCD) in detail. Discussion stages are defined, as D-Stages, and the TNM lung cancer disease staging task that is undertaken in PCDs is briefly explained. The chapter concludes with a description of the PCD in teleconference and observed differences are highlighted.

Results of a questionnaire that asked MDT members about their requirements in a conference system form the basis of Chapter 6. Issues concerning what people wish to see in teleconference under different circumstances and the wish to be made aware of people observing the proceedings, are raised. MDT members responses to what they wished to see when discussing artefacts vs. patient symptoms are surprising. A high value was placed on being able to see remote people while discussing radiology or pathology images across the interface. A reciprocally high value was placed on being able to see radiology, or pathology, images while discussing patient symptoms. These results are discussed in Chapter 6 along with members' evaluations of MDTMs in teleconference and co-located scenarios. Similar to some reports, teleconference does not rate as highly as co-located discussions (Cohen 1982, Egido 1990) for PCDs (Kunkler et al. 2006, Delaney et al. 2004). Specifications for a potential MDTM record are discussed in the context of MDT members concerns.

Having reviewed the overall system, the detail of a stylised PCD and the MDT members, the

discussion returns to look at the pre-MDTM work in Chapter 7 from a different perspective. The temporal organization of MDTM-associated work activities, a recognised interest area for CSCW research, is addressed in some detail. Particular issues for specialist departments such as radiology and pathology, both members of several MDTs, are considered. An example schedule is given and problems are identified for hospitals that have implications for the delivery of services.

Given that radiology and pathology make significant contributions to all of the multidisciplinary teams concerned with the diagnosis of organic disease, it would be reasonable to assume, (particularly after the detail given in Chapter 7), that they may have little to gain from their attendance at the MDTMs. However, Chapter 8 shows that the contrary is true. The importance of supporting inter-professional collaboration is highlighted by demonstrating that the individual *gain* correlates with the individual *contributions* made at the MDTM. The more individuals contribute to the discussion, the more they gain in the process.

The continuing education and learning theme continues in Chapter 9. As well as having the important role in patient diagnosis and management (that is explained in the earlier chapters), the MDTM serves an important function in post-graduate specialist education and training, as well as clinical training for interns and undergraduate medical students. Non-vocal participants outnumber the vocal participants by over 3 to 1 at MDTMs. These observer members of the MDT are mostly medical doctors in post-graduate specialist training. There are also non-vocal participants who take notes to help them in tasks outside of the MDTM. Chapter 9 reports on an exercise undertaken with observer participants to measure their ability to capture information from the proceedings and provides a proxy measure for issues in gathering information from the discussions by more active members of the team. Comparisons are made between performance of the exercise in teleconference and during co-located discussions. It is shown that respondents in the exercise were more likely to agree with, and understand the basis of, the patient management decision but were also more likely to (*wrongly*) believe that the patient would be cured as a result of the intervention when the PCD was held in teleconference. Psychological distancing in teleconference is thought to be partially responsible for this finding which may have implications for medical opinions being offered in teleconference.

Before the final discussion and drawing conclusions from this study, the penultimate Chapter 10 investigates the effect of teleconferencing on the patient case discussion. Overall, for PCDs in teleconference take more time than co-located PCDs. Results showing that there is a loss of flexibility in conversation in PCDs in teleconference are presented first. Then, results of the case-controlled study are presented, detailing differences in the vocalisation of different roles in each of the D-Stages of the PCD in both teleconference and co-located scenarios. For roles with a function to *describe* or *explain*, the effect is shown to be more marked than for others.

In the Discussion and Conclusion in Chapter 11, a pre- and post- MDTM workspace is proposed together with a multimedia record of each individual patient case discussion that would be linked

Table 1.1: Terms used for meetings between different specialist clinicians

Term used (and acronym)	Comments
Clinical Pathology Conference (CPC)	greater emphasis on pathology
Clinical Radiology Conference (CRC)	greater emphasis on radiology
MDT	sometimes confined to cancer cases
Surgical risk management	usually confine discussion to surgical cases
Tumour boards	usually confine discussion to cases of tumour pathology
Multidisciplinary Cancer Conference (MCC)	same as Multidisciplinary Team Meeting (MDTM)
Multidisciplinary Management Team	term sometimes used for Multidisciplinary (MDT)
Multidisciplinary Clinical Team	term sometimes used for Multidisciplinary (MDT)

to the patient's electronic record EPR (when implemented). Emphasis is placed on providing meeting facilities that would enhance the work of the MDTM and make it more reliable. Solutions are proposed that integrate the pre- and post-MDTM work into the meeting and support greater interaction among team members during MDTMs.

Chapter 11 also discusses particular additional needs in teleconference to support collaborative effort across the interface, decrease the psychological distance and increase common ground.

1.3 Terminology

Teleconferencing: The term 'teleconference' is used throughout this thesis to describe a live connection using a telecommunications system supporting the provision of video and audio services over a phone line. In literature, the term videoconference is also used to describe such a system.

Multidisciplinary team meetings: For the meetings being examined in this study, terminology can differ between different countries, different regions and even within the same hospital or group of people. Since commencing this study, the term used locally for this meeting has gradually changed, reflecting the changing practices that are ongoing in organizational life. Some of the terminology may reflect the historical development, or a slightly different focus. For example, for the respiratory multidisciplinary team in this study, there was a long tradition of holding a 'Clinical Pathology Conference' (CPC) between the respiratory physicians and the pathologists. Surgeons participated from time to time. The current MDTM where the radiologists, pathologists, surgeons, oncologists and physicians all play an active role, has its origins in the old CPC meeting and for many, the acronym CPC was always used. As new staff join the group and other staff leave, the terminology has changed to reflect the shift in focus from being, primarily, an aid to diagnosis for the physicians, to being a more complex multidisciplinary activity. Table 1.1 lists some of the terms used and notes any slight shift of emphasis. In all of these 'types' of meetings the PCD process is similar, i.e. clinical findings are reviewed in conjunction with data gathered from investigations and a decision is made on the next step in the process.

Regardless of the emphasis, or the terminology used, the practices among these teams at their meetings is similar and the work reported here will have relevance across a broad range of meetings

between different medical specialities involved in patient care.

Chapter 2

Background

This chapter provides background information to set this study of multidisciplinary medical team meetings (MDTMs) in context and to provide a perspective from which to consider the analysis of results in later sections. Two distinct aspects of background are provided, namely, 1) the theoretical area of CSCW, job design and team working in healthcare and 2) the background of the multidisciplinary medical team who co-operated in this study.

In conducting this work, ideas were drawn from a number of subject areas that span medical service research and organization psychology as well as computer science. Organization psychology has significant contributions to make to CSCW and in this study, principles in interpersonal communications, job design and team working are incorporated as they pertain to MDTMs and are helpful in the design of solutions presented in later chapters.

Recent developments in healthcare working are outlined here at the outset to further contextualise this study and highlight its importance. Results in this study have the potential to have wide-ranging impact on technological developments in the health service, which will directly impact on the quality of care for individual patients. Information is also provided here on medical team working and where this study, (that is situated within a hospital), overlaps with CSCW theoretical research interests. In order to avoid any ambiguity in the use of the terms 'team' and multidisciplinary teamworking in healthcare, compared with the usage of the word 'team' within industrial settings, a brief overview is given of their operation within a hospital setting. In proposing design considerations in Chapter 11, principles of job design were borne in mind that are outlined in Section 2.3. Finally, in an effort to provide the reader with a sense of time and development in this study, the chapter concludes with a short history of the multidisciplinary team under study in Section 2.6. Specific quantitative data collection episodes are also provided in the timeline in Figure 2.1. The data gathered during these periods form the basis of the material presented within the following chapers.

2.1 Multidisciplinary team working

Over recent years there has been significant growth in multidisciplinary team working (Ruhstaller et al. 2006), because of increasing specialisation, advances in medical technologies (Batchelor & McFarlane 1980), including teleconferencing, and recommendations by respected agencies (Wright et al. 2007, Board of the Faculty of Clinical Radiology 2005, NCCAC 2005, Rasmussen & Bulow 2005, Alberts 2007, Calman & Hine 1995). These developments have led to a need for highly specialised health professionals to engage in intense collaboration to provide effective services (Arnaudova & Jakubowski 2005, Hall & Weaver 2001) and building multi-disciplinary (or inter-disciplinary) teams to address the complex problems arising in patient care can reduce health care system error (Øvretveit 1999).

The practice of having MDTMs is becoming increasingly necessary and MDTs and their meetings now occupy a central role in developed health systems (Houssami & Sainsbury 2006). Patient outcomes have been shown to benefit from having their treatment managed in a MDT setting (Birchall, Bailey & King 2004, Sainsbury et al. 1995) and multidisciplinary team (MDT) working is now advised as a better way of organising health services for patients, particularly cancer patients (Wright et al. 2007, NCCAC 2005). MDT practice has become widespread, particularly in the United Kingdom, and MDTMs are being incorporated as a standard into cancer patient care pathways in Europe as well as in Australia and North America (Nicholls 2007, Alberts 2007, Balding & Anderson 2007, O'Higgins 2006). As the benefits in cancer care are being appreciated, MDTMs are being advocated as the standard of care for a wider range of illnesses (Windsor & Forbes 2007, Jefford et al. 2007).

The 'raison d'être' of the MDTM is to improve the service for patient diagnosis and management. MDTMs are fora where the MDT members, specialists from different clinical disciplines, meet to review patient cases, establish a diagnosis and disease stage, decide on the most appropriate course of management for the patient and co-ordinate those patient services among their membership. The role and value of the MDTM in its contribution to patient care was underestimated in the past, but respect for MDTMs is growing as the practice becomes more widespread. The MDTM is where MDT members interact and through the activities more than one function is implemented and several services are delivered that embrace patient management, educational and organizational objectives (discussed in Chapter 4).

The MDTM developed from its role in teaching under-graduate and post-graduate medical students and has its origins in clinical-pathology, clinical-radiology and surgical risk management meetings (Wong & Birks 2004). It provides a forum for the introduction to new concepts and techniques in both clinical and experimental medical sciences and has evolved in response to the increasing complexities of patient care and demands for improved quality of services. Within multidisciplinary medical teams (MDTs) each specialist role contributes his, or her, particular skill and knowledge for the benefit of the patient. From the patient's perspective the MDTM

facilitates their review and management with the multidisciplinary team. For the hospital, the group engages in on-going learning and thus becomes more educated. MDTMs give clinicians an opportunity to broaden their experience through sharpening their diagnostic skills on cases that are uncommon, involve difficult decisions, or that present specific diagnostic dilemmas. From the organizational viewpoint, the MDTM facilitates the collection of information for audit purposes, it serves quality improvement process objectives, allows for comparison between different investigative procedures in the diagnostic process. Through the continuing development of personnel, it also serves as an organizational learning forum. The MDTM thus contributes valuable information for the development of quality improvement processes, including clinical practice guidelines, and can be regarded as an organizational quality assurance mechanism. The MDTM can also be described as a lateral process in the hospital that co-ordinates the multidisciplinary tasks and the hierarchical investigative processes (Hatch 1997).

Just as an individual diagnostician must integrate data from a variety of sources (Cicourel 1990), MDTMs involve the integration of information derived from several sources and the employment of a complex decision making process whereby the best evidence-based therapeutic strategies can be applied. There are certain items of information essential to this process, namely the patient's case history, the working clinical diagnosis, the radiology results, the laboratory results and the results of various other diagnostic procedures that may be relevant e.g. ECG, EEG, pulmonary function tests. Most of these items of information have to be laboriously gathered by hand making the MDTM a very time consuming process for a considerable number of people. In addition it is not uncommon for one or other of the items to have been mislaid, lost or erroneously filed rendering the decision making process inadequate. The information used in MDTMs is largely available in digital form (e.g. radiology, results of diagnostic procedures, histopathological and cytological images etc.) with certain notable exceptions such as the clinical data. However, many of these items are stored or manipulated on stand-alone systems with minimal integration.

The demand for meetings is growing, as practice guidelines are updated and more and more organizations include MDTM in new revised recommendations. Experience among those who have already implemented MDT working is positive. Large teaching hospitals, in particular, are witnessing these developments and the increase in the number of multidisciplinary team meetings (MDTMs) that results. It is argued that there is significant value in discussing *every* patient's case at a multidisciplinary meeting (Jefford et al. 2007). Some clinicians appeal that mechanisms be explored to involve the patient in the decision-making processes affecting them (Edwards & Elwyn 2001). It can be expected, given current trends for more multi-disciplinary teamwork that involves the patient in their own treatment decisions, that patient's expectations in the future will include a DVD recording of their case discussion at a MDTM for personal (and perhaps, family) review. While requests for such recordings have not yet been documented, requests are on-going for new MDTMs, more lengthy MDTMs and more in-depth discussion on a larger number of patients.

But for the full benefits of MDTMs to be achieved and potential be developed, improved solutions are needed to overcome the difficulties being experienced that are documented in this study.

The pressures on MDTs to redefine their work, provide safer services of higher quality to more people, and adopt new technologies to maximise efficiency are driving change in healthcare. There is a concern that with pressures for change, technologies may be implemented without the impact being fully understood and 'faults', or system weaknesses, might be inadvertently introduced into the work system that would negatively impact on patients' lives (Koppel et al. 2005). It is acknowledged that part of the reason that technological tools have not always been successful in their implementation is because they were often not designed with the needs and goals of their human users in mind (Galegher, Kraut & Egido 1990, Carter, Garside & Black 2003). So, with the maxim in mind that

> "the future arrives of its own accord, progress does not",
> (*Poul Henningsen, 1894-1957*, Danish revolutionary and designer)

the aim is to identify ways that technology might be utilized to effect progress and would make the MDTM more effective. Appropriate technologies cannot be identified without a thorough understanding of the underlying activities and information needs, and the knowledge generation achieved through collaboration and co-ordination among these workers.

Poor communications and failures in interpersonal interaction can account for 70-80% of errors in healthcare (Arnaudova & Jakubowski 2005), and improving communication systems in health services continues to engage researchers and practitioners. The MDTM is the main forum for communication between members of the MDT and it is critical that support is incorporated into meetings that will enhance the communication process and reduce the potential for errors and misunderstandings. Given that traditional models of communication and interaction in healthcare have relied on paper, and form driven mechanisms of communication and recording, more attention needs to be given to supporting new models of interaction at work (Hardstone et al. 2004), such as MDTMs. Understanding the dynamics of communication and the interrelationship between communication and information tasks can be expected to help evaluate the role of technological support (Coiera 2000). Thus, the examination of the information needs of medical specialists and how MDT members collaborate and share information at MDTMs helps identify how technology might be applied to support group activities.

The form of collaborative work done at MDTMs is considered to reduce healthcare system error (Øvretveit 1999) by providing a 'triple assessment' in the clinical correlation of results from radiology, pathology and the clinical findings that improves the quality of the diagnosis (O'Higgins 2006), and improving co-ordination and communication among MDT members in treatment planning (Calman & Hine 1995). For example, modern cancer treatment can involve chemotherapy and/or radiation therapy and/or surgery administered sequentially, concurrently, or in combination, depending on tumour variables, within a particular timeframe. Determining the best combination of

treatment(s) for a particular patient, as well as co-ordinating the treatment can be problematic. The MDTM is proving to be a useful forum to determine and co-ordinate appropriate treatment.

2.2 MDTMs and CSCW

Team meetings are essentially interactive in nature and it is explained in Chapter 5 how the work at an MDTM is accomplished through talk, supplemented with the use of visual artefacts. There are similarities to other areas of collaborative work that involve interpersonal communication in group work such as hospital ward rounds, shift hand-overs (Munkvold, Ellingsen & Monteiro 2007), analysis and planning tasks. Computer Supported Cooperative Work (CSCW) is concerned with understanding "the nature and characteristics of co-operative work with the objective of designing adequate computer-based technologies" (p.9, Schmidt & Bannon 1992) to support or enhance the activities. CSCW approaches to analysing work, that follow information flows and ways that team members collaborate are considered appropriate in this study.

Medical diagnosis is accepted to be an intellectually complex task and the product of complex social processes (Cicourel 1990). The decision on appropriate clinical management of a patient is also complex. Both tasks are undertaken in MDTMs and involve the construction and maintenance of a shared representation of the problem which is achieved through talk and the sharing of visual objects. It is proving difficult to support workplace activities, whether in a particular location or dispersed geographically. Difficulties with the adoption of computer technology are emerging (Galegher, Kraut & Egido 1990), such as in teleconferencing (Kathleen E. Finn & Wilbur 1997) and prescribing systems (Koppel et al. 2005), and it is apparent to CSCW designers that a greater understanding of the nature of the work is needed in order to support or transform it (Bossen 2002, Luff, Hindmarsh & Heath 2000). Researchers in the area have long recognised certain difficulties and point out that in order to build effective systems we must understand the nature of the group, the organization and social processes where the technology is to be applied (Horn et al. 2004, Berg 1997, McGrath 1984).

The collaborative activities and social interaction in workplaces is of special interest in CSCW. It is imperative that we understand how work is co-ordinated and collaboration is achieved in practice and in context (Symon, Long & Ellis 1996) and the importance of socially organised practices and reasoning that includes the use of artefacts (Hartswood et al. 2003). Howell (1991) predicts that design considerations in the future will include affective, emotional, motivational and social considerations. Design questions will not end with demonstration of superior performance, but will extend into the realm of consequences for human interaction, morale, motivation and quality of work life.

The work of a multidisciplinary medical team, the focus for this study, involves intense collaboration that adds dependability to the overall patient management and diagnostic process (discussed

in Chapter 4). The MDT can be described as an autonomous work group with collective autonomy to conduct their tasks. Such teams have become known as *high performance work systems* (Buchanan & Huczynski 2004). Media spaces, workflow technologies and decision-support systems are developments within CSCW that have engaged research and been the focus of some debate within the field (Luff, Hindmarsh & Heath 2000), and have the potential to be usefully applied in the MDTM context. Thus, reinforcing the decision that the area of CSCW is an appropriate place to situate this work.

Despite the ready availability of low cost bandwidth (Anderson et al. 2007) and the recognition that participants experience a discomfort when using teleconference (Ruhleder & Jordan 2001), the lessons learned from the introduction of teleconferencing have been disappointing. Kathleen E. Finn & Wilbur (1997) report that numerous studies have yielded conflicting results. Unless the work conducted in video-mediated communication involves physical tasks (Fussell, Kraut & Siegel 2000), negotiation (Short, Williams & Christie 1976) or communication among people with different native languages (Veinott et al. 1999), videoconferencing (or teleconferencing) is not reported to add any material benefit (over audio only) other than user satisfaction (Olson & Olson 2003).

The collaboration observed at an MDTM differs from much of the collaborative work that has engaged many researchers (Kathleen E. Finn & Wilbur 1997), in that the MDTM involves few physical tasks. However, like some CSCW studies, the MDTM incorporates the use of artefacts as an aid in communication (Whittaker 2003) and can be described as work that is conducted through *talk*. Employees engage in order to achieve co-ordination and the MDTM involves an adoption of formal procedures as well as dynamic interaction, depending on the nature of the individual patient case under discussion. Opinions are exchanged, re-interpretation of data occurs, negotiation may be involved, persuasion can be evident and consensus is achieved through verbal interaction, that is sometimes supplemented with the use of artefacts. For the type of group under study, tasks are executed through verbal articulation and the group becomes productive in the process. In other words, the task is achieved through vocal interaction and there is no physical product, other than notes from which records will be constituted afterwards.

Communication mediated by teleconferencing and 'temporality' are both topics of interest in CSCW and recurring themes in this study because of their importance in the work of the MDT and its MDTMs. Noting that 'space' can be bridged but time is fixed and proceeds slowly at a fixed rate, Reddy, Dourish & Pratt (2006) observed that medical workers incorporate information seeking into their practical everyday tasks and comment on how information is sought, provided and managed through temporal rhythms, trajectories and horizons. The MDT at their MDTMs is analogous to a 'spaghetti junction' of information flows with team members providing, seeking, sharing information and generating new knowledge in the process (discussed in Chapter 8). The maintenance of satisfactory temporal organization of the work in-between MDTMs is shown to be

critical for a successful meeting. As well as issues for a single MDTM, problems are identified, in Chapter 7, for the hospital in the maintenance of the many MDT that are needed to provide the variety of specialist services delivered. Teleconferencing impacts on temporal work rhythms. As well as PCDs taking longer, more time is needed for the co-ordination of radiological images and pathology samples for discussion at the MDTM. These additional time constraints for teleconference MDTMs pose potential threats to MDTM dependability and are discussed in Chapter 4.

The MDTM is a complex process, or high performance work system, that extends well beyond the limited amount of time spent at the actual meeting. The study presented here shows that pre- and post-meeting activities and work rhythms play a critical role in its success. In order to establish success criteria against which recommendations can be made and further technological improvement designed, the roles that MDTMs have in healthcare must be understood. These roles span service functions as well as individual professional roles and group needs. The collaborative nature of the patient diagnostic and management services, evidenced in this study, is complex and difficult to analyse. Chapter 6 shows that to rely solely on participants' stated views on what constitutes essential teleconferencing functionality is unsatisfactory. Expressed views do not match observed behaviour and determining appropriate technological support requires sophisticated analysis of actions, information flow as well as function and work processes.

2.3 Job and System Design

While CSCW is the main perspective from which the work of the MDTM is investigated here, the study also draws on ideas from research on job design that are considered relevant to the analysis. The work of Hackman and Oldham (1980) is considered of particular relevance as it offers an additional context in which to consider support for the MDTM and helps prompt design ideas presented in Chapter 11.

The job characteristics model of Hackman & Oldham (1980) sets out the links between the features of the job, the individual's experience and outcomes in terms of motivation, satisfaction and performance and places great emphasis on the need to build in autonomy and feedback into work roles. The motivating potential score (MPS) is a measure of job satisfaction and potential stress in the work. High scores are associated with well designed jobs and low scores characterise jobs that induce high stress for workers that are generally made visible through high levels of absenteeism, employee turnover and illness.

$$\text{MPS} = \frac{\text{Skill Variety} + \text{Task Identity} + \text{Task Significance}}{3} \times \text{Autonomy} \times \text{Feedback}$$

Part of the design of jobs is the design of computer systems that can be effectively used by the people in the job. Interaction design is concerned with developing products that are *usable*, and providing an enjoyable experience is considered as important as being effective to use and easy

to learn (Preece, Rogers & Sharp 2007). Usability design has its roots in the cognitive sciences, and emotion and cognition are now known to be thoroughly intertwined in our brain functioning (Norman 2004). In the design of work and computer systems, attention must be given to human needs and functioning within the systems created. Attention to job design principles of providing autonomy and feedback can be predicted to enhance the job satisfaction potential of the work and deep analysis of local communication behaviours can help generate economically inspired population-level explanations of information and communication technology use (Coiera 2003*b*).

Teams are generally accepted to perform better than individuals acting alone, especially when performance requires multiple skills, judgements and experiences (Katzenback & Smith 1993) and the design of systems of teamwork is an on-going challenge of management. Teams are considered to afford their members greater learning potential, improve the utilisation of capabilities within the group, increase personal job satisfaction as well as commitment to the organization and reduce work stress (Steijn 2001).

As well as supporting the work of the team, the technology design needs to support good working relationships and interpersonal relations among team members, which are considered crucially important for effective teamwork. Interaction between people with some degree of continuity between successive interactions will form the basis of an interpersonal relationship. Interpersonal relationships that are task based, non-trivial, and of continuing duration characterise working relationships and like social relationships, working relationships develop over time and can vary in their stability, mutuality and efficacy (Gabarro 1990). Design interventions for the MDTM need to take account of the delicate nature of interpersonal communication and relationships and strive to support and strengthen the modes of communication.

The MDTM system being investigated in this work involves people working in particular roles within a team, within a hospital, and interacting with technology in the course of their duties. Looking at Hackman & Oldham's (1980) job characteristics model suggests that great impact will be achieved through building autonomy and feedback mechanisms into any technology that might be usefully applied. Reinforcement, or on-going learning, for multidisciplinary teams is identified as a key component in continuous quality improvement (CQI) interventions (Solberg et al. 1996) and supporting interaction between team members, while helping the working relationships, can be predicted to improve the MDTM performance.

2.4 Work Systems and Collaboration in Healthcare

The development of communication technology within the health services, and teleconferencing technology in particular, is a reflection on the changing nature of healthcare delivery structures in today's society. As well as services such as radiation therapy being delivered nationally through a small number of large centres (Hollywood 2003), traditional team structures are developing and

reconstructing themselves into multidisciplinary teams and directorates.

Teleconferencing is being embraced in the context of this study as a technology that facilitates service improvement and is economically efficient. The extension of the multidisiciplinary team to a wider geographic area, through the use of teleconferencing is a reality (Kunkler et al. 2006, Delaney et al. 2004). Services are currently being developed which rely on teleconferencing technology for their delivery (Department of Health and Children 2001, Hollywood 2003, Coiera 2003*a*, Calman & Hine 1995). Multi-disciplinary medical team (MDT) meetings being held over a teleconference link are becoming a regular feature in many hospital settings. Ongoing pressures to deliver high standard services to geographically distributed locations through the utilization of teleconferencing technology is resulting in the implementation of systems without the full implications being investigated or fully understood. While the introduction of teleconferencing has obvious benefits, the full implications of this change (i.e. introducing teleconferencing) for MDTMs remain to be elucidated. Furthermore, *rapid rates of change* can introduce stress into systems for which failure-prevention mechanisms have not yet been identified.

The introduction of teleconferencing technology is shown in this study to impact on the internal dynamics and functioning of the MDTM in Chapter 10, where results of video-supported analysis are used to compare co-located patient case discussions (PCDs) with those held in teleconference. There are undisputed benefits of teleconferencing and the interaction structure is not significantly affected by the technology. But the finding that a case discussion in teleconference takes significantly more time than a PCD in a co-located MDTM alludes to the practical difficulties introduced by this practice.

This increasing use of teleconferencing for specific purposes, such as in MDT meetings, is affording the opportunity to explore issues in the use of video technology that have not been fully resolved (Finn, Sellen & Wilbur 1997). Although the usefulness of video-mediation in the communication of detail on artefacts has been identified (Whittaker 2003), there is an on-going debate on the value of video in computer-mediated communication (Olson, Olson & Meader 2000). Furthermore, the interactive nature of medical work is only now being fully appreciated and issues pertaining to how medical staff interact, and exchange information in the course of their work, are emerging (Hartswood et al. 2003, Hardstone et al. 2004).

Within work processes in health care, it is usual for tasks to be conducted while adhering to strict communication protocols (standard operating procedure, SOP). When staff are communicating to one another, strict procedures are followed such as checking several items of information, in sequence, and 'signing off' (and sometimes double checking by a second person) to indicate these items were satisfactory. For example, three pieces of data for the patient identification: the name, date of birth and hospital number. These three items are checked when conducting any procedure or test on the patient (or sample from a patient). There are currently no 'SOPs' for MDTMs. Practices have developed locally to the new service demands and groups communicate

informally between different hospitals, to pick up ideas from others with regards to improving the processes. The analysis in this study, as well as contributing to ideas for system design to support the MDTM activities, serves as a foundation for the development of a set of protocols or guidelines to be developed by the MDTs of the future.

2.5 Team working in health care

While individual workers in healthcare tend to communicate, and interact, on a one-to-one basis with the patient and with colleagues in the conduct of their individual tasks, they work as part of a larger group, or team. The term 'team working' is a tradition in healthcare, but differs from the popular usage of the term in manufacturing industry and deserves explanation. Traditional medical teams work within a limited, defined, specialist area and have an internal role hierarchy. Consultant led, a clinical (medical or surgical) team has a number of non-consultant hospital doctors of varying experience, ranging from several junior members (with little or no specialist experience) to a small number of highly qualified and experienced staff. The size of a medical team will be determined in the volume and nature of the service it provides. A large teaching hospital can expect to have large teams. In typical teaching hospital, teams are grouped together into larger units, or Departments, for administrative efficiency, and there is a ratio of approximately 1 Consultant to 1 Registrar to 1 House Officer to 1 Intern (the most junior member of the team). The traditional medical team just described, represents a grouping of individuals in a functional structure to deliver a particular service.

A multidisciplinary medical team (MDT) is not a team in the traditional medical sense of the term. It is a relatively new development in healthcare and needs to be distinguished from both traditional medical team models and also from the modern management concept of 'team'. It does not have the group task roles commonly identified in other work teams such as 'elaborator', 'energizer', nor maintenance roles such as 'harmonizer' or 'compromiser'. Neither are individual roles such as 'blocker', 'dominator' or 'aggressor' (Buchanan & Huczynski 2004) appropriate when describing the behaviour of these types of teams. A multidisciplinary medical team (MDT), such as those observed in this study, is composed of a number of traditional teams and an associated number of other complementary, but individual, professional roles. Several teams, all of whom have a common interest, (usually centering on a biological system, such as lung), group together in a loosely coupled structure. Individual teams and individual MDT members work relatively independently of one another in the course of their routine work. They are best described as a number of distinct and separate, but related, professional roles coming together to agree how best to progress the patient's management, with the patient's best interest in mind.

The respiratory MDT under study comprises those clinical staff in 3 medical respiratory teams, 2 surgical teams, as well as radiologists (2), pathologists (2) the MDT Co-ordinator, clinical (1)

and medical (1) oncologists and their teams, physiotherapist (1), specialist nurses, data managers and the technical support person. Altogether, over 30 individuals make up the respiratory MDT and this group hold a once weekly meeting to review patient cases, establish a diagnosis, disease stage and decide on the most appropriate course of management for the patient.

In the case of a clinical multidisciplinary team, such as the respiratory MDT, it is useful to consider the members as individual specialists who conduct independent tasks before and after the meeting. They also rely on each other's contribution to facilitate the successful completion of their individual roles. This support is provided through the MDTM, as well as through individual contact during the week. For many of the MDT members, they do not work directly with one another, day to day, but they are available on request to one another in the event of an emergency, or difficulty, in-between meetings.

2.6 Team Development

It was already mentioned that a single team was used to provide the main data in this research. While other teams were examined for comparison purposes, and points of similarity or difference are sometimes noted, the respiratory MDT at St. James's hospital co-operated in allowing data to be gathered from their work. There are some points worth documenting with regard to this team, and their development over recent years. In observing that groups develop and change systematically over time, Arrow et al. (2004) comment that team development is a central theme in group development work, which seeks to characterise the ways in which groups and systems change over time.

This study is not attempting to investigate the development of this team, nor address team characteristics that might influence the adoption of technology. The team was chosen because it represents a typical multidisciplinary medical team team. It has a relatively long tradition and demonstrates stability; meetings are never cancelled, (at least not within the living memory of any team member), the meeting is well attended and the team demonstrate an interest in on-going development of their work at MDTMs.

This section briefly documents the developments over recent years for the respiratory MDTM, for information purposes, as well as landmarks in this study. Figure 2.1 is a timeline of significant events over the period of this work. The respiratory MDT is in existence over 25 years and has embraced change as opportunities presented. Over that period the meeting has grown to become an important hub in patient management and changes are on-going. It can be expected that these trends will continue into the future.

The preparation of the project proposal commenced in early 2004. At that time the team used an overhead projector and a microscope with T.V monitor attachment at their meetings. A set of lightboxes (explained on page 38) were also available. As part of an initiative to foster collab-

oration in cancer research and development between Ireland, Northern Ireland and the National Cancer Institute in U.S.A., reported in Martino et al. (2003), a teleconferencing system (called Telesynergy®) was made available at St. James's hospital, in the same building where the respiratory MDT held their weekly meetings. The team moved location in June 2004 and held their first meeting in teleconference the following month (July 2004). The first initiative (with hospital x) did not develop into a regular event, because of difficulties in scheduling. The scheduled time, 0800 hours on Monday mornings, did not prove satisfactory for hospital x. However, a later initiative in November 2004 to link in teleconference with Tullamore regional hospital led to a twice monthly event between Dublin, Tullamore and Mullingar in the Midlands region, from January 2005 that continues at this time. A further teleconferencing initiative with Letterkenny regional hospital, in December 2006, has led to a twice monthly event since January 2007. Currently, on the first and third Mondays of each month the MDTM at St. James's (Centre A) links with Letterkenny (Centre D), and on the second and fourth Mondays there is a simultaneous link between Dublin, Tullamore (Centre B) and Mullingar (Centre C).

Over the period 2004 to 2007, a number of significant changes have taken place. A MDT Co-ordinator Manager and 3 MDT Co-ordinators were appointed in January 2005 to help in the management of records, before and after meetings. Following an initial training period an MDT Co-ordinator was assigned for each of the main MDTs and the respiratory MDT gained a new member in March 2005. After the establishment of the MDT Co-ordinator role, it was agreed that all requests to have patients discussed at meetings would be directed to the MDT Co-ordinator, who would then gather the necessary materials to be reviewed by the pathologist and radiologist for the MDTM. It was further agreed to have a 'cut-off' time for adding patients to the following Monday's MDTM agenda. The 'cut-off' was to facilitate the gathering of all the required materials and allow time for pre-MDTM review. In November 2006, this 'cut-off' was revised to the earlier time of Thursdays at 11.00am. In January 2005, a practice was initiated to project details of the patient under discussion during case discussions. This initiative was welcomed but the initial template was changed a year later, in an effort to improve the display of information. That revised template is currently displayed throughout the PCD on a side wall of the meeting room (and will be discussed in Chapters 6 and 9.

The MDTMs continue at this time, sometimes with difficulty because of the volume of work and issues with timing and scheduling. Bank Holiday Mondays cause a set-back, for example, because of four full routine working days instead of 5. But the group are optimistic and hope to develop the meeting further, in time, once some practical timetabling issues are resolved. It is likely that more time will be allocated to MDTMs to enable more patients to be discussed in greater depth as the practice develops in the future. It is imperative that the means to improve dependability are identified and incorporated into routine practice for the full benefits of MDTMs to be achieved.

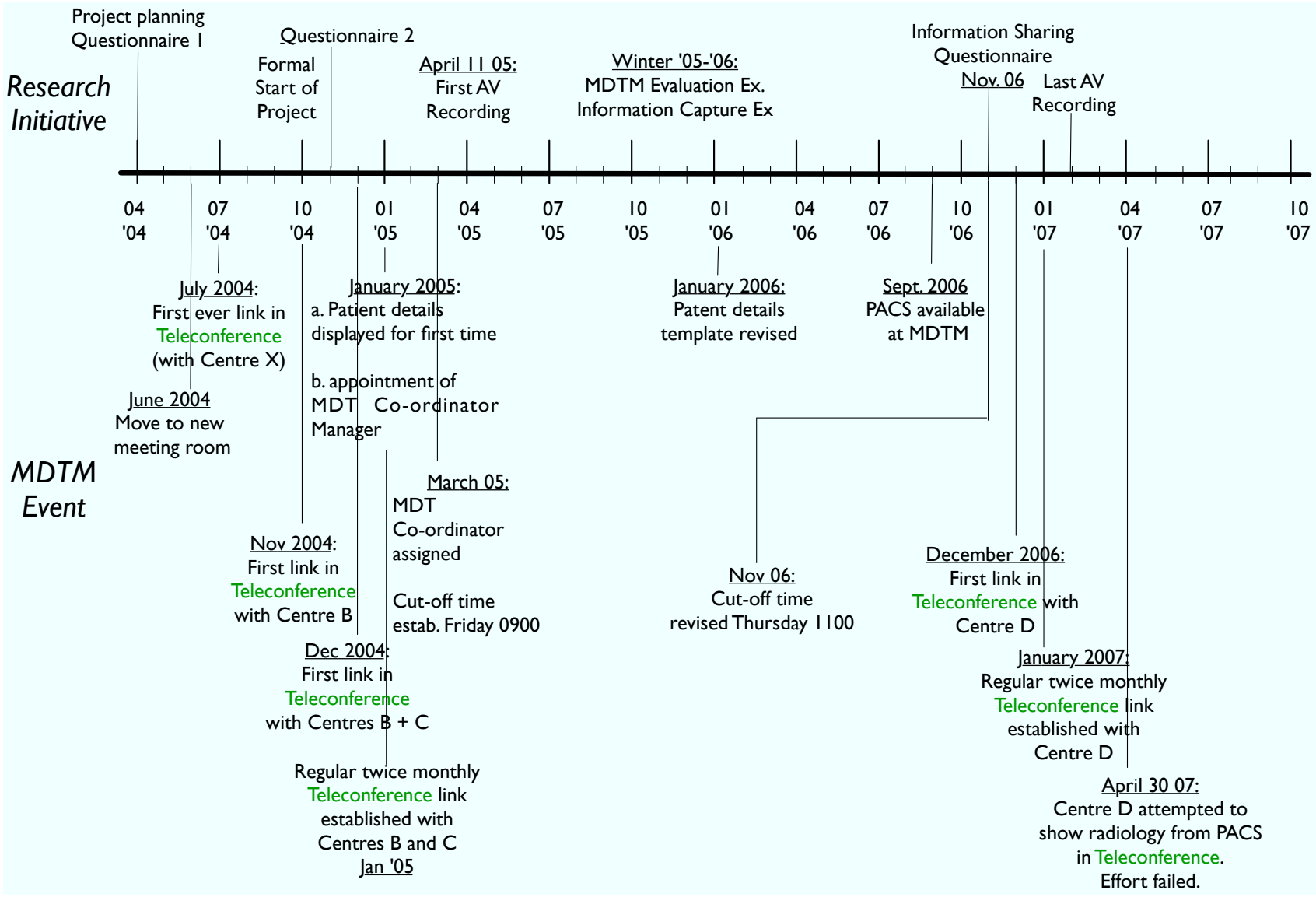


Figure 2.1: Timeline showing developments for the MDTM and landmarks in this study

Chapter 3

Methodology

This chapter describes the work undertaken in conducting this study and the methods used. The general approach adopted will be outlined first and specific methods will be described in Sections 3.1 through to 3.7 where it is explained how each method contributes to the goal in this study. In later chapters, when the results of a particular aspect of the study are being reported, the specific method used in gathering the data for that chapter will be detailed further. A number of methodologies are used because they complement one another in many respects, and also because they serve to minimise the limitations and biases of the individual methods employed.

Computer Supported Co-operative Work (CSCW) is concerned with the need to support multiple people working together using computer systems (Preece, Rogers & Sharp 2007) and provides a useful approach in this study of MDTMs. CSCW approaches to analysing work, and to articulate ways that team members collaborate are drawn upon in this study. The methodology employed here combines an ethnomethodologically-informed ethnographical approach of Randall, Harper & Rouncefield (2007), Hughes et al. (1993), Crabtree (2003) and Harper (2000) to video-based interaction analysis (Jordan & Henderson 1995) in the context of the tasks (van der Veer, Lenting & Bergevoet 1996) and content-free dialogue analysis (Dabbs & Ruback 1987, Jaffe & Feldstein 1970), with a focus on case discussion structure. Understanding work and organization "from the inside" can provide insights into the organizational situatedness of the work, the methods and practices through which work activities and interactions are assembled, and is useful in the design of technology to support it (Dourish & Button 1998).

This work investigated the temporal organization of activities, at macro and micro levels, through unobtrusive observation by being part of the group under study. The method is closer to the ethnomethodologically-informed ethnographical approach of Jordan & Henderson (1995) and of van der Veer, Lenting & Bergevoet (1996) than others (e.g. Crabtree 2003) who reject the use of any theoretical framework and rely exclusively on a rigourously descriptive mode of research. This study utilises a framework as an aid in the conceptualisation of the nature of the subject

material and to guide the research (Section 3.9), and does not rely exclusively on description. As well as using quantitative data to support analysis of the events at a micro level, data were also gathered at a macro organizational level to investigate the phenomena from a broader perspective. van der Veer, Lenting & Bergevoet (1996) note that CSCW work stresses the importance of group phenomena and organizational structures and this approach is considered useful in examining the work of multidisciplinary team meetings.

Becoming incorporated into the team facilitates unobtrusive observation which are verified through the use and analysis of questionnaires, exercises, interviews and video recordings. Combining qualitative and quantitative data facilitates a deep understanding of the activities and allows testing and reviewing of observations. Furthermore, the collection of qualitative and quantitative data allowed for the comparison of users expressed requirements and beliefs with their exhibited behaviour.

The MDTM is a complex work situation where facts and opinions are pooled, and ideas generated, questioned and refined among a group of specialists. This activity serves a number of functions that include patient management, organizational learning and team building (which are described in detail in Chapter 4). Analysing the MDTM to elicit system requirements that will inform the design of technological support for this type of activity is not straightforward, and no single method is readily available. Following the approach of Randall, Harper & Rouncefield (2007) to focus on the nature of the work itself, and the information flow rather than the interactions per se, a number of tools and perspectives were drawn upon to understand the tasks involved and the difficulties experienced by staff in the conduct of their work. The notion of the MDTM as a 'system' (described in Chapter 4) pervades this work, as well as theoretical concepts and ideas on work flow, organization, job design and team work. In keeping with current notions of work design in healthcare, the patient is considered central to all the work processes and tasks undertaken, even though this may not be explicitly stated in the text. Along with the principle of the Hippocratic Oath to 'do no harm to anyone', lies a principle for healthcare workers, to have the interest of the individual patient in mind when conducting work on his/her behalf. So too, is this value, to hold the patient's best interest as central to the activity, embedded in this study.

How team members interact during MDTMs provides evidence of the information flows during the activity, and helps understand the nature of the task and difficulties in the conduct of the work. Seeing the people "being ordinary" in the conduct of the work is important for analysis (Sacks 1984), and observing people at meetings and while conducting their pre- and post- MDTM tasks was valuable in this regard. Ideas from the school of Interaction Analysis Jordan & Henderson (1995) were found useful, particularly in the use of video recording and in identifying the internal structures of the patient case discussion. Since the work of the MDTM is conducted through 'talk' and the use of artefacts, and technology is utilised to mediate among the team members, the use of conversation analysis tools is considered appropriate (Randall, Harper & Rouncefield 2007) in

conjunction with the detailed description of the cognitive activities during a patient case discussion.

The nature of the MDTM work and interaction of participants at the meeting can be analysed from a number of perspectives. The MDTM system, described in Chapter 4, was developed following information learned through observation and the examination of the patient management workflow. This view of the MDTM system is examined in closer detail in Chapter 10 when an individual PCD is described; and a macro view of the MDTM system is presented in Chapter 7. The data gathered that served as the basis for these descriptive chapters consisted mainly of MDTM observation (summarised in Table 3.1) and review of organizational records.

The approach in Chapter 5 overlaps the foci for analysis identified by Jordan & Henderson (1995) which allow for analysis from the start of the meeting to finishing. The content-free analysis of turn-taking described by Dabbs & Ruback (1987) and Jaffe & Feldstein (1970) allows measurement of the effect of teleconferencing on case discussions in MDTM's internal environment reported in Chapter 10. This content-free analysis of vocalisation serves as a useful tool by which the effect of teleconferencing on interaction is measured. It is considered an appropriate, and relevant, tool since it allows a direct measure of the effect of the change in the technology (teleconferencing) on the communication tasks involved.

A questionnaire served as the basis for the data reported in Chapter 8 which examined the MDTM and the PCDs primarily from the perspective of the *active* participants. The objective in distributing the questionnaire was to elicit a self-assessment of the value of the discussion among the different specialists. This method proved useful since all of the senior members of the team responded. Questions were completed in private by each of the specialists, thus avoiding any direct researcher influence on the users' responses.

In consideration of the multifunctional nature of the MDTM, an exercise described in Section 3.4 (and reported in detail in Chapter 9) was directed at the observer participants who attend the meeting for educational purposes. As well as aiming to explore the educational value of the PCD, the exercise was designed to serve as a proxy measure for some roles who take notes at MDTMs as part of their responsibilities.

A principle was adopted not to interfere with the work of the group, and to respect the time constraints of individual medical staff by gathering data by the least obtrusive methods possible. Table 3.1 summarises the work undertaken in gathering data to inform the analysis in this study. Table 3.1 shows the periods in which the different data gathering data tasks were undertaken, the range of MDTMs observed and the amount of time spent at meetings. Some of the MDTMs were held in teleconference and the development of this practice over the period of study is described in Chapter 5. Structured, semi-structured interviews, evaluation exercises and questionnaires were used to check observations. Policy documents, hospital (organizational) records and artefacts were reviewed throughout the period of study (2004 -2007).

The meetings of the Respiratory Multidisciplinary Team (MDT) at St. James's Hospital,

Method	Objective	Time period	Note
Attendance at local MDTMs	Observation	April 2004	
Respiratory	1.5 hr weekly start Oct 2004	through	>300 h
GI	comparison observation		>120 h
Lymphoma	comparison observation	to	>120 h
Urology	comparison observation	September	> 70 h
Head and Neck	comparison observation	2007	> 70 h
Breast		2005 - 2006	> 70 h
Haematology		2005	15h
Gynaecology		June 2007	2 h
Attendance at remote site	for remote perspective	Summer 2005	2 MDTMs
Attendance in other Country	for comparison	Dec 2006	2 days
Interviews	throughout period under study		
Artefacts (including MDTM records)	throughout period under study		
Questionnaire 1	To establish attitudes, at outset of study, 2004		
Questionnaire 2	Seeing Artefacts / People	May 2005	Chapter 6
Questionnaire 3	Information Sharing	Nov 2006	Chapter 8
Exercise	Information Gathering	Nov 05 - Jan 06	Chapter 9
Digital Recordings	Quantitative data and verification of observations	From April 2005 thru' Feb. 2007	Chapter 10
MDTM Evaluations	intermittently over period of study in conjunction with audio-visual recordings		

Table 3.1: Summary of work conducted for analysis of MDTMs

Dublin, was the principal setting for this study. Members of the respiratory MDT served as the main subjects, co-operated in questionnaires, interviews and the exercises described. All quantitative data were collected from this respiratory MDT. Other group meetings were observed for comparison and to prompt investigation of any differences that exist (as documented in Table 3.1).

There were two phases to the work. The first concentrated on understanding the tasks and workflow of the MDT and the second phase involved more quantitative data analysis on the effect of teleconferencing on the proceedings. The first phase involved ethnographic study of co-located meetings, semi-structured interviews, a questionnaire and the study of policy documentation and artefacts. The aim was to elucidate the roles, overall structure and information flows (described in Chapter 4). No video recording of co-located meeting proceedings was involved in the initial phase. Neither was any remote link using the Telesynergy® system employed. Up to 40 people were in attendance, at weekly MDTMs, over the period under study, of whom 10 were consultant clinicians (3 female, 7 male) and regular participants. In the second phase video recording of proceedings was undertaken and exercises (see Appendices) were conducted to gather specific data for quantitative analysis and reported in later chapters. All data in this study were analysed using the Statistical Package for the Social Sciences (SPSS, version 11). Comparative analyses of differences were conducted using the Student's t-test or Chi-square χ^2 tests as appropriate. Tests used are indicated in the respective Tables. Statistical significance was defined conventionally as a value of $p \leq 0.05$. Ethnographic observation was continued throughout the entire period of study.

While researching the practices of the MDTs and their meetings, permission was sought and given to attend proceedings (explained in Section 3.8). When ethnographers engage in the study of a task domain they aim to become a participant observer with the status of 'apprentice' (van der Veer, Lenting & Bergevoet 1996). Being accepted as an observer in the group in early 2004 achieved the status achieved by many ethnographers and this assimilation into the group under study followed standard ethnographic practices. By Summer 2005, training was offered and accepted, to operate the Telesynergy® equipment and formally facilitate the MDTMs by opening access to the building and meeting room, operating the equipment and securing the premises after the conclusion of proceedings. Being incorporated more fully into the group and being able to fulfil a team role while conducting the research transformed the 'apprenticeship' to an 'insider' status and served to further enrich the role of participant observer. Over the period of research, demonstrating reliability by always having the meeting room ready for the weekly meeting, fulfilling delegated responsibilities (such as reminding remote consultants of scheduled teleconference connection), and on-going communication, helped develop and maintain trust. As well as the weekly MDTM, invitations were extended to attend other meetings between members of the team and to observe occasional bronchoscopy and surgical procedures.

3.1 Meetings

Attending meetings as a participant observer was aimed at gaining close familiarity with the tasks conducted by MDT members at MDTMs through intensive involvement with the team in its natural setting. The direct observation of behaviour at meetings was central to data collection in this study.

Co-located meetings were observed at St. James's Hospital (Centre A) for over 14 months. St. James's is the largest acute general hospital in Ireland and teaching hospital for Trinity College. It has 963 beds and provides an extensive tertiary cancer care service.

After the first 6 months, in late 2004, teleconferencing using the Telesynergy® system (Center for Information Technology & National Institutes for Health 2007) was introduced. Since early 2005, teleconference links are scheduled twice monthly to hospitals in Tullamore (Centre B) and Mullingar (Centre C), both smaller regional hospitals in the Irish midlands. Centres B and C have Polycom Teleconferencing systems installed. In December 2006, a teleconference link to Letterkenny (Centre D), a regional hospital in the North-West of Ireland, was initiated. A twice monthly link was formally established in January 2007 with Centre D. A reduced version of Telesynergy® system, developed in conjunction with the full Telesynergy® system is installed at Centre D. It is planned to install the reduced Telesynergy® system at Centres B and C in the future. All connections are via ISDN lines.

Weekly meetings of the respiratory MDTM were observed over the 3 years of this study. Weekly

meetings were also observed of the Head and Neck MDTM since early 2006 when they arranged their meetings to precede the respiratory MDTM and requested facilitation. Request was also acknowledged to facilitate the urology MDT meeting in mid-2005 when it was first initiated and meetings have been attended since then. In addition, MDTMs of the Gastro-Intestinal (GI), Haematology, Lymphoma and Breast Head and Neck were facilitated and observed for comparison purposes from time to time. Over 600 hours of co-located meetings were observed and approximately 80 hours of multidisciplinary team meetings, with simultaneous link to two remote hospital locations, B and C, were observed and approximately 4 hours in a single link with hospital D were attended. Observation at MDTMs was mainly at the large teaching centre, Centre A, but teleconferences were also attended at remote hospitals Centres B and C, in order to observe different groups and perspectives.

Currently the respiratory MDTM at Centre A links with Centres B and C on the second and fourth Mondays each month at 0815, and links with Centre D on the first and third Mondays at 0900 hours. No MDTMs take place on Bank Holiday Mondays. So far, alternative arrangements have been made with Centre D to connect on the second Monday of a month with a Bank Holiday, to deal with cases that require discussion. Meetings have been conducted with connections at 0815 to Centres B and C that lasted 30 minutes and a second teleconference session at 0900 with Centre D.

Respiratory services in the midlands area are delivered through Centres B and C in co-operation with one another. The respiratory physician is based in Centre C and the medical oncologist is based in Centre B. The medical oncologist at Centre B provides all the medical oncology services in the area and also links weekly with the GI MDTM and monthly with the Lymphoma MDTM. These meetings were observed for comparison with the Respiratory MDTM proceedings.

A 2-day visit to the Western General Hospital in Edinburgh was arranged in December 2006 to observe practices of the breast MDT and their meetings in order to compare work practices in a different jurisdiction and support validation of this study.

3.2 Interviews

Although the interview, as a method to understand users is considered to be a failure (Randall, Harper & Rouncefield 2007), it was considered reasonable to make use of the interview as a research tool in this study, since it is being used in conjunction with other data gathering methods. Interviews with team members, individually, allowed for the exploration of ideas, the checking of observations and the opportunity for team members to raise issues of concern. While interviews provided an opportunity to communicate directly with the researcher and build rapport, because of the time pressure on team members and the need to be sympathetic to their situation, more rapport was in fact achieved though regular attendance at meetings.

Semi-structured interviews were held with the consultant and senior medical personnel as well as the paramedical and clerical attendees. Having specific questions in mind helped gather data in a systematic way and being flexible allowed the exploration of ideas that arose in discussion.

Medical and surgical interns were not formally interviewed: their participation is transient due to the nature of their work contracts. More experienced non-consultant clinical staff were asked about work practices and routines. Time constraints on the multidisciplinary team members, its leaders particularly, meant that interviews were often short, and taken when an opportunity presented. It was sometimes only possible to interview surgeons, for example, in-between operations, or talk to medical staff in-between bronchoscopy sessions. More lengthy interviews, in more appropriate settings, were possible with less senior staff. Any information that was accessible through non-consultant staff was gathered at their interviews. Time spent with consultant staff was used to verify information gained from others and to answer questions known only to consultant members of the team. The constraints under which staff were interviewed may have served as, what Harper (2000) calls, a "ritual induction". Seeing the specialists in their "coal-face" setting helped gain more understanding of the difficulties and complexities of the work of MDT members and helped become acquainted with staff.

The interviews afforded opportunities to confirm observations and interpretations and they served as important opportunities to interact with team members and, through interaction, build rapport and develop trust. The interviews also contributed to a richer understanding of the work of the multi-disciplinary team and difficulties for medical and nursing staff in today's climate.

3.3 Questionnaires

Questionnaires are traditionally used to investigate questions in a sample from a very large population. However in this study, because of the difficulty in conducting interviews and the fact that all the group was issued with the questionnaire, it was considered reasonable to use this method. Questionnaires proved useful in gathering specific data for this study. Short questionnaires necessitated little of the participants' time and allowed for quantitative analysis later. Indeed, short questionnaires proved more successful than lengthy interviews. All questionnaires were distributed before a MDTM and collected afterwards. Team members tended to complete the questionnaire either before the start of a meeting, or they remained for a couple of minutes at the end of the meeting to complete it. Occasionally a member took the questionnaire and returned it by post, some time later.

Questionnaires were distributed at the outset of the study to assess participants' experience in the use of technology and their general attitudes towards it. A follow-up questionnaire was distributed one year later, following 8 months of teleconferencing experience, to establish any change in attitude towards video and answer more specific questions raised through ethnographic

observation. Questionnaires and face-to-face interviews with remote participants were conducted in their natural work setting in hospitals B and C. A third questionnaire was issued in Autumn 2006 to formally investigate information exchange and sharing among MDT members.

3.4 Information Capture Exercise

An exercise to assess observer participants ability to gather data from case discussions, reported in Chapter 9, was undertaken over 6 weeks in the Autumn of 2005 and early 2006. December and early January were avoided because of possible seasonal disruption over Christmas and the New Year. Measuring the observer participants' ability to capture information from the proceedings served as a proxy measure for same by others who gather data as part of their role within the team and also to provide a measure of the educational value for those participants who attend to broaden their experience. The information capture exercise is reported in full in Chapter 9. This was the only 'test' conducted during MDTM proceedings. All other data gathering methods that involved the MDTM participants, i.e. questionnaires and interviews, were conducted outside of the MDTM setting.

3.5 Video recording

A sample of over 30 hours of video-recording at 20 MDTMs, with over 350 patient discussions, was collected at Centre A to verify observations and allow for detailed inspection of speech patterns of behaviour. A single recording of one meeting was taken at Centre B, to compare with the recording of that same meeting at Centre A. Having simultaneous recordings from both sides of the teleconference interface allowed for the different perspectives to be reviewed.

In order to minimise intrusion on the meeting activity, the video camera was placed at the back of the room and, after initial set up, was left unattended for the duration of the meeting. A test recording was taken one week before data collection to allow participants to become familiar with the presence of the camera and check methodology. Thus, effects resulting from the introduction of recording equipment to the meeting room were minimised. The focus of the camera was towards the front of the room, recording the artefacts being exchanged, screens that people were looking at and the backs of the main participants. This vantage point allowed the recording of the speakers head turning and direction of gaze as well as giving an indication of their gestures. In addition, a recording on S-VHS was taken of the images displayed on plasma screen throughout the meeting.

Potential medico-legal and confidentiality issues with regard to video recording were overcome through undertakings that the video would be used only for the purpose intended, i.e. for this study only, and that tapes would be destroyed following collection of annotation data.

The meetings that were video-recorded included meetings facilitated by different technical sup-

port operators to ensure that bias was not introduced by having a single operator. However, the role of technical operator at meetings is not an autonomous role, but relies on cues. The choice of input for the screen display is prompted throughout the proceedings by the MDTM participants.

3.5.1 Video Analysis

After converting the S-VHS recording to digital format, the recordings were synchronised and annotated using the Elan Linguistic Annotator (MPI 2005). The annotations were then analysed in a statistical package.

Analysis of talk provides a perspective which emphasises the interactive nature of human behaviour and findings from interaction in conversation have been found useful in informing the design of interactive systems (Norman & Thomas 1991).

Following the methodology employed in Dabbs & Ruback (1987) and Sellen (1992), individual turn-taking in speech contributions to the meeting were annotated for each case discussion. Measuring absolute turn times in this way is context independent, since it relies on intervals of talk and silence, and therefore avoids biases in annotation of turns (Jaffe & Feldstein 1970, Sellen 1992). Measurements of the dialogue elements are reported in Chapter 10 to provide quantitative measurement of the effect of the introduction of teleconferencing on MDTM proceedings. Analysis of the content-free dialogue measures also identified a structure to the patient case discussion event that is 1) context sensitive, 2) content independent and 3) facilitated the elucidation of a protocol, or participation structure (Jordan & Henderson 1995, Dourish 2004) followed during patient case discussions.

Two sets of detailed measurements of dialogue elements were undertaken and are reported here. The first set is an initial analysis of recordings, which comprised discussion of 53 cases[1] in both co-located and teleconference sessions and was reported by Kane & Luz (2006).

The second analysis is a case-controlled study that was conducted following the recording of over 30 hours of recordings at 20 MDTMs and is reported fully in Chapter 10.

Definitions for the dialogue elements used namely, *'turn', 'group turn', 'silence'* and *pauses* are given in Chapter 10 where the findings on their analysis are presented. Speaker switches, overlaps and simultaneous speech patterns were not annotated for these meetings as the proceedings are relatively formal, structured and occurrences of these phenomena were rare.

As well as identifying individual patient case discussions, the case type, managing Consultant and type of referral, i.e. if it was a local GP or tertiary referral, was noted for each case. Annotations were also made of the screen display recording, synchronous with speaker turns and pauses, in order to conduct the analysis reported in Chapter 6.

The analysis of artefacts was not conducted on the entire set of recordings because the wiring of

[1] Of these, 5 cases were excluded because they represented interruptions in the normal proceedings and did not contain complete patient case discussion.

the S-VHS recorder, which was used to capture the screen display, did not allow for the recording of images from the St. James's network. Due to organizational issues, concerning patient privacy and data protection, assess to the hospital Picture Archive and Communication System (PACS) was made available only through a special extension of the St. James's computer network. The PC with the Telesynergy® system is connected to the Trinity College network and although buildings are located on the same site, St. James's hospital and Trinity College buildings are on different computer networks. Telesynergy® is installed in the main Trinity College building at St. James's, with a link to the Trinity College network only. Thus, recordings of the screen display, post-PACS implementation are blank whenever an image is being shown from PACS. It would not have been possible to differentiate between the display of blank screens and radiology images from PACS.

3.5.2 Quality Assurance of Annotation

All annotations were gathered by the researcher. Having one person conduct this work ensured consistency in any bias introduced. To ensure quality some segments of recording were annotated twice, (in duplicate) independently. Comparison of both sets of annotations was acceptable with an error rate of approximately 1-2%. As a further quality measure, annotations were randomly checked for accuracy in timing and labelling both by the researcher and individual volunteers external to this study. If a random check of 10 annotations in a case discussion were considered accurate, that case discussion was not checked further. If a single major inaccuracy, or more than 3 minor inaccuracies, was found when checking a case discussion, the entire case was redone and checked until satisfactory. For the selection of the 54 cases for detailed comparison, each case was rechecked, using the random check of 10 annotations, before being included in the study.

3.6 Hospital Records

Work processes, departmental records and artefacts including policy documents were reviewed. Work processes were documented (reported in Chapter 4) by talking to staff, observing work at clinics, bronchoscopy sessions, and staff at work in radiology and pathology departments. Patient notes tend to be structured and data is collected in systematic ways. Sample forms were gathered to examine the information collected at different parts of the work processes. The main policy document guiding the work of the respiratory MDT is O'Connell (2004). Internal Histopathology Department records were used to gather data for Table 7.3.

3.7 Technology used at meetings

A dedicated meeting-room, with a Telesynergy® workstation, a SMARTboard™ installed, and a light-box, is used for MDTMs at the main centre, Centre A (Figure 3.1). Telesynergy® is a

multimedia, high resolution medical imaging workstation and is described in detail by Kempner et al. (1997), Martino et al. (2003) and McAleer, O'Loan & Hollywood (2001). The workstation comprises a Tandberg 6000 teleconferencing unit which provides camera and screens; a document imager; a high definition videocassette recorder; a microscope with electronic stage and digital camera; a desktop computer; high definition monitors and other tools for pointing and drawing (Center for Information Technology & National Institutes for Health 2007). (At time of writing a new radiologist PACS reviewing workstation is being installed but is not yet operational.)

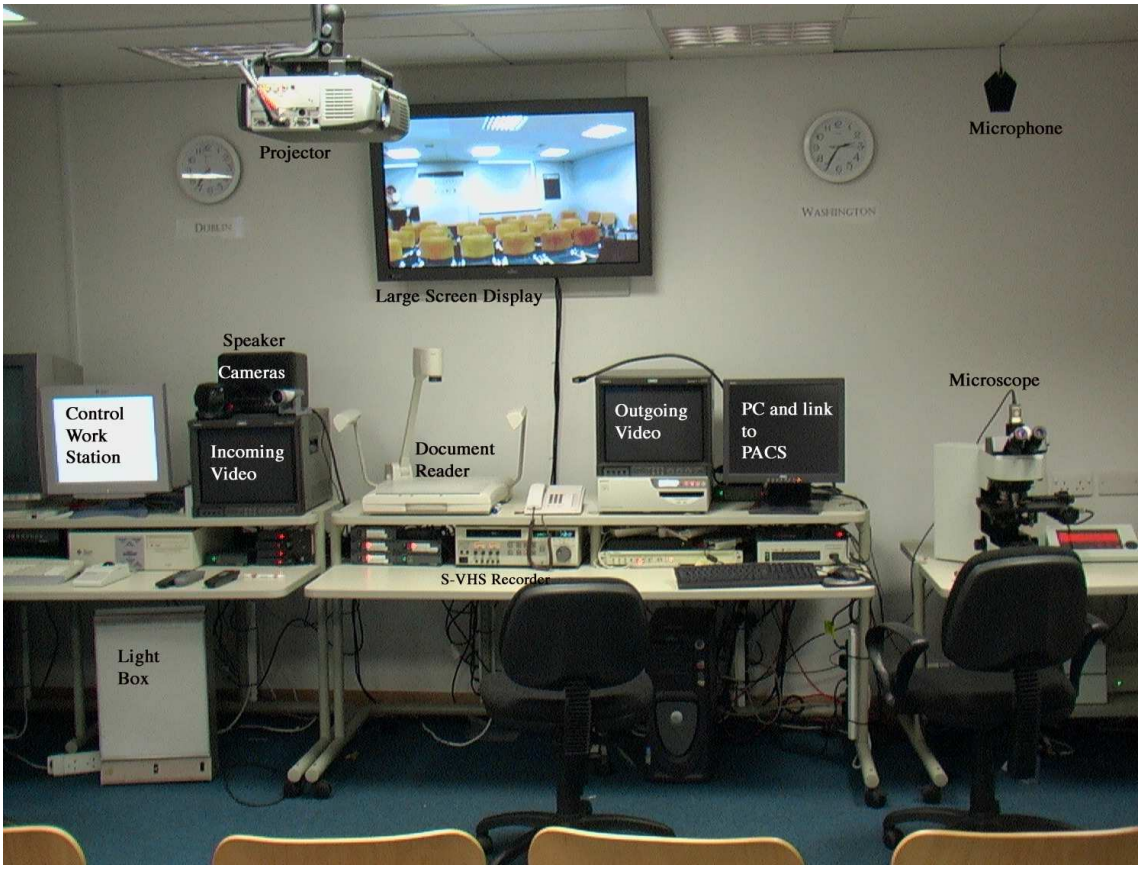


Figure 3.1: Telesynergy® set-up and meeting room. The SMARTboard™ is installed on the right adjacent wall (out of view).

The system provides full-duplex audio and high quality video. There is no perceivable audio or video lag when using the system. A SMARTboard™ is used for additional display purposes on the right adjacent wall in Figure 3.1, that is out of view but whose location is shown in Figure 5.1. Images are projected from the desktop computer onto the SMARTboard™ using the ceiling mounted projector.

This meeting room is used by the team under study for its weekly MDTM (Centre A). The Telesynergy® system and SMARTboard™ are used at both co-located and teleconference meetings. During a MDTM, the plasma screen is the main focus of attention and the SMARTboard™ serves as a secondary, but continuous, display of details of the patient under discussion. The secondary

display is not visible to remote participants in teleconference. At co-located meetings the light-box was regularly used up to 2006, in addition to the Telesynergy® system, to facilitate comparison of multiple film sheets.

The light-box is a rectangular box, of which all sides except one are made of metal. The front panel is made of a white translucent (often glass) panel. There are fluorescent light tubes inside the box and the white translucent panel covering these fluorescent tubes allows for bright light to be transmitted. Clips on the outside of the box allow radiological films to be positioned in front and the fluorescent light transmitted allows for clear viewing of the film images.

During the period of study, a PACS system was introduced in the hospital. The hospital network was extended to the meeting room and an additional desktop computer was installed to facilitate access to the radiological images. The PACS system was installed in the meeting room in late 2006. Following the introduction of PACS, the use of the light-box was reduced but not eliminated. The annotation data gathered from recordings, which served as the basis for the quantitative data, were gathered before the implementation of PACS. As more and more images become available on the PACS system there is less use being made of the light-box.

The equipment shown in Figure 3.1 is used for co-located and teleconference meetings at Centre A. The only difference between the two scenarios in the use of equipment is the use of the video conferencing link to connect to one or two remote sites at teleconferencing sessions.

Figures 3.2, 3.3 and 3.4 show the teleconferencing facilities at remote centres B, C and D respectively. At time of writing a 60" plasma screen is being installed at Centre D to replace the pull-down projector screen shown in the picture.

3.8 Ethical Approval

Because of the sensitive nature of the meeting content, it was important to gain the trust and confidence of the participants at the outset. Initial interviews, circulation of the project proposal and discussion with participants helped in gaining this trust. Ethical approval was sought, with the support of the clinical staff involved, from the St. James's Hospital and Adelaide and Meath Hospital (incorporating the National Children's Hospital) Joint Research Ethics Committee.

In seeking approval, the project plan was submitted along with an application form in accordance with the committee's requirements. In granting approval, it was noted that this study has no interest in any individual patient data, that this research is concerned with work methods and protocols and the design of computer support to make the process more effective.

An undertaking was given with respect to patient confidentiality and professional approach to this research in strict adherence to St. James's hospital policy (St. James's Hospital 2006) and the Data Protection Acts of 1988 and 2003 (Data Protection Act 1988, Data Protection Act 2003).

No individual patient data were collected in the process of this research study. Quotations

Figure 3.2: Polycom™ teleconferencing unit at Centre B.

Figure 3.3: Polycom™ teleconferencing unit at Centre C.

Figure 3.4: The reduced version of Telesynergy® installed in Letterkenny.

or examples of clinical cases given in this thesis are generic and represent typical situations that might occur. No example given here, for illustrative purposes, is true in fact and any resemblance to a real event is coincidental.

3.9 Framework for Analysis

In approaching this study of MDTMs, long consideration was given to the type of data to collect and the most appropriate methods to gather data in the circumstances. Because the study involved a real team in a large busy hospital setting, caution was exercised in the approach taken. Interference in the work of the team, that might possibly have a negative impact on patient care, was avoided on principle.

A framework was devised (Figure 3.5) to help direct the data gathering, structure the complexity of the work and to serve as a project guide. The framework supports the fundamental philosophy to support current work practices, facilitate the expression of the findings, and allow sufficient emphasis to aspects found to be of critical importance.

It is well recognised that there is a complex relationship between social structures, work processes and technology. MDTM work is particularly complex as it is an integration of several specialist roles and a number of related, but independent, functions. Individual participants at the MDTM, each acting in their specialist role, contribute their professional expertise to the team. Meetings represent distributed knowledge coming together and being shared. The process of collaboration in this way adds value to the individual items of information presented and builds new

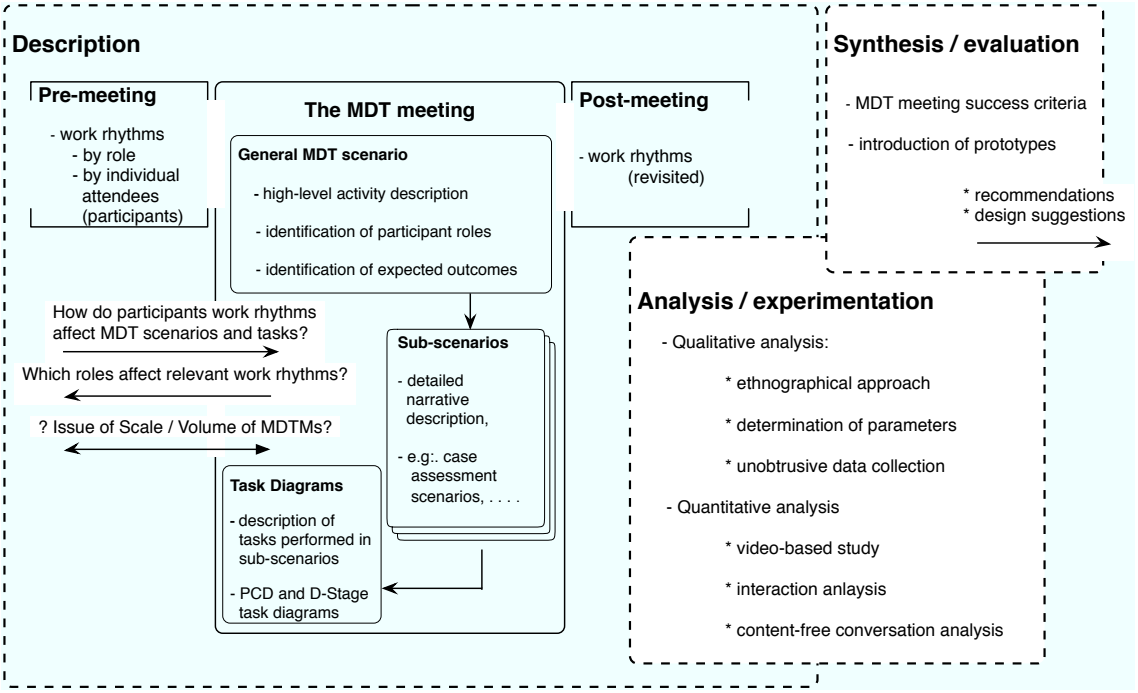


Figure 3.5: Framework for investigation of multidisciplinary medical meetings.

knowledge. The expression that 'the group has within it more knowledge than any individual alone' is true of the MDTM. But rather than place much emphasis on individual personal differences, individual *roles* are considered of greater importance within the group activities. Furthermore, the context of the group activity at an MDTM in the overall patient management process and with respect to the pre-meeting and post-meeting activities are integral components of the framework (Figure 3.5).

In addition to incorporating the pre- and post- MDTM activities, the framework in Figure 3.5 is useful in combining the concepts and techniques used in this study since it incorporates ideas from groupware task analysis (e.g. van der Veer, Lenting & Bergevoet 1996), common information spaces (CIS) (e.g. Bossen 2002) and organization behaviour (e.g. McGrath 1976).

Groupware task analysis (GTA) examines group and organizational activity for the purpose of analysis and design. The computer supported co-operative work (CSCW), including common information spaces (CIS), perspective is concerned with the support requirements of co-operative work arrangements and has a focus on the interrelationship between information, actors and artefacts in the work. Organization theory approaches recognise that for complex and less analysable tasks it is appropriate for information to be communicated face-to-face or in group meetings and prompts investigation of co-ordination and control mechanisms (Daft 2001, Hatch 1997).

The work of the respiratory MDT is complex and because of high interdependence in the diagnostic and treatment services, it requires high levels of co-ordination to carry out its tasks and responsibilities. Research on communication in organizations gives support to the wisdom of

supporting the work of this team in its face-to-face interactions. The MDTM, along with its pre- and post- meeting activities, can be described as a social structure that acts as a co-ordination and control mechanism for hospital services and is part of the quality management of the patient care process.

While either of the GTA, CIS or organizational theoretical approaches could potentially be used for analysis, it is considered that a single approach would not fully meet the needs of this study. MDT-related tasks and processes are concurrent, co-ordinated, and extend beyond the duration of a single meeting. The respiratory meeting happens at a particular time in a designated place. At the meeting, data from an earlier time period are reviewed and decisions made that effect future work. Consistent with fundamental principles of CSCW approaches of following the information flow, its life-cycle and its various modalities (Harper 2000), the framework developed examines information flows before, during and after the meeting. Time issues, like pace and the temporal organization of task activities (McGrath 1988) and work rhythms (Reddy & Dourish 2002), are important dimensions to the study of MDTM activities. Distance adds another dimension. The work situation for the teleconference activity, while similar to the co-located meeting, needs to take account of the distance issues and remote perspectives. The role of participants and their contribution to that information infrastructure and their work routines are incorporated too. Consideration of scale, or volume, of MDTM activity is also included.

The research framework devised provides structure through *description* and *analysis* and supports evaluation as well as *synthesis* of new solutions. The approach in this study has similarities with approaches that situate cognitive activities in the context in which they occur (Howell 1991, Bossen 2002, Bannon & Bødker 1997) and follows information flow (Harper 2000).

The *description* component covers three aspects: *pre-meeting activities*, the *meeting* itself and *post-meeting activities* from two dimensions. The two dimensions of description refer to the *main teaching centre* and *remote users* perspectives. Pace, the temporal organization of task activities (McGrath 1988) and work rhythms (Reddy & Dourish 2002) are part of the description component and allow for the elucidation of roles participants play and their contribution to the information infrastructure through analysis of work routines. The investigation of the effect of scale, or volume, of activity on a hospital (Chapter 7) is also facilitated. At a finer-grained level of description, some detailed scenarios and task description, borrowing on task analysis approaches (Pinelle, Gutwin & Greenberg 2003, Paternò 2000, van der Veer, Lenting & Bergevoet 1996), underpin the data presented in Chapters 4 and 5.

The *analysis and experimentation* component forms the basis for the qualitative and quantitative study of the various interactions arising from the roles and processes addressed in the description component. The overlap between the description and analysis parts indicates a two-way information flow in the sense that descriptions, scenarios and task hierarchies can be complemented or amended through information derived from the analysis part. Analysis is presented in

Chapters 6, 7, 8, 9, and 10.

The *synthesis and evaluation* component aims at establishing performance and success criteria, provide recommendations, and identify areas that can be better supported by technology. While some statements are made within individual chapters, where appropriate, the synthesis part of the model, suggesting ways in which the MDTM might be made more dependable or enhanced, forms the basis of Chapter 11. The introduction of prototypes is included in the research framework to support the development of specific tools (Cameirano, Kane & Luz 2007) and future design activities. The results of analysis in Chapters 6 to 10 provide the material for the synthesis in Chapter 11.

Chapter 4

The MDTM as a System

In this chapter the process of a multi-disciplinary medical team meeting (MDTM), its functions and operation in co-located and teleconference discussions are described.

Chapters 7, 8 and 9 examine particular aspects associated with the proceedings, and the effect of adding teleconferencing to the MDTM is assessed later in Chapter 10. This chapter aims to provide an overall understanding of the meeting, the people involved and the role of the MDTM in patient management. The work processes that impact on the MDTM, before and after, and the interactions that take place during the meeting will be described as well as an outline of the professional roles involved. In the first instance, the overall purposes of the meeting will be introduced and it will be explained how the MDTM fits into the patient management process. After outlining the professional roles and functions of the MDTM, some issues will be discussed that concern the overall patient management processes with respect to the MDTM. The individual patient case discussion is described in Chapter 5 and presented in quantitative detail in Chapter 10. Detailed understanding is necessary at the outset in order to appreciate some of the analysis that follows in later chapters.

The MDTM is described here as a system that adds dependability to other diagnostic and patient management processes. Patient management processes have developed to incorporate MDTMs and these MDTMs now occupy an important hub in patient management. As well as improving the quality of the process, areas of vulnerability have been introduced as a result of modern practices and these will be highlighted. The overall MDTM will be explained utilising task analysis diagrams to clarify detail and as an aid to understanding.

The study method adopted for this section, (detailed in Chapter 3), combines ethnographic observation of MDTMs and the associated work processes and participant interviews.

4.1 The MDTM System

Adopting the definition of dependability in a system as "the ability to deliver services that can justifiably be trusted" (Avižienis et al. 2004, p.13) and "the ability to avoid service failures that are more frequent and more severe than is acceptable" (Avižienis et al. 2004, p. 13), three interrelated concepts in the context of MDTMs are described at the outset.

The MDTM System is a context, or *common information space* (Schmidt & Bannon 1992, Bannon & Bødker 1997), with sets of associated tasks that are conducted pre- and post-meeting. The 'Inputs' of the MDTM system are the information generated through the pre-meeting tasks that are conducted independently by members of the MDT. The 'Outputs' of the MDTM include the post-meeting tasks and responsibilities undertaken by various members as a result of the discussions at the meeting. The MDTM is an organic entity consisting of the physical infrastructure surrounding the MDTM, i.e. the room, the Telesynergy® equipment, the audio and video communication channels (when in teleconference), the microscope, the document reader, the light-box etc. The MDTM also encompasses "boundary objects" such as radiological images and pathology samples. These images and samples are "plastic enough to adapt to ... constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" (Star & Griesemer 1989, p.46). The active participants at the MDTM are a class of MDTM participants termed here as *actors* whose joint interpretation of MDTM objects and events also form part of the MDTM system (Bannon & Bødker 1997). This definition is compatible with the perspective adopted by Avižienis et al. (2004) regarding computer-based systems, i.e. "systems which also encompass the humans and organizations that provide the immediate environment of the computing and communication systems of interest" (Avižienis et al. 2004, p. 12). There is a temporal dimension to the MDTM and associated processes which extends over 7 days (5 working), with peak activity concentrated within the MDTM system from 0800 to 1000 on Monday mornings. The MDTM system and associated processes are depicted in Figure 4.1.

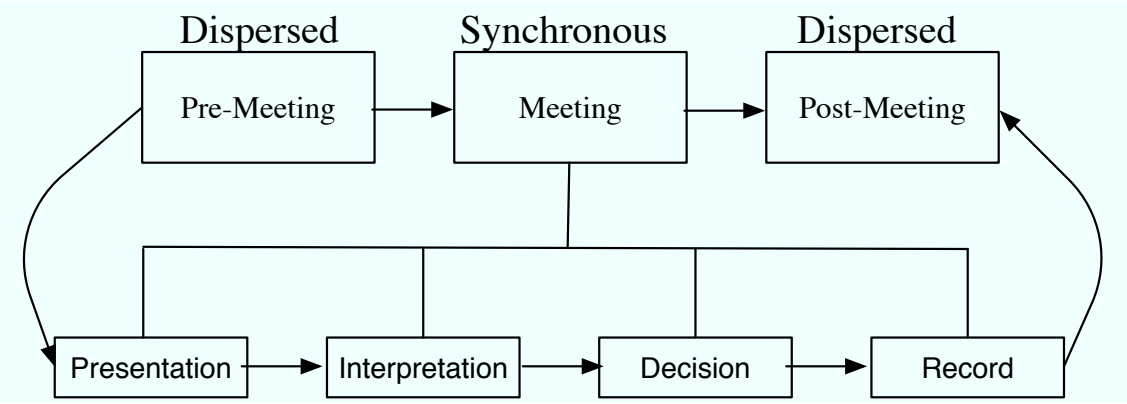


Figure 4.1: The MDTM is part of a process that includes pre-meeting and post-meeting tasks. Pre-meeting work is presented in discussion. The decision record directs post-meeting tasks and responsibilities

Services provided by the MDTM fulfil its roles and functions as a system that enhances the patient care pathways and contributes to learning. The functions of the MDTM encompass patient management, education, organization and social roles. Patient management functions are summarised in Table 4.2 and will be explained in detail later in Section 4.2.3. Education of undergraduates, post-graduates as well as the professional development of medical and other staff is a concurrent secondary function to patient management. Audit is facilitated and information managed through MDTM activities. The social function of the MDTM, while secondary, is significant in its contribution to staff morale and team-building.

Trust is the extent to which members of the team can safely rely on the service provided by the MDTM to support their work. In other words, how the MDTM system avoids unacceptable service failures within the broader context in which the MDTM is inserted (e.g. wrong patient management decision) and also in terms of failures internal to the MDTM proceedings, (e.g. misunderstandings or missing radiological images).

By defining the MDTM as a system, boundaries are established between the system and its *external environment*. While the pre- and post- meeting activities depicted in Figure 4.1 are external to the MDTM system, they are part of its task environment, called here its *external task environment*. The *internal task environment* is where the MDTM takes place, with all its activities, for the designated time.

The MDTM adds dependability to the patient care pathway and services delivered by the MDTM need to be reliable in order to provide a more trustworthy system overall. This reliability is achieved through reducing vulnerabilities and making processes more efficient. For MDTMs to be effective there are associated pre- and post- meeting activities, intersecting with individual work systems, that need to be successfully conducted. These dependencies, while posing latent threats to dependability, provide the potential to make the MDTM more reliable.

4.2 MDTM Roles and Functions

Before reviewing the work processes and the internal structures of a patient case discussion (PCD), the roles involved and the functions of the MDTM are described. It is more useful to consider the conduct of the work done at the meeting in terms of roles, rather than individuals. While there are individual differences in the conduct of roles at work, interaction behaviour is generally dictated by the work roles of the individuals rather than individual differences. Each of these roles and how they contribute, influences the structure of the MDTM and will be briefly described, as well as the general team and directorate structure in the hospital.

4.2.1 Professional Roles

The roles that contribute within a single multidisciplinary medical team will be dictated by the nature of the speciality and the services being delivered. Suggested attendees include radiologists, pathologists, surgeons, physicians, medical and radiation oncologists, nurses, dieticians, palliative medicine and pastoral care (Wright et al. 2007).

The multidisciplinary work described in this study, involves the diagnosis and management of non-psychiatric diseases and requires diagnosticians such as radiologist and pathologist members within the team. Depending on the speciality, and the size of the hospital, differences in the constituent MDT roles can be expected. For the head and neck MDT, for example, a plastic surgeon plays an role in the group. In the gastro-intestinal (GI) MDT a dietician role is incorporated, and a chest physiotherapist is usually a member of a respiratory MDT. Only very large hospitals will be able to accommodate all the roles that might be involved for a particular service to be delivered. It is now advised for those hospitals that do not have all the needed specialists in-house, that linkages be made via teleconference so that specialists can meet in a 'virtual' meeting (Wright et al. 2007).

Not all of the roles involved in the respiratory MDT are active participants in the MDTM, although they will be in attendance. The respiratory physician, cardio-thoracic surgeon, clinical and radiation oncologists, radiologists and pathologists are the lead roles involved at respiratory MDTMs. The observer participants at MDTMs are roles such as the nurse, data managers, MDT Co-ordinator and physiotherapist. If any of these roles have a contribution to make to a patient case discussion (PCD), they contribute. It is a rare event for observer roles to intervene in a PCD, but it not unusual for a question to be asked by a senior team member, particularly of the nurse, or MDT Co-ordinator members of the team.

A consultant member of staff is usually assigned a team that consists of a Registrar and/or a Specialist Registrar, and a number of House Officers of varying experience. The size of the team will usually be determined by the volume of work for that specialist and the nature of the hospital service. A teaching hospital, for example, like St. James's, will have a greater teaching component than a non-teaching centre and can be expected to have a larger team. Many of the team positions are categorised as specialist training posts. Interns are the most junior members of the clinical team. Of the team members, the Consultant is the only permanent member of staff. Other team positions are contract posts that vary in duration depending on their nature, the training schedule and experience required. Contracts are usually awarded for either 3-year, 1-year or 6-months duration. All contracts start on either January 1st or July 1st. Within a 3-year or 1-year contract, however, there is internal movement between teams. Interns are required to spend 6 months gaining general medical experience and 6 months surgical experience before full registration. In a teaching hospital, a 6-month medical intern contract might include 2 months respiratory medicine, 2 months GI and 2 months in another area. Thus,'the team' is in constant flux, with regular changes of junior members of the teams and major changes (and upheaval) on

July 1st and January 1st each year.

The individual roles will be briefly described next. For all of the roles described here, individuals also have teaching and research responsibilities and provide emergency support for the accident and emergency department.

Respiratory Physician

The respiratory physician is usually the first specialist to whom a patient with suspected lung disease will be referred. A respiratory physician manages patients with a broad mix of life threatening, acute, chronic, and terminal disorders. The work involves patient assessment in out-patient clinics, ordering tests on the patient, conducting bronchoscopy procedures and managing those respiratory in-patients while in hospital. A respiratory consultant physician can expect to have a number of in-patients and out-patients in their care at any time. The working week involves out-patient and bronchoscopy clinics, ward rounds and providing respiratory consultations to other doctors' patients on request. For example a patient may have been admitted under the care of the geriatric services and the geriatrician wishes to have the patient assessed for lung disease by the respiratory physician. In such cases the patient will remain under the care of the geriatrician (unless transferred) and a consultation will be provided by the respiratory physician.

The bronchoscopy procedure involves the insertion of a fiberoptic bronchoscope into the patient's bronchus to visualise the airways and mucosal surfaces. Samples can be taken for pathology (histopathology, cytology and microbiology) through specially designed instruments. The bronchoscope equipment has the facility to take still pictures or DVD recordings of the airways. The bronchoscope is also connected to a monitor in the procedure room facilitating the visualisation of the airway through the optics on the bronchoscope, or on the monitor. The display of the procedure also allows for other team members to visualise the airways and for teaching points to be demonstrated. Currently the database connected to the bronchoscopy equipment is a 'stand alone' system. Pictures are regularly printed and brought to the MDTM by the physician undertaking the procedure.

The respiratory physician selects patients from their bronchoscopy list for the following MDTM. In the past, when workload was smaller, all patients referred for bronchoscopy were automatically discussed at the MDTM following their procedure. Because of increased workload, and demands, only those patients with tumours, or complex lung disease are tabled for discussion.

There are currently four consultant respiratory physicians appointed at St. James's hospital.

Cardio-Thoracic Surgeon

The cardio-thoracic (CT) surgeon is a specialist surgeon who removes masses, segments, or lobes of the lung as the clinical need requires. CT surgeons operate on cardiac patients too, but it is their work in lung surgery that is within the remit of the work of the respiratory MDT. (For cardiac

surgery they will work with a different set of medical specialists, called cardiologists.) CT surgeons also perform diagnostic and therapeutic surgical procedures under Video-Assisted Thoracic Surgery (VATS).

Patients are usually referred from respiratory physicians or another clinician. Another surgeon (other than CT) may have a patient in their care who has a lung finding and in such cases the patient will be transferred to the cardio-thoracic surgeon.

The CT surgeon is frequently referred patients on whom a definitive diagnosis has not yet been established. Irrespective of whether there is a clear diagnosis, the surgeon will establish the patient's health status as well as the tumour type, its extent and anatomic location before undertaking a major procedure. There are also a number of investigative procedures that are only ever undertaken by a CT surgeon on anaesthetised patients such as a mediastinoscopy, which is an examination of the chest under the chest bone (sternum) and allows for the examination and sampling of lymph nodes for abnormality.

Following a surgical procedure, surgeons will continue to manage their patient until he, or she, has achieved full post-operative recovery, at which time he, or she, may be transferred back to a medical colleague for longer term care. Depending on the circumstances, the surgeon may maintain surveillance of the patient through regular visits at the out-patient clinic.

A surgeon will usually table all of his, or her, cases for discussion at the MDTM, pre- and post-procedure. Facilities are available in the operating theatre for video recording of the procedure and from time to time the surgeon may bring a short movie to demonstrate a point to clinical colleagues at the MDTM.

Medical Oncologist

The medical oncologist is the specialist who administers appropriate chemotherapy to patients diagnosed with cancer. Medical oncologists ('oncologists') tend to sub-specialise and individual oncologists take special interest in a couple of areas. There are four medical oncologists at St. James's, one of whom is a specialist in lung cancer, a member of the respiratory MDT and attends the respiratory MDTM (and is also a member of other MDTs).

Oncologists may be referred patients directly from outside the hospital, in which case they will table that patient for discussion at the MDTM. Otherwise, oncologists tend to have patients referred to them *from* the MDTM and take over the care and management of the patient following discussion at the meeting.

Radiation Oncologist

The radiation oncologist is the specialist who administers appropriate radiation therapy to patients diagnosed with cancer. The role of the radiation oncologist, with respect to the MDTM, is similar to the role of the medical oncologist.

Radiation oncologists tend to sub-specialise also and individual radiation oncologists take special interest in a couple of areas. There are two radiation oncologists at St. James's one of whom is a specialist in lung cancers and attends the respiratory MDTM. The radiation oncologist member of the respiratory MDT is also a paediatric radiation oncologist and works over three hospitals.

The radiation oncologist may also be referred patients directly from outside the hospital, in which case the patient will be tabled for discussion at the MDTM. Most often, the radiation oncologist has patients referred to her *from* the MDTM and she takes over the care and management of the patient following discussion at the meeting.

Radiologist

Radiologists are clinicians who use imaging methods to achieve their diagnosis and individuals tend to specialise in the interpretation of image data from difference modalities, e.g. ultrasound, and in different biologic systems, e.g. lung. Radiologists, like pathologists, always interpret image data in the context of clinical information. A respiratory radiologist is a member of the respiratory MDT. At one time, there were few imaging options for the lung and a chest x-ray was the only 'picture' available. Developments in medical imaging have led to the routine clinical use of computed tomography (CT), positron emission tomography (PET), ultrasound (US) and magnetic resonance imaging (MRI). Depending on the density of the tissues being examined, different imaging approaches are used. For lung, traditional chest radiographs (x-rays) and CT scans are used routinely and the radiologist brings an expert interpretation to the image findings. There are two consultant radiologist members of the respiratory MDT.

During PCDs one of the radiologists illustrates and interprets the image findings to the MDTM. If images are on film, the document imager is used. When the image is available electronically, it is projected from the PC onto the overhead display. The two radiologists alternate turns presenting, or attending, meetings. The presenting radiologist reviews all images beforehand in MDTM preparation. If the agenda is particularly large, the radiologists may split the caseload for the meeting between them. The presenting radiologist will sit at the front, beside the document imager. The second radiologist will assume a seat in the front row, along with the other consultants.

Pathologist

The pathologist member of the team contributes his, or her, diagnostic opinion on the tissue or cell samples submitted by the respiratory physician and surgeon for analysis. Fundamental to the pathologist role is the integration of clinical information with laboratory studies and observations of tissue alterations. Similar to the situation in radiology, summary information is provided to the pathologist when samples are submitted to the laboratory and further clinical information is acquired on the case through the interactions with the radiologist and clinicians at the MDTM.

The pathologist illustrates the laboratory findings by either projecting the actual tissue sample

using a microscope, or presenting digitised images of the samples that were taken during pre-meeting preparation. There is one consultant pathologist and one non-consultant pathologist members of the respiratory MDT. The non-consultant pathologist is in training and reviews all cases with the consultant pathologist in pre-MDTM preparation.

MDT Co-ordinator

The administrative role of MDT Co-ordinator organises the gathering of all patient records prior to the MDTM, takes notes during the meeting and ensures that a summary sheet with the MDTM decision is filed in the patient's chart afterwards. The MDT Co-ordinator is also responsible for maintaining the meeting agenda and attendance lists from the meetings. This role must ensure that all relevant up-to-date patient information, particularly slides and all imaging are available prior to the meeting. The role of MDT Co-ordinator has developed in recent years since the first appointment in January 2005. All MDTs in St. James's hospital have a designated MDT Co-ordinator and in the United Kingdom it is noted that the vast majority of teams have introduced this role. In some cases (in the U.K.) the function is occupied by a nurse specialist who also has a role in communicating directly with patients (Soukop et al. 2006). Having this key role is a recommended standard for meetings in Canada and considered an institutional requirement. The role is described as 'the 'glue' that ensures the continuity' of the MDTM and there should be a designate assigned in case the Co-ordinator is unavailable (Wright et al. 2007, p.1009).

Clinical Nurse Specialists

The Lung Cancer Co-ordinator is a respiratory nurse specialist, a permanent member of the team, fulfils a liaison role between the patient and the respiratory clinicians. It is this nurse who will meet and talk with individual patients and their families, and will meet all lung cancer patients. As well as serving an important role for the group, the nurse can also act as a 'patient advocate' at meetings, advising the group if the patient has particular needs, or wishes, that should be taken into account. (The role of patient advocate during PCDs is not exclusive to the nurse role. Any clinician looking after a patient knows the patient's circumstances and will take these into account when weighing up the treatment options. This is discussed later in Section 5.4.

This nurse will also liaise with outside agencies and establish tests that will need to be undertaken, make appointments and informally oversee the management of the patients. When a patient is referred to the surgeon, for example, the nurse will review the letter with the surgeon and undertake to arrange the necessary tests before the patient meets with the surgeon at an out-patient clinic. In this way, when the patient sees the surgeon, all the routine tests results will be available and the surgeon and patient can discuss treatment options in the light of findings. It has become (almost) routine practice for the patient to be discussed at the MDTM before meeting the CT surgeon. (This will be discussed later in Section 4.4.5). There is one respiratory nurse

specialist on the respiratory MDT.

There are also four cardio-thoracic surgical nurse specialists one of whom attends the MDTM as rostered and an oncology nurse specialist who regularly attends.

Data Managers

Data managers attend the MDTM and find it a useful forum to gather data. Otherwise, data are collected through referral letters and patient paper charts. Data gathered during a meeting are later confirmed and entered into the appropriate database. There are several databases maintained by the respiratory MDT, for historical reasons, that serve different purposes. The cardio-thoracic database maintains records of all patients on whom cardio or lung surgery is undertaken. The 'lung MDT' database maintains records of all respiratory patients discussed at MDTMs. Its purpose is to provide 'rapid' information on current caseload, but may not be 100% accurate because many of the cases have not had a definitive diagnosis. A subset of the MDTM database is a lung cancer database and is used for long term follow-up and audit purposes. There are two data managers, both of whom attend meetings but do not actively participate in discussion.

Clinical researchers

Clinical researchers are members of the team and attend MDTMs. They are passive members of the team and take notes for later use.

4.2.2 MDT Meeting roles

Some of the roles described above play a very active part at the MDTM and a few of these roles have specific duties at the MDTM namely the radiologist and pathologist, which are unlike the tasks normally conducted by their role in routine work (in their respective areas). The MDT Co-ordinator, has the special task at the MDTM of taking note of the disease staging agreed and the decision made by the group. In addition to the roles already described, there are a few additional roles generated at the MDT meeting. These are the 'lead clinician', a consultant MDT member, and the 'technical support' person, who may, or may not, be a member of the team at other times of the week. There are also two others who schedule their attendance to coincide with the meeting and provide services at the start and end of the meetings: the caterer and the pharmaceutical representative.

The Lead Clinician

A number of studies recommend that there be a recognised leader with designated responsibilities to ensure smooth functioning of the MDTM (Wright et al. 2007, Bauman, Winqiust & Chin 2005). For groups studied here, the lead clinician is a consultant who calls the meeting to order and acts

as 'chair' to the proceedings. There is usually an individual awarded the title of 'lead' and the role of 'lead' acts as 'anchor' for the group and occupies an important communication role for group members, both inside and outside of the MDTM. If an individual member, for example, wishes to discuss a process or policy issue concerning the meeting, they will approach the lead clinician to discuss it in the first instance.

In the absence of the lead clinician at an MDTM, another consultant member of the group will adopt the role for that meeting. Currently one of the respiratory physicians works as lead physician. This is a voluntary role, nominated and supported by the other team members. It is an understanding that this lead role will be reconfirmed from time to time by the group.

The lead clinician is also responsible for co-ordinating an annual meeting of the team to review policy and procedures of the MDT and the MDTM. Other meetings will be convened should a need be identified among the group.

Technical Support

A nominated individual attends the meetings to operate equipment. This person takes cues from team members with regard to the image source to be displayed on the overhead screen at MDTMs. This person makes the necessary connections for teleconferencing and troubleshoots any difficulties that may arise.

After spending several months with the respiratory team, the researcher in this study was invited to perform this role for the MDTM.

A second person, and observer participant MDT member, sits near the computer at the back of the room and moves the agenda sheet displayed on the SMARTboard™ as the MDTM progresses through the PCDs.

Caterer

The MDTM is held at 0800 on Monday mornings and tea, coffee, scones and pastries are provided, sponsored by a pharmaceutical firm. Caterers are organised to deliver the refreshments 15 minutes before the start of the meeting.

Pharmaceutical company representative

The company representative sponsoring the morning refreshments regularly attends at the appointed time, outside of the meeting room. This affords an opportunity for the company representative to meet with the doctors and discuss new products or common interests.

Members of the public, including pharmaceutical representatives and caterers, are not invited to attend meetings in order to maintain patient confidentiality and ensure unbiased case review (Wright et al. 2007).

Table 4.1: Overview of MDTM functions, tasks for MDT members and the services delivered, through interaction and knowledge sharing at meetings.

Function	MDTM tasks	Services
Patient Management	correlate test results exchange opinion assess options share information	diagnosis disease stage Patient management decision
Education	Articulation Description Discussion Interaction	Increase in individual knowledge develop experience organizational learning
Organization	Interaction Data gathering Note-taking	Policy Development Database entries Co-ordinated action post-MDTM Recruitment to Clinical Trial
Social	Social interaction	Improved communication channels Team-building

4.2.3 Role of the MDTM

At the MDTM, the professional roles described in the Section 4.2.1 come together and have discussions for a special purpose. The role, or function, of patient management through these meetings, makes the MDTM an important co-ordinating mechanism across hierarchical structures in the hospital organization. In improving the co-ordination of the necessary individual patient services and involving several specialists in decision-making a real quality benefit for the patient and hospital is achieved. While the primary purpose of these discussions is to agree patient management, there are other secondary roles fulfilled in this process. The functions of the MDTM, summarised in Table 4.1, serve to make other intersecting systems more reliable. For example, the execution of a pre-meeting task, such as the review of a pathology sample, ensures the result is available for discussion at the MDTM. Otherwise, that task might be accidentally overlooked or not completed within an acceptable timeframe. Group work also has other benefits to the organization and individuals involved, which are summarised in Table 4.1.

Patient Management Function

The patient management function is the overt purpose of the MDTM and the most important service provided by the system. The structure of the case presentation is borne out in video analysis (Chapter 10) and is described here.

While Figure 4.3 depicts the overall work processes, it does not show how the patient management process is managed through the MDTM. For an individual patient, their details are brought to the group by the clinician to whom they have been assigned (or *expected* to be assigned, which

will be discussed later in Section 4.4.5). When the patient's details are discussed at the MDTM, and the best treatment strategy decided, their care may be transferred to another clinician. This patient management process is represented in Figure 4.2.

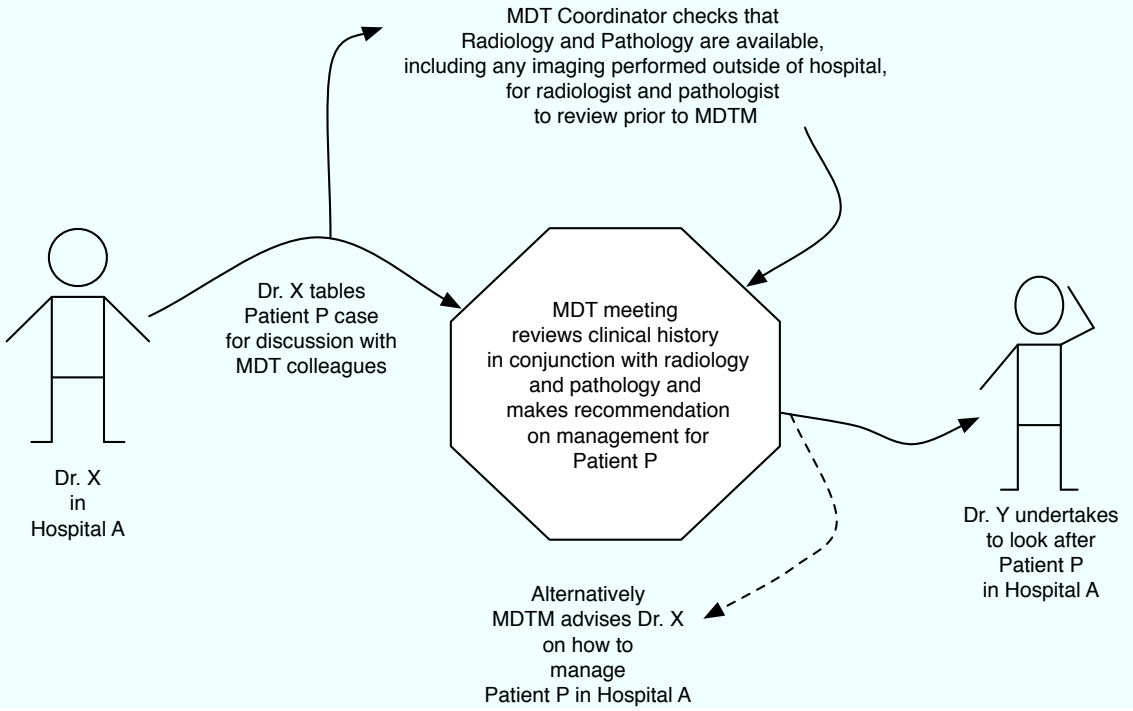


Figure 4.2: The MDTM in the patient management work processes

There are two major elements of a patient case discussion. The diagnosis is the first task and takes about two-thirds of the time given to a patient case discussion. The clinical correlation of the clinical, radiological and pathological findings, (the triple approach), in making the definitive diagnosis helps ensure that a potential false negative in one of the investigation modalities is highlighted and/or investigated. False negative tests will also be captured through the interactions at the MDTM. Suppose a situation where the respiratory physician suspects, on clinical examination, that the patient is likely to have cancer, and orders radiological imaging and a tissue biopsy from a suspicious area in the bronchus (that was visualised at bronchoscopy). If the patient has cancer, then the bronchoscopy finding will have identified that the tumour is in the bronchus, the radiology will also locate the tumour and suggest its extent and the pathology result will provide the tumour type. If one of the investigations (bronchoscopy, radiology or pathology) says that there is no tumour, this would need to be explained and the test would need to be reviewed and/or repeated. In a similar way, a 'false positive' from a single investigation will be identified, for example, if an abnormal area at bronchoscopy is biopsied and is found to be due to inflammation. Bronchoscopy can be expected to have more abnormal areas visualised that turn out to be malignant lesions, because it is not possible to differentiate between a benign or malignant abnormality through visualisation alone. Headline news reporting incidents such as "Review ordered over cancer mis-

diagnosis" (Siggins 2007) or "Team of experts to investigate cancer test error" (Wall 2007) tend to reveal that multidisciplinary team review with the triple approach was *not* in common practice. These sort of incidents led to the development of guidelines that incorporate a 'triple assessment' as part of the routine work process (O'Higgins 2006).

It is generally accepted that group decision-making is superior to individual decision-making because the group has within it more information than any of the individuals alone. Furthermore, a group involved in decisions become more committed to the implementation of the decision that is made (Goodwin & Wright 2004). Thus, a patient's definitive diagnosis from the MDTM is more likely to be reliable than a decision made by an individual clinician, and the management decision is more likely to be executed. The MDTM has a unique function, in its task to agree disease staging. TNM staging is a difficult task for an individual specialist to establish with accuracy (explained in Section 5.3.1) and critical for the choice of appropriate treatment protocol or clinical practice guideline.

The second task of the PCD relates to the patient management decision and the co-ordination of any treatment. When treating a patient, the medical approach (e.g. antibiotic treatment) or surgical methods (e.g. excision) are the two main approaches. For cancer patients treatment can be more complex and involve several specialists: chemotherapy given by medical oncologists, removal of tumour by a surgeon, application of radiation therapy by the radiation oncologist, or palliative care by the medical teams. Individual cancer patients may benefit from chemotherapy, surgery and/or radiation therapy given in a combination of one or more approaches and administered in sequence, or concurrently. It is important for optimum benefit for the patient that there is good communication among specialists and co-ordination of treatments. The MDTM is an ideal mechanism to facilitate the interaction among the specialists and the co-ordination necessary to achieve patient benefit.

Education Function

The MDTM serves an educational function for under-graduate medical students, it is an accreditation requirement for a postgraduate specialist programme and is recognised as part of continuing professional development (CPD) for clinical staff. There is an opportunity to extend experience with unusual cases by sharpening diagnostic skills on cases that are uncommon, or that present specific diagnostic dilemmas. The meeting also provides an opportunity to explore scientific background and recent medical literature pertaining to the area. The introduction of new concepts and techniques in specialist areas, such as pathology and radiology, can be facilitated through this meeting.

Hospital Organization Role

For the hospital, the forum facilitates the collection of information that can be used for audit purposes and having the meeting structure incorporated into the hospital work process serves quality assurance objectives by complying with current clinical practice guidelines for the management of lung cancer patients (Alberts et al. 2003, NCCAC 2005, O'Higgins 2006). It is not unusual during PCDs to divert to a discussion on current clinical guidelines and possible shortcomings within common practice. As well as having weekly opportunities to consider current clinical practice guidelines (CPGs), the MDT meets at least once annually to review general guidelines, current research and work practices and has contributed to the development of Irish guidelines in O'Connell (2004). Having on-going review of work practices through audit, in conjunction with the review of CPGs, facilitates policy development and the development of revised guidelines (Shekelle et al. 2001).

The meeting has a co-ordinating role between the hierarchical departmental structures in the hospital. Although pathology, radiology, medical and surgical departments co-operate in the course of their work, they are separate structures within the hospital. Through the establishment of the MDTM, an improved system of patient care is developed that reduces the risk of medical mismanagement (Øvretveit 2000), making the hospital service more dependable.

The MDTM is a feedback mechanism for participants in their individual work and can be seen as a vehicle for enhancing individual motivation and performance (Hackman 1980) as well as facilitating audit activities. The hospital gets feedback on the MDT activities through audit reports, generated from information of which some is obtained at the MDTM. The MDT also gets feedback on its performance through frequent interim audit reports and although much of the data is incomplete when presented, because of short timescales, the team value information on recent cases and find it useful to monitor trends. For example a figure from an interim audit report might be: "There were 6 non-small cell tumours in the past month, 5 of which were from female patients and two of those had a history of breast cancer." Even though the data are incomplete, the information might flag that a possible trend should be observed and prompt a research study.

The hospital has an important research role, which the forum facilitates. The MDTM forum is also useful for increasing awareness of available treatments (Forrest et al. 2005) and in helping recruitment of patients into suitable trials (Corrie, Shaw & Harris 2003).

Social Role

The MDTM also serves a social purpose in helping build communication channels between individual members of the team. Some team members work independently and with little contact with other multidisciplinary team colleagues outside of the Monday meeting, and the opportunity for task related communication and discussion within the meeting setting has benefits outside of the meeting itself. For example, the pathologist at an MDTM might explain the importance of getting appropriate clinical data on the laboratory request form. A case might get presented, where the

pathological sample was examined in the context of specific information provided at the time of request. At the meeting more information might be revealed that would require the sample to be re-evaluated in this new light. For interpretative tasks in radiology and pathology, contextual information is important for accurate interpretation. Lack of information is a potential source of medical error. Through interaction at the meeting, clinical staff will have a greater understanding of the importance of providing appropriate information on the pathology (or radiology) request form in the future. This potential lack of understanding of each other's professional needs was recognised in Symon, Long & Ellis's (1996) study of a radiology department. In this study the MDTM forum served as an opportunity for mutual education of requirements in the conduct of individual task activities.

Within the structure of the meeting event the beginnings and endings are clearly opportunities for social interaction, both task and non-task related. Refreshments at the start of the meeting offer a focus for social exchange. After the meeting business is concluded, individuals and small groups confer on other task related issues, such as the informal discussion of another patient's presentation or conferring on notes and clarification on follow-up tasks and responsibilities. Such "beginnings" and "endings" form an important part of the co-located meeting event structure, help build mutual trust and are events brought about by collaborative achievement (Jordan & Henderson 1995) and are described in more detail in Chapter 5.

The MDTM has a number of functions, but the main focus here centres on the patient management services provided. The nature of the collaboration among the specialists in the conduct of their role when providing that service is of special interest and provides the main focus for this research. Chapter 9 reports on an exercise that has implications for the role of the MDTM in providing clinical training. Reference to other functions is intended to give an understanding of the complex nature of the MDTM system only.

4.3 Meeting context

It was briefly described that the MDTM is a forum where the test results are reviewed and the patient management is decided. Before proceeding to examine the meeting in more detail, it is worthwhile to review how the MDTM intersects with the overall patient diagnostic and management process and consider the importance of timing and co-ordination of routine activities in order to the MDTM to be effective.

When a patient presents with respiratory symptoms a protocol of investigations is triggered which includes clinical examination, radiological imaging and bronchoscopy. Tissue samples will be taken for cytological and histological analysis during bronchoscopy, or other image-guided procedure. Results of these investigations are discussed at the MDTM and a decision on the best next step for the patient is agreed. Patients who are referred for surgery will be discussed again

Table 4.2: MDTM services to patient management and threats to dependability

Service	Input	Output	Threats	Failsafe mechanisms
Diagnosis and Staging	Clinical, radiology, pathology findings.	Clear diagnosis, clinical and pathology staging.	Missing people (information), No radiology, No pathology, Tech. failure, Time constraints.	Rostering, Routines, Redundancy, PACS.
Treatment Plan	Clinical and pathology staging, expert opinion.	Treatment decision, and care plan.	Missing people (expertise), Incorrect or Incomplete staging, Inadequate follow-up, Time constraints.	Designated responsibilities, Clinician review, Record for patient chart, Audit.

after their surgical procedure, when further information is available from the resected specimen and imaging has been repeated. To achieve a satisfactory discussion at the MDTM, all procedures must be satisfactorily conducted in a timely way, within a limited timeframe, to allow for results to be available at the MDTM. If there is failure in a work process on which the MDTM depends, the discussion will be compromised.

4.3.1 Temporal organization of diagnostic activities

Multidisciplinary team members, without exception, have busy schedules and each specialist area has separate work routines. For the clinical medical staff there are respiratory out-patient clinics, ward rounds and four half day bronchoscopy sessions each week, as well as the provision of a respiratory consult service to other in-house clinicians, attending to accident and emergency rosters and dealing with respiratory and general emergencies. Typically for an individual member of a respiratory medical team, their day starts at 8.00am with a ward round after which they attend an out-patient clinic and proceed to do bronchoscopies in the afternoon.

The first encounter with a patient for assessment is at an out-patient clinic where a decision will be made on investigations to order, including radiology, blood and pulmonary function tests, and if the patient should have a bronchoscopy. Requests for investigation are made using a requisition form (or electronically, for some tests) by a clinician and are then scheduled by support staff. All requests for procedures will include critical patient identifiers as well as the reason for the request and relevant clinical details. Patients attending an out-patient clinic who require a bronchoscopy will normally have the procedure performed within that week. Registrars on clinical teams also have

responsibility for academic and teaching activities like journal clubs, case presentations, hospital grand rounds and tutorials with junior doctors, medical students, and other staff. There is no fixed finishing time. Team members don't leave the hospital until all problems related to their patients are sorted out, usually by 8 or 9.00pm.

During a bronchoscopy procedure the bronchus and airways are examined and samples are taken for pathology and microbiology. Pictures are often taken and included in the bronchoscopy database (and may be shown at the MDTM). Samples sent to pathology are accompanied by a requisition form, fully completed with appropriate information, as explained in Section 2.4 in Chapter 2.

On arrival at the laboratory, specimens are registered, examined and processed by scientific staff. If the sample arrives before 4.00pm, processing will be completed by the following morning at 11.00am and stained slides passed, with a laboratory worksheet, to a pathologist in-training for examination. After examination by the pathologist-in-training, pathological slides are re-examined with an experienced histopathologist, or cytopathologist, and a report is hand-written onto the laboratory sheet that accompanied the microscopy slides. The formal report will be typed later into the laboratory information system (LIS) by secretarial staff. A printed report will be sent to the requesting physician and is electronically available via interface to other designated parties, including the patient auditing and tracking system (PATS) database managers. In the case of respiratory patients, an electronic copy is downloaded into the respiratory database. If the sample being investigated presents diagnostic difficulty, extra tests will be performed on the sample and further opinions sought. Within the group of pathologists, at least one will be an experienced respiratory pathologist who is consulted on difficult cases. The laboratory at Centre A processes specimens from approximately 100 patients per day. A turn-around time of at least 2 days is necessary for bronchoscopy samples. The turn-around time for surgically resected lung specimens is 5 days, on average. The respiratory pathologist reviews all samples to be discussed at the MDTM, before the meeting, with the pathologist-in-training who normally presents the pathology on each case at the MDTM.

Within the radiology department, patients are scheduled for chest x-rays, CT scans and PET scans as required. Requests for imaging are made in the first instance by the respiratory physician. Patients for chest x-ray are scheduled immediately. Requests for CT and PET scans are reviewed and prioritised by a radiologist following examination of the chest x-ray, and then scheduled as appropriate. In some instances additional imaging is prompted by the radiologist on examination of the initial images.

Pre-Meeting activities

The MDTM work-process including its associated pre- and post-meeting activities is represented in Figure 4.3. At the outset of this study, there was a cut-off time on Thursday afternoon for clinical

staff to advise of patients to be discussed on the following Monday morning. A list of patients was circulated to all participants at 0900 on Friday morning to allow time for each participant to check that they had all the necessary materials they needed to take to the MDTM on the following Monday morning. Since late 2006, that deadline has been brought forward to Thursday morning, and the list is circulated by 1200 on Thursdays, because of increasing workload and difficulties being experienced on Fridays by team members in their preparation for Monday's meeting.

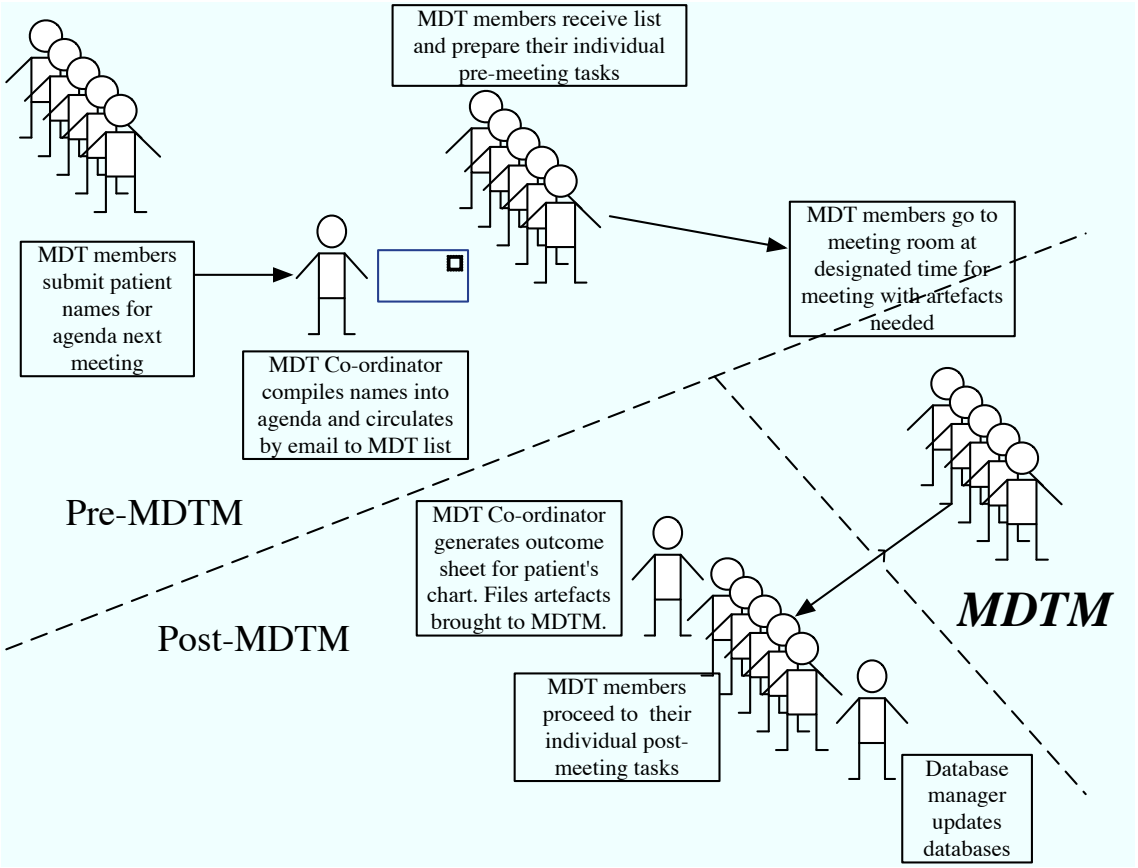


Figure 4.3: Overview of MDTM and its associated work processes

Meeting preparation takes time, especially for radiology and pathology who review all images and samples on the patients for discussion. Most of the pre-meeting work is conducted by the radiologist, pathologist and the MDT Co-ordinator. Current practice is that individual team members submit a patient's name and hospital number, via webpage on hospital Intranet, together with relevant clinical history to the MDT Co-ordinator for inclusion on the agenda for the meeting. On a Thursday morning the MDT Co-ordinator distributes the list (i.e. the agenda for the next meeting) to all members of the MDT by 1200. On receipt, individual members review any preparation they may have to do, in advance of the meeting.

Many of the investigations that generated the radiology or pathology material may have been performed in different institutions. These need to be located and relayed to the designated radiologist and pathologist, respectively. The MDT Co-ordinator liaises with external institutions to get

any imaging or tissue samples that may have been undertaken and delivers these external items to the radiologist and pathologist. The radiologist reviews images for the patients on the agenda; the pathologist reviews the pathological material. An indication of the proportion of material that is required to be retrieved from outside institutions is given in the discussion on timing issues in Chapter 7 and Table 7.4. The impact of the MDTM on radiology and pathology departments is addressed in more detail in Chapter 7.

Departmental activities associated with MDTM preparation reduce vulnerabilities within those departments. The review of materials from external sources also serves as a system check. In this way, the pre-meeting activities add dependability to inputs to the MDTM. Goffman (1990) introduced a metaphor of 'backstage activities', and later Bannon & Bødker (1997), that can usefully be applied here. This pre- meeting preparation serves to present the 'backstage' departmental processes as less complex to the MDTM, and thus trust is generated between the MDTM and the individual departments providing services to it.

The Meeting

The description of the MDTM given in this section is an overview that sets the ground for the detailed description that is given in later chapters. The MDTM's internal task environment is collaborative and social in nature: sharing information, dialogue and discussion. The conduct of the meeting, while professional, is friendly, supportive and relaxed. The respiratory multidisciplinary team is made up of three respiratory medical and two thoracic surgical teams, oncologist, radiologists, pathologists, radiation oncologist, nurse specialists, physiotherapist, radiation therapist(s), database managers and technical assistant. Having more than one of a particular speciality improves debate and introduces an element of fault tolerance into the MDTM system (i.e. if someone is absent). If someone cannot be present they arrange for another to represent them in the discussions. The meeting agenda (list of patients) has artefacts (or materials) associated with each patient.

Artefacts comprise radiological images, pathological samples and a page with patient details. Sometimes pictures from the bronchoscopy, PET scans on CD or occasionally a video clip of a surgical observation may be included. A clinician may also choose to include another item that will be of interest to the meeting. For example, the radiation oncologist once brought a radiotherapy treatment plan, showing the direction of the radiotherapy beams and the dose distribution, to show how a new tumour was situated in the region of the lung that was previously irradiated for a different tumour. The page specifying the patient details, which includes smoking history and ECOG[1] score was introduced in the early part of this study, in 2005, by participants to help clarify details of the patient under discussion. This page is projected onto the SMARTboard™ display (see Figure 3.1) at the start of patient case presentation and remains on display for the duration of that

[1]Eastern Co-operative Oncology Group

discussion. An observable sub-structure in the meeting is the individual case presentation, which is borne out in an analysis of the video recordings and is presented in Chapter 10. Like the model described by Housley (2000), team members occupy clearly defined positions and have specialised knowledge that they feed into the decision-making process. Team members recognise each other's special (or individual) expertise. The typical case discussion that happens at an MDTM is central to this study. The case discussion has an internal structure that is described in Chapter 5 and a more detailed quantitative analysis is given in Chapter 10.

As well as having a structure, the case discussion has an accepted style of delivery within the group. The patterns observed are similar across all the MDTMs attended including the MDTMs in other hospitals, in Edinburgh, from the experience of the MDT members and from descriptions in literature. Individual team members yield, or defer, to one another's expertise and question one another to gain additional information for their own professional purposes. For example, suppose the radiologist has just illustrated an image of a tumour on a CT scan, pointed to its location and estimated the tumour size (and the pathologist has not yet presented the pathology finding). The surgeon might ask the radiologist "how far is it from the aorta?", which would reveal that (s)he is considering how (s)he might remove it surgically. Yet, depending on the tumour type (information yet to be contributed by the pathologist), surgery may not be an option. Interaction behaviours during PCDs are described later.

Services delivered by the MDTM present a 'smoother front-stage' view of hospital processes: the complexities of the patient management process are hidden within the MDTM and decision processes appear more straightforward from the patient's viewpoint. Thus, more trust is generated between the user (patient) and the hospital services. Generally speaking, a meeting is considered a success if (a) MDT members attend and are on time, (b) all patient test results are available and unambiguous, (c) necessary pre-meeting work routines were successfully completed (d) there are no technical breakdowns and (e) the decision agreed to is successfully followed through. Missing team members, missing test results or artefacts, omission of pre-meeting work, technical breakdown and lack of follow-through on meeting decisions are threats to dependability, (Table 4.2), not only for the MDTM but for the overall patient management processes. It can be seen that MDT-related tasks and processes are concurrent, co-ordinated, and not restricted to a single meeting.

The respiratory multidisciplinary team at St. James's Hospital meet once weekly to review the diagnosis of patients presenting with lung disease, agree staging of cancer cases and make a decision on the next step in the patient's management. Twice monthly, this group meet with other specialists at two remote hospitals via teleconference links. The remote hospitals have some specialist lung disease services provided by the larger centre. It is also an opportunity for the remote clinicians to broaden their experience through exposure to rare patient cases, and confer with specialists on treatment policies. The MDTM can be described as a sort of 'peer review' where clinicians present their ideas, as well as the basis for their view and fellow clinicians are

welcome to debate, criticise and/or offer an alternative viewpoint. There is also an important educational aspect to these meetings and attendance at the MDTM is recognised to qualify for Continuing Professional Development (CPD) credits by professional and registration bodies. The educational function of the meeting will be described in page 57. Other than the teleconference links, the meetings in teleconference serve the same functions as the co-located meetings and work processes are the same for both settings.

The meeting proceedings will be described in more detail in later sections. For now, it is sufficient to say that the radiology and pathology is reviewed and a decision is made on the best management strategy for the particular patient.

Post-Meeting Activities

Following the meeting, duties assigned will be undertaken and completed. Attendees will have taken notes, where relevant, on items they will have to follow up on after the meeting. For example, a decision to order a PET scan will need to be scheduled with the patient and with the radiology department. Individual clinicians with patient responsibility will meet with their patients and advise them of the MDTM assessment of their case. The advice of the MDTM will be discussed with the individual and the final decision on the treatment plan agreed with the patient. Post-meeting tasks add dependability by speeding up the process for the patient being treated: independent, concurrent or sequential treatments are efficiently scheduled following the MDTM.

Other work generated by the meeting includes updating the respiratory and surgical PATS databases. The MDT Co-ordinator will return radiology and pathology artefacts to the appropriate location. The updated patient details sheets will be sent back to the patients' clinicians by the following Wednesday for checking and 'signing off', after which they are filed in the individual patient's chart by the co-ordinator. This page with patient summary information, including clinical and pathological staging, management decision and MDTM date, now filed in the patient's chart, becomes part of their formal hospital patient record. The sign-in attendance sheet is filed in hospital records by the co-ordinator.

4.3.2 Conduct of Proceedings

Throughout the discussion on a patient case, participants face the main plasma screen where patient details, radiology and pathology are displayed. In response to prompts, the operator switches between the document reader (for radiology), the microscope (for pathology) and the PC (for patient details). When an image is displayed on the plasma screen the view is set to display the same image for all centres in teleconference. When the room cameras are in use (in teleconference), and an artefact is *not* on display, the usual configuration is that each centre can see its own outgoing video and two in-coming video transmissions through a 3-way picture configuration. When images are being shown from Centre A, the outgoing video is allowed to dominate and this single

image is shown on the plasma screen. Configuration protocols are under review and will not be discussed further in this study. Users seem to value the 3-way setting when in discussion, even though it is not easy to see people's faces clearly. During teleconference sessions, the video link with remote participants is displayed on the main plasma screen and competes with the display of artefacts.

The processes associated with a meeting in teleconference is similar to that of a co-located meeting, with some small differences. An individual patient under the care of a clinician at either of the remote centres will continue to be managed under the care of the remote clinician, unless the patient is formally transferred to a clinician at the main centre (St. James's). A patient under discussion may be from any of the centres partaking in the discussion, either Centre A, B or C, and the responsibility for care remains with that site, including the management of patient records. All sites participate in all of the cases presented during a teleconference, but the roles contribute over different geographic locations. Given that each hospital is only responsible for its own cases, there will be some cases discussed at the teleconference which will not have generated all of the pre-meeting work that an in-house case would generate. Any pre-MDTM pathology or radiology, however, that was undertaken by the remote sites will be previewed prior to the discussion and this pre-MDTM review is discussed in more detail in Chapter 7. For cases being managed at the remote site, the post-meeting workload will be reduced for Centre A since the case is being treated at another centre.

Although the social exchange conducted over the video link has its limitations, non-task related interactions have been observed at the endings of teleconferencing sessions. The participants on both sides of the teleconference link do not work at the same hospital but meet from time to time at professional gatherings and are known to one another outside of the MDTM setting.

The conduct of both teleconference and co-located meeting is professional, supportive, cooperative and relaxed. A co-located meeting is more relaxed than an MDTM in teleconference. This is evidenced in what can be described as *informal task-related* interaction and *informal non-task related* interactions. A non-task related exchange might be chat about a football match over the weekend, for example. A task-related remark might be a premature speculation of a patient's diagnosis by a member of the group. For example, after the initial clinical signs are presented someone might say in an aside "I bet its an adeno", without full information to justify that diagnosis. In other words, the atmosphere at a co-located meeting is safe enough such that members might speculate on a final diagnosis before all the information is presented. If someone is proven wrong (or right) in their guess it is greeted with good-humoured response and adds conviviality to the meeting. In the cases studied there was a significantly higher ($p < 0.016$) proportion of informal interaction in co-located cases detected (Table 10.1). In the cases discussed in teleconference, task-related informal interactions were frequently observed, such as remarks about a conference event, but a non-task related informal exchanges were rare. Given that maintaining a balance

between task and socio-emotional activity is often crucial for group performance, it would be interesting to monitor the extent to which the technology contributes to the higher level of formality in teleconference cases but further exploration of this effect is outside the scope of this study.

4.4 Implications for MDTM dependability with teleconferencing

4.4.1 Lack of Symmetry between hospitals

A distinct lack of symmetry was observed between the large teaching Centre, A, and the remote hospitals B, C and D. The Mean attendance at A is 32 and can reach 40; attendance at B and C is usually 6 and 2 respectively. Attendance at Centre D is usually 4 to 6 people. The small group size at Centres B, C and D may account for differences in B, C or D perspectives, compared to A. Just as every organization is different, every hospital has differences, such as size, specialisation, culture and independent work rhythms. For a teleconference meeting to be successful, all work rhythms across all hospitals must synchronise both for the designated time for the meeting and with respect to the pre-meeting activities. Some particular issues for the remote participants are outlined in Section 4.4.3.

In MDTMs in teleconference, participants in Centre A are not only interacting across the teleconference link but interacting with co-located colleagues. The lone participants at B and C, or D, often find themselves as observers to interactions at Centre A. Speech exchanges between participants at Centre A can be rapid and brief. It is not unusual for a participant at A to get a colleague's attention through eye contact and say, while nodding confirmation *"... so, you'll look after him ... ok?"* and the interlocutor nods and *" mm ..yeah."* in reply. Observers, particularly remote observers, reported that they find it difficult to follow the exchange, unless those interacting are visible on camera, and their roles known to the observer. Whether this is a surgeon interacting with an oncologist, or a physician interacting with the radiologist will represent very different courses of action in patient management.

Sometimes, when a number of people at Centre A are exchanging speech turns, remote observers have been observed to raise a finger slightly to get attention and join in the discussion. They have been rarely observed to attempt to interject verbally.

4.4.2 Audio

Audio is critically important for the MDTM, especially in teleconference. If there is any interruption in the audio, misunderstanding may result. For example "*[crackle]* cancer was found". The fact that *No* cancer was found can be easily misunderstood and the *crackle* causes confusion. However, because there is an interaction between the actors, and other items of data are being

evaluated, recovery is normally achieved. Of greater potential seriousness would be instances where someone's contribution is not heard by the remote party. It is easy to hear those co-located in a room, or near a microphone in the remote room. But if someone on the remote side speaks, and is not near a microphone, they may not be heard across the teleconference link. If one has not heard, and not realised there was anything to miss, recovery will not even be attempted. Microphone coverage in the rooms needs to be tested thoroughly in the pre-installation stage.

At the outset of this study, Centres B and C were experiencing difficulties of which Centre A was unaware. Olson, Olson & Meader (2000) had similar findings and observed that people are almost universally aware of the difficulties they are having. In this study, audio at Centres B and C was very clear but a lot of background noise was being transmitted from A. Because of the large group at Centre A the amount of noise generated by paper rustling, coughing and individual movements can be quite high; the transmission is loud and it can be difficult for people at B and C to hear a speaker at A. Normal selective audio perception by the group at A meant they were unaware of the noise being transmitted from the room. The remote participants had not complained as they valued the link and it represented a marked improvement to what they were accustomed. The noisy background from the main Centre (A) was improved by relocating the microphones. The microphones were changed from being in the centre of the room, to being wall-mounted. The adjustment of the microphones at Centre A improved the clarity of conversation for participants at Centres B and C.

When a number of people at Centre A exchange turns with one another, rather than exchanging a turn with someone across the video link, it can be a cause of confusion. People at remote sites have expressed difficulty in following speech exchanges between individuals at Centre A because 'they talk too fast'. Like results published in Olson, Olson & Meader (2000) people tend to speak louder across a teleconference interface and when addressing someone locally they are inclined to lower their voice, and the remote site cannot hear. Difficulty in hearing one another from time to time was also reported at the main centre, for co-located meetings, between the front and back of the room.

4.4.3 Remote perspectives and Video

Controls for switching from the document reader to the camera or microscope are located at the central site (A). The only control at remote Centres, B and C, is the outgoing video camera to Centre A. Remote participants consistently express the wish to see the people at Centre A, and this suggests that there may be a higher need for visual communication for the smaller group. This is borne out in telephone calls to A, from time to time during teleconference, requesting for an artefact be removed off the main display *"so we can see"*. Even when not directly engaged in conversation, remote observers seem to value being able to see those who are talking to one another. At one stage when Centre C was reporting on a patient to Centre A, and the speaker at

Centre C was on screen, remote Centre B phoned the operator at Centre A to *"let us see who he's talking to"*.

Lack of camera control is similarly problematic. Because of the asymmetry of systems in use in the ISDN link, Centres B and C can control their outgoing image to Centre A, but they have no way of controlling or choosing what they see. Furthermore, Centres B and C have no way of communicating needs except by interruption of the meeting proceedings or telephone calls between operators. Currently communication on these difficulties is mostly by telephone, between the teleconference operators. This loss of functionality in both systems is a result of using Telesynergy® to connect to the Polycom units. Both systems would have more functionality if connected to more compatible systems for teleconferencing.

Centre D uses a reduced version of Telesynergy® and has greater potential to synchronise media. However, lack of experience and training of operators means that communication controls tend to be used 'one-way' with Centre A controlling the outgoing images to the remote centres.

When not engaged in direct conversation across the interface, remote participants have expressed difficulty in understanding vocal interaction among the larger group at Centre A. This experience may be analogous to the finding of Bordia (1997) who reported poorer comprehension of discussion in computer-mediated communication. The phenomenon described by remote participants is also demonstrated in Chapter 9 in results that report how observer (co-located) participants demonstrate difficulty assimilating data from the discussion among the lead participants.

4.4.4 Technical Operation

MDTMs have an operator who facilitates the display of material for discussion and manages camera controls. For effective meetings, the operator must be sensitive to cues from the participants and competent to troubleshoot minor technicalities. Operation of the microscope with electronic controls, for example, can sometimes be difficult for new staff. Use of filters and electronic controls may differ from the standard laboratory microscope.

Vulnerability in MDTMs can be reduced through optimising the use of cameras and screens (or monitors). It can be disconcerting if the speaker at the meeting is not visible to the remote party, so cameras should be controlled to capture contributors. If the speaker is not visible or the camera is jerked around too much this can serve to distract observers thus increasing the likelihood of error. The use of multiple screens, and monitors with continuous transmission, would enhance the presentation of images by allowing several items to be viewed simultaneously for comparison, and would help reduce the discomfort experienced when participants cannot see what they want to see. Remote and distributed access to cameras and microphones would provide a selected group of participants with better control over the communication media. Results (in Chapters 5 and 6) suggest that a display of several artefacts at one time in addition to face-to-face views is warranted.

The provision of multiple screens and user controls would also reduce dependance on the technical operator.

4.4.5 Patient referrals

In the analysis of work processes undertaken for this study two problems were identified that pose a threat to dependability in the patient management system with potential for patient mismanagement, namely the lack of a unique patient identifier and the imaging systems used in different centres. These two issue cause problems when patients are being transferred between clinicians and hospitals. Figure 4.2 shows how patients can be transferred among team members through the MDTM. In comparison, Figure 4.4 represents the patient work process when a clinician in another institution consults with a clinician in hospital X (in Figure). *The first issue* is particularly visible in teleconference, when Dr. A is at one of the remote centres and Hospital X represents the main centre. In those cases, teleconference adds dependability to the management system for Patient P because Patient gets the benefit of the discussion and expertise within the extended team. However, record keeping can be problematic if the patient continues to be managed at the remote centre and the main centre does not currently maintain a clinical record of the encounter. Records are maintained at the remote centre.

The second issue: When an external doctor wants to refer a patient to one of the consultants at St. James's this is usually done by a letter requesting an appointment for the patient at an out-patient clinic. On receipt of the letter, it may be apparent to the specialist that certain items of information are outstanding and will need to be made available in order to make a decision on the best care of the patient. Two scenarios commonly occur: (1) the patient already has had imaging and pathology sampling and a printed report is available, or, (2) the patient will need to have imaging performed and/or a pathology sample taken.

In the first scenario, rather than schedule an appointment at the out-patient clinic, the MDT Co-ordinator is requested to locate the patient materials from the outside hospitals and have the case reviewed at the MDTM. The radiologist and pathologist will then review the external images and tissues respectively, and there will be a full discussion at the MDTM, even though the patient is not a registered patient at the hospital and has no registration number.

There have been instances where review of the case at the MDTM resulted in the patient not needing to attend the hospital and the external referring clinician was contacted and advised on the patient management (that did not need further involvement of the St. James's team).

There is no easy way to maintain records of this sort of work practice. As the MDTM becomes more successful, there appears to be more of these occurrences. Table 7.4 in Chapter 7 shows the proportion of images and biopsies that were performed external to St. James's in a sample of patients, and is a measure that is affected by the practice of having 'work-ups' performed in other centres and will be monitored in future studies.

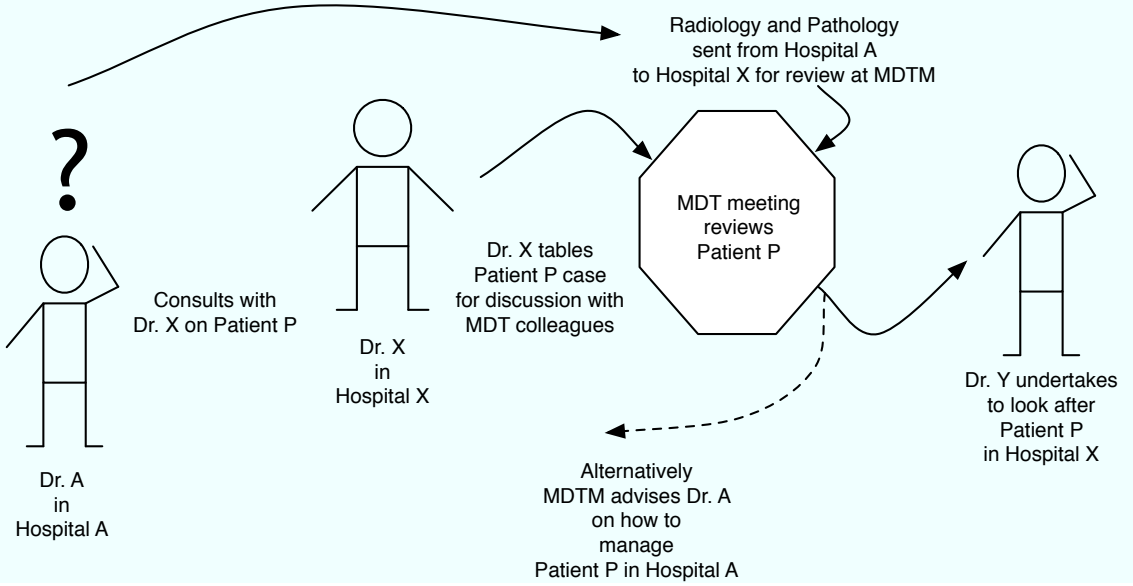


Figure 4.4: The MDTM and the management of referred patients from external institutions

The second scenario related to the 'work-up' on a patient is when imaging and pathology need to be performed before the patient can be fully assessed and is more difficult to manage. In these cases the consultant, on reading the letter, will ask the nurse specialist to ask the referring clinician (or hospital) to organise the necessary tests. When the results are available the consultant will then review the data and schedule an appointment which will be determined by the level of urgency. Again these patients will not be registered on the hospital database, because they are not yet formally assigned to the hospital's care. Yet, their care is being managed, with some difficulty, by hospital staff. If someone says *"We'll get back to you when a full result is available"*, and that person neglects to follow up on that promise, then it is hard to find a mechanism that would alert that this patient case is awaiting follow-up. For a surgeon to ask *"Schedule an appointment for him to see me when the report on his PET is available."* is not an unusual request but proves difficult for the system to manage safely. Currently, this scenario is being managed though the dedication of one or two staff, but there is no formal system to ensure that all cases are followed up. The provision of a National patient identifier and the extension of the hospital system to allow for patient management outside of the traditional 'patient on site' model would greatly alleviate the problem.

Another potential risk scenario, described on page 92, involves discussion on patients who were not tabled for discussion. Teleconference makes it easier to engage in these sorts of 'quick' consultations that do not directly involve the patient. While such consultation may prove very useful, they pose a high risk to dependability as full information is not made available, time has not been allocated in many instances, those offering opinions are usually about to engage in another task and there are no records. Distributed groups have been shown to exhibit a self-serving bias

in their attributions, eschewing personal responsibility and blaming their partners more than co-located groups (Walther & Bazarova 2007). Given the findings reported in Chapter 9 that show psychological distance is increased over the teleconference interface, it is likely that opinions are offered more easily in these teleconference situations than would otherwise be offered by a clinician in a co-located setting, and without the same sense of responsibility being experienced by the opinion giver.

4.4.6 Room for improvement

Many areas of improvement that would reduce vulnerability and enhance dependability can be identified which range from low-tech solutions such as the placement of microphones, to the use of novel technologies such as mobile and ubiquitous computing. Pointing and annotation devices are highlighted, as well as a meeting record and decision support tools, as having potential to improve MDTM services.

Pointing devices: When discussing images, a graphics tablet, a laser pointer and sometimes a pen is used to point on the document reader or plasma screen. The laser pointer is not visible to the remote parties, but is the preferred tool by users as it is relatively easy to share. The graphics tablet is fixed in position so sharing is not feasible. Remote pointing devices, available to multiple participants at all centres would prove useful tools.

A meeting record would potentially be very useful to serve as reference later if needed. A MDTM record could be generated showing the artefacts used with annotations (as well as recording the decision). Solutions using portable devices have potential to capture a valuable meeting record. However there are concerns of confidentiality and security that remain to be resolved. There is a recognised need for a record and the patient details page has become the meeting record for now. Acknowledgement of the limitations of this page has been expressed, but a more acceptable comprehensive record has not yet been identified. The issue of an appropriate record is exacerbated for patients discussed in teleconference.

Decision Support tools that would capture clinical, radiological and pathological information to determine disease staging would help the process. A further prompt of the treatment protocol to be invoked when the disease stage is established would reduce the possibility of error in the selection of the correct protocol. The capture of pertinent details would also assist in the selection of patients for clinical trials. This would help ensure suitable patients were afforded the opportunity to participate in appropriate trials.

Finding ways that technology might help to make the processes more efficient and save time is one of the primary goals of this study. CSCW tools and the optimal configuration of existing technology have the potential to make the work processes more effective. However, there are a number of complexities that require further investigation and are explained in the chapters that follow.

Chapter 5

The Patient Case Discussion

In Chapter 4, an overview was presented that placed the MDTM in the context of patient management, and the MDTM was described as a system that added dependability to the patient diagnostic and management processes. This chapter focusses on a patient case discussion (PCD); several of which take place at a single MDTM. A typical MDTM will be characterised, with attention to detail on a stylised PCD. Interaction will be described through the different parts of the discussion, and illustrated through examples and task analysis diagrams.

The approach in drawing the task analysis diagrams borrows ideas from Pinelle, Gutwin & Greenberg's (2003) 'mechanics of collaboration'. Explicit communication in spoken, written and gestural messages are identified within the task throughout the PCD. Whenever possible, attention is also drawn to mechanics of information communication such as awareness, feedback, visual evidence and overhearing (Pinelle, Gutwin & Greenberg 2003). Ideas are also drawn from Paternò's (2000) 'Concurtask trees'. Most of the tasks conducted in a PCD are performed in sequence. In the diagrams, arrows indicate the temporal relationships between events. Recursion is represented using double arrows and concurrent tasks are described within each phase of the discussion, where appropriate. Solid lines represent links between events that always occur, while broken lines signify events that are often, but not always, observed.

The structure of events has been described by Jordan & Henderson (1995) as stretches of interaction that cohere in some manner that is meaningful. Easily identifiable behavioural units within such structures are called 'ethnographic chunks'. The identification of such chunks is regarded as a first step towards analysis. In this study of MDTMs, structures are observed, the most notable chunk of which is the PCD.

As well as the chunks of PCDs at a MDTM, the beginnings and endings of meetings are collaborative achievements and worthy of note as they reveal the sorts of props and technologies that are thought to be necessary to carry off the event (Jordan & Henderson 1995). The internal structure of the PCD is being defined here in D-Stages and is analogous to the term 'segmentation

of events' used by Jordan & Henderson (1995).

5.1 The Beginning

The MDTM is scheduled for 0800 on Monday mornings and usually starts on time. The technical operator opens the room 15 minutes beforehand and checks on all equipment, namely, the microscope, the document imager, the S-VHS recorder, monitors, the graphics tablet and the Tandberg 6000 teleconferencing unit. The operator also starts up and logs onto the two PCs - one that will access images on the PACS system on the St. James's network and the second, on the Trinity College network, allows the display of a text file on the SMARTboard™, that is mounted on the right hand wall of the room (see Figure 5.1). The second PC is located at the back of the room beside the server.

The MDT Co-ordinator arrives next, about 5 or 10 minutes before the start of the meeting. He organises the sign-in sheet on a table inside the door (see Figure 5.1). He also brings the agenda on a floppy disk and the technical operator loads this file on the computer at the rear of the room. One of the observer participants, who sits at the back of the room, will move this file forward at the start of each new case during the MDTM.

Practices have changed since the start of this study and the custom of having this text file on the side screen display at all times throughout the meeting was instituted as a result of the findings in the second questionnaire (Appendix E, reported in Chapter 6) and the introduction of PACS images from the St. James's network connection. MDT members value having details available on display, even though those facts are not directly under discussion. Before this current practice the second computer was not in use. The meeting room was originally designed as a lecture, or seminar, room and the computer described was intended for lecture presentations to be projected onto the SMARTboard™. For the results reported in Chapter 6, Section 6.3.3, that examines the use of video, the study was conducted before the introduction of PACS and the practice of showing the patient details on the SMARTboard™. Prior to the implementation of PACS it was the practice to have the patient data sheet on the PC on the Telesynergy® system and it was configured so that the SMARTboard™ showed the same image as the overhead main screen (plasma display).

When people arrive at the meeting room, they greet one another and it is an opportunity for social interaction. Tea, coffee, orange juice and pastries are provided, compliments of a pharmaceutical company who sponsors the meeting. A table, with the provisions, is set up outside of the meeting room entrance. From time to time the company representative is present and uses the opportunity to provide literature and discuss any issues with the clinicians. Most of the conversation between team members before the meeting will revolve around activities at the weekend or social events, recounting holiday experience or family events.

When MDT members assemble and take their seats, the meeting is opened by the lead clinician

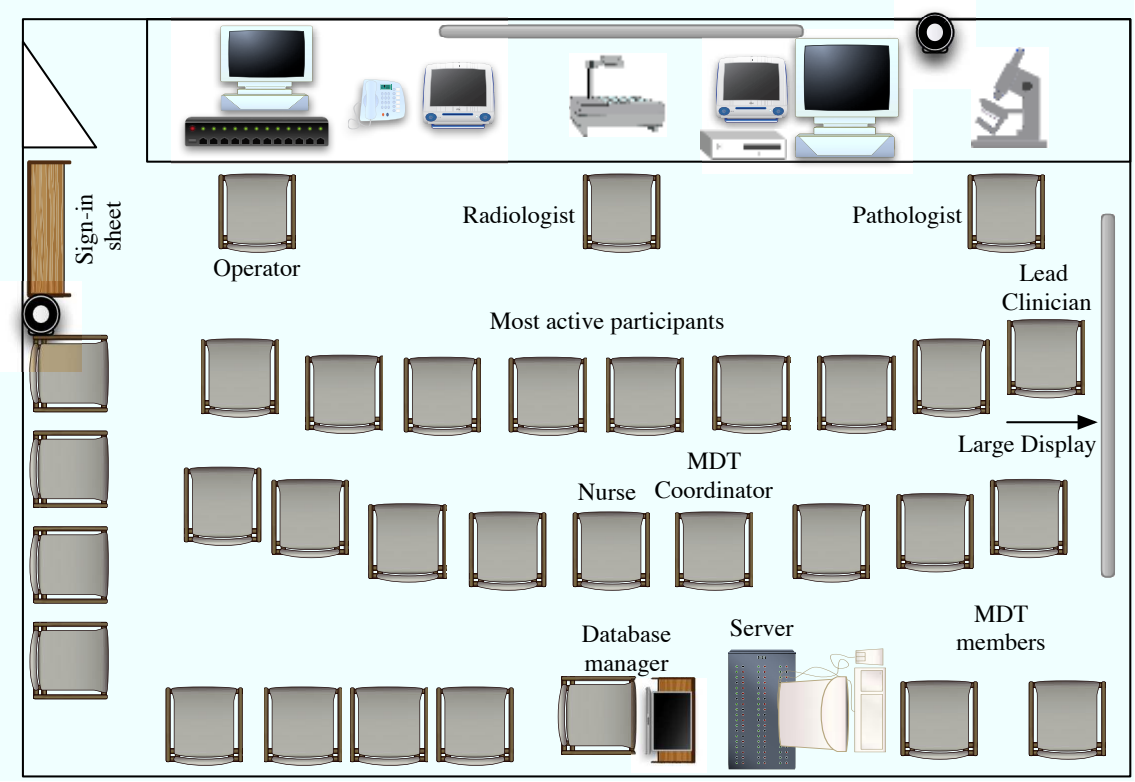


Figure 5.1: Seating arrangements at the MDTM

who announces the first case. The meeting room is shown in Figure 3.1 in Chapter 3. Figure 5.1 is an approximate seating plan. Seats are not fixed, chairs are stackable, and more are added to the room if needed. Attendance is usually about 28 or 30, but has reached as high as 40 on occasions. Late-comers tend to sit in the side seats.

Individuals tend to sit in the same area of the room, from week to week. The front row is occupied by consultants (active participants), but some consultants may sit in the second row, or occasionally a consultant may sit at the back, or side, of the room. The MDT Co-ordinator tends to sit in the middle of the room near the clinical nurse specialist. They may confer privately on notes from time to time. Either the nurse or the MDT Co-ordinator may provide additional notes to one of the active participants, if the note is considered helpful, during a discussion. Notes such as referral letters, PET reports or parts of formal records have been observed to be passed from the non-verbally active participants to one of the consultants, on occasions. The nurse usually brings referral letters on new patients, for reference, if needed. The MDT co-ordinator brings additional copies of the agenda. The database managers sit at the back of the room. The lung database manager usually brings a laptop and connects to the database via an ethernet wall port connection on the back wall. All the seats have a small (optional) table attached, for resting a notepad. Most members take some notes during the meeting. For some these notes may be taken on the agenda page, in personal diaries, or dedicated notebooks as a reminder of patients to contact later on

wards, for example.

Figure 5.2 describes the PCD within the MDTM event. The top row of the diagram represents an MDTM with openings and closings. If a teleconference link is scheduled, the connection is made during the meeting and represented in Figure 5.2 by the broken lines following the opening and prior to closing of the MDTM. The MDTM almost always extends beyond the close of a teleconference discussion. Only once was the close of a teleconference (with site D) observed to coincide with the end of the meeting. In Figure 5.2 the closing of the teleconference and disconnection to the remote site precedes the close of the meeting. Following the opening of the MDTM, discussion of the cases on the agenda begins and is represented in Figure 5.2 as solid rectangles. The rectangle with broken outline represents a case discussed in teleconference (optional). An overview of a PCD is presented in the four columns of the Figure. Single arrows on solid lines connecting rectangles represent sub-events in time sequence. The broken lines represents optional transitions that may, or may not, happen. There may sometimes be a literature reference, for example, during discussion. Or a particular teaching point may be made, or issues in the PCD may prompt discussion on current policy and lead to the development of a new policy. These occurrences tend to take place following the initial phase of the PCD and are associated with the decision-making processes invoked. As represented in Figure 5.2 most of the tasks in a PCD take place in sequence and the concurrent task in the final stage of the PCD is noted. Although some participants may take notes during the discussion, most are observed to take their personal notes during the final stage, the the MDT Co-ordinator is taking note for the official record.

Scheduling sessions in teleconferencing with other hospitals requires high levels of co-ordination and co-operation. It was mentioned elsewhere that twice-monthly the MDTM connects to two remote hospitals B and C and holds a three-way discussion. This connection is currently scheduled for the second and fourth Mondays at 0815, and lasts for about 30 to 45 minutes. At 0815 on those days, the operator will connect to the remote sites in the background, while the MDT continues the business of the meeting. At the end of the PCD under discussion, acknowledgement is made of the remote participants and greetings are exchanged. The patient cases from hospitals B and C, necessitating discussion, are reviewed and the teleconference link is terminated after closing remarks have been made. The MDTM will then continue with the next in-house case. For remote hospital D, there is a one-to-one link on the first and third Fridays each month at 0900 and lasts about 20 to 30 minutes. When a Bank Holiday falls on the first Monday of a month, site D is accommodated at 0900 on the following Monday, i.e. the second Monday, if they have a case to discuss.

When teleconferencing was first introduced, it was not unusual for the remote participants to observe some ‘in-house’ cases, for education purposes. Over the past year, (2006) this practice has been discontinued. Observation suggests that there is some discomfort being experienced at the main site, and the extra time taken in teleconference, even when not directly talking across the

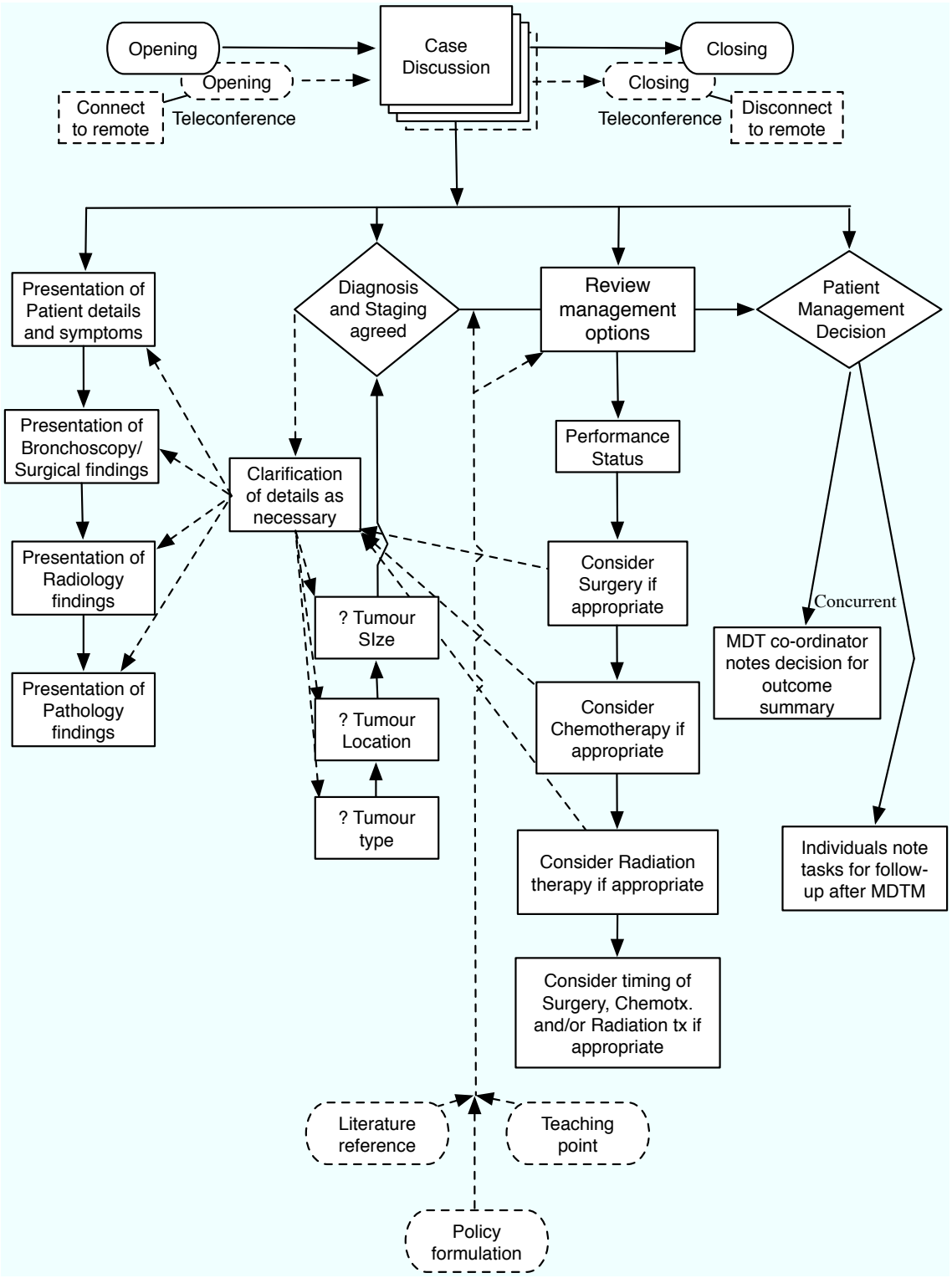


Figure 5.2: A Patient Case Discussion

interface is a burden.

It was noted that for patient case discussions (PCDs) at a meeting, a structure can be identified that will be detailed in the sections that follow. The overview represented in Figure 5.2 gives outline of the activity in the different stages in the four columns of text-boxes. Figure 5.2 also identifies the data items that contribute to the different parts of the discussion and the linkages between the different sections. The solid lines represent regular events, common to all PCDs. The broken lines linking the textboxes in columns highlight points that may, or may not, be discussed during the PCDs. There are also broken lines showing that there may be occasional reference to recent literature, teaching points to which attention of the observers will be drawn, and the PCD may prompt a related discussion on policy matters. The phases, or stages, will be defined as D-Stages and further explained in the following sections.

The case presentation may be considered in four parts (as represented in Fig 4.1): (1) the systematic presentation of results from different investigations, (2) the discussion of these findings in conjunction with the patient's clinical presentation, (3) weighing the treatment options in the circumstances and agreeing a recommendation for further patient management in this case and (4) summary of disease staging and next step to be taken in the management of the patient. For the purposes of this study, the four parts are defined as D-Stages of a patient case discussion.

5.2 D-Stage 1

The opening of a case discussion determines the start of D-Stage 1. The patient's initial presenting symptoms and clinical findings (contained in the printed page) are reported verbally by a registrar. Typically the recount by the registrar is in a narrative style, providing minimal information at first and revealing more information as necessary during discussion, or as required by other participants. Example opening:

> "This 40 year old man presented with persistent cough and shortness of breath for the past few months. He is an ex-smoker with a 30 pack year history. On examination a wrist abscess was noted. There was no major adenopathy".

The patient's story unfolds as a mystery writer might tell a story: the signs, symptoms and findings presenting clues and allowing the attendees to speculate on the differential diagnoses as the story is told. Thus, a participant may (privately) guess what might be coming next and solve the problem before the entire story is revealed, or review their initial hunch on the basis of additional information. After the registrar has summarised the initial presenting symptoms, the radiologist reviews the images and highlights the important features on the projected image using a pointer. The radiologist when showing the images will also relate the findings in a narrative, and in time sequence. First, old images are viewed, if available. These are followed by the chest x-ray and the CT scan. The PET scan is then shown if available. PET scans are always submitted on DVD

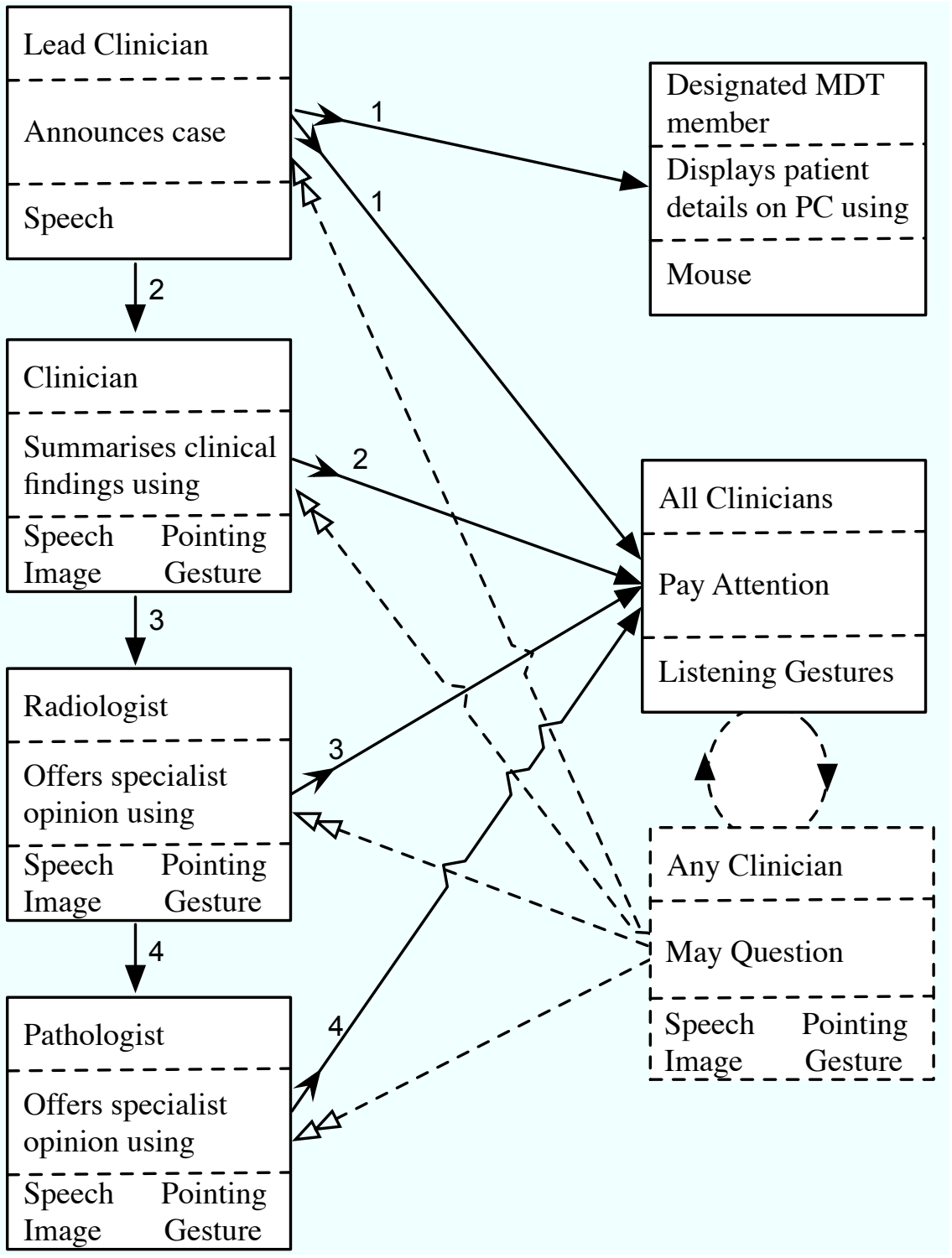


Figure 5.3: D-Stage 1

and can be examined as a video clip. When played the whole body image is rotated through 360 degrees, and an area of increased FDG[1] avidity can be viewed in its 3-dimensional location. (This feature is further discussed in Chapter 11, on page 236.) The radiologist might say, when demonstrating features in an image:

> "It looks like a mass ... at least a T2N2, I should think .. of course, it could, maybe, be a bronchocoele ... maybe ... but I think its more likely tumour".

Occasional questions are asked of the presenters, by the observing members of the team during the presentation of findings that seek more information, or confirmation, on the presenting symptoms recounted such as:

> "Is his ECOG really 1?"
>
> "What's his occupation?", or,
>
> "Are you sure she's never smoked?".

From time to time, during co-located discussions only, it has been observed that a senior member of the team might speculate on the final diagnosis (prematurely, and with good humour), or might ask observers to speculate on the diagnosis given the clinical story and the radiology picture only. If someone is proven wrong subsequently, it is not a cause of embarrassment or censure, but if they are proven correct it is greeted with good humoured praise or awe.

Bronchoscopy findings are then described by the respiratory physician who conducted the bronchoscopy:

> "At bronchoscopy the left main bronchus was occluded, distally".

More questions may be asked, such as:

> "And you didn't see anything in the right [*bronchus*]?".

Some discussion on these findings usually follows by the consultant staff and differential diagnoses are postulated:

> "Could this be sarcoid? Or what about T.B?"

From time to time the respiratory physician who conducted the bronchoscopy will produce a colour picture, printed on paper, of the image seen down the bronchoscope. This is sometimes passed to the radiologist to project onto the large screen, using the document imager, but more often it is passed around among the senior staff.

Then, after the presentation of all the clinical findings and the radiology, the pathologist gives the histopathological diagnosis, which is usually the definitive diagnosis. The pathologist projects the cell and tissue images onto the screen using the microscope and will highlight notable features with a pointer.

[1] F-18 fluorodeoxyglucosepositron emission tomography

> "The bronchial biopsy has small cell tumour in it. See those small dark cells with no cytoplasm ... there . . [*pointing to cells on screen*] .... And that other smaller sample you sent ... was that definitely taken from the wrist lesion? .. because it has tumour too".

Facilitating mutual activity, as in the narrative account of patient history, can provide important insights. The presentation of the patient's clinical history to the meeting does this efficiently without requiring large expenditures of time.

Figure 5.3 is an adapted task diagram to represent the roles involved, the activities and interactions in D-Stage 1. Each rectangle represents an event. Within each rectangle the three sub-divisions describe the role(s), action and method used to conduct the task. Solid lines represent consistent observable activities, arrows indicate the sequence of events and broken lines represents optional activity that may, or may not, take place.

The pathologist often brings microscope slides to the meeting to show the histological findings, and while the radiologist is demonstrating the images, the pathologist can be observed locating the feature to be demonstrated under the microscope. It is becoming a more popular and frequent practice for digital photographs to be taken during pathology pre-meeting preparation and for those digital images to be taken on memory (USB) stick to the meeting, instead of the pathology slides. This practice saves meeting time and allows the pathologist to give full attention to the radiology presentation. However, it does have a cost within the pathology department and is not always possible. As well as time shortage for the pre-MDTM review, sometimes the pathology sample may only be ready for microscopic assessment late on Friday afternoon and there is not time to prepare images in presentation format.

Radiologists have also been observed organising images during the initial presentation of the case (concurrent with interaction among other team members).

Pointing during D-Stage 1 is generally confined to the radiologist and pathologist when illustrating their findings. But others may gaze or point to the screen when asking a question about a feature, for example *"what is that . . there . ."*. Devices used to point at a feature on the overhead display are as follows:

from document imager	pointer from graphics tablet, or pen, paper clip, or finger
from computer	mouse
from microscope	laser pointer
from seat in audience	finger or pen

Gesturing is not generally common but is often observed in discussion on cases that are post-surgical resection, when the approach taken at operation is being described by the surgeon, particularly if it was a difficult or unusual operation. Surgeons tend to use hand movements to describe the size, shape and orientation of a tumour at surgery and have been observed to position and rotate their hands to demonstrate how they detached the tumour from the surrounding tissue. From

time to time, the surgeon may use paper and pencil to draw the structures to demonstrate the point being made and help visualise the cut surface of the picture being shown by the pathologist. Occasionally a surgeon may bring a movie, or video clip, to the meeting to show the MDTM the finding at operation.

The presentation of the detail of the patient case, may sometimes reveal some of the difficulties and underlying stress for clinicians when dealing with people in tragic circumstances on a daily basis. It has been observed that a clinician, when presenting a case, is hoping to pass the patient to a particular colleague by the end of the discussion. Such underlying emotion is revealed in the (fictional) patient presentation and exchange in Table 5.1. The junior doctor is clearly hoping that the surgeon might be able to undertake a curative operation on his patient, but the radiological imaging and pathology of the patient's tumour suggest that surgery would be ill advised. In presenting the patient to the group, the patient's poor health is understated and a foundation is attempting to be made for negotiation later in the discussion. Such negotiations have also been observed by Hardstone et al. (2004) in inter-service work where various membership categories will determine if a patient fits referral criteria and what help can be offered. Stories are told and scenarios developed that involve formulations about the categories to which patients may be assigned.

D-Stage 1 closes following the presentations of the initial facts of the case, or the start of another D-Stage.

5.3 D-Stage 2

The start of D-Stage 2 is determined by the first question following the presentations in D-Stage 1. The clinical correlation of the pathology, radiology and findings on examination, presented in D-Stage 1, characterises D-Stage 2. The findings that were presented in D-Stage 1 are considered in relation to one another and in relation to the patient's general state of health and clinical presentation. Findings from the 3 specialities should be compatible with one another. Questions are frequently asked and clarification sought by team members. This part of the meeting is important in capturing unsatisfactory events in the individual diagnostic processes. Neither radiology nor pathology nor clinical examination can consistently diagnose disease and demonstrate 100% sensitivity and specificity. All have potential to give wrong results. Results of the different investigations should be compatible, or any inconsistencies easily explained. Reviewing the findings of several independent investigations together, at the meeting, reduces the possibility of a patient being wrongly assessed. A clinician might say:

> "Yes, that [*pathology*] picture fits with the CT".

Or the radiologist might say:

Table 5.1: In this exchange in D-Stage 1, the junior doctor is clearly affected by the patient's plight and tries to present him in a light that underplays the patient's poor health and unsuitability as a potential candidate for surgery. In presenting the case, the foundation is laid for negotiation with the surgeon later in the discussion.

Role	
Medical registrar (junior)	"This man presented with a brief history of cough and breathlessness. He has a small mass on chest x-ray but he's very fit and in good health. He's very active - he likes to cycle in the countryside and he plays in a band in his spare time."
Radiologist	"He has a 4cm tumour in his right middle lobe, with what looks like bronchial invasion and widespread lymph node involvement" *[demonstrating the mass on x-ray, consistent with very advanced disease]*
Pathologist	" Yes, the bronchial biopsy confirmed squamous" *[showing the histopathology images which confirm cancer]*
Surgeon	"So, definite T3N1, at least . . it could be T4 ... look where it is .... " Did you say . . if, or. .. how much he smokes?"
Medical registrar	"well, yes, but he's given them up"
Surgeon	"What's his smoking history? And how much does he cycle?
Medical registrar	"He *was* on 60 a day. But he used to cycle daily until recently . . . before he was admitted. He's hasn't smoked since he came in."
Other clinician	"given that he's in a band probably has increased his exposure to smoke"
Surgeon	[*reading from the data on display]* "But you didn't tell us he's nearly 90. What was it you said about a band?"
Medical registrar	He's in an old folks home . . they have a band . . . I guess . . . it doesn't look great . .

"Even if pathology says its not tumour, I still think there's tumour there and you must have missed it" [*referring to the clinician who took the pathology sample*].

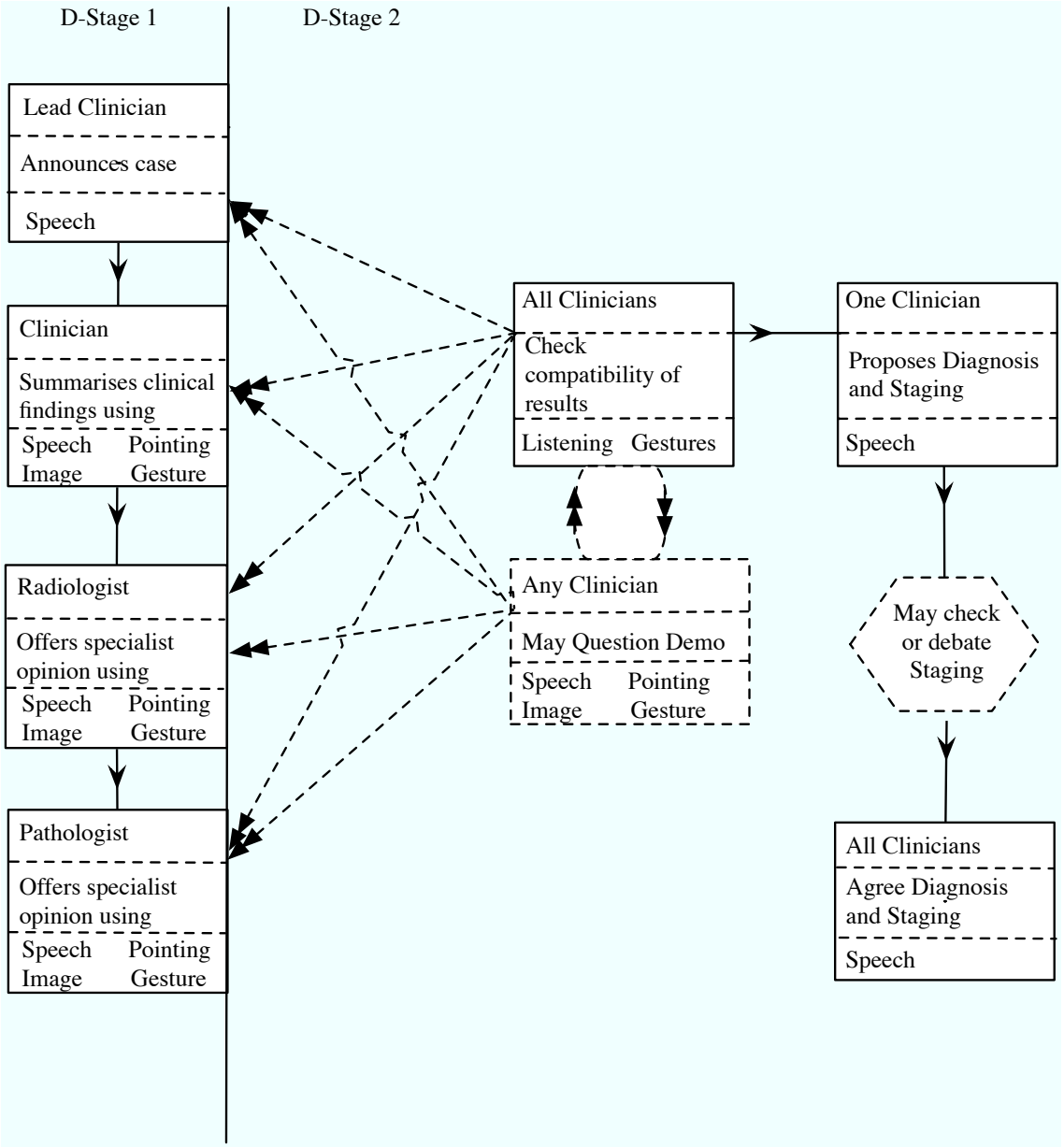


Figure 5.4: D-Stage 2

The aim at this stage of the proceedings is to agree a definitive diagnosis and establish the disease staging. By the end of D-Stage 2 the patient's presenting symptoms have been reviewed and the patient's diagnosis has been established. The combined information of the clinical radiological and pathology findings provides the information for the patient's *disease stage* using the TNM classification. The cancer patient's disease staging influences the choice of treatment approach, and informs the discussion on management options in D-Stage 3.

Figure 5.4 represents the actions that may take place in D-Stage 2. Not all PCDs have a D-Stage 2. Sometimes, when the clinical data is clearly presented and the radiology and pathology are straightforward, there is no need to further discussion and the PCD will proceed directly to D-Stage 3.

5.3.1 Disease Stage classification

Correct disease staging is critically important for appropriate patient management (Cicourel 1990) and is one of the key items of information generated through the co-operative work at the MDTM. The information needed for staging is gathered through investigations conducted by various members of the team it their pre-MDTM work and is the subject for discussion in the first part of the PCD, through the first and second D-Stages. Detail on the TNM classification of lung cancer is provided in Appendix C.

The tissue diagnosis (from pathology), clinical stage (from radiology and clinicians) including TNM score (from pathology, radiology and clinician), the Karnovsky Index or ECOG score[2] (from clinician) and pulmonary function (from clinician) together will determine the appropriate management for the patient (O'Connell 2004). This pooling of information in co-operative discussion generates new information on the patient's health status and is made known by the end of D-Stage 2 during a PCD. But not all cases may have a D-Stage 2. For cases where there is very clear, and unambiguous, information in D-Stage 1, there may be no need for a D-Stage 2. In such cases the TNM staging is evident at the end of D-Stage 1.

The first task of the PCD is to make a definitive diagnosis and once this is established, the end of the first phase of the discussion has been achieved (in D-Stages 1 and 2). The PCD continues to the second major task, namely, the patient management decision through D-Stages 3 and 4. The choice of clinical practice guideline for the management of a lung cancer patient is determined in the first instance by the extent, or staging, of the patient's disease. This item of information provides the basis for the discussion on the management strategy appropriate for the patient in the latter part of the PCD.

There may be occasions when the information discussed in D-Stage 1 and D-Stage 2 does not provide enough information for definitive diagnosis or disease staging. In such cases, the discussion proceeds to decide on the next best step in the circumstances and usually will result in a test being repeated or another procedure being undertaken and the patient will be discussed again at a future meeting when all the requested information is available.

[2]The Karnovsky Index and ECOG scores are measure of general medical condition. ECOG stands for Eastern Co-operative Oncology Group.

5.4 D-Stage 3

The first articulation of a management option defined the start of the third D-Stage and the second 'task' of the PCD. This second part of the PCD is concerned with the patient management decision. The TNM stage agreed in the first part, serves as an input to the second task of the PCD.

In D-Stage 3 discussion continues as to the best next step in the management of this patient. Options are weighed and evaluated. Consideration is given to the appropriateness of surgery, chemotherapy, radiotherapy or other treatment in the circumstances and a decision is made by consensus. Appropriate selected treatments may be planned sequentially or concurrently, depending on the nature of the tumour, the extent of disease and level of fitness of the patient. A patient may also be recruited to a clinical trial on the basis of the findings presented.

When a suggestion for treatment is proposed, it is usually accompanied by the evidence used in making that suggestion and possible side effects, or risks, associated with that approach. As well as taking consideration of the biology of the disease and the patient's level of fitness, clinicians are regularly observed to be working as patient advocates. In this role, the clinician who has spent time with the patient and knows the patient's wishes, will advise the group of the patient's preferences. For example, a patient may wish to attend a family wedding and have his surgery scheduled for afterwards, or attend a special football match. These sort of needs will be accommodated. Or a patient may wish *not* to undergo any treatment. In such circumstances, the meeting will review the case based on the biological data and determine the treatment to be advised based on the TNM staging anyway. The patient will be counselled on the advice of the MDTM and if he, or she, chooses *not* to have treatment, that fact will be documented in the patient's chart.

The clinician looking after the patient and the specialist nurse practitioner are the two roles involved with patient counselling after meetings. Patients do not attend MDTMs and there is no plan to incorporate them into the teamwork at the MDTM. Efforts are on-going in medicine, however, to find ways to involve patients in their own treatment decisions (Frosch & Kaplan 1999).

An example of an exchange during D-Stage 3 is given in the following examples and in Table 5.2. The thoracic surgeon might say:

> "On CT it looks as if this tumour is involving the origin of the right upper lobe. I would want to confirm that on bronchoscopy prior to surgery but he may be suitable for sleeve lobectomy which would definitely be in his best interests as pneumonectomy would carry a significant risk at his age."

Or the clinical oncologist might say:

> "This is a resected T2 tumour post-op. Recent evidence indicates that such patients benefit from adjuvant chemotherapy and this would be my recommended action - she should have an appointment to see me next week to talk this over".

Figure 5.5 represents the possible interactions that typically might take place in D-Stage 3. The clinical presentation and the TNM that was just agreed will characterise the activity in D-Stage 3. If the diagnosis is straightforward and there is a clinical practice guideline (CPG) that can be applied, then there will be little discussion among the clinicians, because they are familiar with all the guidelines through using them regularly in their work.

Like other areas of medical work, as noted by Symon, Long & Ellis (1996) and others (Hartswood et al. 2003), there may be some negotiation and re-interpretation of the findings during a PCD. It is not uncommon in a case with a poor prognosis, and for which little can be done, that medical staff might try to persuade a surgeon to undertake a surgical procedure, even if the risk with a surgical procedure is high. These 'negotiations' tend to occur in D-Stage 3 of the PCD. A sample exchange between an oncologist and surgeon is given in Table 5.2.

Sometimes the findings examined in D-Stage 1 are revisited, when surgery, or other treatment, is being reconsidered. The surgeon wants to review the image to conceptualise the location of the tumour and its relationship with the adjacent organs and visualise the type of procedure he, or she, is likely to adopt. It is not uncommon in the exchanges between the surgeon (or radiation oncologist) and the group for the surgeon (or radiation oncologist) to use gestures to describe how the tumour might be approached (but to a lesser extent than in D-Stage 1). The radiation oncologist will have a special interest in visualising the field of treatment. The medical oncologist will have a greater interest in seeing if the lymph nodes are visible on radiological imaging. In other words, although the radiologist demonstrated the features and has control over the display of images, the different specialities present have slightly different interests, or perspectives, on the same artefact and it will have a slightly different meaning for each speciality.

Of all the D-Stages there is most interaction among the participants in D-Stage 3. The radiologist and pathologist have little input in this part, other than to clarify a finding that they presented earlier in discussion. Sometimes they are observed to start preparing material for the next PCD, a practice which prohibits them from participating fully in the discussion. If the radiologist and

Table 5.2: Sample exchange in the third section of a patient case discussion

Role	
Oncologist	"could you not go in and cut that out?"
Surgeon	"no, I couldn't do that"
Oncologist	"but he's very fit. Is it not worth a try?"
Surgeon	"surgery isn't like that and even though its only 2 cms, its still a T4"
Oncologist	".. .. you mean a T1?"
Surgeon	"no, T4 ... look where it is .... its a T4."
Oncologist	"you're his best chance. Is there a possibility its not a T4?"
Surgeon	"Look ... its abutting the aorta .... its too risky. and even if it is less than 3 cms, once it is in an area that is not resectable, it becomes a T4.... and I can't resect the aorta".
Oncologist	" ...mmm...."

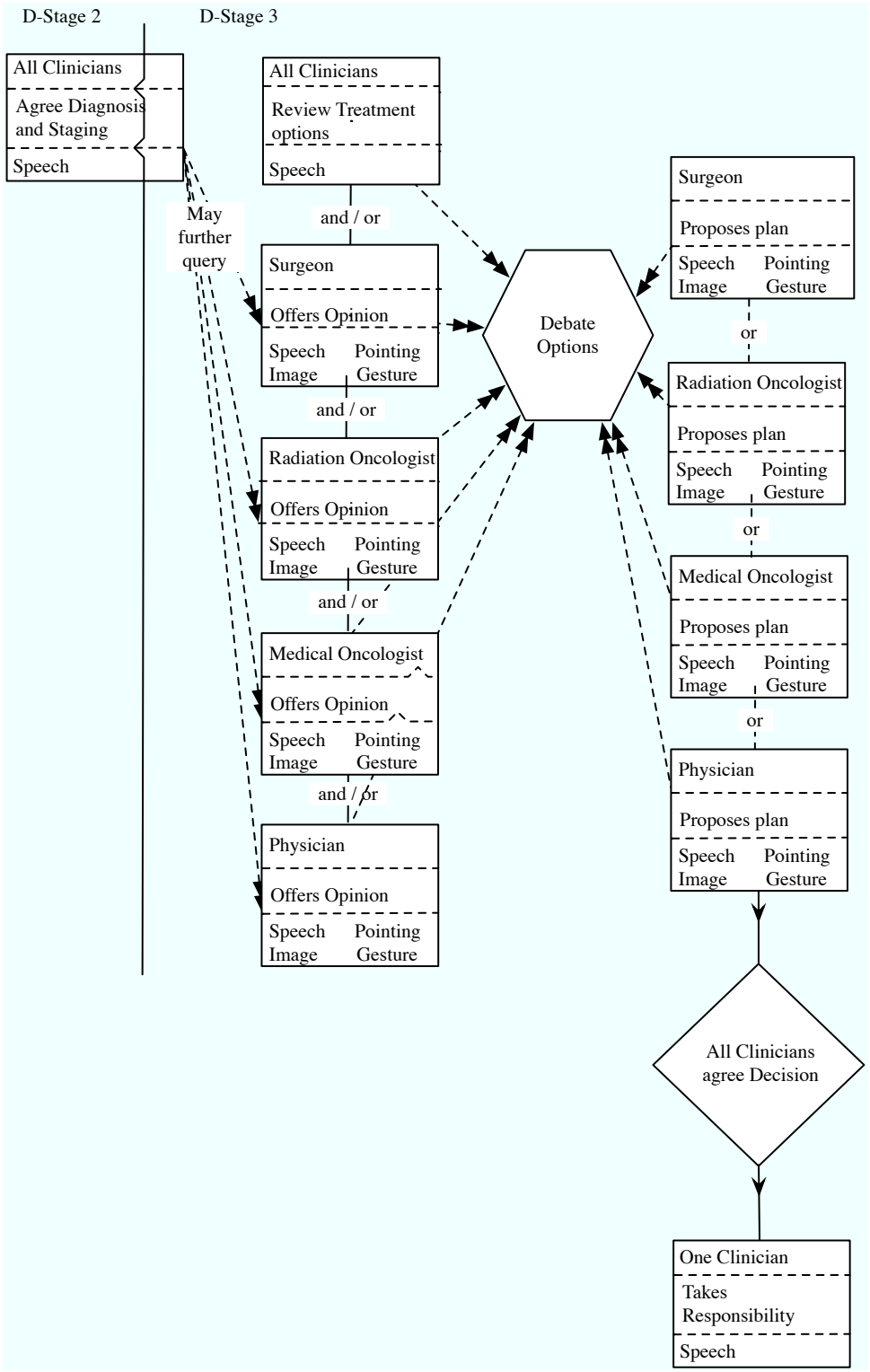


Figure 5.5: D-Stage 3

pathologist become significantly involved in D-Stage 3 it likely represents a discussion where the TNM staging is incomplete and consideration is being given to the feasibility of conducting an image guided biopsy for further investigations.

Depending on the TNM disease stage, which influences the treatment approach, specific specialities can be predicted to be involved. The surgeon, medical oncologist and radiation oncologist can be predicted to be more involved in this D-Stage, particularly in cancer cases. For example, for an extensive stage SCLC, surgery is not an option to consider and the patient is likely to receive radiation therapy. In these cases it can be predicted that surgeons will have little to say and the radiation oncologist will play a more significant role in the discussion.

D-Stage 3 differs from the other D-Stages in the amount of opinion exchanged, options considered and initial proposal revised than any of the other D-Stages. It may be assumed at the outset of a D-Stage 3 that *"so, we will proceed with chemo . . "* but after someone saying *"did we consider surgery in this case?"*, there might be a complete revision of opinion among the team on the most appropriate treatment plan. The final decision could be quite different from the first option proposed, or some of the considerations given in the course of discussion and may eventually decide *"so, we repeat the biopsy and check out that lymph node before deciding"*. These sorts of exchanges can be difficult to follow for observers at the meeting and are shown in Chapter 9 to be easier to follow in teleconference cases.

5.5 D-Stage 4

D-Stage 4 is defined as the articulation of the decision agreed. Finally, at the end of the discussion when the decision is agreed, the lead clinician or senior participant in his absence, will clarify the decision and the clinical and pathological staging of the patient, for the formal record.

> "OK, so we have a pT1N0M0, stage 1a, the PET is clear and the patient will be scheduled for surgery".

There is little, or no, exchange in conversation in D-Stage 4 and could be more aptly described as a 'declaration' by a senior member of the team. D-Stage 4 is short and clarifies MDT members' understanding of the decision agreed in D-Stage 3. The MDT co-ordinator and database manager both take notes for database records. Other MDT members can be observed taking personal notes for follow up at a later time, in notebooks and diaries and on their agenda sheet.

Figure 5.6 is a representation of the 'declaration' summary in D-Stage 4.

The end of D-Stage 4 normally coincides with the close of the PCD. If the announcement was followed by a pause while an active clinician was writing a note, this silence is considered as part of the PCD for annotation purposes. There were rare occasions when a forgotten item was stated for the record such as "By the way, I agreed with the referring clinician on the tumour type when I

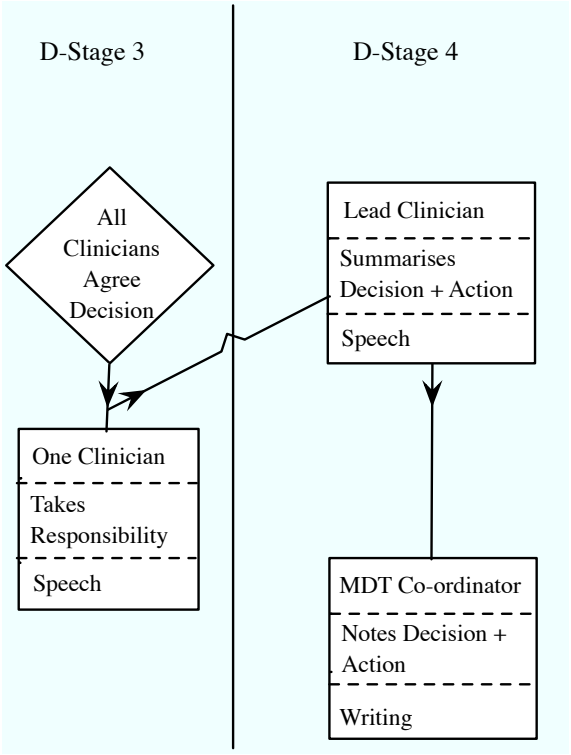


Figure 5.6: D-Stage 4

reviewed the original sample", or a follow-up question asked such as "What did we decide on that last case, I forgot to note . .". but these occurrences were rare.

While there are 4 D-Stages in a typical discussion, not all PCDs exhibit 4 D-Stages; some may have one, or two, or three, only. For example, if the presentation in D-Stage is very straightforward, clinical correlation may be self-evident and there is no formal D-Stage 2. Another scenario might be a situation where there is only one course of treatment for the patient, there is no discussion of the management options (D-Stage 3), and there is an immediate progression to D-Stage 4. For example:

> [*following from D-Stage 2, skipping D-Stage 3 and progressing directly to D-Stage 4:*]
> " . . his ECOG is 3, with a T4 squamous .. . so he's for palliative care."

Or sometimes, if the treatment advised is apparent to all concerned, it may not be formally articulated verbally, resulting in no D-Stage 4, such as in the following example:

> [*in D-Stage 3, surgeon asks*] " . . if we do a sleeve lobectomy . . do you think he's be able for that?"
>
> [*physician*] "Yes, his ECOG is 1 and he seems in good shape."
>
> [*oncologist*] "There's nothing much that I could give him."
>
> [*surgeon*] "OK then."
>
> End of PCD.

5.6 PCD in Teleconference

PCDs in teleconference follow the same format as PCDs without teleconference. The difference is that some of the roles communicate from opposite sides of the teleconference interface. There is an asymmetry between the sites, (mentioned in Chapter 4), both in the numbers attending and with the technology used. The specialities differ at the remote centres. Centre B oncologist and Centre C respiratory physician work essentially alone in their respective hospitals, as neither centre is large enough to support a full multidisciplinary team. Those remote specialists have come to be regarded as 'part' of the team at Centre A, rather than people regarding them as 'outside' of the MDT. For Centre D, there is both an oncologist and respiratory physician on-site. Although the link with Centre D is relatively new, these individuals are also regarded as new members to the MDT at Centre A.

It has been observed that remote physicians, particularly those working alone, place a high value on the teleconference link. At interview in Centres B and C, the clinicians were very accepting of the limitations in their teleconferencing system and said that is was *'better than the old system'* and *'even that old one was better than having nothing at all'*.

Slight differences have been observed in D-Stages 1, 2 and 3. In D-Stage 1, remote participants appear to share more information on the patient's socio-emotional state and comments such as *"he lives alone, but he has good neighbours who look after him"* are not uncommon. The remote centres tend to ask less questions of the pathologist and radiologist in D-Stage 2 and are more likely to prolong the discussion on options in D-Stage 3. Remote clinicians are likely to ask a specialist directly *" what about doing . . .*[suggestion]" which would invite an explanation from that speciality why that approach was *not* being advised. At co-located PCDs, when a treatment approach would not be an option, that specialist tends to remain silent. Any specialist who could administer a treatment that might be of benefit to the patient, volunteers their services. The co-located MDT members tend to know one another's approach well enough that questions become unnecessary most of the time. These observations are interpreted to mean that the lone physicians have an important need for the support of the MDT, are unlikely to question their 'peers' but have less common ground (Clark & Brennan 1991) than if they were working together at the same hospital.

Figures 3.1, 3.2, 3.3 and 3.4 in Chapter 3 show the equipment at each of the Centres A, B, C and D respectively. The equipment at Centres B and C is similar. Neither of these centres have facilities to show artefacts, and have little control over their field of view. The inability to show radiology or pathology is not so important because the radiologist and pathologist are *always* at Centre A side of the interface and like to review all images prior to the discussion.

Centre D has a new Telesynergy® system installed, with two screen displays, and is linked to their local PACS system. There was an occasion when Centre D sent digital radiology images to Centre A (on disk) before the meeting. The images were loaded onto the local PACS system

at Centre A and were reviewed prior to the meeting as part of the pre-MDTM routine. At the meeting, the PACS system at Centre A failed and the image was unavailable for discussion. Centre D loaded the image on their side and attempted to transmit back to Centre A. A few interesting events happened. Firstly, Centre D assumed a visual reciprocity and loaded the image onto their second screen while continuing to talk 'face-to-face' about it. Secondly, when Centre A couldn't see the radiological image they asked Centre D to transmit it, choosing to look at the image instead of the people in Centre D. Thirdly, when Centre D sent the image to Centre A, the image quality was poor and Centre A had to sacrifice the 'face-to-face' view with the remote people at Centre D. The people at Centre A then requested that the radiological image be removed, the 'face-to-face' view be restored, and they chose to talk about it instead of trying to share the view of the radiological image. The radiologist at Centre A could recall the image from his pre-MDTM review, had taken notes and proceeded to discuss it 'blind' with the remote site, while those a Centre D looked at the image on their own PACS system (and maintained 'face-to-face' contact across the interface). There was an awkwardness about the interaction because neither side could satisfactorily refer to features in the image. Deictic references from Centre D were meaningless to the radiologist and participants at Centre A. The discussion was curtailed and it was decided that enough information was available to make the decision anyway. The fact that participants chose to look at the person they were talking to, even though they were talking about the image, was surprising. Even if the image quality had been better, the radiologist at Centre A had no control over the remote image and was more comfortable talking about it while looking at the remote parties (instead of the image). The issue of what the participants want to look at is explored in depth in Chapter 6.

It was also observed that remote sites attempt to have 'informal' patient case discussions that are not encouraged by Centre A. Remote participants seem relatively uninhibited in asking:

'can I ask a quick question about a difficult case?', or,

'I have a middle aged man here with ..... can I ask what you'd do with him?'

This practice is discouraged for several reasons: 1) no radiology or pathology have been reviewed, 2) complex cases deserve full information, 3) while it would be relatively easy for a specialist to give a quick reply, it would be potentially dangerous given limited information, no access to the patient, and no time for consideration, 4) if the advice given was proven to be bad advice it would be very damaging and, furthermore, 5) there would be no mechanism for having a record of the exchange or advice given. The reason remote groups ask these sorts of questions more frequently may be due to less 'socialisation' with Centre A and represent less shared value. Or it may be associated with increased depersonalisation (Sellen 1995) or more uninhibited behaviour in teleconference that was noted by Siegel et al. (1986).

Currently a paper record is maintained as part of the MDTM agenda, that identifies the patient discussed in teleconference and the advice given. This record has no formal standing, but is filed by the MDT co-ordinator for future reference if needed.

5.7 The End of the discussion

In teleconference, when the discussion on remote cases is complete, the participants on both sides of the interface exchange 'thank you's' and bid farewell. They also tend to clarify when they will meet again in teleconference. If an academic conference is due, they may also ask if any of the people present will be in attendance and will plan to meet at the conference. After the teleconference connection has been closed, the team at the main centre continue to discuss the remainder of the cases on their agenda.

When all the cases have been discussed, the business of the meeting is concluded. Sometimes, particularly when the group was not so well established, one member of the group might want to 'ask a quick question' of their team members, but this practice is strongly discouraged for the reasons given above. However, in the co-located setting, team members have been observed to be much more forceful in expressing the problems for them in offering 'quick opinions' and have drawn attention to the group's policy on the matter, i.e. that any patient to be discussed should be tabled for the agenda. If urgent, then an urgent request should be submitted with all the relevant data; the radiologist and/or the pathologist will give their considered opinion and communicate by telephone. In teleconference, participants are much more polite to one another and accommodate the 'quick question' requests (with some hesitation and reservation), despite this being contrary to existing policy. Generally, those specialists who are requested for a 'quick opinion' ask for a more full discussion at another time.

After the majority of the group has dispersed, some of the junior members of the clinical teams, the nurse and the MDT co-ordinator can be seen conferring, gathering radiological images and checking that the correct films are in the correct 'bag'. Sometimes a surgical team may wish to keep the film until the surgical procedure is performed. Or the nurse may retain a set of images because she is aware they will be needed for another clinician's purpose soon or she may have undertaken to return them to a specific location. The MDT co-ordinator has responsibility to return images from other hospitals after use at the MDTM and to ensure that St. James's images on film or disk are returned to the correct location within the hospital. The MDT Co-ordinator also has responsibility for the sign-in attendance sheet, which serves as a formal record. He collects this at the end of the MDTM for filing later. The technical operator shuts down and turns off all equipment and locks up afterwards.

Chapter 6

MDTM participants and their requirements

At the outset of the study the multidisciplinary team (MDT) members at the main Centre A and remote hospitals B and C were asked about their personal experience and current access to computers and what they wanted to see and talk about at meetings. This chapter examines those responses and aims to establish the relative importance of radiology, pathology and clinical findings in patient case discussions. As well as assessing the relative importance of these artefacts being displayed at meetings the use and value of the face-to-face video link at multidisciplinary medical team meetings (MDTMs) held in teleconference is assessed.

Chapter 5 described how the team use the technology provided: MDT members sit facing an overhead screen display. Depending on the what participants request to see on the overhead display, the operator selects the input on the Telesynergy® system. The objective of the questionnaires in Appendixes D and E was to explore the participants' preferences for what they wish to view on the overhead plasma screen. Questions aimed to establish the relative value of radiology, pathology, the patient clinical details sheet and seeing remote parties, if connected in teleconference. The responses to the questionnaires were examined in conjunction with an analysis of screen use on a sample of case discussions and those data form the basis of the material presented in this chapter.

Comparison is made between the use of the screen display at co-located MDTMs and use of the display during PCDs in teleconference. In response to questionnaire 1 (Appendix D), conducted prior to the teleconference initiative, participants were ambivalent in their interest in being able to see the remote participants in teleconference. For questionnaire 2 (Appendix E) following some experience of MDTMs in teleconference, participants had more regard for the video link. It is shown here that attitudes towards video changed positively following participants' experience of teleconferencing. Participants considered being able to see radiology and pathology to be more important than being able to see the remote people. Contrary to the expressed views of its relative

unimportance, analysis of display screen use reveals 60% of the time spent in case discussion is spent in face-to-face view with remote sites. The value of the video link in MDT meetings, held in teleconference, is found to have a higher value than that expected.

6.1 Background

Establishing user attitudes towards technology is a fundamental first step in determining what sort of tools or technology might be appropriate in supporting the work of the MDT meeting (MDTM). Before any solutions might be proposed, the team members' experience, attitude towards, and familiarity with, computers need to be established as these are important factors in influencing the type of solution and how acceptable that solution is likely to be. Furthermore, the technological provisions within the organisation are also an influence on predicting the success of any initiative.

There is a complex relationship between social structures, work processes and technology. For any proposed technology to be successful in its implementation the interplay between the hospital processes, the roles that people conduct and the technology must be in congruence, Technology in the organisation must support the hospital objectives and work in concord with tasks and processes. Individuals must be comfortable using the technology supplied and the technology must support their role within the organization. As service and management structures change within the hospital, so too must the technology change to support the users in their new roles.

In identifying potential technological solutions for the MDTM, a number of strategies are adopted in this study, rather than a single approach. In the first instance, the MDT members are consulted and asked about their needs and requirements. As well as asking these users to identify their own needs, their work must be examined and the work processes understood. Literature study also helps identify areas that are likely to cause problems or issues in the design or in the implementation.

Work processes and the meeting proceedings are described in Chapters 4 and 5. This chapter will review the attitudes and experience of the MDT members (users) and aim to identify some of their requirements, particularly in relation to video.

There has been a lot of debate in the literature on the usefulness of video, much of which is discussed in Chapter 10. This analysis of screen use during MDTMs, described in this chapter, together with analysis of the questionnaires is intended to contribute to this debate.

6.2 Method

Experience and attitudes of users were established through the questionnaire in Appendix D, which was delivered at the outset of the study in 2004 at Centre A. The aim of this first questionnaire was to establish an overall impression of the MDT members' use and experience of technology.

The questionnaire was distributed at Centre A before there was any proposal to have MDTMs in teleconference. After the teleconferencing initiative was implemented, the same questionnaire was distributed to the remote participants and results were examined separately. It was noted that, at the time of completing the questionnaire remote participants were already experienced users of teleconferencing, having had established regular MDTMs with the GI and Lymphoma MDTs as well as having links with other university hospitals. Where results from the remote site differed from the majority result at the main site, these responses are identified separately, or specifically discussed. Other questions asked were exploratory and aimed to establish views on potential teleconferencing and record-keeping, neither of which were part of the practice of MDTMs at that time.

The second questionnaire, (Appendix E), designed to assess attitudes of team members towards the use of video, was distributed in Spring 2005. Aspects of the meeting where video might be more valued were of particular interest. Among the questions was part of question 7 from the first questionnaire. This question aimed to establish if there had been any change in attitude since the issue of the first questionnaire, among participants at Centre A. In the time in-between the issue of the two questionnaires, a teleconference initiative was undertaken and the team had approximately 8 months experience since its initial introduction into MDTM proceedings. The question asked directly if the member wished to see the remote party on the video link. Other questions explored users' viewing preferences with respect to radiology and pathology images in different discussion scenarios, i.e. during the first and second parts of the PCD (the clinical presentation and patient management decision parts). Interest in awareness issues was also examined in the 2005 questionnaire. The distribution of the second questionnaire was confined to the main centre. For logistical reasons, the second questionnaire (Appendix E) was not distributed to the remote locations.

In conjunction with the analysis of the questionnaires, annotations gathered from the screen display at meetings were examined (Section 3.5.1). This analysis on the display of artefacts during MDTMs was undertaken as an adjunct to the information given directly by the users. The purpose of this analysis of screen displays was to compare actual behaviour with expressed sentiment in questionnaires and interviews with respect to the use of artefacts and the visibility of remote parties. It provides an indirect measure of user needs and what is needed to be made visible during PCDs. Measurement data on artefact use during PCDs were obtained from the video recordings described in Chapter 3, Methodology. Elan linguistic annotator (MPI 2005) was used to annotate the recordings.

A further set of data were gathered in Meeting Evaluation Exercises (Appendix G) conducted over a six week period that involved both teleconference and co-located meetings. These evaluations were carried out in late 2005 and early 2006, over six months after the issue of the second questionnaire (Appendix E). MDTM participants were asked to evaluate each meeting on a number of scales. They were asked to give a specific answer in relation to each element of the meeting: the

presentation of clinical details and bronchoscopy findings; radiology and pathology results and the patient management discussion. Participants were also requested to give an overall rating for the meeting on an 11-point scale. Evaluation sheets were distributed to all attendees which included both active participants at the meeting and observer medical staff in training.

During interviews with team members, observations made during MDT meetings were checked as well as the interpretation of the questionnaire results. Attitudes assessed in the initial questionnaire were not discussed with participants before results on the subsequent questionnaire were compiled.

The meeting room and workstation are described in Chapter 3, Section 3.7.

6.3 Results

User Profile

Similar to the competent archaeologists of Goodwin (1994) who are able to see landscape through maps and tools that constitute the profession, so too the participants at the respiratory MDTM share common ground and expect each other to see the world in ways that are relevant to the work and artefacts of their (health) profession. The team is receptive to new technology and interested in finding a technological solution to the demands being placed on them to provide a quality service.

Table 6.1 gives a breakdown of respondents with regard to sex, age, role and speciality. Generally, the group are experienced with technology, are open to developing their use of computers, and are receptive to new ideas. Without exception, all respondents (37) use computers in their work. With 3 exceptions (who described themselves as having 'Some' experience), respondents declared that they had 'Average' (42%) or 'Above Average' (47%) experience and there was one 'Very Experienced' remote user. Most respondents reported that they use computers daily and have access to either a desktop or laptop computer at work and they use spreadsheets, databases, digital scanners, cameras, diaries, notes, email, lists, documents and presentations. Many respondents expressed an interest in more training to extend their current uses for technology. All users (respondents) use Clinical Practice Guidelines (CPGs) and they get these guidelines from either professional organizations, medical literature and from discussion with colleagues. Non-consultant hospital doctors (NCHDs) were provided with the appropriate CPG and remote users tended to accept the CPG from their professional organizations and after discussion with colleagues at the larger centre.

Teleconference

It was explained that at the time of issue of the first questionnaire, in 2004 (Appendix D), the group had no experience of teleconferencing, and the initiative had not yet been proposed. A 'What if?' question, asked MDT members on what they would like to see if there was a teleconference

Table 6.1: Multidisciplinary team profile

Sex:		*Age:*	
Male	20	20-29	10
Female	17	30-39	14
		40-49	8
		50-59	3
		60	2
Role:		*Speciality:*	
Consultant	12	Medicine	15
Non-Consultant	12	Pathology	5
Hospital doctor (NCHD)		Surgery	8
Nurse	11	Radiology	2
Data manager	1	Med. Oncology	5
Lecturer	1	Radiation Onc.	1
		IT support	1

and following the implementation of teleconferencing, the question was asked again (Appendix E). Results are reported in Table 6.2[1] and Table 6.3. Table 6.2 (a) and (b) gives the views of the main site and remote participants, separately. Results are presented as % Frequency of response. Part of the question was repeated (for users' views on 'seeing' and 'hearing') in 2005 and those results are presented later in Table 6.3.

Results in Table 6.2 show that a clear need is identified for radiology and pathology images to be available for discussion. Figure 6.1 illustrates the level of agreement and priorities, overall, of those at both the main and remote centres. Discussion on the patients' clinical findings is ranked the highest, i.e. there was the highest level of 'Strongly Agree' and 'Agree', the lowest level of 'No Opinion' and no disagreement. Radiology was considered next and scored the highest level of 'Strongly Agree'. While there is some 'Disagree'ment on the need to see all pathology, most people agree that they need to see the microscopic images. The level of agreement is less emphatic for the patient management decision, but there is no disagreement on the wish to discuss the patient management decision. With regard to reviewing clinical procedures, such as bronchoscopy, on DVD, there is mixed reaction and almost 14% disagree with this proposal. The suggestion that sounds such as coughs from clinical examination might be captured and presented to the meeting met with 22% disagreement overall (of which 8% 'Strongly Disagree'd).

The questions that asked about seeing and hearing the remote people in teleconference met with greater ambivalence than expected. Consistent with findings of others (Finn, Sellen & Wilbur 1997, Masoodian, Apperley & Frederickson 1995) MDT members considered audio links more important than video communication (Table 6.2). There was little disagreement, overall, that people should be heard (5%), but 35% expressed 'No Opinion' and only 30% 'Strongly Agreed'. When compared

[1]Results differ slightly from those reported in Kane & Luz (2006) because some questionnaires were received following submission for publication.

Table 6.2: MDT members' requirements (at main site and remote location) for what they wanted to see and hear at MDTMs in teleconference *before* any teleconferencing experience. Results are given as % Frequency.

(a) *Main site* MDT members requirements for what they wanted to see and hear at MDTMs in teleconference. % Frequency.

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
See all Radiology	0	0	12	8	81
See all Pathology	0	4	8	31	58
Discuss specific clinical findings	0	0	4	23	73
Review videos from clinical procedures	0	12	19	42	27
Review sounds from clinical procedures	8	12	50	23	8
Discuss, or agree, the patient management decision	0	0	12	35	54
See all people 'live' on video	0	15	50	31	4
Hear all people 'live' on video	0	4	42	31	23

(b) *Remote* MDT members requirements for what they wanted to see and hear at MDTMs in teleconference. % Frequency.

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
See all Radiology	0	0	18	18	64
See all Pathology	0	9	18	9	64
Discuss specific clinical findings	0	0	27	18	55
Review videos from clinical procedures	0	18	46	27	9
Review sounds from clinical procedures	9	18	64	9	0
Discuss, or agree, the patient management decision	0	0	27	27	46
See all people 'live' on video	0	9	27	18	46
Hear all people 'live' on video	0	9	18	27	46

to the overall level of 'Strongly Agreed' for radiology at 76% this figure on needing to 'hear' others is surprisingly low. When one considers that the image data will provide information with which an individual team member can make a personal decision, without reference to another team member, and that this method of working would have been common practice in the past, then the fact that less than one-third of participants 'Strongly Agree'd that hearing remote participants was desirable, can be understood. Being able to 'see' the remote participants met with even less enthusiasm and 50% of people at the main site had 'No Opinion' on the matter and 15% 'Disagree'd it was necessary to see the people on the opposite side of the teleconference interface.

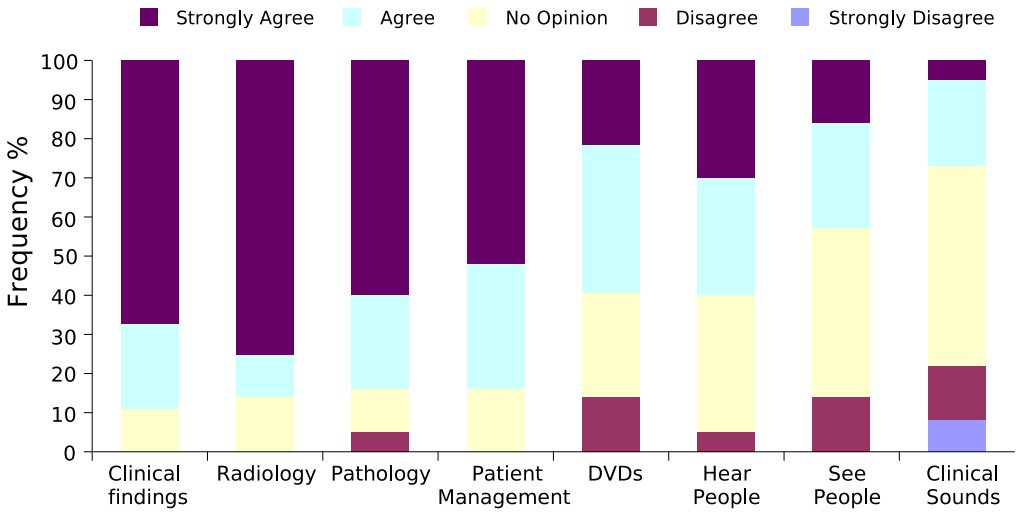


Figure 6.1: The expressed views on the need to see and talk about different items during patient case discussions (from all sites).

Table 6.2 presents the results from the main site and remote centres separately. When differences between the participants at Centre A and the remote participants are examined (Table 6.2) it is shown that all 'Disagree'd with the proposal to share clinical sounds. Remote users demonstrate higher levels of agreement on the wish to see other participants across the interface. All agree with the relative importance of the items for discussion and consider that radiology is relatively more important than pathology. The main site place a higher regard on seeing the artefacts than the remote participants, and reaching agreement on the patient management decision, which may reflect a greater interest on the part of the remote participants to learn the professional *opinion* of the large centre, rather than the necessity to agree with them. While remote participants also placed hearing people on a higher ranking than seeing people, they valued seeing the participants at the main site more highly than the people at the main site felt they needed to see the remote people. This result may reflect a greater visual need for the smaller group when communicating with the larger group, or may be due to teleconferencing experience of the remote users with other MDTMs.

At the time of the installation of the Telesynergy® facility, its main purpose was to support the

sharing of radiology and pathology between geographically distributed centres. After installation, it was found to be used more as a full teleconferencing facility. Approximately eight months after the implementation of MDTMs in teleconference, the second questionnaire was distributed (Appendix E) to explore the users' needs further with respect to what they wished to look at during different parts of the proceedings. Some changes in attitude were noted, following teleconference experience (Figure 6.2). The second questionnaire was not distributed among MDT members beyond the main site. Results are given to the repeated question in Table 6.3.

Table 6.3: MDT members' requirements to see people during a teleconference meeting following 8 months experience of MDTMs in teleconference.

	Frequency %				
Requirement	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
See all Participants - 2004	0	15	50	31	4
See all Participants - 2005	4	7	19	52	19
See all Radiology - 2004	-	-	13	11	76
See all Radiology - 2005	-	-	-	29.6	70.4
See all Pathology - 2004	-	5.4	10.8	24.3	59.5
See all Pathology - 2005	-	3.7	-	48.1	48.1

The number of those who expressed 'No Opinion', on the need for video, reduced to 19% and over 70% strongly agreed or agreed that they required to see the remote party on the teleconference link. This represents a clear shift in attitude following some experience in using the Telesynergy® system and presented graphically in Figure 6.2. This value assigned to video appears to be significantly higher than that reported elsewhere (Kathleen E. Finn & Wilbur 1997, Whittaker 2003).

When questioned on the use of artefacts at meetings ("boundary objects") and the necessity of being able to see radiology and pathology artefacts over the teleconference link, the team was unambiguous in their answers and felt it critically important to be able to share and view radiology and pathology at teleconferences as well as at co-located meetings, regardless of whether the object was under immediate discussion or if other clinical findings were being discussed. Although over 10% had 'No Opinion' in 2004, all had some opinion following teleconference experience. In the case of radiology *all* felt it necessary to see the images being discussed. For pathology, over 96% agreed on their need to see the microscopic pathology image, but there was a small number recorded who felt is was not necessary to see that image (less than 4%). Results are illustrated in Figure 6.4. These results support those of Bly (2003) who noted that when conversations include physical objects, a computer-mediated collaborative environment must enable representation and transformation of those objects in conversation.

It was postulated that when discussing patient clinical details and the patient management

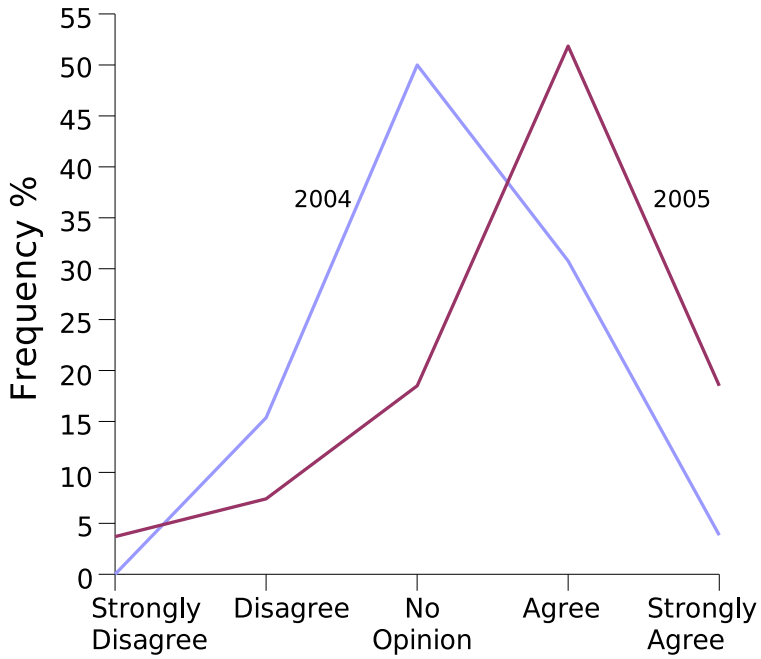


Figure 6.2: Responses on the value participants assign to being able to see remote participants on teleconference link

decision there would be a greater need to see all the participants in the discussion (including those over the video link), than when discussing patient artefacts. Initial results seemed to confirm the hypothesis. The final result is surprising in that MDT members express a relatively high value on seeing the people when discussing the artefact and seeing the artefact when discussing patient symptoms. MDT members also place a significant value on being able to see remote observers (but not a very high value). A 'Relative Value Measure' was calculated for each item by adding the scores received on the respective options, in different scenarios and these Relative Value Measures are presented in Figure 6.3.

Figure 6.3 shows that when the discussion is about the patient's symptoms, MDTM participants value seeing the radiology and/or pathology highest. The 'image that remote people can see' scored next highest (and was probably intended by the respondents to mean the radiology or pathology image). MDT participants also scored the value of seeing the 'Remote Clinician' highly when discussing the patient's symptoms, as well as giving a fairly significant value on seeing observers to the discussion. When discussing patient radiology and pathology (artefacts), MDT participants placed highest value on seeing the remote clinicians. The value on seeing the image that the remote people can see ranked fairly constant in either scenario. It is a surprise that results indicate the highest value on seeing the remote clinicians when discussing artefacts (boundary objects) when those objects are directly under discussion, and may represent a need to get visual feedback from the person with whom an object is under discussion (Figure 6.4 b). It is also a surprise that when the objects are not directly being discussed (when talking of patient signs and symptoms) that

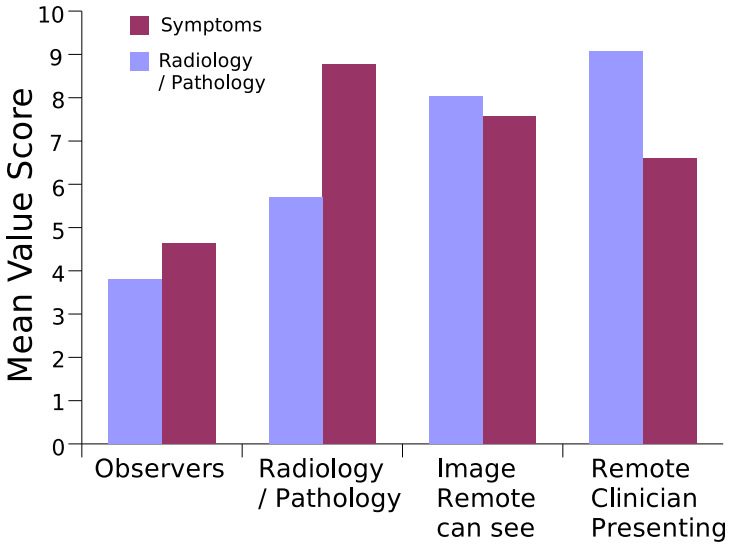


Figure 6.3: Relative value of seeing remote clinicians, patient artefacts and remote observers and the images that others are looking at, when discussing patient symptoms and patient artefacts.

there is a need to see the radiology and pathology boundary objects (Figure 6.4 a).

The results on the value of seeing radiology and pathology, the remote clinicians, images that remote people can see and the value of seeing observers is presented graphically in Figure 6.4. This Figure provides more detail that the relative value measures presented in Figure 6.3. Responses are compared on different priorities when discussing patient signs[2] and/or symptoms and when discussing artefacts (Appendix E).

6.3.1 Meeting Record

When MDT members were asked their views on having a meeting record, they expressed a need for some form of record, but did not show high agreement on the form that record might take. On the direct question that asked if the MDT member would agree to a recording of the MDTM for general files and records, available to anyone who has authorisation to review the patient's chart, the majority (73%) agreed. While no respondent said 'No', almost one quarter (24%) said 'Don't know'. A couple of respondents expressed reservation and one said that while they agreed that there should be a record, they felt a paper record with note of the radiology and pathology discussed would be enough. While the need for agreement by consensus was emphasised by some, one member felt that the opinion of each member of the team should be recorded independently. Table 6.4 summarises the responses to the question that asked opinion on various items that might be recorded for the MDT, or pathology, purposes only. Results are illustrated in Figure 6.5.

It became apparent when talking to MDT members that the issue of an appropriate record of

[2] A 'sign' is an objective physical finding found by an examiner. A 'symptom' is subjective evidence of disease, usually reported by the patient.

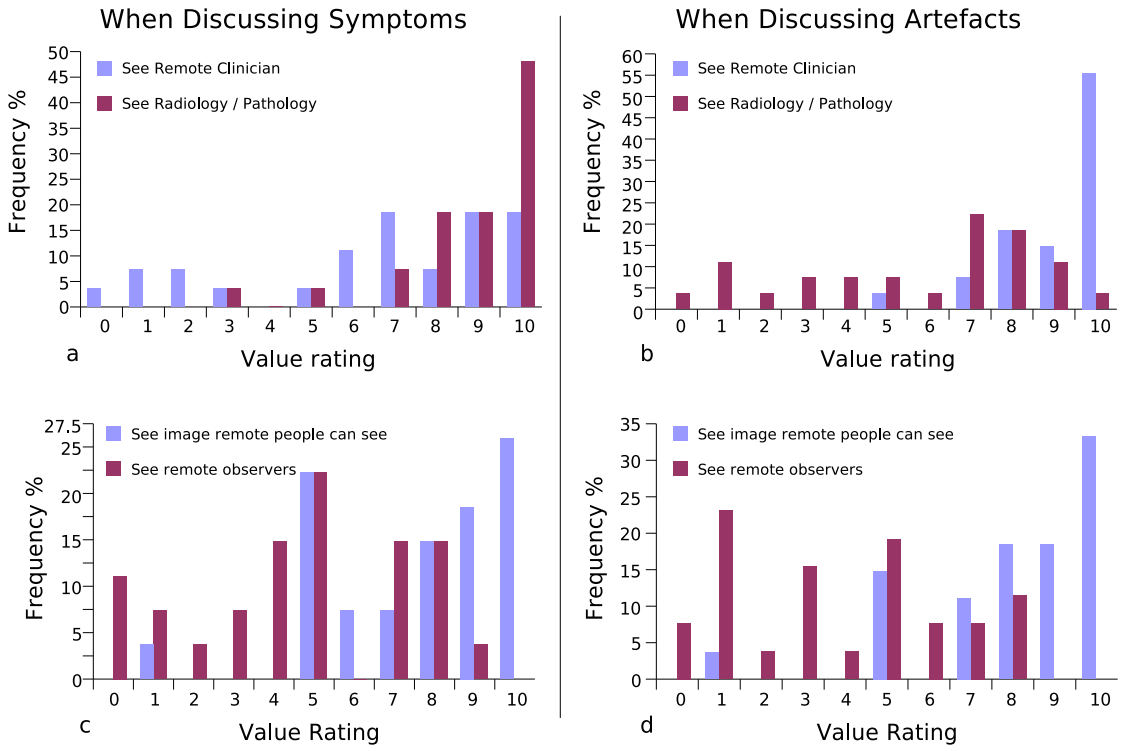


Figure 6.4: Value of seeing people and artefacts when discussing patient symptoms and discussing patient artefacts.

the MDTM is complicated. There is a recognised need for a good record, and many say that it may be a matter of time before an incident results because of the lack of a useful record. Over the period of study, a paper record was introduced that is eventually filed in the patient's chart. Initially this record was generated by the MDT co-ordinator, and at time of writing this is still the practice among some groups. However, for MDTMs with small agendas, the individual patient charts are brought to the MDTM and notes are compiled by the doctor looking after the patient, at the time of discussion onto a pro-forma report and filed in the patient's chart. The one-page report summarises the pathology, radiology and clinical findings, the disease staging, if available, and the recommendation on what to do next for the patient. A meeting record will be discussed later in Chapter 11, Section 11.4.

6.3.2 Awareness

Participants at the meetings want to know when they are connected to the remote site. 78% said they *always* wished to know if they were connected and 11% said they wished to be made aware if the connection was working when they engaged in conversation across the interface. The remainder had 'No Opinion'. 56% of MDTM respondents expressed a wish to *always* see what the remote participants are looking at when linked in teleconference, and a further 30% said 'when in conversation with the remote site' they want to see what those people are looking at.

Table 6.4: Opinion on items to be included in MDTM record for MDT or pathology purposes only.

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
Radiology	-	-	5.4	37.8	56.8
Pathology	-	-	5.4	45.9	48.6
Patient Management Decision	-	2.7	10.8	37.8	48.6
Clinical Findings	-	-	10.8	45.9	43.2
Video or DVD of procedures	-	2.7	16.2	48.6	32.4
Clinical sounds	2.7	2.7	35.1	43.2	16.2
Live video recording of MDTM	2.7	24.3	40.5	21.6	10.8
Still images of participants	2.7	16.2	46	24.3	10.8
Selected parts only	5.4	13.5	51.4	21.6	8.1
All Conversation	16.2	13.5	32.4	27.0	10.8

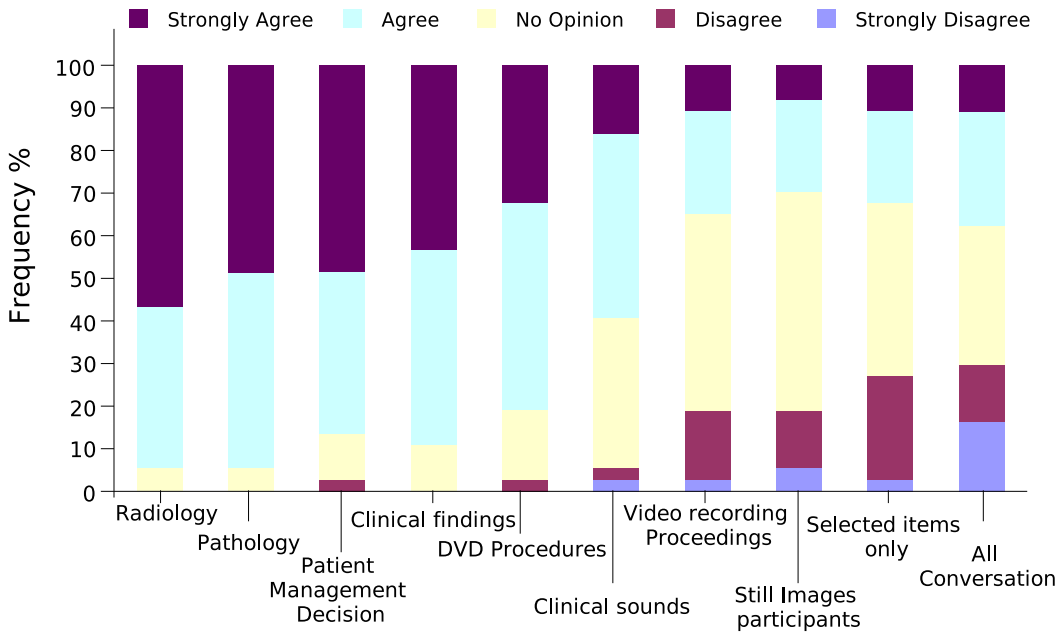


Figure 6.5: Participant opinions on recording items discussed at MDTM for team record purposes.

Team members value being able to see remote observers, if those people are observing for educational purposes. Over 60% expressed a value over '5' (on a 11 point scale) of being able to see those people observing and a minority attributed little (7%) or no value (4%) to being able to see them. The team expressed an even higher value on being able to see what remote people are looking at, with less than 4% ascribing a value less than 5. Results are presented graphically in Figure 6.6.

On interviewing the meeting attendees afterwards it was felt that this question may have caused some confusion. For some people the question was interpreted to ask if they wanted to be able to see the remote party when the remote party may be looking at a radiology or pathology image. Some of the MDTM participants don't like to see their own image on the overhead screen (if the outgoing video stream is accidentally directed to the plasma screen display). The use of the word 'image' in some of the questions also caused some ambiguity. For some people at the meeting the word 'image' is used to specifically refer to 'radiological image' and not the more general meaning intended. However, the result does indicate a value on being able to see remote parties, even when not in direct discussion across the teleconference interface, which is reinforced in the responses to question numbers 4 and 5 of the same questionnaire and depicted in Figure 6.4 (c) and (d).

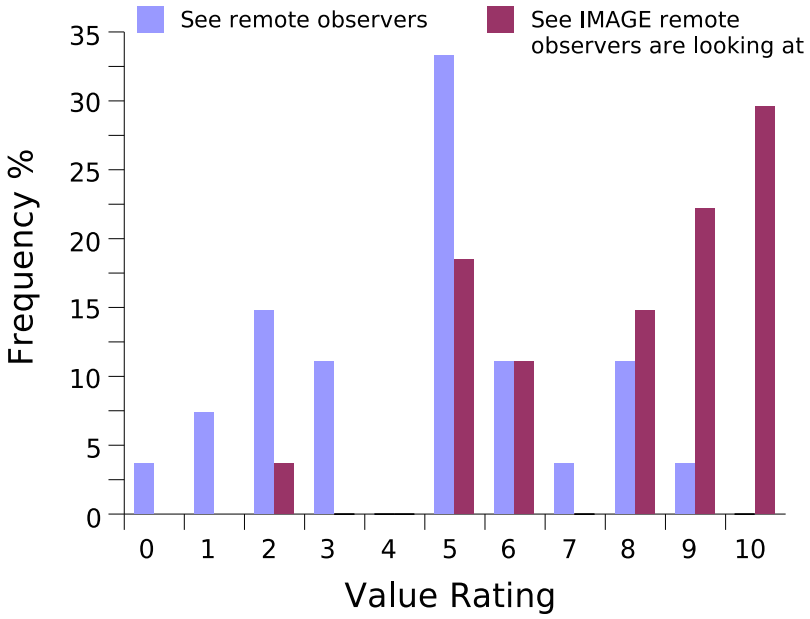


Figure 6.6: Value placed on being able to see observers connected in teleconference and on seeing the image that observers can see.

When MDT members were asked about the value of the 'patient detail' sheet being on display during discussion, there was an unexpectedly high value place on its display, irrespective of whether the discussion was in teleconference, or not. 60% of respondents scored its value in the highest two categories for teleconference PCDs and slightly less, 56%, gave those high scores for co-located PCDs. The sheet with patient details provides the name and a clinical summary and for cases

under the care of the remote participants, information is often very sparse at the time of discussion. The display of the sheet also serves as a reminder of the patient whose case is being discussed and participants have articulated its usefulness as a reminder of the case under current discussion, i.e. an awareness mechanism for the MDTM. Following the introduction of PACS, it became difficult to display the patient details and radiological image from the same PC. Furthermore, the word-processing programme consumed considerable memory that affected the performance of the PACS system. Another server (at the back of the room) is now used to project the patient details sheet from the overhead projector onto the SMARTboard™ during discussions. One of the team members undertakes to change the page at the start of each PCD.

The data presented from questions 2, 3 and 6 in the second questionnaire (Appendix E) that concern attitudes and values towards knowing and seeing when connected in teleconference, are interpreted to mean that it is an important requirement to have awareness mechanisms in place for team members while they conduct their work at MDTMs. The data support a requirement for, and place a significant value on, awareness mechanisms to support MDTMs regardless if those meetings are connected in teleconference or not. Awareness mechanisms would serve to remind participants of the place on the agenda, i.e. the patient being discussed. Other mechanisms are needed to provide information to participants to know if people are connected and observing the proceedings.

6.3.3 Analysis of Artefacts

MDT members placed a high importance on seeing the radiology and pathology artefacts during meetings. Surprisingly they ranked the visibility of artefacts highest when discussing patient symptoms and ranked being able to see remote clinicians highest when discussing the artefacts. An analysis of artefacts on display at meetings was undertaken to examine the use of artefacts during discussions and to see if expressed preferences were matched in the observed behaviours. During meetings, prompts are provided by participants to select and display either the microscopic image, patient details from a PC, radiology images from a document reader, or video input from the remote site during teleconferences. Analysis of the images displayed on the main plasma screen are illustrated in Figure 6.7. Over two-thirds of the time of a patient case discussion in teleconference is spent in face-to-face view with the remote site. It can be seen from Figure 6.7 that both the time for radiology and pathology displays is significantly reduced in teleconference. The reduction is 59% and 55% respectively for radiology and pathology and reflects the relative importance these objects are given in discussion by the clinical staff. The relative reduction of 75% for the display of patient details is not very surprising since the patient detail artefact is not an object of direct discussion in co-located meetings, but as detail displayed for background information purposes. The content of the patient detail sheet is presented verbally at the outset of discussion along with other relevant clinical information.

The remote sites being visible during co-located meetings, 1.5% in Figure 6.7, represents connections being established, in the background, during the co-located part of the meeting. Unrelated artefacts were sometimes displayed during co-located meetings and represent prompts by a participant to move the discussion onto the next patient. Such prompts did not occur during the teleconferencing sessions. These unrelated artefacts on display at co-located meeting were realised to be a distraction and have potential to cause confusion during discussion and the practice of moving on the patient details page has stopped.

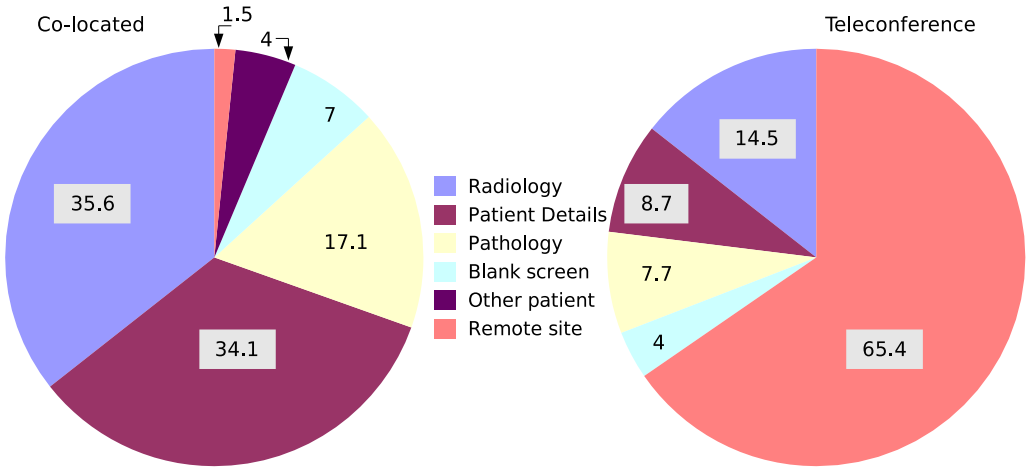


Figure 6.7: Use of artefacts at co-located (left) and teleconference (right) meetings

6.3.4 Evaluation Exercises

The evaluation questionnaire that was distributed over six recorded meetings in Winter 2005/2006 is given in Appendix G. Responses to this evaluation exercise were generally satisfactory, with most respondents demonstrating satisfaction overall. Table 6.5 summarises the % of participants who agreed that about the right amount of time was spent on each element. For example, 90% of respondents agreed that 'about the right amount' of time was spent on the radiology part of the discussion. However some small differences were noted, and while statistical significance is not demonstrated for some of the parameters, Pearson's CHI Square χ^2 test showed significance with 1 degree of freedom for the overall values of 83% and 62% for co-located and teleconferencing meetings respectively (Table 6.5). Overall ratings (shown in Table 6.5 (b)) for the meetings do not correlate well with expressed satisfaction with the meeting elements and observer ratings are lower than participant ratings. While most participants consider individual elements of the meeting as 'about right', in the question that asked for an overall 'score' on the eleven-point scale, the overall satisfaction rating is 7.4 and 6.9 for co-located and teleconference meetings, respectively. These satisfaction rating values are lower than one would expect given that the individual items are

generally higher. When the individual items are examined closely, the results show a relatively low score for the quality of the patient management discussion in teleconference. Only 58% agreed that 'about the right amount' of time was spent on that part of the PCD and 29% said they would have liked more discussion on the patient management decision, i.e. D-Stage 3 of the PCD. This dissatisfaction will be discussed later, in Chapters 8 and 9, in the light of other findings. It is shown in the quantitative analysis of the video recordings on Chapter 10 that more time is spent in D-Stage 3 in teleconference than D-Stage 3 in co-located discussions when clinicians discuss ideas on the best strategy for patient management. In fact, D-Stage 3 is the only stage that is found to consume more time, relative to the other parts of the discussion, in teleconference (Figure 10.3).

Table 6.5: Evaluations of elements at co-located and Teleconferencing MDT meetings.

(a)

Meeting Element	co-located meeting	Teleconference
	% who agreed that for each item below there was 'about the right amount described'	
Clinical findings	77	72
Radiology	90	88
Pathology	94	93
Bronchoscopy findings	90	81
Patient management discussion	74	58
Overall the meeting elements were 'about right'	83	62

(b)
Mean overall ratings of co-located and Teleconference meetings by Participants and Observers. on an eleven point scale.

	co-located meeting	Teleconference
Participant	7.7	7.4
Observer	6.8	5.9
Overall	7.4	6.9

The use of artefacts at meetings was considered very satisfactory at all meetings by both participants and observers. There is a greater variation in the responses to the assessment of elements in the meeting that do not involve the use of artefacts, i.e. the clinical and bronchoscopy findings, and the patient management decision. Ratings for the individual items under discussion is given in Table 6.5 (a). Differences may be partially explained by difficulties being experienced in speech interactions that are not accompanied by artefacts, such as in D-Stages 1 when the patient's presenting signs and symptoms are being described by a clinician, or in D-Stage 3 when a clinician may propose a mode of treatment for colleagues to consider. In these situations it is likely that

there is additional collaborative effort being expended by participants in achieving common ground across the interface and is discussed later in Chapter 10, Section 10.5.1.

When results are analysed with respect to the participant and observer ratings, both those meeting elements involving discussion and the overall meeting ratings are slightly lower for teleconferences than for co-located meetings. However, the numbers are small (less than 1% difference for co-located discussions) and this finding would need to be further explored. Of the 93 evaluations received, only 21 were from observer participants. Overall ratings are summarised in Table 6.5 (b) for teleconferences and co-located meetings by participants and observers. Differences in (b) may be explained in the fact that the meeting aims to serve different objectives for the two groups.

6.4 Conclusions

The data reported in this chapter demonstrate, in the first instance, that user attitudes towards technology can change after some experience of using that technology. Before the teleconferencing initiative was proposed, users were ambivalent in their expressed need to see remote parties in teleconference and, after some experience, a change in that view is demonstrated. The users ascribe a greater importance to being able to see radiology and pathology artefacts than being able to see people across the teleconference interface, and they also express a wish (although less important) to see the remote parties, even if those people are observing proceedings and are not active participants. Yet, analysis of the screen display showed that almost two-thirds of the time in a teleconference PCD is spent in face-to-face view, which contradicted their expressed behaviour in the questionnaires and interviews. At interview it was common for individuals to say:

> "We need to see the x-rays; it doesn't matter if we can't see [*remote parties*]".

The results, at first glance, appear contradictory in that the expressed views of the meeting participants was contradicted in their behaviour when they request to see the remote parties on screen. Collated questionnaire results contradict individual views expressed at interview. However, the questionnaire result matches observed behaviour more closely than interview responses which is discussed in Section 6.3.3, when the use of artefacts at MDTMs is examined (Figure 6.7). This need to see conversants across the teleconference interface is demonstrated in the analysis of the use of screen displays during PCDs.

The demonstration of a change of mind by the users, and the demonstration that what they say may not represent their true need, emphasises the importance of adopting different strategies when determining user needs and system requirements. It is only by clearly identifying user needs that technological support for the collaborative work of the MDT can be provided.

There is no ambiguity in the responses to questions regarding the use of artefacts such as radiology and pathology at meetings. The importance of having radiology and pathology visible during case discussions is clearly articulated by the MDT members in both questionnaires and

through analysis of their use of the display screen at meetings. For over half of the time spent at a co-located PCD, either radiology or pathology are on display. The fine detail that users wish to see in these images requires that the display should support a high resolution of the image. For the microscopic image, the picture represents a magnification of 600 to over 1000 times the tissue element so each part of the system must maintain resolution in order to allow display of the differentiation needed for the various tissue structures. In radiology, resolution is limited to that of the imaging system. As imaging methods are developed with higher resolution, so will visualisation tools, such as screen displays, be needed to support the fine grained detail in the image.

Awareness mechanisms are also important. People want to know when they are being observed and although they do not give it a very high importance, they attribute significant value to being able to see observers to the discussion. Awareness is not confined to awareness of the teleconference connection and there is high importance given to being made aware of the patient under discussion, through the data projected on the side wall, while the discussion is on-going. This is evidenced in the analysis of screen displays that shows that for over one-third of the time at a co-located PCD the patient details sheet is on display. In teleconference, where this display of data is reduced to less than 10% (because of the greater need to see the remote party), the satisfaction rating score for the patient detail element of the discussion dropped from 77 to 72 points. Although statistical significance is not demonstrated, the result prompts further in-depth investigation with a larger sample.

Results here demonstrate a clear user need for video in PCDs, both to see the artefacts and to see the people across the interface (even if not engaged in conversation with them). This need is identified through the questionnaires, analysis of screen use during PCDs and observation. Further analysis on the use of video is presented in Chapter 10. A need for multiple video channels and displays is indicated because of the demonstrated need to see radiology when talking to conversants about the patient's symptoms; and a reciprocal need to see the people across the interface when talking about the radiology and pathology.

Although reported studies have failed to agree that video is important in computer-mediated communication, there is general agreement that the need for video will depend on the task being undertaken (Finn, Sellen & Wilbur 1997). The usefulness of video-mediation in the communication of detail on artefacts has been identified (Whittaker 2003) but the ways in which communication and interaction are embedded in, and constitute, "material realities" needs further exploration. Luff et al. (2003) describe the fact that it is hard for remote participants to see both the object that the local participant is talking about as well as the conduct of that local participant in relation to it, as a "critical interactional problem". This phenomenon may explain why results here are counter-intuitive in demonstrating an important need for participants to have dual channels of visual information; one to provide information on the people in the environment and another to provide information on the objects under discussion.

The evaluation of the individual elements of the discussion and the overall evaluation of the meeting are revealing in identifying an aspect of the teleconference discussion that is probably under-supported by the technology. Table 6.5 shows that the patient management discussion is considered the least satisfactory part of the PCD in teleconference. The patient management decision is discussed in D-Stage 3 and this is the only part of the discussion that is found to be longer in teleconference, yet, 30% of participants felt that there was not enough time spent on this part of the PCD. D-Stage 3 is also characterised by more interaction among participants and less use of artefacts than in the other D-Stages. The use of artefacts is not central to D-Stage 3. This part of the PCD involves discussion on the more subjective aspects of the clinical assessment, such as the patient's clinical presentation and performance status. These more complex clinical assessments may involve a greater interactive component for the clinician in the conduct of his or her work than has been previously appreciated. It is suggested that issues remain in the need for people to see one another in the execution of their work tasks and while this study agrees that the absolute importance of video is difficult to quantify, these data reveal an underlying necessity for face-to-face views during PCDs in teleconference.

These results are interpreted to mean 1) it is critically important to have radiology and pathology available to the MDTM, 2) it is important to be able to see radiology, pathology images and remote people, regardless of the stage of case discussion. 3) when discussing radiology MDT members want to see the clinicians with whom they are in discussion, 4) when discussing a patient with a clinician, they gain benefit from having images on display, 5) people in a case discussion across a teleconference link wish to have visual access to the environment across the interface which includes seeing anyone who may be sitting in on the discussion (observing) and 6) there is a remaining unidentified factor, probably related to face-to-face view and audio quality, that is limiting ease of speech interaction across the teleconference interface. In other words, discussion across the teleconference interface is difficult and there is an element in that interaction that is not being fully supported by the existing technology.

These findings make a strong case for the use of multiple displays at an MDTM in teleconference.

6.4.1 The meeting record

The development of an acceptable meeting record is complex. Although no-one disagreed with having a record, the form that a record might take is not clear from the results. Almost all MDT members would want to record the radiology, pathology and clinical findings discussed. A small percentage did not see a need for the patient management decision to be recorded. This view is a reflection of the changing nature of the MDTM in patient management. Historically, an individual clinician was independent in their patient management approach, and while he, or she, might have sought advice from colleagues, the final decision was theirs alone. Over the years, a change has been evolving, with an individual clinician acting as an 'instrument' of a team, and it is the team

who hold responsibility for the decision. It can be expected that this transition from individual clinician responsibility to shared responsibility will become more established in the future. At this time, individual clinician responsibility still holds, but the decision of the MDTM is considered superior to the individual decision. In the event of an individual clinician choosing a course of action, other than that agreed at the MDTM, the clinician would be expected to justify their action.

There was some interest expressed in having a record of any DVDs or videos discussed, and much less interest in recording clinical sounds. More people seemed open to the idea of having a live video recording of the proceedings, but levels of disagreement increased when participants were asked their views on having recordings of still images, selected items and conversation only. Concerns were expressed that a recording might result in the meeting being less relaxed and members might not participate so freely in discussion. However, it is acknowledged among the group that given the growth in importance of the MDTM discussion a more appropriate record will be needed in the future.

While these results demonstrate a need for an MDTM record, the requirements for an electronic MDTM record will need further investigation.

Chapter 7

MDTM scale and timing

Up to now the MDTM has been described in the context of the overall patient management. It is a *system* that delivers services, and in delivering those services, helps to make the overall patient management process more dependable and build *trust*. Within the MDTM event, the unit of work is the Patient Case Discussion (PCD) and it is through this discussion that the MDTM services are delivered. Within healthcare, the drive has always been to provide patient-centered services, and all hospital work processes are designed with this goal in mind. However, the design of systems to support individual patient-centered services needs to be mindful of the impact of *volume* of patients on structures and resources and the effect of *scale* in the implementation of MDTMs into routine practice.

In this chapter, the effect of the restructuring the work-flow to incorporate multiple MDTMs will be considered in detail from the perspectives of those departments that are the main providers of services *to* the MDTM, namely pathology and radiology. Radiology and pathology contribute to all multi-disciplinary teams (of the kind described in this study). The development of multidisciplinary teams and meetings (MDTMs) is a burgeoning area for radiology and pathology that increasingly impacts on work processes in both of these departments. An examination of the MDTM preparation from the perspectives of the radiology and pathology departments is reported in this chapter.

The aim of the study reported here was to examine work processes and quantify the time demands on radiologists and pathologists associated with MDTM practices at a large teaching hospital (Centre A). The study of time is one that spans many fields and perspectives. The temporal perspective here is concerned with the temporal patterns of MDT work, scheduling of MDTMs and the effect of increase in scale of MDTMs impacts the temporal rhythms in other parts of the work system. The observations reported here reflect a general trend affecting hospitals and the conclusions will have relevance for others implementing clinical practice guidelines.

For one month, all work related to clinical meetings between pathology and radiology with

clinical staff was documented and later analysed.

The number of meetings to which pathology and radiology contribute at a large university teaching hospital, ranges from 2 to 8 per day, excluding Grand Rounds, and amounts to approximately 50 meetings per month for each department. For one month, it was found that over 300 hours were spent by pathologists and radiologists on 81 meetings where almost 1000 patients were discussed. For each 'meeting hour' there were, on average, 2.4 pathology hours and 2 radiology hours spent in preparation. 2 to 3 meetings per week are conducted over a teleconferencing link. The average meeting time is 1 hour. Preparation time per meeting ranges from 0.3 to 6 hours for pathology, and 0.5 to 4 hours for radiology. The review process in preparation for meetings was found to improve internal quality standards. Materials produced externally (imaging, for example) can amount to almost 50% of the material to be reviewed on a single patient. The number of meetings per month has increased by over 50% between 2003 and 2005. Further increase is expected in both the number and duration of meetings, when scheduling issues are resolved. A changing trend in the management of referred patients with the development of MDTMs and the introduction of teleconferencing is noted.

There are difficulties being experienced by pathology and radiology departments participating fully in several multidisciplinary teams. Time spent at meetings, and in preparation for MDTMs, is significant. Issues of timing and the co-ordination of materials to be reviewed are sometimes irreconcilable. The exchange of patient materials with outside institutions is a cause for concern when full data are not made available. The process of preparation for meetings is having a positive influence on quality, but added resources are needed in pathology and radiology to to participate fully in multiple teams and realise the full benefits of multidisciplinary team working.

7.1 Background

Pathologists and radiologists are important contributors to multidisciplinary teams (Fleissig et al. 2006), and the role of these two specialists is different from other multidisciplinary team participants in that they often belong to several groups and actively contribute in many MDTMs. Radiology and pathology, with respect to their work organization and input to meetings, have more similarities than differences. Here, the work associated with MDTMs (and clinical pathology or radiology meetings) is examined and emerging issues are identified in relation to time, scheduling (Bauman, Winqiust & Chin 2005, Delaney et al. 2004) and pre-meeting work that the development of such meetings has on radiology and pathology departments. Senior staff in radiology and pathology now spend almost 20% of their time either in preparation for, or participating in, meetings with clinical staff.

Reddy, Dourish & Pratt (2006) noted that people in organizational settings use their knowledge of temporal features to plan and co-ordinate their work activities and that a lot of co-operative

activity, from conversational turn-taking to project planning, is dictated by the temporal organization of the world. In a similar way, the timing of the MDTM dictates how an MDT member plans and conducts his/ her work, especially the pre-MDTM tasks on which the MDTM depends to successfully conduct its business. In describing time as a socially structured resource and group processes as complex systems with temporal patterns, Arrow et al. (2004) notes that most work on the temporal perspective tends to assume a single, shared perception of time by all group members. An examination of a single MDT (such as the respiratory MDT) with its range of specialists, with separate routines and diverse work patterns, would reveal a variety of perspectives within that single team. However, this study takes a slightly different approach to others by examining how a small number of specialists maintain membership within many MDTs and the pressure this places on their time resources. For the roles with significant pre-MDTM tasks, such as the radiologist and pathologist, work is performed within strict deadlines. For the roles whose tasks are predominantly post-MDTM, a different set of rhythms are invoked that are not so time dependent. Temporal patterns of decision-making, such as at the MDTM, have been identified to improve the quality of the decision and adapting activity patterns to match the task and contextual demands is considered essential to effective group performance (Arrow et al. 2004). The *scale* of MDT working becomes an issue, as individual specialists form groups and involve other specialists. The complexity of large scale rhythms gives rise to a matrix of networks in which connections between members, information, tools and physical space are being constantly established, and modified, rhythmically over time. As the trend for more MDTMs continues to rise, scale of MDTM working with multiple groups becomes an issue that needs attention.

Some of the demands for more MDTMs are attributed to developments in teleconferencing technology which has facilitated change in service structures and the geographical extension of multidisciplinary teams (Jack 2005). Consultations are taking place through MDTMs, patient care pathways are being tailored and treatment is being co-ordinated through case discussions. A change in patient referral patterns is noted here, (illustrated in Chapter 4, Figure 4.4, page 71), both because of the availability of the meetings and the interactions via teleconferencing. In other words, the patient case is being discussed at an earlier point in the patient care pathway, than it otherwise would occur. This trend is expected to continue as the practice of having MDTMs becomes more popular and external links via teleconferencing become more established.

While this study is confined to one hospital, a 963 bed facility where over 2,000 new cancers are treated every year, these results will have significance for others, particularly tertiary referral centres and teaching hospitals, who are predicted to experience similar changes. Although the demand for meetings has been growing over recent years, the issues surrounding MDTMs for service departments such as radiology and pathology have not been formally articulated nor quantified until now. The demand for meetings continues to grow and requests are on-going for new MDTMs, more lengthy MDTMs and more in-depth discussion on a larger number of patients. But for the

full benefits of MDTMs to be achieved, improved solutions are needed to overcome the experienced difficulties documented in this study.

7.2 Local practice

It was noted in the Introduction, Section 1.3, that terminology for meetings between radiology, pathology and clinical teams varies. The term multi-disciplinary team meeting (MDTMs) is used for meetings to which both pathology and radiology contribute and at which physicians, surgeons, radiation and clinical oncologists, at minimum, have input. Clinical-pathology and clinical-radiology conferences (CPC and CRC) are held between clinical teams and pathology and radiology staff respectively. Internal departmental processes are the same for MDTMs and CPCs or CRCs.

As part of good practice policy, radiology images (Board of the Faculty of Clinical Radiology 2005), biological material and all reports are reviewed prior to discussion at MDTMs. This review is important in quality management and serves as a system check for the MDTM and within the individual departments (radiology and pathology) involved. It was noted in Chapter 4, Section 4.2.3, that meetings serve an educational role as well as having organizational and patient management functions, so preparation of MDTM material will keep potential teaching points in mind that can be shown at the meeting. The preparation also serves a education function within the respective departments for radiologists and pathologists in training.

It was already explained in Chapter 4 that for all meetings, a list of patients to be discussed is notified, in advance, to team members. Patient samples and images are located (if not on the Picture Archiving and Communications System), along with reports, for review by radiologists and pathologists, prior to the meeting. Any patients who have had radiological imaging, or tissue sampling performed elsewhere will have those items reviewed in conjunction with any current materials.

7.3 Method

Meeting agendas and notes, radiological images and pathology samples used at meetings were examined. Internal pathology department records for 2003 enabled comparison with November 2005 data for pathology. Semi-structured interviews were conducted with consultant and non-consultant medical staff, nurses, technical and support staff.

Meeting preparation work by medical staff was self-reported. Senior radiology and pathology staff were asked to prospectively note the time they spent on meeting preparation for the month of November 2005. At the end of that month, the time spent was reported in interview. Figures quoted here are agreed averages and take account of the mixture of cases one would expect to encounter (biopsies, resections, type of image sets and repeat review) for an average meeting.

Technical and administration work estimations are not fully quantified. The focus was on the time spent by senior medical staff in radiology and pathology, i.e. at specialist registrar and consultant level.

Special focus was given to the month of November 2005, a 30 day month with 22 working days (Monday through Friday). The numbers and types of meetings held, the patients discussed, the radiological images used and pathology samples reviewed were counted. November, 2005, was a typical working month and gives a representative view of MDTMs at St. James's hospital. Grand rounds and internal meetings, as part of post-graduate specialist training were excluded.

The patient cases discussed at the selection of meetings involving radiology and pathology (Table 7.1) were also examined to measure the frequency of cases being discussed within the same type of MDTM and across different MDTMs for the period under study. For a sample of the MDTMs in November 2005 a more detailed examination was conducted, to quantify the pathology specimens and radiological images reviewed that were the product of procedures performed elsewhere. Patient referral patterns were noted.

7.4 Results

Table 7.1 is an overview of the meeting schedule, the preparation involved and the mean numbers of patients discussed. The table includes all MDTMs, CPCs and CRCs. There are 6 meetings scheduled per week that involve both radiology and pathology together (MDTMs). There are an additional 8 CRCs and 7 CPCs per week. There are also twice monthly, monthly and other less frequent meetings. Table 7.1 summarises the meeting schedule and those held in November 2005. A total of 94 meetings were scheduled and 81 were held that took 75.5 hours of time. 8 CRCs, 2CPCs and 2 MDTMs were cancelled due to unavailability of key personnel and one MDTM was cancelled because the late notification of the agenda did not allow time for meeting preparation. Pathology was represented at 55 meetings that lasted a total of 57.75 hours while radiology was represented at 52 meetings that took 42.5 hours in total for the month under study. Table 7.2 summarises the hours spent in preparation and at meetings during the month of November 2005. Reported values take account of situations where images or samples might be quickly reviewed, may not be relevant to the discussion tabled, and will not be presented to the meeting.

At least one consultant radiologist and pathologist always attends an MDTM, and often two are designated members of a single multidisciplinary team (and two regularly attend). Pathologists and radiologists in-training regularly attend MDTMs for educational benefit. An individual radiologist or pathologist can expect to spend a half day a week attending MDTMs and another half day, at least, in preparation for meetings.

Meetings held with either radiology or pathology, (CRCs and CPCs), represent situations where either a) radiology or pathology serve more important clinical needs, or b) there is a high volume

Table 7.1: Meeting schedule overview.

Day	Description	Time	Duration (Hrs Nov)	Preparation (Hours) Pathology	Radiology	Mean No. cases
Mon	Respiratory	800	2 x4	6	2	22.25
Mon	Gynaecology	800	1 x4	5	2	9
Mon	Hepatology CRC	1300	1 x4	-	0	cancelled
Tues	Breast	800	1 x5	3	1	14
Tues	Dermatology CPC	1245	1 x4	2.5	-	7
Tues	Haematopathology CPC	1400	1 x5	2	-	9.6
Wed	Haematology CRC	800	.5 x5	-	2	8
Wed	GI[1] CRC	830	.75 x5	-	3	15
Wed	Hepatology CPC	1300	1 x5	0.33	-	6.2
Wed	CMD[2] CPC	1400	1 x5	1	-	27.4
Wed	Oncology CPC	1600	1 x5	1	-	3.5
Thurs	HNT[3] CRC	715	.75 x2	-	1	8
Thurs	HNT CPC	745	1 x2	3.5	-	15
Thurs	GI oncology	730	.75x3	3.5	2	6.7
Thurs	Lymphoma	815	.75 x4	2	1	5.5
Thurs	Gerontology CRC	830	.75 x4	-	1	10
Thurs	Rheumatology CRC	915	.75 x4	-	0.5	10
Thurs	Medical GI CPC	1315	1 x4	2	-	8
Thurs	Med Oncology CRC	1330	.75 x4	-	4	15
Fri	Urology	915	.75 x2	2.5	1	4.5
Fri	Neurology CRC	1300	1 x4	-	0	cancelled
2wkly	Skin cancer CPC	1415	1	2.5	-	47
Mthly	Oral med./surgery CPC	1300	1	3.5	-	10
Mthly	Renal pathology CPC	0800	1	0	-	cancelled
Mthly	Infectious Disease CRC	1400	1	-	1	9
Mthly	Death Conference	0800	1	3.5	1	2
Qrtly	Endocrinology CRC	1230	1	-	0	not due Nov
Occsnl	Maxillo-Facial CPC	1400	1	1.5	-	7
	Total November '05 hours		83.5	140.15	84	914.2

Table 7.2: Time spent at, and in preparation for, meetings during one month

Department	Meeting Time per month	Average Preparation Time per hour meeting	Total hours per month
Radiology	42.5	2.0	126.5
Pathology	57.75	2.4	197.9

of work with limited discussion time, or c) there is no time within the schedules for the people involved to be in the same place at the same time. As examples: in vascular surgery, imaging is of key importance and pathology is not so significant; dermatologists rely heavily on pathology but do not have a great need for radiology. Dermatology hold two meetings: a weekly meeting to review non-cancer pathology and a second, twice monthly, to deal with skin cancer. For Head, Neck and Thyroid (HNT), it was not possible to find a time for everyone to meet together, so the HNT specialists met with radiology and pathology on alternate weeks (which was less than satisfactory). Since mid-2006, the HNT group have agreed a half-hour week on Monday mornings at 0730 (ahead of the respiratory team).

7.5 The pre-meeting review

All images and tissue samples are reviewed prior to discussion at meetings, separately and independently of the main work process, regardless of whether the materials were produced internally or externally to the hospital. This review applies for all meetings; it is ancillary and complimentary to the original work of making the primary diagnosis (Board of the Faculty of Clinical Radiology 2005). In the review, the primary diagnosis is confirmed and refined if necessary. Table 7.2, shows Time spent at, and in preparation for, meetings during the month of November 2005.

The review of external work serves as a check on the original report, both for opinion differences and expression. For radiology the full image set is rarely available. For pathology, slides and processed tissue are received from referring institutions.

The internal review serves an internal quality assurance function within pathology and radiology. The material to be discussed is reviewed by the consultant, often in association with a registrar, and material for presentation is selected and prepared. Typically, the person reviewing the specimen for discussion is not the same person who undertook the initial examination within the main work process. Discrepancies in reports will be discussed within the department in the first instance and a revised, or amended, report may be issued in the light of those discussions. Practice differs in radiology and pathology with regard to the issue of contradictory reports, particularly in the absence of full image sets, and a formal policy remains to be agreed and established.

The issues of internal quality assurance for radiology and pathology will not be further covered here. It is sufficient to note that the practice of a second review of materials is a recognised method

of improving quality in work processes (The ASC Executive Board 2000). For November 2005, the pathology department reviewed tissue samples on 628 patient cases. This represents almost 47% of the total caseload for that month. While an exact figure is not available for radiology for November 2005, the radiology department performs approximately 10 CT thorax scans per week, and reviews approximately 25 CT thorax scans for a Monday morning respiratory meeting. Approximately 2,200 imaging studies are performed each week and it is conservatively estimated that between 10 to 15% of the radiology workload is reviewed in preparation for MDTMs.

7.6 Workload

The workload for senior medical staff, associated with attendance, preparation and review of materials pre-MDTMs, is given in Table 7.1. In addition to the medical staff workload, administrative and technical staff are also involved in preparation for meetings. Four clerical staff were appointed in March 2005, to co-ordinate the pre-meeting work associated with MDTMs, (circulate agendas, locate radiological images and pathology slides) and take notes at the meetings. The MDT Co-ordinators, also liaise with outside agencies to exchange images and pathology material for review at the meetings. In addition, administrative staff in radiology and pathology are involved in meeting preparation and in the receipt and packaging of material for the postal services.

Approximately 4 minutes of pathology clerical time is used when an in-house patient case is notified for discussion at a forthcoming MDTM. When outside material is sent for review, an additional 10 minutes is spent opening the package and logging receipt, and packaging for return later by post. Additional technical time is not always associated with MDTMs, but when external tissue is sent for review, additional tissue sections are often required and extra special stains may be performed, mostly immunohistochemical methods. For November 2005, 55 external pathology cases were reviewed for MDTMs, of which 21 had special techniques applied. Overall approximately 15 minutes administrative work in pathology is associated with each internal patient to be discussed at a meeting. (The time will be longer if histological slides have to be retrieved from old archives.) In radiology, considerable time may be spent searching for images, if the image is not available on the recently installed PACS, or if images need to be retrieved from outside institutions.

7.7 Meeting times and places

Similar to others (Macaskill et al. 2006, Bradley, Zutshi & Nutting 2005), with 5 exceptions (out of 28), all of the meetings are held early morning or at lunch-time. Figure 7.1 shows the timing of the MDTMs for November 2005. For most MDTMs the scheduled meeting duration is one hour, but meetings frequently run over time. Because of the high demand for meetings to be held between 0730 and 0900, some groups have agreed to curtail their discussion to accommodate another group.

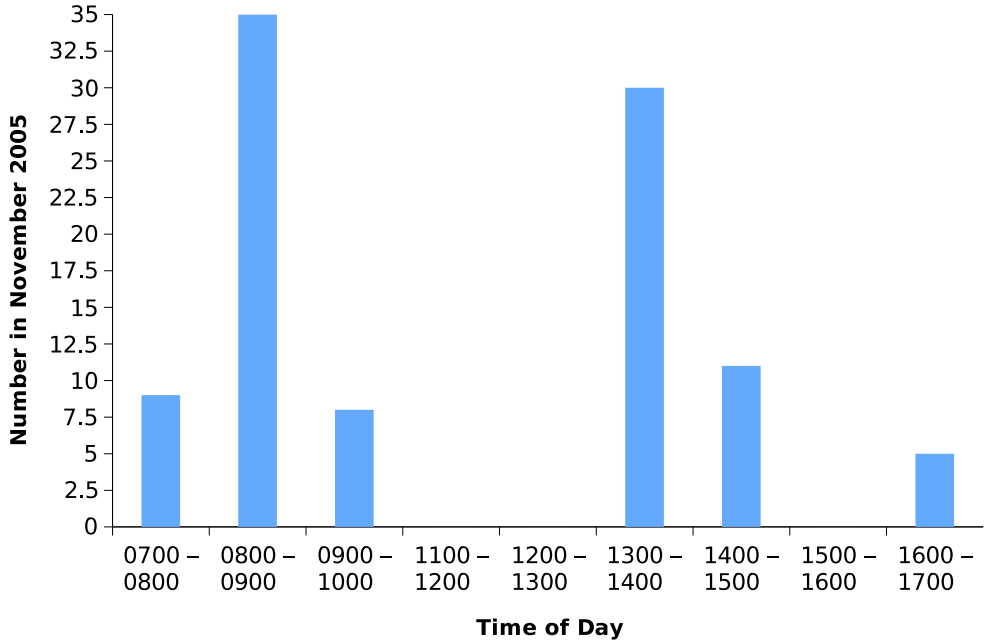


Figure 7.1: Timing of Multi-disciplinary meetings

With two exceptions meetings are held on-site. Three meeting rooms are used, one of which is equipped with the Telesynergy® teleconferencing workstation. Out of the 6 MDTMs held each week, with both radiology and pathology present together, there are three teleconferencing links to remote hospitals using the Telesynergy® workstation. The GI MDTM link weekly with Centre B in the midlands. At the time of collection of these data, the respiratory MDTMs linked to Centre B and Centre C concurrently, twice monthly, while the lymphoma MDTMs link with two hospitals (one of which is Centre B), one at a time, over successive weeks, on a once monthly basis for each remote hospital.

The co-ordination of individual schedules, out-patient clinics and theatre sessions for all of the individuals involved in a MDTMs requires high levels of co-operation and sometimes it is not logistically possible to reconcile all the schedules involved. Several specialist appointments are contracted over multiple hospitals and for a meeting to be arranged, schedules must be co-ordinated over the several hospitals and many teams affected.

Teleconferencing to some distant hospitals was initiated over 2004 and 2005. For November 2005, there were 10 hours of MDTMs conducted with a teleconference link involving 3 other hospitals. It is anticipated that the amount of meetings held over teleconferencing links will increase, both in the frequency and duration for existing associations, and as teamworking develops over multiple sites.

Table 7.3: The Development of Pathology meetings from 2003 to 2005

	2003		2005		Overall
	All	Teleconference	All	Teleconference	Increase
No of hours per week	9	0	13.5	8	50%
No of cases per month	426	0	628	5.5	47.4%

Table 7.4: Analysis of the number of patient cases, pathology samples and radiological images at a sample of MDTMs

Meeting ID	Patient cases	Patients with Imaging	Total studies	External studies	Patients with Pathology	No. Pathology specimens	External Pathology
A	4	3	6	3	1	1	0
B	14	8	8	5	13	42	6
C	10	8	13	3	9	35	0
D	9	8	8	4	6	14	1
E	4	3	5	1	3	3	0
F	5	3	7	4	4	4	0
G	4	2	3	1	2	4	0
H	5	4	8	7	5	9	7
I	5	5	12	4	5	8	6
J	7	6	11	6	6	9	4
Mean	6.7	5	8.1	3.8	5.4	12.9	2.4

7.8 The growth in demand for meetings

The number and frequency of MDTMs is increasing. Between 2003 and 2005, 4 new MDTMs were initiated and others increased in frequency. Since 2003, there has been an increase of 50% in the amount of time spent at meetings (from 9 to 13.5 hours per week) and a resultant 47% increase in the number of patient cases discussed (from 426 to 626) (Table 7.3). More meetings are in the planning stages. The advent of teleconferencing has also developed the MDT services over wider geographical areas, from Dublin to Mullingar and Tullamore in the midlands, and to Letterkenny in the North-West. Meetings held in teleconference have increased from zero in 2003 to 2 (of the 13.5 hours) per week in November 2005.

It is expected that this trend for increased frequency and duration of meetings will continue, more meetings can be expected to be held in teleconference, and more patients will be managed through MDTMs in the future.

7.9 Patients, images and tissues

Analysis of a subset of meetings is summarised in Table 7.4. This representative sample of MDTMs held in November 2005 excludes meetings held in teleconference and accounts for 40% of the MDTMs held that month. The aim was to quantify details on the items discussed at the MDTMs, i.e. the number of patient cases who had radiological imaging or pathology samples for discussion; the number of radiology or pathology items for review and the number of those items that were the result of procedures performed at outside institutions.

The number of patients discussed, and the number of radiology images and pathology samples can vary widely between meetings. Table 7.4 gives detail on a set of typical MDTMs (that don't involve a teleconference link) and Table 7.5 gives the average ratio of image studies per patient.

The number of image studies and tissue samples per patient will depend on the disease, its duration and complexity. In radiology, for example respiratory patients typically have chest radiographs, CT and PET scans, while most patients with breast lesions have mammograms and ultrasounds only. In agreement with other reports (Strickland 2000, Langlotz et al. 1995) it was found that radiology films are regularly unavailable for discussion at meetings. Some hospitals report as much as 20% of images are missing when required (Strickland 2000). For pathology, a distinction has not been made between pathology biopsies and large resection specimens, but meetings with large resection specimens for discussion involve more pathology preparation. Digital pictures are taken at gross dissection, as well as photomicrographs of stained sections, as part of the pathology pre-meeting preparation.

Table 7.5: Analysis of the ratio of specimens per patient and the proportion of externally produced material

	Proportion of Patient cases with radiology / pathology	Ratio of patients: specimens / images for examination	Proportion of externally produced material
Radiology	0.75	1.62	47%
Pathology	0.81	2.39	19%

The proportion of patients with radiology and the proportion with pathology specimens is given in detail in Table 7.4. The number of specimens (or image sets) to be reviewed per patient case and the amount of externally produced materials is shown for each discipline. Figures were compiled from a representative (40%) sample of MDTMs held in November 2005 and exclude meetings held in teleconference.

Tables 7.4 and 7.5 also shows how almost half of all the images, and approximately 20% of all pathology samples reviewed were from outside institutions. The figure for radiology images would have been much higher than 47% if all images had been available for discussion. The cases represented in Table 7.4 were current patients of St. James's who underwent some investigative procedures elsewhere prior to referral. When conducting this review summarised in Table 7.4, instances were noted of patient imaging and pathology being reviewed in advance of the patient being examined by the clinical specialists in St. James's (i.e. on receipt of the referral letter). This issue was highlighted in Chapter 4, Figure 4.4.5. These discussions assisted in the prioritisation of a patient procedure or appointment at an out-patient clinic.

For patients from other hospitals, being discussed in teleconference, all the imaging and pathology sampling is performed by others and is reviewed at St. James's prior to the teleconference discussion. Discussion on remote hospital cases in teleconference sometimes resulted in patients not being transferred to St. James's for further assessment (which would have happened if there had not been a meeting). Teleconference case discussions also directed the patient towards the most appropriate clinician for review or treatment.

A patient may be discussed at more than one type of meeting or at a number of meetings. For example, a patient presenting for urological investigations may have an incidental lung lesion on imaging and will be investigated as part of the disease staging process to determine if the lesion is a primary lung or secondary renal cell cancer. If the lung lesion is determined as a primary lung cancer, or isolated secondary, consultation will take place through the respiratory MDTM and a decision agreed on how best

to proceed in the circumstances. Or lymphomas diagnosed through other MDTMs may be considered more appropriately managed through the lymphoma MDTM.

Patients may also be discussed at more than one meeting of the same type. It was explained in Chapter 4 that it is normal practice for patients to be 'TNM staged' and managed through MDTMs. If the patient is discussed on initial diagnosis and it is decided to proceed to surgery, the patient will be presented again to the meeting following the procedure, to review the pathology, imaging (if appropriate) and decide on the next step in management.

It was of interest to know if the same patients were being discussed and how many patients had multiple PCDs within the month. So, records were examined to determine on how many patients there were multiple discussions. These results represent typical working in a large teaching hospital. There were 3 gynaecology and 8 respiratory patients discussed twice at their respective MDTMs. A single patient was referred from the GI MDTM to the respiratory MDTM being held 4 days later, and thus was discussed among two different teams (GI and respiratory). For lymphoma, urology and gastro-intestinal (GI) MDTMs, *no* patient was discussed on more than one occasion. For breast patients it is normal practice to discuss 'clinic' cases (from the lump assessment clinic) and 'histology cases' at breast MDTMs. Histology cases are those referred for surgery from the assessment clinic service and have been scheduled for review following their resection. There were 68 case discussions in November, representing 53 women, 15 of whom were reassessed following lump resection. For the respiratory meetings, there were 87 patient case discussions in November 2005 on 79 patients. 8 patients were discussed at two meetings and one patient was discussed three times. There was one example of a patient being placed on the agenda but the discussion was deferred until the following week. Of these 87 patients, 55 were 'new' in-house cases and a further 10 were from outside institutions.

The situations that necessitated more than one discussion at the respiratory meeting were as follows:

- Repeat bronchoscopy was needed x1.
- Histology unclear, more work in progress. Full path result awaited. x1
- Needs PET and biopsy result x1
- PET scan needed and review x3
- Unclear pathology, needs U/S guided biopsy x1
- Unclear pathology, needs surgical biopsy x1

Thus, approximately 10% of case discussions for respiratory and breast are repeat review discussions within the same month. Review time is not the same for all cases, depending on specimen type (biopsy or complex resection), or the number and type of image sets to be examined. Times given for MDTM preparation takes these variations into account.

7.10 Discussion

The continuing demand for the review of pathology and radiology findings at meetings is a testament to the perceived value and success of such reviews. One of the experienced benefits of MDTMs is the opportunity for clinicians, radiologists and pathologists to meet together and build common ground with

respect to terminology and expression in formal reports. Communication has improved between radiologists, pathologists and clinicians, both in the provision of pertinent information to radiology and pathology at the time of request and the provision of formal reports from radiology and pathology whose meaning is clear to clinicians. Furthermore, technological developments in radiology and pathology makes the choice of investigation and the interpretation of results more complex than in the past, so the meetings serve as an important opportunity for updating professional knowledge and continuing professional development. Table 7.6 summarises the benefits and challenges identified with current meeting practices.

Table 7.6: Summary of key benefits and challenges associated with MDTMs

Benefits	**Challenges**
Clinical, Pathology, Radiology Correlation	Scheduling
Refinement of pathology or radiology report	Timing
Definitive diagnosis, disease stage established	Duration
Improved decision-making	Resources
Co-ordination of patient management	Contractual arrangements
Interprofessional communication	Co-ordinating materials
Feedback and peer review	Pre-meeting review
Local policy development	Reviewing partial images
Preparation improves Radiology and Pathology QA	from outside institutions
Data collection for audit	Formal reporting on
Education	reviewed material
Peer review	Follow-up on assigned tasks
Collective autonomy	Individual responsibilities

Four important issues emerge in fulfilling the demand being placed on pathology and radiology departments: (1) time spent at meetings, (2) timing and co-ordination of meetings, (3) time spent in preparation for meetings, including review and the retrieval of slides, reports and images and (4) review of externally produced images and tissue material.

7.11 Time and resources

The work associated with being part of a multidisciplinary team is a significant workprocess that has emerged within pathology and radiology departments and has not been clearly identified up to now. There is an accepted belief that MDTMs are an improvement in the patient diagnosis and management process and integral to quality systems within the hospital.

The demand for meetings has increased since 2003 and is likely to increase, given the recommendations of professional and regulatory organizations to include multidisciplinary team working in patient practice management protocols. At this time at least two additional meetings are in the planning stage and more have been requested (such as a monthly T.B. meeting). The number of meetings reported here would be greater if requests by clinical staff had been facilitated, and are more than the numbers of meetings reported by others (Wong & Birks 2004). Currently several groups curtail their MDTM time because of time pressure in schedules. Several groups have requested that more time be made available and there is a felt need among many that more patients should be discussed in more depth. However, time constraints have dictated that discussion is highly structured and the number of cases is maintained at current levels.

The practice of producing digital image presentations of pathology material is growing in popularity.

While it adds time to preparation for pathology, valuable time is saved at the actual meeting (i.e. loading the correct slide, locating and focussing the feature to demonstrate).

7.12 MDTMs, times and places

Each multidisciplinary team wishes to schedule meetings with radiology and pathology to suit their routines. For radiology and pathology it is a problem to satisfy multiple teams within a narrow timeframe. Figure 7.1 demonstrates that teams find that the only time that they can meet together is early morning or at lunchtime, outside of the 'normal' routine, because individuals within the team have clinics or theatres scheduled during the 9 to 5 periods and the only time when all members are free is outside of their 9 to 5 routines.

As well as the difficulties of co-ordination and co-operation within St. James's challenges are experienced in managing multidisciplinary team working across several hospitals. Some specialists serve more than one hospital. For example, the cardio-thoracic surgeons are contracted to two hospitals and are members of a multidisciplinary team at each hospital; the schedule in one hospital impacts on the other. For one change to be made, in an out-patient clinic for example, there will be significant impact on many schedules, in different hospitals. Sometimes it is not possible to build schedules to suit the many people and systems affected.

The development of directorate structures, noted in Chapter 2, Section 2.4, has helped group some services, and in scheduling related activities. But pathology and radiology contribute to every team and need to find better ways to work within clinical teams. With developments in imaging modalities and molecular techniques and the capabilities for image-guided tissue sampling, pathology and radiology are co-ordinating more in service development and now occupy a more central role in clinical service delivery.

A further development, since 2003, is the advance in teleconferencing technology which has facilitated the extension of multidisciplinary team working to distant hospitals where the full range of expertise is not available. Co-ordinating schedules for MDTMs in teleconference to synchronise with external institution schedules is an additional challenge. Furthermore, the co-ordination of sending, receiving and reviewing radiology and pathology before teleconference discussions is proving more difficult than anticipated and requires dedicated resources. While teleconferencing technology has facilitated development of some multidisciplinary team services, it has not resolved the problem of synchronous communication between multiple groups with different agendas. Indeed technology, such as teleconferencing, may have increased expectations as to the ease at which specialist services can potentially be delivered and brought additional pressures on staff at specialist (and general) centres that were not anticipated.

7.13 MDTM preparation

While the preparation time overlaps with the internal quality assurance process, it can be difficult to accommodate both the main workflows and the meeting preparation workflow in parallel in the normal working day. Like other reported experience (Raab et al. 2006), discrepancies in reporting of material from outside a large teaching centre justifies the review of all externally produced images and tissue samples. Although a large proportion of the review work is conducted in early morning and late evening,

routine processes can be impacted. As well as registrars-in-training and consultant staff being affected, the administrative work associated with meetings is usually underestimated.

There may be multiple pathologies in a patient and for some patients situations change and they need to be discussed again. Figures here suggest that overall over 30% of patients can be expected to reappear at one conference, (e.g. sequential breast) and $< 1\%$ are discussed at different conferences (e.g. respiratory and GI). Repeat reviews frequently focus on a limited aspect of the case, possibly omitting either radiology or pathology, and thus may take a fraction of the time for a first review. (Figures quoted in Table 7.1 take repeat reviews into account.)

The pre-meeting co-ordination of radiological images and pathology samples takes considerably more time when multiple hospitals are involved than for co-located meetings. Staff at both hospitals need to liaise so that the correct materials are sent and received on time, to facilitate review by the radiologist and pathologist before the MDTM. These items from outside hospitals must be separated from in-house material and returned to source after the meeting.

Both the radiology and pathology departments have cut-off times for requests to review material prior to a discussion on a sample. This means that the objects for discussion must be physically located and brought to the pathology and radiology departments before that deadline. While this may sound straightforward, the location of radiology images and pathology samples from files can be time consuming. Images, in particular, are renowned for being misfiled, missing or simply unavailable. The introduction of Picture Archiving and Communications Systems (PACS) alleviates this problem but other issues emerged with the exchange of images that are discussed later.

7.14 External production of images and tissue material

Some issues arise with respect to the review of external images and tissue material that deserve consideration. Firstly, these data are highlighting changing trends in patient diagnostic pathways. It is proving a challenge to develop systems that co-ordinate the exchange and review of materials within the current schedules. Some patients have imaging done elsewhere while waiting for appointments and some patients may be managed without a need to attend St. James's because of discussion at a meeting. Both the existence of the meeting and teleconferencing are influencing these changing work practices. It was noted in Chapter 4 that on occasions, patient cases are discussed prior to their attendance, following review of radiology and pathology performed elsewhere. If the review and discussion is satisfactory, the patient may not need to attend at all.

Secondly, the exchange of pathology material and radiology images from different centres can cause MDTM system errors and two types of originating faults are noted here: a) the processing protocol faults, b) lack of interoperable standards and protocols and the potential vulnerability introduced through c) missing or unavailable materials.

a) Protocols often differ between hospitals for processing tissue in pathology and capturing radiology images from scanners, which may make interpretation of the resulting material difficult or unsatisfactory. The lack of standardisation of image production and tissue sections can result in less than optimal results (interpretations) within radiology and pathology. The exchange of radiology image sets is less satisfactory

than having full scan data available for review. Analogous to slicing bread, if the slices are too thick, valuable material can be lost in-between the slices.

b) As well as the loss of information, local protocols and equipment settings may produce images that differ; and lack of inter-laboratory standardisation of laboratory staining can cause some discrepancies in interpretation and pathology reporting. Despite the limitations, there is an ultimate benefit to the patient because of the discussion at the MDTM and often those materials are all that are available.

c) The third issue is the logistics of exchange and sharing of externally produced material. The review of patient images is greatly facilitated with the introduction of a PACS. However, there remain significant logistical problems associated with the exchange of patient images from outside institutions in the absence of a suitable infrastructure. Radiological images saved and sent on CD or DVD to another hospital may be unreadable, unless both hospitals used compatible software for saving image data. With an increasingly mobile population, this problem of incompatibility and the inability to share patient images has become more frequent and is now a cause for concern. The implementation of PACS in an individual hospital will still limit the full transfer of image data, when patients are being transferred to specialist centres or the patient is being discussed in teleconference. Ideally, PACS implementation, with agreed imaging protocols, and suitable networks would be available. In the absence of a suitable network, images between hospitals will still be managed through exchange of printed film and images on disk, which constitutes a real threat to dependability. Exchange and sharing of tissue and cell samples are likely to remain an issue into the medium-term future.

7.15 Recommendations

It is generally understood that co-ordination mechanisms in organizations add cost, over purely functional structures (Hatch 1997) and that complexity, uncertainty and interdependence of work, places additional information processing demands to co-ordinate activities (Galbraith 1973). MDTMs serve to co-ordinate the interdependent work involved in patient diagnosis and management and can be expected to incur an additional resource cost to realise their potential benefits. Additional radiologist and pathologist staff are required to fully service the needs of MDTMs at current levels. As well as radiologist and pathologist support, additional support is needed for co-ordination of materials and follow-up on administrative tasks assigned at meetings. Four co-ordinators currently administer the 7 weekly meetings listed in Table 7.1, that involve both pathology and radiology. Ideally, the role would be developed and there would be a designated co-ordinator for each meeting.

Many of the problems currently being faced in implementing MDTMs as part of good practice would be alleviated through the addition of additional resources. However, resources alone will not remedy issues of timing, and co-ordination; nor problems associated with different imaging protocols and incompatible software systems. High levels of co-operation will be needed between departments and hospitals to facilitate work schedules. Scheduling of theatre sessions, for example, will impact on pathology workflow and affect meeting schedules. Enough time must have lapsed between surgical removal of a specimen and the meeting to allow time for tissue processing and review. The lack of imaging protocols and compatible standards to support portability is an issue that might be best addressed by the development of agreed standards

through representative and professional bodies.

7.16 Conclusion

Pressures of timing and coordination, in particular, are identified as challenges to MDTM dependability. The synchronisation of work schedules for team members, with the temporal structures needed for the MDTM, is a challenge in a large busy hospital. When the MDTM is extended to service multiple hospitals, and individual team members participate in several multidisciplinary teams, the synchronisation of work schedules becomes even more difficult and is only possible with high levels of cooperation and goodwill. The strict temporal organization needed for the MDTM and its associated task environment is both a strength and weakness of the system. When work rhythms become embedded in the organizational processes, they become stronger and more dependable. Change becomes difficult. Once firmly established in the work routine, work rhythms will absorb a certain amount of disturbance, but when they are fragile and become unstable, work rhythm recovery can be difficult.

A new work process has been identified within radiology and pathology departments, that is separate from the main work-flow, which has been growing and becoming more established. This change in structure has evolved as a result of the development of MDT working and MDTM as part of the team processes. There are three particular issues related to time arising from the study in this chapter: the synchronisation of work routines, extra time needed to co-ordinate materials needed for review at MDTMs and extra time needed for pre-MDTM preparation for radiology and pathology staff.

Work rhythms must be synchronised for individual participants at the MDTM, as well as synchronising with others whose routines are affected. For instance, in an individual hospital all the members of the multidisciplinary team must be free to meet at the same time. The MDTM can only take place when its members are not otherwise scheduled for theatre or endoscopy sessions, out-patient clinics or other meetings. MDTM members such as the thoracic surgeons who participate in two multidisciplinary teams (in two hospitals), need to agree work routines in two hospitals to facilitate their participation in the two groups. For the rural hospitals, they need to adjust their work routines to suit several large centres and groups. A change in routines in one group will impact on other groups' routines. If co-operation is not forthcoming from all the people affected, the systems will break down.

Synchronising a weekly routine (such as Centre A) with two bimonthly routines (at Centres B and C) can be problematic. As noted here, the team at Centre A meet weekly and connect in teleconference twice monthly to Centres B and C. It is not unusual for a patient at Centre B or C to be referred to Centre A for surgery, following the advice of the MDTM. When that patient's case is being re-evaluated following the surgical procedure and placed on the agenda for discussion this should coincide with a teleconference event (as patient care is frequently transferred back to Centre B or C). Such patients may be accidentally scheduled for a co-located MDTM which is less than desirable. Their discussion will be then be deferred to the next date. Having 'additional' cases scheduled on the agenda for some weeks can further impact on 'normal' routines and interfere with post-meeting work-flows.

The interactions between pathology, radiology and clinical specialists at meetings allows for the clinical correlation of patient data, the agreement of a definitive disease stage (though the refining of professional

opinion) and the establishment of an agreed treatment strategy for the patient. While there are time savings for many clinical specialists in synchronous communication with clinical colleagues, there is an additional time burden that tends to be overlooked for pathology and radiology departments. The time involved in attending meetings and in preparation for meetings is becoming a more significant part of the total time available for radiology and pathology. Further demand for MDTMs is predicted, given the emphasis on multidisciplinary team working, technological developments in imaging, advances in pathology and in technologies such as teleconferencing, so the scale of multidisciplinary team meetings, as a method of work, can be expected to increase in the future. In order to reap the true benefits of multidisciplinary teamworking and MDTM developments the timing and scheduling issues highlighted here for radiology and pathology will need to be resolved.

Chapter 8

Information Sharing at MDTMs

In this chapter, information sharing among active participants at the MDTM is examined. Since the MDT is a 'community of practice' and learning is a characteristic of such communities (Wenger 1999), the MDTM, where members interact and collaborate, can be expected to provide a valuable opportunity for education and professional development. This chapter examines the individual specialist roles with respect to the contribution made to the discussion and the information gained to assist in the conduct of post-meeting tasks and responsibilities. It has already been described in Chapters 4 and 7 how some roles have more preparation work than others and there are roles who use the meeting to determine, or direct, their later work schedules. While the overall education benefit of the MDTM is not in question, there are a number of specialists in the MDT, with highly visible input to MDTMs but less visible benefit from the discussion, so an investigation was undertaken to assess the relative education values for the different members of the team.

All participants, vocal contributors and observers included, are shown to experience benefit from their attendance at the meeting. The interactions facilitate greater effectiveness of individual roles and communication among team members is enhanced through the use of image artefacts. To specifically examine the information exchange and information needs among lead participants at MDTMs a combination of the questionnaires, participant evaluations and interviews in conjunction with ethnographic observation was used. Participants' perception of their contribution to the discussion and the information they gain as a result were examined for each of the different roles involved.

The primary goal in this exercise was to examine team members' expectations before the meeting, their satisfaction afterwards with regard to the information they shared and gained with their fellow team members. Given that the information contributed in discussion is available independently in text form in distributed records it was postulated that some roles were information providers to the MDTM while other roles used the meeting to obtain that information. For example, the pathologist demonstrates the tissue findings during the patient case discussion and the formal pathology report on the findings is sent from the pathology department to the requesting clinician, is eventually filed in the patient's (paper) chart and is also available electronically on the electronic healthcare record (EHR) system.

A second, and related, goal was to examine if the interaction at a meeting through discussion helps in

fulfilling the information needs for the conduct of members duties outside of the meeting. It was expected that the study would reveal a small number of critical roles, that make a unique contribution, and without whom the MDTM would not be possible. How well individual contributions to the group are regarded by their team colleagues is also of interest.

Determining if MDT members had need to access MDTM post-MDTM information the availability, accessibility and ease at which specialists' information needs post-meeting were met was also an objective. Individuals were asked if they had any requirement to refer back to items discussed at the meeting in the conduct of their respective duties after the meeting, what items of information they access and how this need is achieved. Participants were asked also to indicate the level of difficulty normally experienced in satisfying these information needs after the meeting.

Rather than look at individual differences, it is more useful to consider the specialist roles that the individuals occupy. Different specialist roles contribute particular types of information to the MDTM and play their part, more or less, in a sequence during a patient case discussion. Furthermore, there are specific information needs that are particular to individual specialist roles.

The findings show that all members experience benefit from their attendance at the MDTM. High levels of interaction at meetings results in more knowledge being generated for the multidisciplinary team and the use of artefacts enhances the communication process. The information generated at the meeting makes the MDTM a valuable learning forum at the individual, group and organizational level.

Pre-meeting preparatory tasks are identified that are critical for a successful meeting, and post-meeting needs are also identified for MDTM participants related to the information to which they were party at the meeting. Members would like to be able to refer back to items that were discussed, particularly the decision or recommendation made and it is proposed that the implementation of improved meeting records is a challenge worth pursuing.

8.1 Context of exercise

The proceedings of the MDTM are described in Chapter 5. Here, some points are reviewed for emphasis, to provide better context for the analysis of a questionnaire that provides the main data reported in this chapter.

When the MDTM convenes, the MDT bring knowledge and expertise from a range of disciplines: physicians, surgeons, radiologists, pathologists, clinical and medical oncologists and nursing. Each specialist brings items of information to the meeting and pools it into the discussion. Some specialities may describe findings augmented by images, such as radiologists who contribute in the diagnosis; others bring expertise and contribute more to the discussion of the management decision, such as oncologists.

In the first part of a patient case discussion, the proceedings are highly structured and clinical, radiology and pathology take turns in presenting information to the group. The clinical findings (signs and symptoms) are reviewed in conjunction with the radiology and pathology findings. The MDTM is the *only* place in the patient care pathway where this three-way correlation of findings occurs. Correlation of the findings in this way allows for the revision and reinterpretation of results, the resolution of any inconsistencies and prompts investigations that need to be repeated or draws attention to unsatisfactory work practices

within the organization. Typically, in the first part of the discussion, the patient's definitive diagnosis is established and, as noted in Symon, Long & Ellis (1996), diagnosis might not be as straightforward as one might expect. The process of preparation for this first part of a discussion takes place pre-meeting and has been found to improve the quality of the individual workprocesses outside of the meeting (Chapter 4, Section 4.3.1).

The second part of the case discussion is less structured and more interactive; specialists from several disciplines interact through questions, offering advice, clarifying details, explaining their opinions, etc.. While the first part of the meeting is characterised by the use of images to support the presentations, the latter part has more talk among specialities who engage in speculative appraisal of the options and achieve consensus on the most appropriate course of action to recommend to the patient. By the end of the discussion each individual role has been party to the discussion of pooled information. The information giving roles of many of these specialists are recognised by their colleagues (Catt et al. 2005) and several studies have found that the additional clinical information provided to meetings often altered the diagnosis and affected patient care (Santoso et al. 2004, Wong & Birks 2004, Newman et al. 2006).

The MDTM forum is an organizational learning resource. Jefford et al. (2007) concluded that the multidisciplinary forum helps educate individual clinicians and professional groups and participation is a requirement in post-graduate specialist training. The MDTM also provides an opportunity for continuing professional development for hospital staff, that is recognised as part of Continuing Medical Education (CME) (The Irish Medical Council 2007). Verbal articulation and dialogue is recognised to have considerable promise as a problem-formulation and problem-solving philosophy and technology (Schein 2003) as well as learning benefits (Collins 1996). Organizational effectiveness is increasingly dependent on valid communication, increasingly hinges on the development of a common language and any form of organizational learning requires the evolution of shared mental models. Dialogue is a necessary first step in the development of those shared mental models (Schein 2003).

Despite the acknowledgement that the MDTM forum adds dependability to the overall patient care pathway, and the recognised potential for technological support, the MDTM utilises relatively little technology to support interaction or sharing of images among clinicians. Other than access to the picture archiving and communication system (PACS), a PC, document reader, microscope and an overhead large screen display (all of which are used in the first part of the discussion) technological support is not employed. *No* technologies are currently available to support the second part of a case discussion where the treatment decision is made and the care plan is agreed.

8.2 Method

For the exercise reported in this chapter, a questionnaire was devised to enquire of the MDTM participants their information needs and the degree to which the MDTM satisfied those information needs specific to their individual role. Team members were invited to identify the amount of information that they perceived they contributed to the MDTM (*Contribution*) as well as their perception of the new information they gained (*Gain*) as a result of the discussion. Because of the way the work is conducted, with several pathologists working in several separate rooms at one time, no attempt was made to quantify the

information in terms of specific data items, rather, self-reported values were used. Values were collected on a 5-point Likert scale and allowed for the comparison of individual Contribution vs. Gain as well as relative comparison between the different roles involved. The terms 'gain' and 'contribution' are used here to describe the self-reported information contribution or gain respectively, that were perceived to pertain as a result of the respondent's participation in patient case discussions at the MDTM.

There was a separate question inviting details of enquiries that team members might make of records *after* meetings, to fulfil their individual needs in the execution of their role. This question aimed to identify particular items of information that a meeting record might incorporate, to facilitate team members in their work following the MDTM.

Draft questionnaires were tested, and revised versions reviewed, with a number of observer participants before being issued to the group. A total of 40 questionnaires were issued among all the staff involved at the respiratory MDTM, which included over 20 junior doctors and medical students. Completed response sheets were collected at the end of the meeting. Although the respondent's role and level of experience was recorded, individual responses were submitted anonymously. Follow-up semi-structured interviews were conducted with team members.

Prior to the issue of the questionnaire, evaluations of the MDTM and the different elements of the meeting were collected over a series of meetings (Appendix G). The description of the patient's clinical and bronchoscopy findings, the results of their radiology and pathology as well as an assessment of the amount of the discussion about the patient's management were evaluated by the attendees. Attendees were asked to rate contributions and indicate if they would have liked more, or if too much time was given to a particular aspect. Responses were collected on a 5-point Likert scale (see Appendix G). Some of the results of the evaluations are reported in Chapter 6, but responses were reexamined in the light of the findings of questionnaire designed for this study (described above).

8.3 Results

The number of responses to the questionnaire was low. A total of 17 questionnaires were returned, submitted from senior members of the team only. No junior doctor or medical student completed the questionnaire. A breakdown of the respondents' roles in the multidisciplinary team (MDT) is given in Table 8.1. All roles who normally participate in patient case discussions were represented in the submitted questionnaires.

When junior members of the team were questioned about their reason for not submitting a completed questionnaire, they expressed feelings of inadequacy in responding to the questions and chose to abstain. Some junior doctors had a concern that 'poor scores' might be reported to their senior colleagues, despite being told that there was no such thing as a 'wrong' answer and that responses were anonymous and would not be made known to senior team members. These junior team members reported that they contributed nothing to the discussion but gained a lot and they regarded their attendance as analogous to attending a tutorial. Their views were not incorporated into the data reported here. Results analysed were confined to the questionnaires submitted and subsequent interviews with those respondents. Although the numbers are small, they merit analysis since all respondents were senior members of the team (and the most senior members of the team completed the questionnaire).

Of the 17 respondents, 7 were consultants (and the most senior members of the MDT). Six of the others were specialist registrars (4) and registrars (2), and next in seniority to the consultants. Eleven of the respondents have over 5 years experience in their role; the breakdown of experience is summarised in Table 8.1. Since *all* of the senior team roles completed the questionnaire, this allows for conclusions to be drawn for this particular group. Inferences cannot be made with certainty with regard to other groups. However, given the similarities between this MDT and other multidisciplinary medical teams observed, the analysis of results reported here may be generalisable and likely apply to other teams and situations. This questionnaire would need to be replicated with other teams to verify that the results reported here represent a feature of MDTs.

The analysis here pertains to the active participants at the MDTM only. Exercises that involved the observers only are reported in Chapter 9. Although the numbers may appear small they represent the composition of a typical multidisciplinary medical team of this nature and function.

8.3.1 Providing and Receiving Information

Six of the respondents feel they contribute little (3) or nothing (3) to the proceedings, claiming they are non-contributors. A further 3 respondents feel that they contribute a 'moderate' amount and 6 respondents feel that they 'contribute a lot' to the MDTM. There were 2 non-responses to this question.

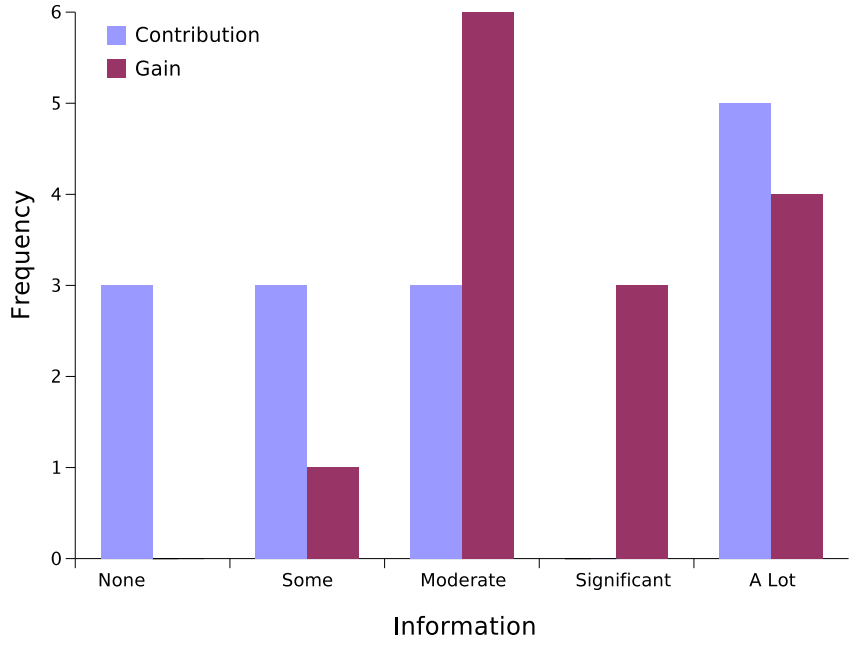


Figure 8.1: Information Contribution and Gain

With respect to individual gain, as an outcome of the case presentation and discussion at the meeting, almost all respondents perceive a significant information gain. Nine report a "moderate' (6) or 'more than a moderate amount' (3) and 5 claim to 'Gain a lot' from the proceedings. There were two non-respondents to this question. Individual respondent's perceived contribution and gain is shown in Figure 8.1. Experienced members of the MDT are equally likely to report a great benefit from the discussion as their less experienced

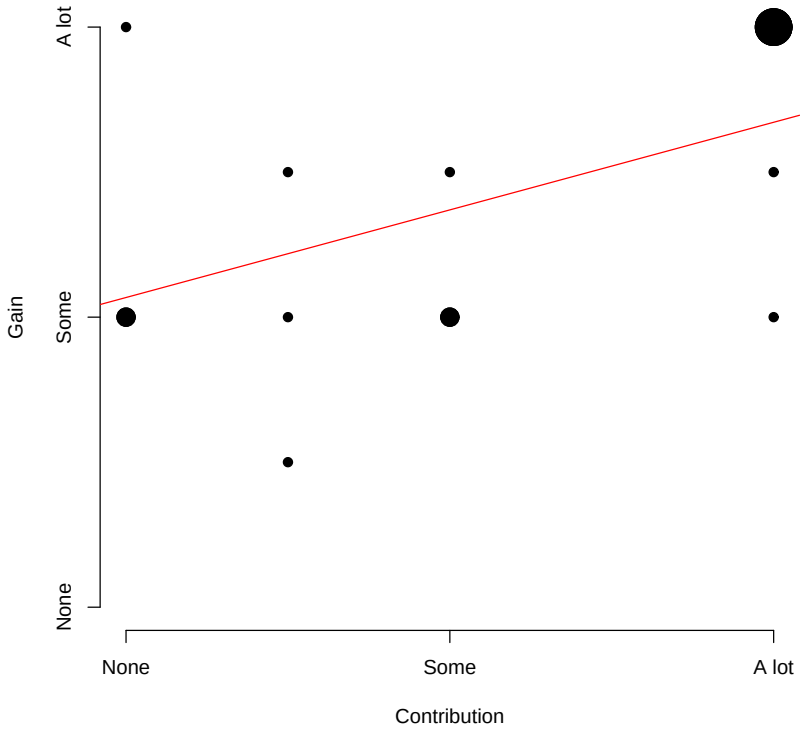


Figure 8.2: Individual Contribution and Gain

colleagues.

All, except two, claim that they gain at least as much as they contribute. The actual figures are: 7 claim they contribute exactly the same amount as gain, 6 claim they gain more than contribute, and 2 claim they contribute more than gain. For the two respondents who claim to make a greater contribution than they gain, both consider that their contribution is 'a lot' and their gain is at least a 'moderate amount'. Thus, in fact, *all* respondents experience a positive gain from the discussions. It is noteworthy that 7 claim to make contributions equal to their gain. Four (4) of this group categorise the quantity as 'a lot' and 3 say 'a moderate amount' or more. This can be interpreted to mean that the more a participant contributes to the discussion, the more they gain as a result. Figure 8.2 was generated from the 15 responses. The figure shows the individual perceived gains relative to their contribution to a discussion and the size of a point is proportional to the number of responses obtained for a co-ordinate. Respondents self-perceived contribution to the meeting is represented on the x-axis and their self-perceived gain of information from fellow team members is the y-axis. A trend can be seen between the amount of gain reported and the contribution made to the discussion, supporting the idea that information is generated through the interaction. $t = 2.0447$, $df = 13$, p-value= 0.06168, Pearson's correlation $r = 0.4933$.

The overall perceived information generated at the meeting compared with the information contributed to the discussion is represented in Figure 8.3. The Figure shows the total expressed amount of information contributed from the individuals to the group and the total of the perceived information gained during the

discussion. The MDTM is a rich information resource for the hospital and when information in pooled in this way the MDTM becomes a significant font of organizational learning, particularly if this learning can be embedded within formal organizational records.

8.3.2 Information presentation

Participants were asked to describe the specific types and forms of information provided by their role to the meeting. Their responses are summarised in Table 8.2. The first set of items relate to patient details, i.e. information provided by the patient. There is also significant information provided to the MDTM from the professional experience and knowledge of the participants.

Team members emphasised in their responses to the questionnaires and at interviews, that while the information may be contained in pictures or images they bring to the MDTM, they also bring their interpretation of the data and *diagnosis* to the meeting. It would be wrong to believe that the image data in itself contains all the information that it represents. It is the interpretation of the image in conjunction with the other findings that provides the knowledge necessary for the definitive diagnosis and effective treatment of the patient. For example, the radiologist interprets the radiology image in the light of the clinical information provided at the time of the imaging request. Through further interaction at the MDTM with the pathologist and clinical colleagues, the image is reviewed in conjunction with the pathology and clinical findings. It is not unusual for interpretations to be revised in the light of new information received through interaction at the MDTM (Wong & Birks 2004, Santoso et al. 2004, Newman et al. 2006). The clinical correlation between the radiological, pathological and clinical findings that is conducted during D-Stages 1 and 2 of the PCD provides valuable job performance feedback to the different specialities. For example, if pathology (or radiology, or bronchoscopy) reports a 'negative' result and the other two investigations are 'positive', investigation of the 'false positive' investigation might reveal vulnerabilities in the methodology used in the process.

Generally speaking, team members were satisfied with the presentation of information from their own role to the meeting (12) with a minority (3) dissatisfied. There were two non-respondents. Among the reasons for dissatisfaction expressed were: a) that more time was needed for preparation beforehand; b) that their contribution would be more valuable if all surgical patients were *always* discussed prior to their surgery (which doesn't always happen due to time constraints) and c) the equipment at the MDTM was not user friendly in allowing them to make the most of the image they wished to show. Items a) and b) listed here are process issues; item c) refers to the technology currently used at the meeting. The system referred to was generously donated to support a teleconferencing initiative (Hynds, O'Shea & Hollywood 2006) and was not designed for this particular setting that involves multiple users at the same time.

The specific issues raised concerned the use of the system by the pathologist and radiologist. The microscope controls are electronic, to facilitate remote control by a remote user with a similar system. Movement of the microscope stage, where the slide is placed, is controlled by using a joy-stick device and is not as easy to control direction or speed as the traditional manual micrometer knobs. Changing the lens objectives is also controlled electronically and proves cumbersome. The microscope has been replaced over the course of this study by an older non-electronic microscope. The pathologist is outside reach of controls to switch the screen display to the microscopic image.

Role	No.
Physician	4
Surgeon	2
Pathologist	2
Radiologist	2
Clinical Oncologist	1
Radiation Oncologist	1
Nurse	2
Database Manager	1
Researcher	1
MDT Co-ordinatoor	1

Experience	Frequency
>20 years	2
11 to 20 years	4
6 to 10 years	5
1 to 5	5
<1 year	1

Table 8.1: Respondents' roles at the MDTM and level of experience.

Information type	Frequency
Findings on clinical examination, or at surgery	6
Patient symptoms	4
Patient radiological images	2
Tissue pictures	2
Professional experience	7
Professional knowledge	7
Other (bronchoscopy findings)	2
Other (images)	1
Other (data)	1
non responses	1

Table 8.2: Information contributed in discussions.

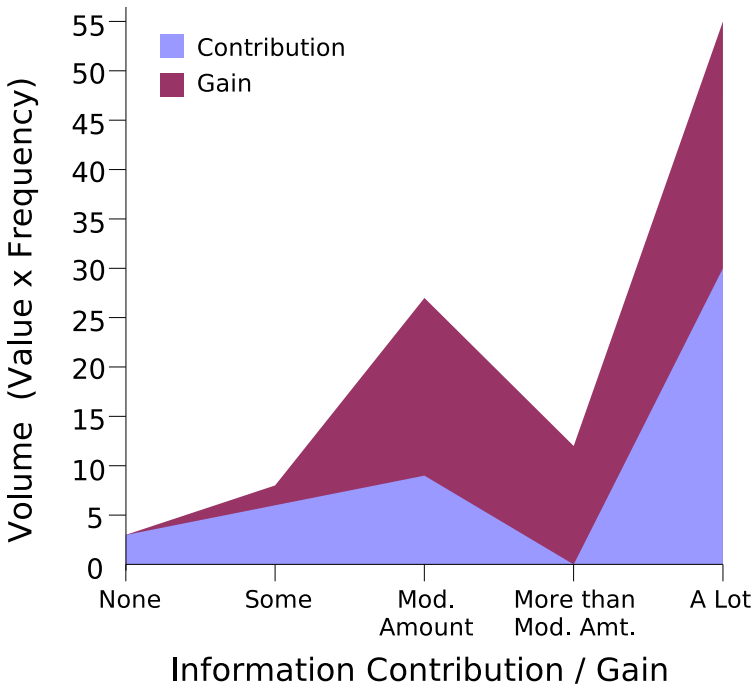


Figure 8.3: Group Contribution and Gain

For the radiologist, the document reader and the PC are the tools used and the control to switch from one to the other is placed out of reach. The PC is slower in loading images than the radiologist can comfortable demonstrate a feature. The automatic focus feature on the document reader must be disabled or else the rapid movement of radiological film on the platform caused blurring of the image. Although the automatic focus button may be disabled, it is located beside the zoom control and can be accidentally activated when the zoom button is being used.

The active participants are out of reach of all controls on the system and the only device available for use is a laser pointer, which cannot be seen in teleconference by the remote side. Both the radiologist and pathologist like to use the laser pointer, but must remember it is not visible to the remote participants in teleconference. The radiologist tends to use a pencil to point on the document reader and the mouse on the PC. It would be desirable if the PC and electronic controls on the microscopic were more responsive and if participants had control over the display screen. A device that would be comfortable to use and be able to point on the remote side of the teleconference interface would be welcomed.

An issue was raised at interviews that needs to be highlighted. Pathologists and radiologists are consistent contributors to MDTMs, regardless of speciality (i.e. gynaecology, lymphoma, lung). Both these specialities issue formal written reports on the material being presented as well as demonstrating the significant image features at the MDTM. In other words, participants at meetings also have available to them written reports that are filed in the patient's chart (or record) and although available, team members find it important to have the radiologist and/or the pathologist articulate their findings verbally. Disquiet was expressed by both radiologists and pathologists during interviews that while they know what the formal record says, because they oversaw the issue of the written record, they have a concern that they

may be misunderstood when they articulate image findings at meetings. While they aim to emphasise features and add nuance to help in the differentiation and interpretation of findings, they have a concern that their manner of delivery may be misinterpreted by listeners. For example, some image features may be attributed to an inflammatory, or malignant, process and while the presenter may feel that the weight of evidence is in favour of it being one process more than another and might say *". . . . its probably benign . ."*, a listener may wrongly over-interpret this statement to mean that the finding *is* benign. Another example is when a tumour was described as *". . . a typical carcinoid . . "* it was wrongly noted as *". . . atypical carcinoid . . "*, which changes the nature of the patient's condition dramatically and has treatment implications. The potential for this sort of error is a cause for concern. Presenters of information do not have any way of knowing what personal notes any individual listener may have taken for later use, and if these notes might contradict the written formal report. Several clinicians expressed concern that misinterpretation of nuances, or misattribution of expression, might mislead another clinician and ultimately affect the management of the patient. Presenters of information have an interest in receiving feedback that their message was received and understood as they intended. This concern was also articulated by surgeons when they give their opinion on a patient's suitability for surgery. If an error in understanding results in a patient being referred to the surgical out-patient clinic, the error can be corrected and the patient will not proceed for surgery. But if the misunderstanding results in the patient *not* being referred when they are, in fact, a suitable candidate, then there is the potential for the patient to be adversely affected by the mistake. This issue highlights the need for a technological solution to facilitate an information-rich record that would be consistent, reproducible, could be referenced as required and would provide the added value needed that is not currently embodied within the current written record. The information-rich record proposed would satisfy the sender, be available for checking, and provide clarity for the receiver. Ideally a feedback mechanism would be developed to facilitate a 'return message' to confirm that the understanding of the receiver was that intended by the sender. Some of these communication difficulties could potentially be reduced through a combination of behavioural and technological solultions. Misunderstandings in communication have been shown to account for the majority of medical errors (Lingard et al. 2004, Øvretveit 1999) and the provision of timely, complete and accurate information can be expected to improve patient care. If those roles with responsibility to *provide* information, such as radiology and pathology, had systems in place to acknowledge when information was received, alerts could be generated when information had not been accessed. If, for example, when a clinician accessed a pathology report there was a check system to tick key words (such as 'benign') the system could generate feedback for pathology to indicate the data was understood correctly, or incorrectly, in the circumstances. These sorts of checks would not detract from the interaction and information generated at the MDTM, but would serve to enhance the overall system. Such 'checks of understanding' systems could be incorporated into an electronic meeting record, to be activated when accessed, for use post-MDTM event.

8.3.3 Evaluation of MDTM contribution

With regard to the information gain for participants, most felt satisfied with the contribution of their MDT colleagues. Some of the MDTM participants said they would welcome a greater contribution from

pathology. Both pathologists and radiologists expressed a strong need for detailed clinical information on request forms beforehand to enable them to better prepare for the MDTM. The problem of adequate clinical information being provided to radiologists and pathologists is a common problem and identified also in other studies (Symon, Long & Ellis 1996, Boyle et al. 2004). There was also an expressed need by all participants for the explicit articulation of the agreed outcome, or management plan for the patient, from the lead clinician.

Results to the question on participants' contributions were reviewed in conjunction with meeting evaluations over a series of meetings. A summary of participant's evaluations is given in Figure 8.4. Participants were most satisfied with those contributors to meetings who articulated their findings through use of artefacts, i.e. radiology and pathology contributions were rated more highly than those who presented information through voice alone.

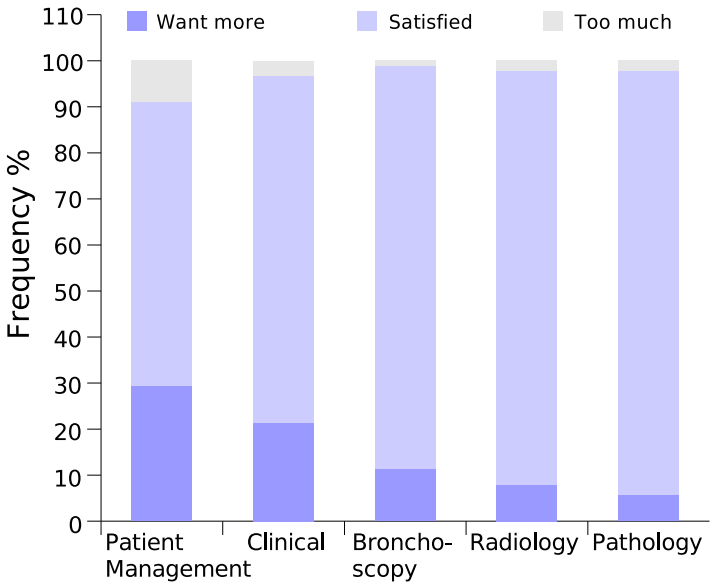


Figure 8.4: Evaluation of Contributions

Figure 8.4 shows the patient management part of the discussion was considered the least satisfying and that over one-third of MDTM participants would have liked to have more discussion on the patient management and clinical aspects of the discussion. Both these aspects of the case discussion are conducted through vocal interaction without the support of artefacts. At the opposite end of the scale, both radiology and pathology demonstrate relevant features in images. Bronchoscopy features are given in a verbal report to the MDTM. The visual appearance of the airways is described and sometimes the description is supplemented with an image and shown to participants. Thus, it can be seen from Figure 8.4 that those contributions that utilised artefacts to supplement their presentation were rated more favourably than the aspects of the meeting that involved talk alone.

8.3.4 Post-Meeting needs

Participants were asked to indicate the type of information they currently consult, the level of difficulty experienced, and information they would like to be able to access after the meeting. The type of information

currently accessed and the information respondents would like to access more is summarised in Figure 8.5. When respondents indicated that they currently access an item, they assumed that they will continue to access that item in the future. In Figure 8.5 those expressing a wish to access an item in the future, represent MDT members who do not currently have access to that information.

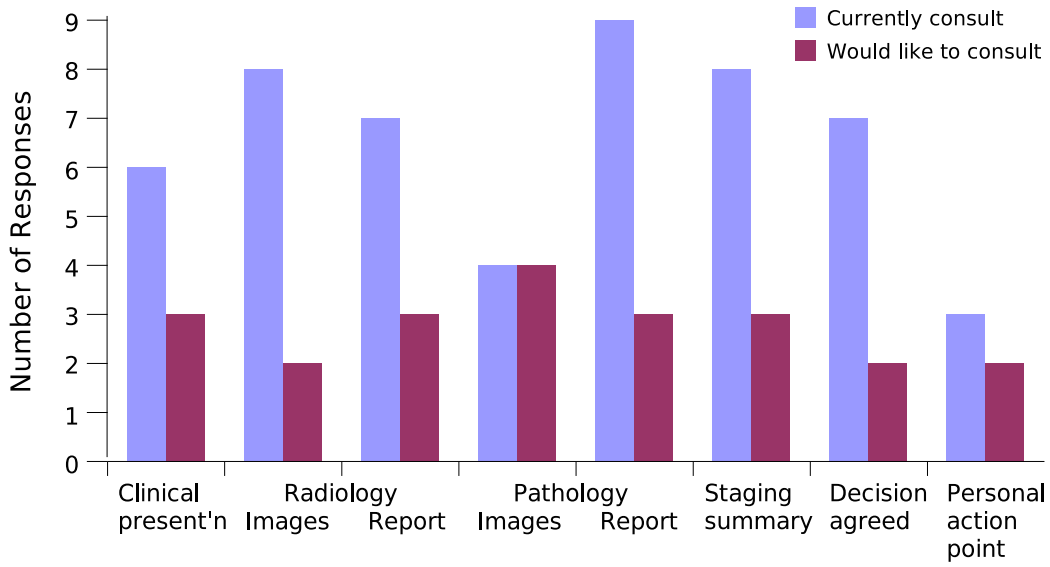


Figure 8.5: Information needs post meetings.

The levels of reported difficulty in accessing items of information after the meeting is summarised in Figure 8.6. The level of difficulty reported for radiology images is relatively low, because of the introduction of a new Picture Archiving and Communication System (PACS) system in the hospital. However, comments were made that there are fewer access points than staff would like, in some areas. Issues around the access of pathology reports include criticisms of the turnaround time needed in pathology and are not solely due to lack of electronic access. Access to view pathology reports (text) has been made available through the Electronic Patient Record (EPR) system that was introduced in conjunction with the PACS project.

The level of difficulty reported in accessing information after the meeting (with respect to information discussed at the MDTM in Figure 8.6) correlates with responses given to the question regarding the information they would like to be able to access in the future (Figure 8.5). So, technological support that would make it easier to access formal pathology reports, summaries of the TNM disease stage and access to the decision agreed would be considered highly useful. The ability to note and refer to personal action points would also be welcomed.

There remains a significant issue with regard to the format of a formal record of the latter parts of a case discussion, namely, the disease staging summary, the decision agreed and the consequent action that needs to be taken. While many respondents reported that they sometimes experience difficulty locating the clinical findings in patient charts, more people said that the outcomes of the discussion are more difficult to establish afterwards (than clinical details). It is current practice that an administrator member of the team records the decision made on a form which is later filed in the patient's chart. Although this practice is the current standard, patient charts with filed forms may not be available to all clinicians when

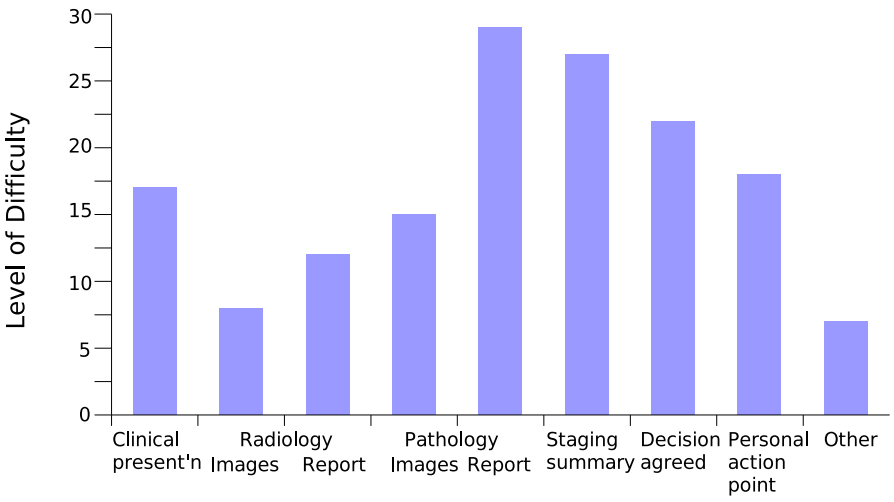


Figure 8.6: Difficulty in accessing information

needed. Clinicians tend to take personal notes during meetings, for personal reference use afterwards. While personal notes are useful, the official record is the one that has medico-legal validity with respect to the MDTM decision. If members of the team have differences in their understanding of what was agreed and decided, the current formal record can prove weak in resolving and establishing the true facts afterwards.

8.4 Discussion

In this section the main findings with respect to information sharing are reviewed and the challenges for CSCW are pointed out in terms of supporting communication among MDT members at MDTMs. Where possible, suggestions are made that would improve on known problems in terms of technical support and better coordination of work processes.

It was postulated at the outset that some roles might attend the meeting for the sole purpose of imparting information and if a particular role was identified as critical to the proceedings, or if information could be specifically identified that could be provided without an individual clinician, then technology could be proposed to target the provision of those specific information needs. But no particular speciality was identified as 'critical' to a successful meeting; it was felt that all specialities should be present for the meeting to be a success. Harmonising and synchronising work rhythms (Reddy & Dourish 2002) offers the best solution to enable all participants to be available together, as discussed in Chapter 7. Emphasis is given to the importance of radiology and pathology in the establishment of a definitive diagnosis and the medical oncologist and radiation oncologist to the discussion on appropriate treatment options. These four specialities (radiology, pathology, medical oncology and radiation oncology) are core members of several multidisciplinary teams, compared to specialists such as a respiratory physician who belongs to one team. It is discussed in detail in Chapter 7 how radiologists and pathologists spend a lot of their time in preparation for, or in attendance at MDTMs. And it was described in Chapter 5 how radiologists and/or pathologists have been observed to prepare for their next contribution concurrent with discussion

among other members of the team (page 81) thus prohibiting them from fully participating in discussion during that time. Technologies that might support pre-meeting preparation for radiology and pathology, or customised note-taking for oncologists have the potential to positively impact on work practices for those specialities. As well as facilitating preparation and easy access to material afterwards, the radiologist and pathologist would be free to become more actively involved in the PCD (rather than spend time absorbed in preparation for their next contribution).

Participants' contributions vary on the amount of knowledge, experience, views and interpretations of data that they bring to the discussions, but all members gain experience regardless of their rank or experience level, even though the MDTM is not the only source of the data (which are available through distributed records). Contributions are more highly valued when they are supplemented with image artefacts (Figure 8.4) and participants would like to have more time for discussion. Figure 8.2 shows that while some people may gain a lot with little contribution, there is a correlation between higher contributions and high gains from participation, suggesting that efforts to support increased interaction among the participants will yield important gains. Tools that would support the use of multiple images at once could potentially save presenters' time that is currently spent locating, loading and referring back and forth among different image sets, and allow more time for interaction and discussion.

The aspects of the discussion that rely on vocal interaction, and rated less favourably, are difficult to support technologically. But if the talk processes and the role of interplay between speech and actions that take place (Clark & Krych 2004) were better understood, through deeper analysis of how knowledge is shared and grounding achieved, the information needs of clinicians at MDTMs might be better facilitated. The development of a meeting skills taxonomy to support communication, situation awareness, teamwork, decision-making and leadership such as those identified for surgeons in the operating room (Flin et al. 2006) has the potential to help understanding of the interactions that take place at the MDTM and develop technological supports to enhance those interactions.

8.4.1 Information, knowledge and learning

In this chapter, the term 'information' has been used mainly to refer to patient data items and disease processes. There are other levels of information processing that are evident at MDTMs, namely the internalisation and feedback that is embedded in the exchanges at individual, group and at hospital organization level that should be noted. There are many facets to the MDTM and the development of any tools that might support the activities must understand, and take account of, the multi-dimensional nature of the activities. The activities to be supported need to be considered from the perspective of an individual team member, the interactions that occur between team members and with the knowledge-capture need for the organisation, i.e. solutions should be sought at the individual, group and organisation levels.

It is understandable that a surgeon will gain additional information from listening to a radiologist articulate significant image findings, but the benefit to the contributor of information, in this example the radiologist, must not be overlooked. The articulation of thought, and connecting new experiences to existing knowledge, enhances the development of clinical reasoning (Murphy 2004, Koschmann 2002). Communicating or justifying one's views has been shown to yield cognitive benefit (Pingree 2007). People learn through dialogue with one another and, in the process, transform their understanding (Collins 1996).

This self-development is *not* represented in Figure 8.1. At interview participants had not considered this self-learning when responding to the questionnaire. Individuals tend to overlook this self-benefit and consider others as the sole providers of gain. However on reflection, participants acknowledge and agree that the articulation of information develops their own knowledge and understanding. Thus, the person presenting the information to the group benefits themselves through the articulation of the information. The MDTM is a 'knowledge-building community' in the respect that knowledge and learning are a by-product of the social processes (Hoadley & Kilner 2005): knowledge is generated and shared where there is purposeful conversation around content in context. Elements can be identified in MDTM that occur in communities of practices: content, conversation, connections, (information) context and purposes. The greater these elements are present in any community, the more likely and effective the knowledge generation and transfer will be (Hoadley & Kilner 2005).

Extending this description of the MDTM as a community, and rather than seeing knowledge as a thing that belongs to an individual, it is more useful to adopt Koschmann's view that collaborative learning is best described as a discussion of "meaning-making in the context of joint activity . . . . mediated through designed artefacts." (Koschmann 2002). Knowledge is generated through discussion at the meeting and is represented in Figure 8.3 as being a volume of information made available through the group activity, that can also be conceptualised as 'common information space' (Bannon & Bødker 1997). Although contributed by the individuals present, the body of information belongs to the group. Stalh in his outline of learning models described how groups are believed to construct knowledge by a synergistic effect that merges ideas from different perspectives (Stahl 2002).

> "In collaborating, people typically establish conventional dialogic patterns of proposing, questioning, augmenting, mutually completing, repairing, and confirming each other's expressions of knowledge. Knowledge here is not so much the ownership by individuals of mental representations in their heads as it is the ability to engage in appropriate displays within the social world" (Stahl 2002, p. 177).

In this example of the MDT the group knowledge is achieved through group discourse, is spread across people and artefacts and persists in physical artefacts. This group knowledge generated for a case discussion could potentially be captured in a persistent meeting record that would eventually be filed in the patient's (electronic) chart. Sets of records could be used for educational benefit and a record would also serve as a resource for audit and practice reflection.

How does the MDTM provide feedback? Feedback is provided to both clinicians and the organisation through the group activity. The product of the group work is ultimately evidenced in how well patients are managed and feedback is provided through regular audit reports and physical artefacts such as the attendance record. Having satisfying meetings with all attendees is an important feedback mechanism for maintaining energy, cohesiveness and embedding the MDTM routines. As long as individuals experience personal benefit, the team benefits and the MDTM practice is reinforced. Should it happen that members experience dissatisfaction, then the practice of MDTMs can be predicted to become vulnerable. Attendance at the MDTM is voluntary, so user involvement and acceptance of any technological support is critical for successful continuance of the MDTM practice. Any initiative to enhance the participants' experience would be welcomed.

For individual level feedback, consider the work of any of the clinical specialists who participate in the MDTM. Each individual works relatively independently outside of the meeting time. For roles to be effective, work tasks must have feedback mechanisms to provide the individual with information about their job performance. Hackman and Oldham in their seminal work on job design (Hackman & Oldham 1980) identified feedback as critical to effective work performance. For many of the roles participating at the MDTM, the meeting itself provides feedback on their performance, as well as providing a context to their individual contribution. For the radiologist, pathologist and clinicians, their opinions and observations are correlated with one another. Tissues removed by surgeons are shown in images by the pathologist and margins are discussed: confirmation is provided that the targeted tissue was satisfactorily removed. So, as well as being a forum for patient management and professional training, the information sharing and interaction at MDTMs serves important functions with respect to performance feedback for team members.

8.4.2 Radiology and Pathology

Information seeking and sharing for MDT members is not confined to the MDTM event, even though in most instances the information was available at the meeting. Radiology and pathology images and reports, are regularly accessed outside of the meeting by team members and there are levels of difficulty associated (Figures 8.5 and 8.6). While radiology images are more frequently accessed than radiology reports, the reverse is true for pathology. There are several possible reasons for this imbalance. One reported reason is the number of times MDT members 'seek' the pathology report while the sample is in process. The turnaround time for pathology can be 5 days or longer, depending on the level of disease complexity. There are occasions when the final pathology report has not been concluded by the time the MDTM takes place and MDT members will afterwards seek the final report. Ideally, information would be available at the MDTM and efforts to synchronise work flows with MDTM discussions (described in Chapter 7) would make a significant contribution towards reducing vulnerability of the MDTM in this regard. But closer examination of information seeking behaviour, utilising the concept of work rhythms (Reddy & Dourish 2002), will identify potential solutions, such as alert mechanisms, to advise when information is available to requesting clinicians.

The need to access radiology images, but not reports on those images, is sometimes interpreted by radiologists that other clinicians (mistakenly) believe that they are competent to interpret a radiology image, but not a pathology image, and may explain why radiology reports are less often read than pathology reports. Radiology images are more widely accessed also because images can have different meaning for different specialities and individuals may feel that they can satisfy a personal need by reviewing an image, even with their limited knowledge of radiology. For example, a surgeon may have a need to use the image to help conceptualise the surgical setting and 'see for him, or her, self', with a view to removal of a tumour. An oncologist's interest may be the status of lymph nodes and the tumour volume rather than the precise location of a tumour and its adjacent structures. Thus, a record generated will need to serve multiple needs, or multiple forms of a record will be needed to accommodate different perspectives. Radiology and pathology images are part of the knowledge infrastructure whose depths of interdependence and their role in knowledge production needs to be recognised (Bowker & Star 1999).

The correlation visible in Figures 8.5 and 8.6 between the wish to see an item and the difficulty

experienced in trying to access the information suggests that reducing the level of difficulty will satisfy some of the current needs of team members. Increasing the number of access points, investigating rhythms in the seeking behaviour as well as alert mechanisms, note-taking tools and a meeting record all have potential to reduce difficulties in satisfying these post-MDTM information needs.

8.4.3 Decision basis and outcome

Almost half of all comments from respondents about their post-meeting information needs concerned items directly associated with the patient management decision and the underlying rationale (clinical findings and disease staging), or basis, for that decision. These are all items that are available at the MDTM and would have been revealed in the discussion. There are two explanations for this re-seeking of information, either the information was not noted at the time, or the information was missing during the PCD. Harmonising MDTM work rhythms with intersecting rhythms where team members frequently have a need to access clinical presentation, disease staging and the decision agreed at the MDTM, will make the processes more efficient and reduce the vulnerability introduced with missing items of information. Personal notes or available records would support reference back to the discussion for MDT members afterwards.

Senior staff reported less frequent need to refer to a personal action plan; and this observation is explained in the fact that tasks relating to appointments and follow-up details are delegated to more junior members of the team than the respondents to this questionnaire. Observer participants at the MDTM are shown to have a greater need for personal notetaking than the vocal participants (Chapter 9).

Without doubt there is information gain for MDT members at the MDTM but it can be difficult to refer back to that information afterwards, particularly with regard to decisions made at the meeting and the underlying basis for those decisions (Figure 8.6). The decisions made at the MDTM form the basis of the patient care plan, or the material resources for action (Suchman 1987). In an effort to improve the process, formal articulation of the summary decision was introduced, in D-Stage 4, to make explicit the patient management plan, allow for checking agreement and make it easier for those who wished to write notes. Current paper method for recording the decision of the meeting remains could be improved. While the PDA application, described in Chapter 11 would go a long way to satisfying individual needs, it does not attempt to resolve the issue of the formal hospital record that would allow multiple concurrent access.

Long term ambitions to implement a full electronic medical record system will need to incorporate a summary of the decision, as minimum, into the patient's record. A case can be made to incorporate in the record, the underlying basis for the decision, the specific images and artefacts reviewed as well as the options that were considered when the decision was being made. The form that any potential record should take, i.e. text-based, still images, audio and/or video will need to be agreed with users. Just as the need for MDTM has slowly been growing in popularity, so it can be expected that the detail that users will wish to include in the formal record will grow as practices become established. Flin et al. (2006) developed a taxonomy of non-technical skills for surgeons, made up of four skill categories to improve communication among professionals in the operating room. The taxonomy provides a framework and common terminology that allows surgeons to communicate effectively with each other in this area of practice and helps trainees and others develop abilities in the workplace. These categories of 'situation awareness', 'decision-making', 'communication and teamwork' and 'leadership' could be applied in situations such as MDTMs to improve

communication at the meeting. The development of an MDTM skills taxonomy modelled on the work of Flin et al. (2006) is currently being considered by the respiratory MDT.

In summary, there are different levels at which design interventions would make the process of collaboration, interaction and information sharing at MDTMs more satisfactory. At a basic level, the design of instrument controls could be implemented; at other levels support for articulation of ideas through facilitation of a greater use of images would enhance proceedings. Given that current patient reports do not fully meet user needs, evidenced in the need for specialist presentations at an MDTM, suggests that current paper (and electronic) record systems have not managed to embody all the information needed for health professionals to carry out their tasks and fulfil their responsibilities. Supporting interaction among participants rather than the static storage of data will prove more satisfactory in the longer term. Technology that will allow pre-meeting work to be transferred more easily into the MDTM setting; devices for pointing and annotation would facilitate greater interaction and personal notetaking devices would serve to support post-meeting work. Meeting records, designed with user involvement would potentially satisfy several longer term needs and goals and be linked with more traditional patient records.

8.5 Conclusion

Information exchange at MDTMs is more than simply a sharing of patient data items. All participants gain information and more information is generated for the group than the individual contributions would suggest. The articulation and interaction through conversations yields benefits, not only for the patient, but also for individual practitioners, the group (MDT) and at the hospital (or organization) level. These results suggest that supporting interaction and exchange of information through the use of image artefacts will enhance the collaboration and exchange. Acknowledging the multiple facets to the information sharing practices at MDTMs provides insight into what might be required to support activities at MDTMs. The interaction setting, the MDTM, should not be isolated as a separate entity for study as it is intrinsically connected with pre-meeting and post-meeting activities. While the MDTM adds dependability to the overall patient management work system, it also depends on the pre- and post- meeting tasks to be effective. The development of an MDTM skills taxonomy will be a useful first step in the development of any tools that would support interaction at the MDTM, such as identifying specific items of information that need to be articulated. It is likely that any technological developments to support information sharing will be more effective if they are integrated into supporting interactions at the MDTM and integrated with the related pre- and post- meeting activities.

Chapter 9

Information Capture at MDTMs

Chapter 8 reports on information sharing among specialists at the MDTM and the focus is on the interactions between senior staff, all of whom are active participants at MDTMs. In this chapter the focus shifts to the non-vocal participants and examines the ability of *observers* at the meetings to capture information from the proceedings. It is shown how both audio and visual sources are used and how the patterns of use differs in teleconference and co-located meetings. Patient facts in text display are more successfully captured in co-located meetings, while obtaining information from the dynamics of the discussion is more successful in teleconference. Overall response rates are significantly higher in teleconference, with an increase in the 'correct' rate, and no overall increase in errors, even though teleconference case discussions are perceived to have lower (educational) value than co-located discussions.

The paper exercise in Appendix H was conducted over a series of meetings at the end of 2005 and early 2006 with observer participants. The proceedings in which the exercises were undertaken were recorded to facilitate the analysis.

9.1 Introduction

Observers attend MDTMs as part of their professional training and their behaviour is examined in capturing information central to the meeting's purpose. The focus on the observer participants is justified in terms of the educational role of the MDTM (Newman et al. 2006) and by the fact that a measure of the effectiveness of information gathering by observers is a proxy measure for same by active participants.

The MDTM plays an increasingly important role in inter-specialist communication (Ruhstaller et al. 2006). Effectiveness of a meeting depends, among other factors, on how well its participants (including observers) can perceive, assimilate and interpret the information exchanged during the meeting. Meetings are important communication spaces and communication failures are large contributors to adverse clinical outcomes and recognised as a source of significant morbidity and mortality (Lingard et al. 2004, Coiera 2000). Examining the risk of possible miscommunication is important when evaluating MDTM effectiveness and the use of communication technology such as teleconferencing (Zuiderent, Winthereik & Berg 2003). Identifying potential threats to communication effectiveness and supporting inter-professional communication

at MDTMs will directly impact people's lives.

All members of the multidisciplinary team (MDT) should be able to understand the proceedings and follow the discussion; for some it is an integral part of their work and for others it is an important part of their training. Most of the observers attend as part of their education and there are also some observer work-roles in the MDT who take formal notes for post-meeting follow-up tasks and responsibilities, such as the Data Manager and MDT Co-ordinator (described in detail in Chapter 5). For senior participants, it is critically important that they communicate effectively with other MDT members. Because of the nature of the work, and the research principle observed here not to affect the active work of the MDTM, this study was conducted with volunteer observers who were not engaged in the main business of the meeting but attend as part of their on-going training. In directly measuring the effectiveness of the MDTM for observers it is aimed also to deduce potential difficulties that exist for active participants at these meetings by proxy measure. It is reasonable to assume that active participants are more effective in gathering information from the discussion than passive observers since the interest level of both are likely to be different and the active participants are more knowledgeable about the topic being discussed. Nonetheless, the volunteer observers, although lacking the specialised knowledge and experience of the senior members of the team, undertook an active role in participating in this exercise during the PCD. Although we can expect that the senior team members would have performed better than the volunteer proxies, the difficulties experienced by the active participants can be expected to be reflected in these results.

Both audio and visual sources are shown to be used for data gathering and the pattern of use differs when MDTMs are held in teleconference. Communication mediated by artefacts rates more satisfactory than communication by monologue alone. Subjects find it difficult to respond to questions requiring the assimilation and interpretation of data from dialogue. In teleconference discussions, subjects are more inclined to be in agreement with, and understand the basis for, the decision and believe that the patient might be cured as a result.

Detailed description of a stylised patient case discussion (PCD) is given in Chapter 5. Conducting a patient case review and making a decision in front of an 'audience' is analogous to a tutorial. There is redundancy of data in PCDs: information is provided in both text and speech, and is often repeated during discussion. For the exercise (Appendix H) reported in this chapter, at least three questions can be answered by listening to the opening sentence and potentially six questions can be answered from information in the opening statement, as in the following example:

> "Jane Doe is a 65 year old lady who presented with a 6 month history of cough and dyspnoea and recurrent chest infections. On examination she had clubbing and reported pulmonary TB as a child. She is a current smoker with a 50 pack year history."

Review of notes and the video recordings confirmed that the patient's details were on display on both the main plasma screen and the SMARTboard™ and that the TNM classification was verbally articulated by one of the lead participants in each case.

Although the latter part of the PCD is less structured, the questions directed at the second part of the PCD can usually be answered by being attentive to the final summation of the PCD in D-Stage 4, for example:

> ". . . he's a T1N0M0, squamous, so he can be scheduled for lobectomy with [*surgeon*]".

Thus, some items of information, such as the patient's sex or cancer status, are available to observers repeatedly throughout the case discussion. Some other information generated through talk, such as the TNM staging, is often repeated and/ or summarised at the end of the discussion.

The term 'data capture' is used in this chapter to describe the perception, assimilation and interpretative processes people use when gathering information needed to perform tasks. Participants' ability to correctly capture the data presented to the MDTM, through text, images and talk, is vital to the work being undertaken.

9.2 Exercise Method

Ethnographic study, with audio-visual recording and a questionnaire was used (Jordan & Henderson 1995). A single page, 21-item questionnaire was designed to be completed during an individual patient case discussion (Appendix H). The questions were composed to capture information retrieved through different types of cognitive processes used by an observer at the meeting, namely a) auditory attention and information capture and b) visual attention and information capture, c) interpretation of aural or visual data presented and d) evaluation, or judgement, on the decision process and outcome for the patient. Table 9.1 shows a breakdown of the types, and number, of questions included in the exercise. Seven of the questions were 'open' questions requiring the participant to listen or look at artefacts to search for the required information. One of these open questions was a subsidiary option in a closed question.

Table 9.1: Question types used in exercise

	Question type		
Cognitive demand on subject	Open	Closed	Total
Audio / Visual Data Capture	3	6	9
Interpretation of audio and visual data	3	3	6
Rating or judgement	1	5	6
TOTAL	7	14	21

Closed questions were formatted as multiple choice options. Some sets of choices were simply 'yes', 'no', or 'don't know' alternatives, while other questions offered choices of specific information, (for example, a choice of lung tumour types if the patient was considered to have lung cancer), and aimed to elicit items of fact and interpretation from the respondent.

Of the 7 open questions, three aimed to measure the direct capture of information presented either verbally, in text form, or via both modalities in the discussion. The remaining open questions were more complex, requiring the participant to assimilate and evaluate the information received. These questions asked the participant to supply the most significant symptom presented with regard to the patient's diagnosis and prognosis. The final open question asked for the patient's diagnosis if the patient did *not* have cancer.

Data items that are matters of fact normally shown in text and articulated in a patient case discussion are: name, age, sex and smoking status. Responses to these facts were either 'correct' or 'incorrect'. The patient's current diagnosis is articulated in the course of discussion, whether the patient has cancer, the

type of cancer and disease stage are items that can be expected to be gathered in the first part of the discussion. Questions on the treatment plan for the patient, i.e. whether or not the patient will have surgery, chemotherapy and/or radiation therapy were expected to be answered from data presented during latter part of a case discussion.

Matters of interpretation, based on data presented, were important symptoms in diagnosis and prognosis, disease stage and treatment plan. The patient's main symptoms are articulated at the start of each case, but the significance of those findings is rarely referred to. Or, a radiologist might describe a patient's tumour as a "1cm tumour in the left lower lobe" which would be consistent with a T1 tumour, without the term 'T1' being articulated. Thus, if the questionnaire respondent marked T1 as the disease stage in such a case, it was noted that the information was available from the data presented and the respondent had made the correct interpretation. A question asked if the management decision might represent a cure for the patient and was expected to be interpreted by the participant based on the patient's diagnosis, disease staging and treatment plan, as well as prior knowledge of the likely outcomes for such scenarios.

Self-rating questions aimed to measure the level of a participant's understanding of the proceedings and were aimed directly at the pathology, radiology and clinical contributions as well as the underlying basis for the final decision. Other rating questions sought the participant's level of agreement with the decision made and their opinion of the likelihood that the patient would be cured as a result of the intervention proposed. This latter question aimed to measure the participant's level of knowledge and confidence of the subject material. Values were recorded on a five-point Likert scale and analysed. The final question required the participant to assign an overall rating for the educational value for the discussion and subjects were asked to assign a number between 1 (highest) and 10 (lowest).

For many of the questions asked, both audio and visual data sources of the answer were available to the participants.

9.2.1 Distribution

The exercise in Appendix H was reviewed by the lead clinician and validated before use. It was considered that all the questions could potentially be answered within the duration of a case discussion. The questions were presented in the order in which the information is usually given in the discussion.

The questionnaires were distributed among observers at a series of MDTMs in late November and early December 2005 and late January 2006. Christmas and New Year were avoided because of potential seasonal disruption. A new template for patient details was introduced by the team from the first meeting of 2006 and the exercise was not conducted at 3 meetings following its initial introduction. Video recordings of the MDTM proceedings were undertaken in conjunction with the issue of questionnaires, to check data sources and correlate with responses. Volunteers were assured anonymity, advised of the aims of the exercise and instructed to turn to the following new page at the start of each patient case discussion.

No senior participants at the MDTM participated in this information capture exercise because of potential interference with their role, function or the business of the meeting. All subjects in this exercise were observers at the MDTM; the majority of whom were non-consultant doctors. There were also clinical research scientists and an occasional medical student among the volunteer subjects. It was not possible to track individual responses to the exercises from week to week, because of the anonymity agreed at the

outset.

9.2.2 Analysis

Answers were entered into the statistical analysis software and analysed according to the type of data source and cognitive demand on the participants. For each question the video recording of that patient case discussion was reviewed and it was determined through study of that recording if the patient data were verbally articulated, presented in text form, or via both modalities to the meeting. Variations in the case presentation were noted. For example, a narrator might present information in talk that was not available in text or images; or, data might be displayed on screen but omitted in discussion. In 3 cases the patient's name was never articulated and in several cases the age was not referred to in discussion. In some cases the verbal narrative followed the initial display of the patient details and opened with:

> "This patient presented to OPD with a history of ...",

without the name or the age being articulated.

Similarly, some other items of data were omitted from the discussion, but were displayed on screen. There were also instances of information being given in talk that was *not* on display on screen. These facts were taken into account when analysing the responses to the questionnaire. A 'correct' response sheet was generated for each patient discussion and subjects' responses scored against that standard as being either 'correct' or 'incorrect'. As well as determining if the correct response was provided by the respondent, levels of agreement among respondents were noted.

Identifying items that were verbally articulated or on visual display at the meeting helped determine the modality used by respondents to capture the information presented. Where data were presented in both audio and visual forms and participants provided the correct answer, it was not possible to determine from which modality this information was retrieved. When information was given in a single form only (i.e. either audio or visual), or incorrect data were submitted in the exercise, the response from the subject indicated the source from which they attempted to retrieve the information. For example, in a situation where the patient's year of birth was displayed on screen, but not articulated in discussion, and the correct answer to the patient's age was given in the exercise, it can be assumed that the subject retrieved these data from the visual display and calculated the year of birth. Or if incorrect data were articulated during the case presentation, contradicting the correct data on visual display, the submitted response revealed from where the information probably emanated.

The design of the patient data sheet was changed, coincidentally, over the course of the study. The MDT Co-ordinator, with responsibility for the patient details template, made changes (in consultation with the lead clinician) because of complaints that clinical details in the original template were difficult to read. For meetings from January 2006, and affecting 2 weeks of this study, a revised version of the patient data sheet template was used. The revised template utilised a different font in smaller size and had a different layout for content, with clinical information being given more prominence. The information content in both versions was the same.

Pearson's Chi-square tests (χ^2) were used to check for differences in categoric responses (correct, incorrect and non-responses) where appropriate. Scaled variables such as the number of responses per

participant were compared under different conditions using t tests, and the Mann Whitney U test was used when comparing rating responses for the presentation of findings and the educational rating.

'Don't know' responses were reviewed in conjunction with the video recordings and text documents available at the meeting and categorised as 'correct' or 'incorrect'. If the discussion had clearly made the information known, then a 'don't know' response was considered 'incorrect'. If the information was *not* made available during discussion, then a 'don't know' response was designated as 'correct'. Non-responses for each question were examined.

There were very few responses to the open questions. All responses were reviewed and will be referred to in the text where appropriate.

9.3 Results

A total of 23 participant subjects returned 345 response sheets, from 92 patient case discussions, over the 5 weeks of this study. The majority of participants attempted over 70% of the cases discussed each week. The Mean completion rate for the 21 questions on each case was approximately 50%. A breakdown of the data collected from teleconference and co-located case discussions is summarised in Table 9.2. Some participants reported difficulty in the exercise and while many didn't articulate any problems, the level of cooperation deteriorated over the 5 weeks of study. In the first week, 8 volunteers were recruited who returned 162 completed response sheets. By week 6 only 19 completed response sheets were submitted.

Table 9.2: Breakdown of response sheets for analysis

Setting	Patient Cases	Response Sheets
Teleconference	25	85
Co-located	67	260
TOTALS	92	345

Questions requiring the respondent to capture factual data from the proceedings were analysed in two sets. The first set of 6 questions comprise those relating to the patient details which were usually displayed in text form as well as being articulated in the first part of the case discussion. The second set of questions (6) relate to the management decision which would have been articulated in the latter stages of the discussion though conversation among the lead participants.

A correct, or ideal, response sheet was generated for each case discussion following review of the recording and participant responses were compared with the ideal and scored. For all closed questions responses were either 'correct', 'incorrect, 'incorrect but understandable' or 'non-response'. 'Incorrect but understandable' responses were those that represented situations where information was articulated in discussion that contradicted text information on visual display.

For one of the open interpretative questions, namely the patient staging, there was a single correct response that was sometimes verbally articulated during the discussion. Responses to this question were considered either 'correct', 'incorrect' or 'partially correct'. Only incorrect submissions for 'patient stage' were counted as true errors.

The results are presented in the following order:

a) matters of fact and interpretation;
b) items requiring assimilation from discussion and consideration, namely the open questions that asked about signs in diagnosis, prognosis and the disease stage;
c) items that required retrieval from the dynamics of the discussion, i.e. the management decision;
d) opinion on the management decision, and
e) rating of the educational value of the discussion.
Differences for patient cases discussed in teleconference versus co-located scenarios is monitored in the presentation of the results through the following sections.

9.3.1 Matters of Fact and Interpretation

Questions that enquired about patient facts were relatively well answered. These questions sought particulars of 'forename', 'Age', 'sex', 'smoking status', 'cancer status' and 'type of cancer', if present. At the outset of a patient case discussion, and at several times throughout the discussion, the patient details sheet is on display giving the patient's name, date of birth, smoking status and relevant clinical information. These items of fact are also referred to in discussion.

The responses to individual questions on facts will be reviewed first. Then the responses to questions on facts will be examined collectively and compared with results of information gathered from the active discussion. The examination of responses to individual questions provides valuable evidence on the nature of the cognitive processes being utilised by individuals to gather information.

Name: Respondents were usually able to provide the name of the patient being discussed. There were 36 instances of misspelling of the name, which suggests that the audio source was utilised in generating these errors. The patient's name was *not* articulated in 3 case discussions but was displayed in text form and all respondents correctly provided those names. Thus, both audio and visual sources were used to capture the data. No names occurred that were ambiguous with respect to the patients gender, in this exercise.

Age: No age was offered in 37 out of 345 responses, (which were generated from 20 out of the 92 of the patient cases discussed). Of these 37 non-responses, 26 (70%) occurred in week five of the study following the introduction of a revised template for the display of patient details. In 4 patient case discussions (week 5), no age was submitted by *any* respondent and these non-responses account for 14 (38%) of the total non-responses. There were a further 11 non-responses returned from 4 patient cases. For the cases where *no* age was submitted, the age of the patient was never articulated during the discussion. For other cases, in week 5, with a majority of non-responses, the Age was both on display and articulated during the discussion. There were two other patient cases where there was one respondent out of a potential four. For these cases in week 5 that account for 70% of non-responses on Age, the new template was in use and all were co-located discussions, suggesting that the text display of the date of birth was the main source, and audio a secondary source, of the information to answer the question for Age for many respondents.

Table 9.3 summarises the responses for Age. Of the 308 age responses submitted, over 80% of submissions were correct and there were 63 errors recorded. The rate of error in teleconference was almost double that for co-located discussions, and when the new template was introduced there was a dramatic increase in the rate of errors submitted. While 23% of responses submitted the incorrect 'Age' from co-located

PCDs, the number of errors from teleconference PCDs increased to 31%. (Table 9.3). χ^2 was significant at the 0.001 level both for the difference between teleconference and co-located scenarios and with the introduction of the revised template for text display.

Table 9.3: Responses (%) for Age in Teleconference and with revised text template for patient data

	Frequency %		
Setting	Correct	Incorrect	No Ans
Teleconference	69	31	2
Co-located	77	23	41
Patient Details Template			
OLD	76	24	4
NEW	67	33	34
Overall number of response sheets	245	63	37

Table 9.4 gives a breakdown of the errors encountered for this question on Age. The distribution of errors in the teleconference and co-located scenarios are compared. The error breakdown when different templates were used for the display of patient data are also shown in Table 9.4.

Examination of the types of error reveals the source being used for the information. Of the errors recorded, 43 appear to be miscalculations from the written date of birth displayed on screen and the remaining 20 errors were in agreement with the age that was articulated (in error) during the discussion, and considered 'understandable errors' in this exercise. Results are reported in Figure 9.1 as % frequency.

Table 9.4: Breakdown of 63 'errors' submitted for the 'Patient's Age' in Teleconference situations and following the introduction of a revised template for patient data

	Frequency (%)	
Error	Co-located	Teleconference
from TEXT source	79	21
from AUDIO source	15	85
	Old template	New template
from TEXT source	79	21
from AUDIO source	60	40

It was not possible to deduce whether the audio or text medium was preferred in all instances. In the case of the 'understandable errors', 66% were in teleconference where the age was incorrectly articulated across the interface and contradicted the date of birth in text. Reviewing video recordings suggests that respondents could see the remote speaker, text was not convenient and the audio channel was used. Audio is critical. It was reported that it is easier to hear in teleconference discussions than at co-located meetings. The speaker volume for sound from the remote sites is generally louder than speech in the same room. Microphones in the room capture and transmit sound to the remote site and the speaker reproduces the incoming audio signal only.

Comparing results from teleconference with those from co-located discussions shows respondents are more willing to submit an age in the teleconference scenario, even though that answer was often incorrect.

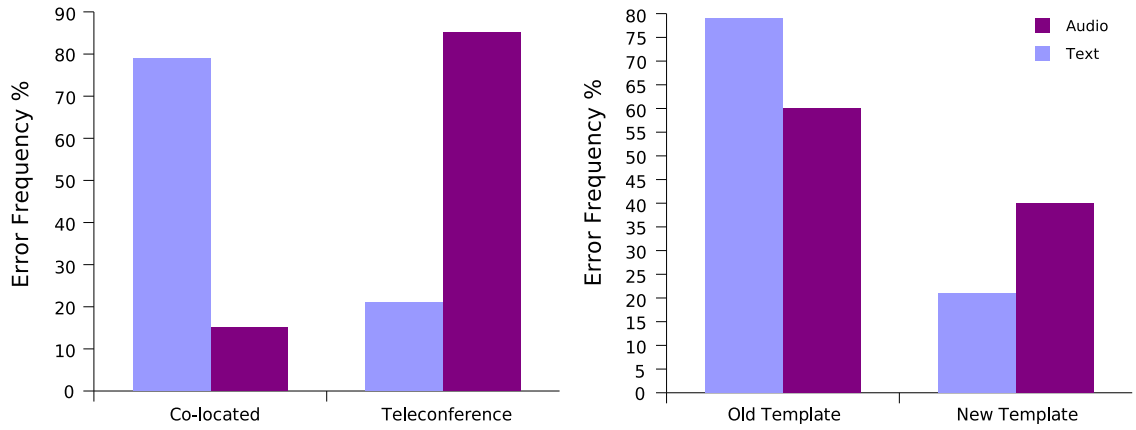


Figure 9.1: Breakdown of 63 'errors' submitted for the 'Patient's Age' in Teleconference situations and following the introduction of a revised template for patient data

The % errors returned for Age was almost doubled in teleconference, (probably due to a much higher rate of errors from the audio source). For the question that asked the patient's Age, there were more errors of calculation submitted in co-located settings and more errors from the audio source submitted from teleconference discussions. The combination of these results, suggests that text source for Age was more often accessed in co-located discussions and the audio source was more frequently accessed during teleconference. Analysis of artefact use during teleconference showed that the display of patient details was reduced during teleconference, in preference to the display of the face-to-face view with the remote site (Chapter 6, Section 6.3.3). This may partially explain why the audio source was accessed more frequently in teleconference, given that the text display was not so readily available (as well as the audio quality being superior).

Examining those cases where the text template for patient details was used, the error rate almost doubled following the introduction of the revised version (18% to 33%), reported in Table 9.3. There is a higher rate of errors from the audio source (26% to 46%), a lower rate of error from text calculation (74% to 53%) and an increase in the non-response rate (4% to 35%) following the introduction of the new patient details template (Figure 9.1). This pattern of results suggest that respondents were relying on visualising the date of birth to answer the question on Age and were unable to see the date in the new template. While some switched to the audio source to find the Age, many were unable to access the information from audio and left that field blank in the questionnaire.

The results show significant difference in the teleconference and co-located settings and when the old and new templates for patient details were in use. The number of teleconference cases were examined which utilised the new text template display (12) and found a 38% error rate of which 89% could be attributed to the audio source. Thus, the introduction of the new template increased teleconference error rates (for Age) and illustrates how both media (text and talk) were utilised by respondents in teleconference to find the Age of the patient. The slight increase in errors from an audio source in teleconference when the new template was in use, from 85% to 89% suggests that the template change did not make a lot of difference for teleconference discussions and reinforces the finding that both audio and text sources were used.

The distribution of errors from the co-located case discussion, teleconference scenario and the use

Table 9.5: Patient's cancer status

	Frequency (%) for Cancer status		
Setting	Correct	Incorrect	No Answer
Teleconference	59	8	33
Co-located	50	8	42
Patient Details Template			
Old	49	9	42
New	62	5	33

of the different templates suggest that participants were more audio-attentive than visual-attentive in teleconference and were more inclined to retrieve the age of the patient from the discussions rather than the text data (in teleconference discussions). The implications for use of the screen display in teleconference will be discussed in the next section. In co-located discussions the text display took preference over the audio channel as evidenced in the relatively high number of calculation errors submitted for co-located discussions. Both audio and visual sources were used to retrieve the data needed for case discussions held in both teleconference and co-located settings.

The response rate for Age was greater in teleconference cases, with an increase in overall efficiency (i.e. more correct responses), but a greater proportion of errors came from the audio source. At co-located discussions efficiency was maintained (i.e. no increase in errors) at the expense of the response rate (which was lower).

Sex and Smoking status: There was little difference between the accuracy of responses in teleconference and co-located discussions for these questions. Most respondents answered satisfactorily. Although examination of the false 'yes' errors (63%) submitted for 'smoking status' suggests that observers to the case discussion may not have been attending fully to the material being presented to the meeting. The majority of patients discussed are either current smokers or ex-smokers so it can be deduced that the relatively high proportion of 'yes' errors represents guesses by the respondents (and that a proportion of the correct responses are probably due to chance).

Does the patient have cancer? Most patients under discussion at MDTMs either already have a diagnosis of cancer, or are suspected of having the disease. Of the 92 patient cases discussed, 15% (14) were found to be negative for cancer (i.e. the diagnosis was T.B. or other non-cancerous condition) and 10% (9) did not have any definitive diagnosis by the end of the discussion and required further investigation. 27 errors were returned from 18 case discussions (out of 92). In other words, in most cases respondents were correct but in almost 20% of case discussions observers submitted an incorrect response as to the patient's cancer status.

Results submitted for cancer status are summarised in Table 9.5. Similar to the pattern for the question on Age, respondents seemed more inclined to answer questions in teleconference (with fewer non-responses). The revised template has a more prominent display of clinical details than the earlier version and suggests that respondents may have deduced the patient's cancer status from clinical details displayed in text. This pattern suggests that both audio and visual sources were being used to find the information and that utilisation of the text source was most efficient.

If cancer, what type? For most discussions (almost 90%) the response was correct or within ac-

Table 9.6: Factual patient data presented to the MDTM (name, age, sex, smoker and cancer status)

	Frequency %				
Setting	Correct	Accepted	Errors	No Ans	p
Teleconf.	73	6	6	15	
Coloc'd	70	3	7	21	0.001
Patient details template					
Old	71	3	7	18	
New	69	4	4	23	0.05

ceptable limits. Between three (3%) case discussions, 9 errors (53%) were returned suggesting that there was ambiguity in 3% of case discussions (two of which were co-located and one discussion was across a teleconference link).

The response rate was higher in teleconference cases to questions that asked for the cancer status and type (compared to co-located discussions), the error rate was unaffected and there was an increase in the number of acceptable responses. In situations where the new template was used to ask the patient's cancer status, there were higher response and correct rates compared to the old template which may have been due to the more prominent display of patient details in the new template. However, examination of the use of the new template in teleconference (for this question on 'cancer status') made no significant difference, with an error rate of 8% (same as overall), thus, reinforcing the interpretation that in teleconferencing participants relied mainly on the audio source for data.

For situations where the 'Old' and 'New' templates were used there was a small but statistically significant difference in the effectiveness of the meeting in capturing items for all questions on patient facts. For questions on 'Name', 'Age' and 'Smoking status' there was significant difference ($p \leq 0.01$) for each question. For teleconference discussions, analysis of individual questions on patient facts are not statistically significant individually, except for the question on Age. However, a summary of all the errors on matters of fact in the patients details, namely, name, age, sex, smoker, cancer status and cancer type (Table 9.6) shows how the response rate is significantly improved in teleconference ($p \leq 0.01$) and with lower overall error rate than that for co-located discussions (despite the errors for Age). Table 9.6 summarises the results on questions enquiring of patient factual data. The reason why the response rate is better in teleconference (for this and other questions) may be due to the fact that teleconference cases take longer (shown in Chapter 10) or may be associated with respondents feeling 'more detached' from the interactions and prepared to take more personal risk in submitting responses.

9.3.2 Patient Signs and Symptoms

There were two questions that required respondents to interpret data in discussion that deserve separate mention. These questions asked respondents to submit a) the signs or symptoms[1] that were most important in achieving the diagnosis and b) the signs or symptoms most important in predicting the patient's prognosis. This information would have been indirectly captured from the case discussion. It is a very

[1] A 'sign' is an objective physical finding found by an examiner. A 'symptom' is subjective evidence of disease, usually reported by the patient.

rare event for a team member to say during a case discussion that a particular symptom is pathognomonic for the disease in question and it did not happen for any of the cases in this exercise. Neither was any opinion expressed by a team member as to a particular symptom being a predictor of the prognostic outcome. These questions required for respondents to attend to the presentation and make an interpretation of the data items presented in text, images and/or talk. Response rates for teleconference and co-located discussions were 58% and 43%, respectively, to the request for a 'diagnostic symptom'. Fewer submissions were made for a 'prognostic indicator' (overall 19%), with a 14% higher response rate for teleconference over co-located discussions.

Results suggest respondents were unable to submit an appropriate response, unless there was an explicit reference in text or discussion. It is unclear why the response rate was higher in teleconference for these questions. However, the fact that communication over teleconferencing is perceived to be more orderly than face-to-face communication (Sellen 1992) may have encouraged respondents to submit answers, even if those answers turn out to be incorrect.

9.3.3 Disease Stage and Patient Management Decisions

In this section the results of questions relating to matters of interpretation, especially those relating to the patient management decision, are reported. Questions associated with the decisions made are those that asked if the patient would have chemotherapy, radiation therapy or surgery as well as a question that asked if the decision made would effect a cure for the patient.

In order to answer these questions successfully, the respondent was required to attend to the conversation among the senior participants and follow the dynamics of the proceedings. There would have been a greater cognitive demand on respondents compared to many other questions, as information can be often questioned, interpretations revised and options weighted. For example, a contributor might say,

> " . . so, we have a T1N0 here and we should proceed to lobectomy . ."

to which another member might say

> "I think she should be considered a T4 because . . .".

It might be a another minute before it is agreed that there isn't enough evidence to say for certain and it is decided to repeat the CT imaging. A surgeon, or someone else, might add

> "his ECOG status is really poor . . even if he is a T1, I don't think he's fit for surgery anyway."

There might follow a conversation for several minutes before a decision is made to have a PET scan and review the patient in a month's time. Another scenario is for one of the team members to say "It looks like small cell, limited stage, disease, so you'll look after him", while nodding and making eye contact with the oncologist member of the team. For an observer to understand the management plan for chemotherapy agreed in this exchange, s/he will need to have followed the logic of the discussion and have a knowledge of the roles of the respective members of the team. In many cases, the decision was summed up at the end of the discussion, so respondents potentially had more than one opportunity to retrieve the information needed to answer the questions posed in the exercise.

A single open question asked the disease stage and was poorly answered and while there were fewer errors in teleconference, analysis of results showed no statistical significance.

Patient Management Decisions

The decision made on the patient's management was asked through five closed multiple choice questions that asked subjects if the patient would have surgery, chemotherapy, radiation therapy and when, or if, radiation therapy would be scheduled. A final question asked if the respondent believed the patient would be cured as a result of the treatment.

A submission rate of 15% was made for these management related questions discussed in teleconference and twice that rate was offered for co-located case discussions (30%). No statistical significance was found using χ^2 when missing values were excluded, but when the non-response rate was included in the calculation, χ^2 was significant, $p \leq 0.01$, for the chemotherapy, radiation and surgery questions and $p \leq 0.05$ for the question that asked if the respondent believed the patient would be cured (or not). For teleconference cases, respondents had a lower error rate than for co-located case discussions (7% and 15% respectively).

The mean responses per submission to questions related to the patient management decision is given in Table 9.7. The ability of respondents to capture data related to the patient management from discussion among the lead participants was much lower than their ability to retrieve patient facts. The success rate in teleconference in comparison to co-located discussions is significant.

Table 9.7: Summary of Mean 'correct', 'acceptable' and 'incorrect' responses for on the patient management decisions per respondent per case discussion

Mean per response	Correct	Acceptable	Incorrect	Response Rate
Teleconf.	1.5	0.13	0.44	43%
Coloc'd	0.9	0.09	0.36	27%

Responses to questions on the patient management decisions were examined with respect to differences in the teleconference and co-located settings, and in the template used. The pattern of responses is significantly different with a higher response rate and 'correct' rate for case discussions in teleconfence. When the 'correct' responses for all patient facts and questions on patient management decisions are examined it can be seen that teleconference is overall more productive ($\chi^2 = 18.1$, $df = 5$, $p = 0.003$). The use of the old and new template for the display of details made a significant difference to the yield of correct responses on patient facts, but it made no statistical difference to responses on patient management decisions. The pattern of results demonstrates the sources from which data were being gathered. Patient facts were obtainable from the text display and it was necessary to follow the interactions in discussion to learn the patient management decision.

Agreement and Understanding of decisions

The reported levels of agreement and understanding of the patient management decision was examined through the use of two direct and one indirect question. Subjects were asked if they agreed with the man-

Table 9.8: Respondents' level of understanding and agreement with patient management decisions (%)

Agree with decision?					
Scene	Yes	Some	No	No Ans	p
Coloc'd	19.6	2.7	0.4	77.3	.041
Teleconf.	34.1	3.5		62.4	
Understand the basis of decision?					
Coloc'd	18.1	4.6	0.8	76.5	0.011
Teleconf.	34.1	1.2	1.2	63.5	
Belief that the patient might be cured?					
Scenario	Correct	Accepted	Incorrect	No Ans	
Coloc'd	12	5	15	78	0.033
Teleconf.	24	4	7	65	

agement strategy and if they understood the basis of the decision. The third question asked if s/he believed the patient would be cured as a result of this management plan agreed. Generally respondents didn't answer this question unless they agreed with the management strategy (i.e. few respondents expressed any disagreement). There was a greater submission rate for teleconference discussions than for co-located ones (42% and 25% respectively). The pattern of responses was similar for the three questions (Table 9.8). More responses were submitted for, and respondents said they agreed more with, decisions made in teleconference (as well as understanding the basis of the decision). Respondents were more confident in their belief that the decision might effect a cure, or not, for the patient in teleconference discussions. Chi square (χ^2) was significant for all three questions (see Table 9.8). Table 9.9 is a summary of the results related to patient management decision questions.

9.3.4 'Rating' or Evaluation Questions

Rating questions asked participants to submit a score for the clarity of clinical, radiological and pathology findings and the educational value of the discussion.

Radiology was rated highest in terms of clarity of the findings and pathology rated second to radiology. Surprisingly the clinical findings were rated least clear, even though the majority of people present (including respondents) had more clinical expertise than either pathology or radiology. (Clinical findings were presented in monologues during this exercise.) The measures given for radiology and pathology correlate with one another and with the amount of time these items were given during discussion. In other words, the more time that was spent the higher the rating, and if there was a high rating for pathology there was a high rating for radiology (and vice versa). There was no significant difference (Mann-Whitney U test) between the scores in teleconference and co-located settings in ratings for radiology and pathology (both of which utilise images in presentations).

In contrast, the mean frequency distribution (%) for the clarity of clinical findings in case discussions in the co-located setting was compared with teleconference case discussions and while the response rate for co-located meetings was less than that for teleconference, submitted values rating the clarity of clinical findings in the two scenarios tended to rate clarity higher in co-located case discussions. These findings are consistent with the paradox observed in Bly (2003) between the need to see things while talking about them

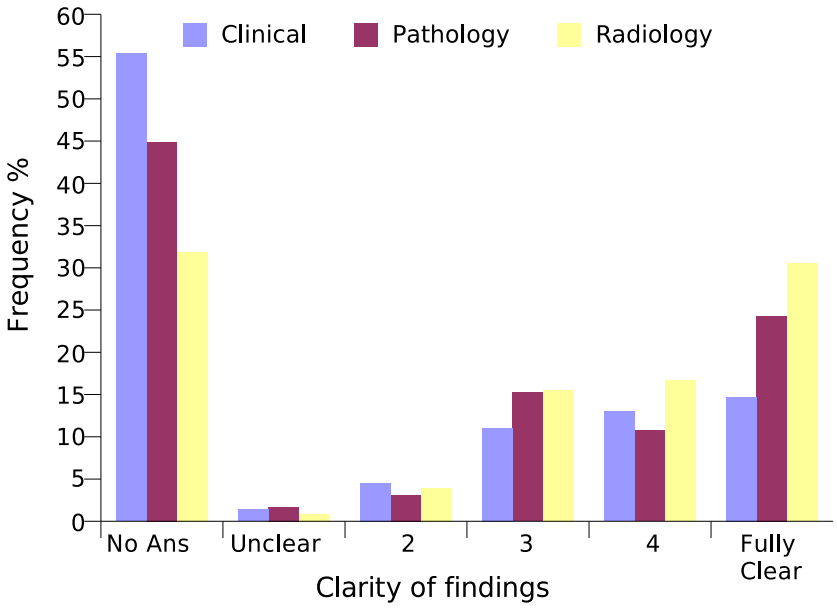


Figure 9.2: Perceived Clarity of Clinical Radiology and Pathology findings

and the lack of demonstrated success when doing so in computer mediated environments. But more data would be needed to demonstrate statistical significance. When the presentation elements, i.e. radiology, pathology and clinical findings are combined, the overall rating of the presentations was significantly higher for teleconference cases ($p = 0.005$), but the statistical significance may be overstated given there was high non-response rate.

It was anticipated at the outset that case discussions held in teleconference would be considered more educational from an observer's perspective, since cases selected for discussion by remote hospitals represent complex cases on which external expertise is being sought. Contrary to expectations, and shown in Figure 9.4, discussions held in teleconference had more values in the mid-range than many co-located discussions. Some co-located case discussions were highly rated with respect to their educational value, but some also scored very badly (and much lower than any teleconference discussion). The evaluation of the educational benefit reported correlates highly ($p \leq 0.01$) with the clarity rating of the presentation of findings, i.e. respondents gave higher educational ranking when patient findings were clearly presented. For perceived educational value 51% of responses in teleconference and 63% of co-located discussions were rated in the top half of the scale.

9.3.5 Response Rates

Examination of missing values revealed a clear difference between the patterns of response in teleconference and co-located patient case discussions. The average number of questions answered per case discussion was 48%, when broken down amounted to 57% for teleconference and 46% for co-located discussion ($p < 0.01$).

Table 9.10 summarises the results obtained from the set of questions on patient facts and management decision questions. The patient 'facts' would have been retrieved from the first part of the meeting, and formally presented in text or talk. Answers to the management questions would have to have been retrieved

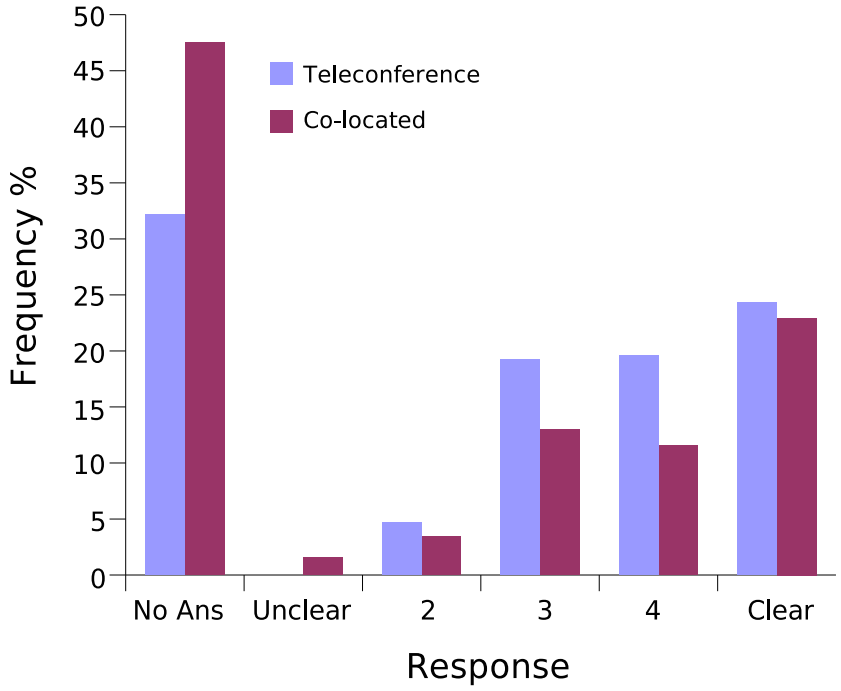


Figure 9.3: Perceived clarity of findings in teleconference and co-located case discussions.

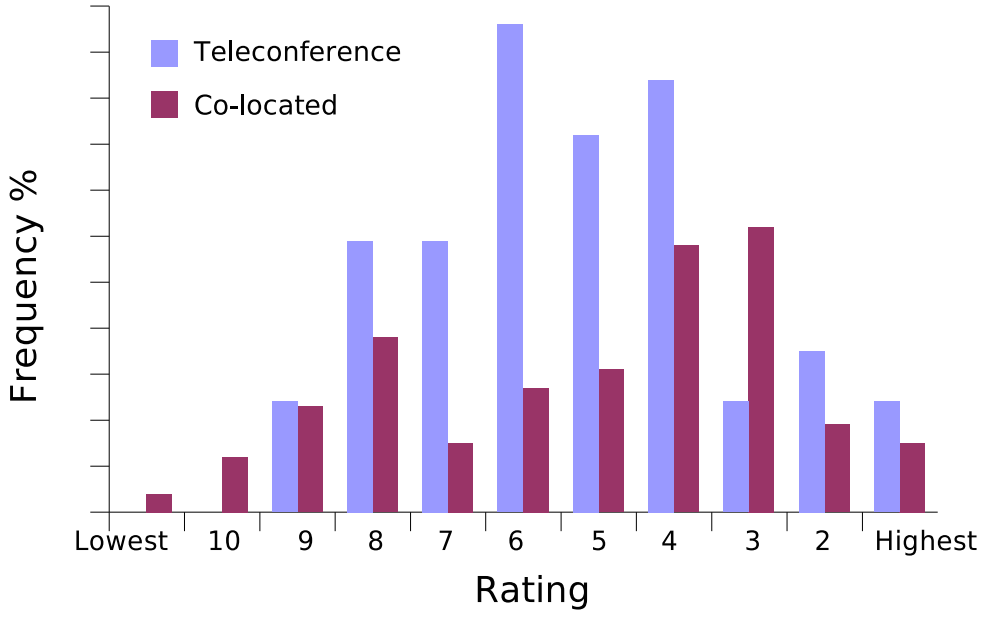


Figure 9.4: Perceived Educational Value of teleconference and co-located case discussions.

Table 9.9: Summary results with respect to questions to elicit detail on patient management decisions

Variable	Type	Frequency % Correct (%)	Incorrect (%)	No Ans (%)	p
?Surgery	Coloc.	25.8	14.2	60	0.004
	Teleco	41.2	15.3	43.5	
?Chemo-therapy	Coloc.	25.8	8.8	65.4	0.012
	Teleco	42.3	9.4	48.2	
?Radiation therapy	Coloc.	23.1	6.2	70.8	0.003
	Teleco	37.6	10.6	51.8	
When rad'n therapy	Coloc.	10.8	2.3	86.9	0.021
	Teleco	21.2	4.7	74.1	
?Cure result of decision	Coloc.	16.5	5.8	77.7	0.03
	Teleco	27.0	8.2	64.7	
	Coloc.	20	8	72	
TOTALS	Teleco.	33	10	58	0.001

from the conversation among the lead participants. Tables 9.10 and 9.11 show that the rate of acceptable and correct responses dropped low for these questions whose answers needed to be retrieved from the conversation (and the non-response rate was high). It can also be seen that for co-located discussions respondents tended to submit a non-response, rather than an error, for all types of question. The overall error rates submitted for patient details and management decision questions is about the same (8-9% of questions).

Table 9.10: Summary of responses for details of patient facts and management decision questions

Questions	Frequency % Correct	Incorrect	No Ans
Patient details			
overall	71	9	20
teleconference	74	11	15
co-located	70	9	21
Management Decision			
overall	23	8	69
teleconference	33	10	58
co-located	20	8	72
TOTALS	49	8	42

9.4 Implications of Findings for MDTM Work

In summary, respondents were generally able to correctly retrieve the information necessary to answer questions, particularly on matters of fact (Table 9.6). It was much more difficult to answer questions that required assimilation of data from conversation (Table 9.10), (a finding reported by Bordia (1997)). Respondents were more likely *not* to submit an answer than submit an incorrect response (although a small proportion of errors were recorded). Furthermore, data suggest that respondents are more willing to submit

Table 9.11: Ratio of correct responses in co-located and teleconference discussions per response sheet

Correct responses	Ratio Correct : Response sheet
Patient Details	
co-located	4.18:1
teleconference	4.36:1
Management Decisions	
co-located	0.41:1
teleconference	0.61:1

a response in teleconference, given that the overall response rate was significantly higher in teleconference for items retrieved from discussion (Table 9.10). This may be explained by a greater 'psychological distance' experienced in teleconference (Sellen 1995) and uninhibited behaviour that results (Siegel et al. 1986).

Both audio and visual sources were used to gather the information and response rates were improved, overall, in teleconference discussions. This is measured both through the absolute number of questions answered per response sheet ($p < 0.01$) and an examination of the pattern of responses and non-responses, using Chi square (χ^2) tests.

Overall error rates were not clearly affected in teleconference. However when responses on questions related to patient facts are compared with questions related to the patient management decision, differences emerge. There was some increase in incorrect responses in teleconference on matters of fact such as age. Respondents returned a higher 'correct' rate in teleconference for items that needed to be retrieved from the dynamics of the proceedings as illustrated in responses to the patient treatment plan questions shown in Table 9.7.

Reflecting on these results, it is useful to consider the responses collectively as representing situations where a) there was direct capture of data explicitly presented versus b) data captured from conversation and interaction among the active participants and c) how teleconference affected the ability of respondents to capture those two types of data. In conjunction with looking at the results in this way it is useful to consider the data source that participants revealed they were using to answer the questions. The type of errors made when the old and new templates were in use revealed the use of the text source, for example.

9.4.1 Direct capture of Data presented

Use of Audio: Audio is demonstrated to be the most important source for both factual data and understanding conversation at the MDTM, particularly in teleconference. The use of audio as the preferred data source is evidenced in the analysis of items of patient facts, especially errors to the question on Age. Misspellings in a name suggest that audio was used as the data source. But instances where respondents correctly identified the patient whose name was not articulated show that respondents did not rely solely on audio. For the question on Age, which was presented in both text and talk, there were significantly more errors in teleconference discussions, (Figure 9.1), and analysis of the response sheets in conjunction with the audio-visual recording of the meeting shows that respondents were relying more on audio than visual text data to respond to the Age question in teleconference, (χ^2 value = 14.93, $df = 3$, $p = 0.02$).

(Table 9.6 summarises results on questions on patient facts.)

The ability to gather data on the patient management decision, from listening to the conversation among the lead participants in teleconference, also gives evidence to the importance of audio at meetings. Observers at the co-located were particularly weak in being able to report on the patient management plan. The audio source was reported to be clearer in teleconference, which may also have contributed to the audio source being preferred over visual data in teleconference discussions. The exercise itself may also have had an effect of influencing respondents to rely more on the audio channel (since they were actively engaged in writing an answer on the response sheet).

These results suggest that support for better audio at co-located meetings would improve the meeting efficiency and also reinforce the need for high quality audio in teleconference.

Use of Visual data: Optimising the display of visual data will improve performance, even in teleconference. The text display of information during a discussion was evidently used by respondents. This is proven through analysis of errors to the Age question and the change in the error patterns after the introduction of the new template for patient details. Furthermore, non-responses to the question on Age were highest in teleconferences that utilised the new text template for the display of patient details which reveals that respondents didn't rely completely on the audio channel for information in teleconference.

The introduction of the new template for patient details influenced the success rate. For some items it had a positive effect (i.e. 'cancer status') and it also had a negative effect (e.g. Age). This can be explained in the layout of information in both templates: the old template had the patient's date of birth more prominently displayed and the new template showed the patient's presenting details more clearly.

There was no effect on the error rate for responses to the patient management questions in teleconference using the different text templates, proving that audio sources were always accessed to retrieve this information. In other words, for simple matters of fact, the textual display of data was very important. Management decision questions were *not* influenced by the text information on visual display, i.e. the information regarding the management decision was captured from the conversation (i.e. audio source).

A plausible explanation for errors of calculation being submitted in co-located settings, and more errors from an audio source submitted from teleconference discussions, is because of the format of information displayed on the main screen display during PCDs. Visual displays at co-located meetings show text data or images. When connected in teleconference, however, the sites are in visual communication with one another and displace the information that would otherwise be on the screen display. Given a choice of what to view, participants at the meeting have demonstrated a need to be able to see the face-to-face view with the remote site (Chapter 6). The results here demonstrate that the capture of factual information is efficiently achieved through text, but when this text display is reduced during teleconference (Figure 6.7) MDT members switched to using the audio source, with a resultant increase in the error rate. This result makes an argument for having multiple screens available in teleconference discussions. Results show that when factual data is presented in competing text and audio forms there is a bias towards the audio source and a consequent greater potential for error. An argument can be made for the need for three display areas (at least), or three dedicated visual channels as follows. a) Providing persistent text display of pertinent patient facts would serve to clarify important identifiers and details and also provide an awareness mechanism to know which patient was being discussed. b) Face-to-face view with

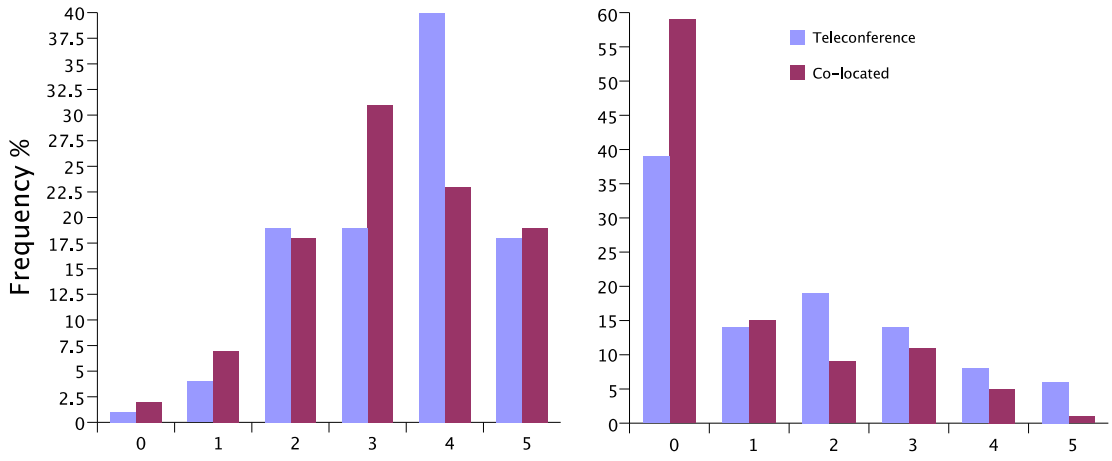


Figure 9.5: No. of Correct Answers submitted per respondent per case in Teleconfernce and co-located case discussions. Correct responses for Patient Factual Details are shown on the left; correct responses for Management Decisions are on the right.

the remote party is considered important by participants at MDTMs and may contribute to the slightly greater efficiency in capturing information from conversation in teleconference. (Team members tend to sit facing the screen displays during meetings.) c) The third screen could display the image artefact under discussion, such as the radiological image. A fourth screen could be utilised to show an alternative artefact: perhaps the last image discussed. The fourth screen would also allow for simultaneous comparison between images. PDA applications could also be developed that would allow data capture for personal later use (described in Section 11.2.2).

9.4.2 Evaluation responses

The evaluations for the clarity of clinical, radiological and pathology findings correlate with the time given to their presentation and the more formal structured manner in which these data are presented. Among MDTM attendees the main expertise is in clinical medicine. Yet, the clarity of clinical findings, which would have been more understandable to the attendees, rated lower than for either radiology or pathology (both highly specialised areas). But both radiology and pathology utilise images to convey their findings, and the ratings submitted correlate with the amount of time radiology and pathology images are normally displayed. As described in Section 6.3.3 radiological images occupy considerably more time on screen than pathology images or the patient details page.

The reported higher variance in educational value of co-located discussions suggests that co-located discussions are often more satisfying than teleconference discussions. Cases discussed in teleconference are considered more mediocre, with most cases scoring mid-scale in the evaluation. These results in the evaluations reported here from the exercise in Appendix H, are consistent with results of the exercise conducted in Appendix G that is reported in Chapter 6.

There remain issues with teleconferencing that are not well understood and require further research. Results show that respondents are more willing to offer opinions on decisions made in teleconference, reflected in responses to reported levels of agreement on the patient management decision and if the

patient is likely to be cured as a result of the decision (Table 9.8). It is not clear why respondents more willingly submit answers, particularly incorrect responses, in teleconference case discussions. This is most noticeable in the belief that the patient will be 'cured' in a case discussion in teleconference, and seen in the slight increase in errors to this question in teleconference. Given that respondents would have known that lung cancer is not a 'curable' disease, unless the case was a T1N0 non-small cell cancer and suitable for surgery (which was not the case), it is surprising that there was an increase (albeit a small one) in the number of errors submitted for teleconference cases to the question on belief of cure for the patient. However, this result concurs with findings of Straus & McGrath (1994) who found that a group member who recorded group decisions made more errors in the computer-mediated condition. Straus & McGrath (1994) interpreted that the higher error rate might possibly reflect poorer comprehension in the computer-mediated condition. While the error rate in some cases might be possibly due to less comprehension, this explanation is contradicted in the higher response rate and correctness rate by respondents in teleconference on information retrieved from the teleconference discussion. The presentation of all findings was rated slightly better in teleconference, but the overall rating of the educational value was less than expected. This apparent preference for cases discussed in the co-located setting is also reflected in the results of other evaluations of teleconference reported in Delaney et al. (2004) and Macaskill et al. (2006). In reporting high levels of satisfaction for many attendees, Fielding et al. (2005) noted comments that face-to-face meetings are preferred and those with less satisfaction scores do not always attend meetings.

9.5 Conclusion on Information Capture exercise

The pattern of results demonstrate how people utilise the communication mode that engages the least cognitive demand to satisfy their information need. The mode of presentation of information is very important for the effort to be successful. Both audio and visual sources are used by individuals to elicit the information needed; the choice depending on the quality of the medium. Thus, the efficiency of the meeting is greatly influenced by the attention given to the mode and communication media utilised.

The importance of good quality audio to support interactions, particularly in teleconference is highlighted. Also, the visual presentation of data is demonstrated to influence the successful communication of that information, seen in responses to Age and 'Cancer status' questions with the use of the revised template for display.

Observers at meetings find it difficult to capture information from others' dialogues and results show that communication through the use of artefacts, such as radiology and pathology, improves the clarity of the communication within the MDTM setting. For information to be successfully retrieved from dialogues, the information needs to be explicitly articulated in discussion or supplemented with clear visual data.

In being more willing to submit responses to discussions in teleconference, even if incorrect in some cases, respondents achieved enough correct responses to make them statistically more efficient, i.e. there was a higher number of correct responses in teleconference. This willingness to offer agreement with decisions, even though the decision itself was not necessarily retrieved properly, may reflect an issue mediated by the technology in the discussion. Rutter, Stephenson & Dewey (1981) proposed in their model of cuelessness that it is the aggregate of cues that determines the psychological distance; the fewer the cues, the greater

the psychological distance. This psychological distance has been demonstrated to increase the symptoms of depersonalisation, disengagement and uninhibited behaviour (Siegel et al. 1986, Sellen 1995) and suggests that more visual data would provide more cues, reduce the psychological distance and reduce the error rates in data gathering from teleconference PCDs. Although the reduction in cues is associated with higher response rates in these data, increasing the response rate and reducing the number of errors is the objective. In medical work, a non-response (or 'no opinion') is preferred rather than a response that might prove to be an error, since a non-response renders the communication deficiency visible and provides a prompt that more data is desired. If a role, such as the MDT Co-ordinator, takes notes during a PCD, it is important that those notes are accurate. The data here suggest that in the current set ups that there is a reduction in cues available in teleconference that has the effect of increasing the psychological distance for participants. Improved visual displays for the teleconference link would provide more cues and additional visual displays for patient data would help reduce the error rate.

Although there were some errors recorded, information retrieval at MDTMs is possible and for discussions held in teleconference the correct response was submitted more often than in co-located scenarios, even though the co-located meetings were generally rated more favourably than teleconference discussions. Thus, teleconference appears to add more efficiency to information retrieval in MDTM patient case discussions.

Developments in technology such as teleconferencing has engaged CSCW research in the past, but there remain issues that are not fully understood: why teleconference appears more successful but does not always rate as satisfying as co-located discussions, for example. Efforts to support synchronous communication have tended to concentrate on 'same time, different place' issues (Kathleen E. Finn & Wilbur 1997). Results here identify a need to support 'same time, same place' co-located dialogue that would make meetings more efficient. Given that work environments are becoming more interactive in the execution of tasks, especially healthcare, efforts to support interactive, non-physical, work tasks would be worthwhile.

Chapter 10

Patient Case Discussions

In this analysis of multidisciplinary medical team meetings (MDTMs), the patient case discussions (PCDs) informed through ethnographic observation are described in Chapter 5. Here, the PCDs are inspected in quantitative detail, derived from the video recordings of meetings, in an effort to characterise the discussions and to determine what effect, if any, the introduction of teleconferencing has on the proceedings. Jordan and Henderson's (1995) foci of analysis include 'Segmentation', 'Turn-taking' and 'Participation Structures' and these foci serve as a backdrop to the analysis in this chapter.

The structures by which members of the team interact during a patient case discussion are elucidated. It will be shown how the PCDs are highly structured events. The PCD progresses through a series of stages, defined as D-Stages, and different specialist roles contribute in a particular way within each D-Stage.

Teleconferencing is shown to have an effect on the PCD, with those held in teleconference taking, on average, 56% longer to achieve. The D-Stage structure is relatively unaffected however, and the extra time needed in teleconference is explained by the extended duration of vocalisation (talk spurts) of participants ($p = 0.000$). The reason for this difference is not easily explained and conflicts with findings of other reported results of field and laboratory experiments (Finn, Sellen & Wilbur 1997).

It is suggested that a deficiency in the audio-visual support is responsible for the extra time needed in teleconference.

10.1 Background

There are two main areas of literature that contribute to the analysis of the data in this chapter, namely interaction analysis and studies on groups mediated by technology. Firstly, work on interaction analysis and on structures in talk is outlined. Relevant work on groups mediated by technology is then reviewed especially those studies that have examined the effect of teleconferencing on speech interactions.

A generally accepted goal of Interaction Analysis is to identify regularities in the ways participants use their resources in their environment (Jordan & Henderson 1995). The segmentation of an event is the identification of an internal structure that is recognised and maintained by the participants. For PCDs, this segmentation is described in the definition of D-Stages in the discussion. Transitions from one

segment to another has been of particular interest to interaction analysis researchers and it is pointed out that the negotiation of seamless transitions is particularly important in complex work settings (Jordan & Henderson 1995).

The concept of 'participation structures', or frameworks, where individuals share a common task orientation is a useful way to examine the specialist roles in the PCD and within different D-Stages of the PCD. Participation structures are described by Jordan & Henderson (1995) as "fluid patterns of mutual engagement and disengagement". It is accepted that participation structures will make visible mutual availability and alignment and that the work done through participation frameworks provides the interaction infrastructures through which collaboration and co-ordination can be achieved among individuals (Jordan & Henderson 1995). The maintenance of such social structures is provided through the mutual visual and auditory availability of participants' activity. Thus, examination of the interaction infrastructure through the analysis of role and speech contributions in D-Stages of PCDs will help understanding of the dynamics of the proceedings.

There have been numerous studies of groups being mediated by technology and analysis of the work is complex because of variation in the study method, technology used or nature of the group and tasks. Reported results vary widely in their findings and have been contradictory. Early work by Ochsman & Chapanis (1974) concluded that the single most important decision in the design of a telecommunication link should center around the inclusion of a voice channel and that the addition of a video channel has no significant differences in the communication times or behaviour. Using 'time' as an objective measure of efficiency, communication through an audio/video link is found to be less efficient than when collaborators are co-located (Fussell, Kraut & Siegel 2000, McGrath 1992). Some research suggests that video is useful for physical tasks that are inherently visual and that views of each other's work spaces is more effective than 'head-to-head' views (Whittaker 2003). In contrast, teleconferencing makes no difference and is as good as face-to-face interaction in a problem-solving task (Chapanis 1975, Gale 1989, Masoodian, Apperley & Frederickson 1995), and negotiation tasks (Sellen 1995). Some research found that speech was similar, the speed and accuracy of work was no better and that video served as a distraction and made the experience worse (Matarazzo & Sellen 2000).

McGrath (1992) extracted some generalisations from the literature with regard to computer-mediated communication for group behaviour. Firstly, the amount of interaction or participation is found to be more equally distributed in computer-aided groups because there is a great reduction in the total number of acts in computer-mediated as compared with face-to-face interactions. Secondly, groups with computers take longer to carry out a given task than face-to-face groups (in spite of having less participation), at least when the group is inexperienced with the technology, and they are less likely to reach consensus. Groups mediated by computers have demonstrated higher quality on certain tasks such as idea generation (Bly 2003). McGrath argues that it may be the task structure rather than the computer mediation that influences the higher quality because computer-mediated groups tend to be more organised, a fact on which O'Conaill, Whittaker & Wilbur (1993) agree. McGrath attributes this greater organization because groups have more procedures to simplify the handling of complex information. Thirdly, results for user satisfaction, comparing computer vs. face-to-face, have been equivocal and about evenly split between studies of higher, lower and no difference for computer groups (McGrath 1992). In making these generalisations, McGrath

noted that the vast majority of research on which he based these generalisations is static, i.e. involving ad hoc groups using computer systems for a single session compared with face-to-face groups whose members are used to working face-to-face all their lives.

On the other hand, studies demonstrated that video added benefits to the process, outcome or user experience (Olson, Olson & Meader 1995). Neither visual communication nor physical presence alone proved to be a critical variable for Rutter, Stephenson & Dewey (1981) who found that the more cue-less the settings, the more task-oriented, depersonalised and unspontaneous the conversation and suggest that the primary effect of cue-lessness is to influence verbal content. More recent work by Olson, Olson & Meader (1997) found remote work with high-quality video is as good as face-to-face, and remote work without video is not as good as face-to-face. They also found that video in remote work is preferred over audio-only, but equally to face-to-face work.

Early research tended to concern itself with issues surrounding visual information in communicating awareness, at the expense of visual information about the objects under discussion, and concluded that visual information is important for conversational efficiency and especially referential communication (Gergle, Kraut & Fussell 2004). Research focus more recently shifted to investigation of the usefulness of seeing others' workspaces. Early work on video was seen to have neglected the importance of shared objects as part of a shared context and video has been considered to have more potential if used for tasks that involved the use of complex 3D objects (Whittaker & O'Conaill 1997). Although Olson, Olson & Meader (1997) found that distributed groups produced work that was indistinguishable in quality from face-to-face groups using high quality audio and video, they prompt the question of whether trust and co-operation can be engendered if people engage in discussion by video, and suggest it is not achievable given the fragile nature of electronic communications in facilitating the building of common ground (Olson, Olson & Meader 2000).

Isaacs & Tang (1993) conducted substantive workplace studies on the use of video, and they found that the advantages of video depend critically on the near instantaneous transmission of audio, thus emphasising the importance of high quality audio to gain the benefit of video. The importance of supporting talk through audio and visual support was recognised by Veinott et al. (1999) who concluded that video *does* matter, not only in formal negotiations, but also in the more subtle and daily negotiations of meaning in ordinary conversations. Research on the use of video to support interaction is intrinsically linked to work on talk. While much effort has focussed on visual inspection and building common ground through observing workspaces, inspection of conversation patterns and talk has been used in investigating the effect of video on peoples' interactions (Clark & Krych 2004, Isaacs & Tang 1993, Sellen 1992).

Research on turn-taking systems in talk was identified as a topic of interest by Sacks, Schegloff & Jefferson (1974) who suggested that identifying how a turn-taking system can adapt to, or is constrained by, a particular activity can yield information about that activity. Since the early work by Sacks, Schegloff and Jefferson (1974) much has been written on 'turn-taking' and to interaction analysts 'turn-taking' involves much more than 'talk' and includes turn-taking with bodies and artefacts (Jordan & Henderson 1995). For the purposes of the analysis in this chapter the term 'turn-taking' is being avoided because of the variety of definitions in literature. The data gathered for this analysis concerns 'talk', i.e. speech, and the word vocalisation is used for clarity. (Definitions are given in Section 10.3.)

Aspects of conversation, and the distribution of talk among participants, have been the focus of much research on small group behaviour (Bales 1950. Reprinted 1976.) and the effect of communication technology on speech patterns (Sellen 1992, O'Conaill, Whittaker & Wilbur 1993, Cohen 1982). Sacks, Schegloff & Jefferson (1974) noted that conversation can accommodate a wide range of interactions, be sensitive to various combinations and can adapt to deal with changing situations. The organization of turn-taking for conversation was identified as the formal context-free apparatus that can be sensitive in local instances of its operation and "exhibit its sensitivity to various parameters of social reality in a local context" (Sacks, Schegloff & Jefferson 1974). Furthermore, conversation is identified as a collaborative activity and the length of a 'turn', or vocalisation, is determined both by the current speaker and potential next speakers working jointly.

When people work together in joint activity they try to ground what is said and grounding is most efficient when individuals can monitor each other's voices, faces, gestures and workspaces (Clark & Brennan 1991). Co-ordinating attention between the 'sender' and 'receiver' of a message is considered essential for satisfactory communication between people. Conversation speech is perceived by ear and eye: visual articulatory information is integrated with acoustic information in a highly complex process. Watching congruent articulatory gestures improves the perception of acoustic speech stimuli and in some instances observing talker's articulatory gestures that are incongruent with acoustic speech can change the auditory precept (Tuomainen et al. 2005).

Being able to monitor workspaces was found to be critically important in physical work tasks (Clark & Krych 2004) and enables people to communicate and ground their conversations efficiently (Hadelich et al. 2004). Visual-feedback (in terms of shared work spaces) has been shown to have an effect on the smoothness and effectiveness of linguistic communication (Hadelich et al. 2004) and reduces overall collaborative effort (Gergle, Kraut & Fussell 2004). Clark & Wilkes-Gibbs (1986) used a study of noun phrases in demonstrating how participants in conversation bear mutual responsibility towards understanding each other's utterances and in keeping with the principle of least collaborative effort, showed that the more effort speakers put onto the initial noun phrases, the less refashioning it is likely to need. Remote gestures were found to influence the structure of collaborative discourse (Kirk, Rodden & Fraser 2007) and while one party might communicate feedback by poising, pointing, eye gaze and head nods, speakers often responded by altering their utterances mid-course, timed with precision (Clark & Krych 2004).

With specific regard to the effect of technology on face-to-face interactions, while Sellen (1992) did not report any difference in objective speech measures and Cohen (1982) found teleconferences to be more orderly and polite with fewer interactions, others found that conversation over ISDN lines was characterised by significantly fewer turns of greater length (O'Conaill, Whittaker & Wilbur 1993) and that the overall proceedings took longer with a greater equality of participation (Bordia 1997). In contrast, more frequent and shorter turns were reported in video conferencing than in a face-to-face setting by Isaacs & Tang (1993). The difference in findings in studies may be due to the technologies employed or the conditions in which the studies were undertaken which varied from desktop video-conferencing (Isaacs & Tang 1993), or over ISDN lines with half duplex and poor vision (O'Conaill, Whittaker & Wilbur 1993) and various video-conferencing systems (Sellen 1992). The Telesynergy® system, described in Chapter 3, Section 3.7, connects to remote sites over ISDN lines, utilises full duplex audio and is considered to produce good

quality video images (Martino et al. 2003), but not to high resolution level.

Reported studies were mostly based on laboratory experiments with dyads and while Sellen (1992) reported on a debate and the experiment reported by Williams (1975) involved brainstorming, most others involved some task or physical activity, such as building blocks (Clark & Brennan 1991), bicycle repair (Kraut, Fussell & Siegel 2003) or map reading (Veinott et al. 1999) with dyads, mostly, where instruction and listening or interpretative tasks were involved. In this study of MDTMs there are several differences compared to reported studies. First of all, this study is conducted in its natural work setting, with a group of 5 to 9 active participants (rather than dyads). The nature of the collaborative task is *not* physical but is conducted through talk and the exchange of ideas. Most reported studies involved physical tasks. Apart from the radiologist and pathologist (who support their presentation with artefacts), the active participants remain relatively still. Unlike studies such as Greenberg (1990) where users interact through the use of tools, or work on a shared whiteboard (Gale 1989), MDTM participants sit in a theatre-like arrangement, all facing the screen display. Two main tasks are performed in the course of a PCD: 1) a problem-solving task in determining the patient's diagnosis and 2) a planning task in determining the course of treatment to be followed. No physical product results from the activity of discussion (apart from the paper record summary generated post-meeting). In the process of executing the MDTM tasks, information is exchanged verbally and sometimes some of the participants use images to illustrate their findings. Each of the participants is an expert in his, or her, own field and contributes their specialised knowledge, experience and opinion to the discussion. Collaboration is achieved through talk and the MDTM tasks have more in common with debate (Sellen 1992) or negotiation tasks (Short, Williams & Christie 1976) than with physical work investigated by Kraut, Fussell & Siegel (2003).

Pointing and gesturing are sometimes observed, but relatively little compared to other work settings in reported studies (Pinelle, Gutwin & Greenberg 2003). At MDTMs studied here, participants can see each other's workspaces across the teleconferencing interface. They don't always have a clear image of people's faces across the interface (described more fully in Chapters 6 and 5) and they must sacrifice this view whenever they choose to see an artefact. Telesynergy® provides a document camera and a microscope and can display either the document view, the microscope view or the person view, but not more than one at a time. Participants do not individually handle any computer technology except for the radiologist and pathologist who have limited interaction with a document reader, a PC and/ or, a microscope.

10.2 Hypotheses

Work on conversation suggests that the PCD, as a product of joint activity, can be characterised and can be shown to have a predictable structure. This structure is likely to demonstrate flexibility while maintaining its overall integrity. An examination of the meetings with regard to the number of cases on the agenda for each meeting and the time taken for each meeting will establish if this feature holds true for PCDs.

The internal structures identified and defined for a PCD are shaped by the progression of the discussion and through the talk structure and role differences in contributions in different parts of a case discussion. PCDs can be characterised based on objective measures: number of participants, number of vocalisations, number of vocalisations per participant and amount of vocalisation in a PCD. Analysis of these profiles

in two conditions, i.e. teleconference and co-located scenarios will allow for an examination of the effect of teleconference on the MDTM proceedings. Although structures have not been examined directly in the literature, results of Jordan & Henderson (1995) suggests that there will be no difference between co-located PCDs and those held in teleconference.

Results from small group studies by McGrath (1992), suggest that PCDs in teleconference can be expected to be more organised and have fewer 'acts'; there will be less participation in teleconference and they will take longer than co-located PCDs. McGraths (1992) work also suggests that PCDs in teleconference may be less likely to achieve agreement. Given that McGrath acknowledged that inexperience of the group with the technology may account for differences observed, and that the most recent substantive work of Olson, Olson & Meader (1997) found no difference between the group mediated by high quality audio and video, it can be expected that PCDs will be unaffected by teleconferencing technology.

Differences that may emerge from the comparison of structures in co-located and teleconference settings may be associated with conversation and audio-visual feedback. Explicit efforts to ground conversation are likely to be more evident in teleconference discussions.

10.3 Method

The research approach is detailed in Chapter 3, Methodology. The particular action taken in conducting the analysis reported in this chapter is given here and the definitions used when annotating the recordings are given in the next section for convenience. The analysis reported is based on measurements obtained from video recordings of MDTM proceedings. Of the 20 meetings recorded, 19 are used in the analysis. Measurements from week one are excluded from the quantitative study to minimise any effect that the introduction of the camera equipment may have had on the proceedings.

The video recordings were annotated using Elan (MPI 2005) and the measurements analysed in a statistical package.

The information gained from ethnographic observation provides the framework within which the video analysis is conducted. The review of the video recordings also informed the general understanding and allowed for hypotheses to be examined and revised.

The method of examination of the MDTM proceedings followed the "foci of analysis" of Jordan & Henderson (1995). The structure of events within the MDTM, i.e. the segmentation, the temporal organization of activity, turn-taking practices and participation structures are examined. The turn taking practice followed content-free approaches (Jaffe & Feldstein 1970, Dabbs & Ruback 1987, Sellen 1995) with some modification (described in the following section). The tradition of content-free analysis, led by Jaffe and Feldstein (1970), analyses the patterns of sounds and silences in monologues and dialogues. Dabbs and Ruback (1987) applied the examination of on-off patterns of vocalisations to provide useful information about group processes. Focussing on content-free measures in PCDs aimed to gather information on the paralinguistic and non-verbal features of the group interactions. Furthermore, this content-free approach alleviated research responsibilities under the data protection legislation (Data Protection Act 2003, Data Protection Act 1988) and enabled greater co-operation among team members in this study.

The MDTM is composed of several PCDs and a PCD can be considered as one of Jordan's (1995)

"ethnographic chunks". For each of the recorded meetings, the individual PCDs are segmented and the overall length of a PCD examined, in the first instance. Following segmentation of the MDTM into PCDs, the individual PCDs are subdivided by defined D-Stages. These levels of segmentation were undertaken as 'layer' within Elan (MPI 2005). A further layer of vocalisation and silences was generated for individual PCDs. Each vocalisation was marked with an individual speaker identifier which allows for individual and role differences to be examined.

Examination of the structures within a case discussion, determined by definition of the activity, allowed for the quantification of the different parts of the proceedings. Quantitative data of the elements, D-Stages, within a case discussion allows the elucidation of the internal structures, and an estimate of the stability (or variability) within those structures. Other measurement data were collected to further characterise the discussions and to determine if the use of teleconference affected the MDTM proceedings. Those measures used are the number of vocal participants, the length of time spent in a PCD (i.e. PCD duration), the number of vocalisations per PCD, the number of vocalisations per participant, the length of a vocalisation, silences and 'group talk'. Parameters are examined for the overall PCD and at each D-Stage of the discussion. The vocalisations are also examined as a measure of the role contribution and role contributions are examined in each of the D-Stages for both co-located and teleconference discussions.

10.3.1 Definitions used

Definitions used for the objective measures of conversational structure followed the approaches of Jaffe & Feldstein (1970), Dabbs & Ruback (1987) and Sellen (1992). Turn-taking in speech contributions to the meeting was annotated according to the following definitions:

Vocalisation: is a talk spurt that lasts a minimum of 1 second. The first unilateral sound defines the start of a vocalisation and it must continue without interruption for at least 1 second. The vocalisation ends when another individual vocalisation or group talk begins. A duration of 1 sec was chosen because there are many exchanges that last approximately 1sec, and many events that are shorter than the definition used by Sellen. This definition of a vocalisation has similarities to the *'turn'* used by Sellen (1992) but differs in two respects: a) the minimum duration used here is 0.5 seconds less than Sellen's definition of a 'turn'; and b) Sellen defined her 'turn' as a series of talk spurts that extended over the period that the speaker 'has the floor'. In this study, if a pause lasting 1.5 occurred during the talk (Sellen's 'turn') period, the pause is counted as a 'silence'.

Silence: A period without talk, that lasts a minimum of 1.5 seconds, is called 'Silence'. The definition of *silence* is similar to Dabbs' concept of *switching pauses*, but includes *pauses* that may occur between vocalisations by an individual speaker.

Group Talk: Similar to the definition of Dabbs & Ruback (1987) 'Group Talk' is defined as beginning "when an individual speaker has fallen silent and two or more others are speaking together" for a minimum of 1 second. The Group Talk ends the instant any individual is speaking alone or a period of silence begins.

Measuring absolute turn times in this way is both content- and context-independent, since it relies on intervals of talk and silence, and therefore avoids biases in annotation of turns (Jaffe & Feldstein 1970, Sellen 1992). Complex approaches to the definition of 'turn-taking' are avoided such as that of Sacks,

Schegloff & Jefferson (1974). The definitions used here also differ from those of Dabbs & Ruback (1987) and Sellen (1992) in that the term 'turn' is not included. Instead, the simple definition of vocalisation or 'utterance' that lasted for over 1 second is used.

The overall case length within the MDTM was measured, based on the following definition:

Case length: The start of a case length is the opening of a case discussion which commences with an announcement by an active participant of the patient to be discussed. Typically, the announcement is made thus:

> "The next patient is John Doe. Who's looking after him?"

The presentation of clinical findings follows by the doctor designated to look after John Doe. The end of a case length is determined either by a formal closing, or the start of a new case. An example of a formal closing, which happens in most cases, is:

> "So, John Doe will have a PET scan and Dr. Amber will see him in her clinic with a view to surgery, as soon as that PET result is available."

Sometimes, there may not be any clear announcement in closing, but this is an uncommon event.

D-Stages within the case discussion are measured according to the definitions of D-Stages given in Chapter 5, Sections 5.2 to 5.5. Sometimes it can be difficult to categorise the D-Stages in PCDs strictly according to the definitions given in Chapter 5. The distinction between D-Stages 1 and 2 become blurred if questions for the presenters commence early in the presentations, and the proceedings may drift slightly from their usual conduct. These occurrences (2) are labelled D-Stages 12 (see Table 10.9).

D-Stages 34 represents discussion where the decision was not clearly summarised at the end, but was articulated during the discussion in D-Stage 3.

Speaker switches, overlaps and simultaneous speech patterns are not annotated for these meetings as the proceedings are relatively formal and occurrences of these phenomena are rare.

10.4 Patient Case Discussion (PCD) analysis

A preliminary analysis was conducted on recordings for weeks 3 and 4 and reported in Kane & Luz (2006) and Table 10.1. This analysis served as an initial investigation and prompted the more detailed investigation reported in the remainder of this chapter.

The vocalisation distribution among speakers was calculated, following common practice in content-free analysis (Dabbs & Ruback 1987), using the notion of *entropy* Shannon & Weaver (1949). Entropy (H) is calculated for a probability distribution P of vocalisations by n speakers, where each p_i corresponds to the probability that speaker s_i is speaking at a given time during a case discussion, as set out in equation (10.1). It quantifies the average uncertainty about who is speaking at any given time. Intuitively, it is a measure of the degree of randomness in the succession of speech turns. When the setting is highly organised the value of H is low. This metric is of special interest here since it can be uniformly applied across case discussions to determine if the use of teleconference affected discussion structure. Measuring entropy is not intended as a substitute for close inspection of content but rather as a first approximation which is sensitive to structural variation in dialogues (Jaffe & Feldstein 1970).

$$H = \sum p_i log \frac{1}{p_i} \tag{10.1}$$

Table 10.1: Average number and duration of individual turns, people participating, informal exchanges, group turns, silences and entropy (H) per case.

Parameter	Welch's 2-sample t-test	Teleconference	Co-located
Time spent per case	$p < 0.006$	x	$\frac{2}{5}x$
Number of turns/min. per case	$p < 0.025$	5.3	8.6
Turn Duration (in seconds)	$p < 0.001$	13.14	7.42
No of active participants	$p < 0.002$	8.62	7.00
% informal conversation	$p < 0.016$	0.13	2.26
Turns per person per case	not sig.	4.06	3.48
Group turn duration per case	not sig.	2.17	1.66
No. Group turns/min. per case	not sig.	0.23	0.372
% silence per case	not sig.	3.28	4.29
Turn distribution (H Value)	not sig.	2.422	2.250

There is a considerable difference in the length of time for teleconference cases and those in a co-located session. The average duration of the case discussion during a teleconference session is 147% longer than at the co-located meeting. Welch's two sample t-test shows significant difference ($p < 0.006$). Neither turn distribution (H value), nor the turns per person per case are found to show any significant difference in the two scenarios. In fact, the remarkable similarity in turn distribution entropy for co-located and teleconference situations suggest a stable structure for case discussions which remains unaffected by communication constraints introduced by teleconferencing technology. This relative stability in the structure of the discussion is discussed later in page 187, and illustrated in Figure 10.3.

Patterns for group turns and silences apparently differed but statistical analysis revealed no significance in this result. In addition to the significant difference in the length of time per case discussion, there are significant differences in turn duration, number of turns per minute per case (fewer in teleconference) and number of participants per case discussion. While there is a measurable difference in the number of people actively participating in a teleconference ($p < .002$) the significance may be overstated since, by definition, a teleconference link involves more people. The figures nevertheless suggests that the roles played by participants at remote centres do not typically subsume those played by Centre A participants but rather complement them. The statistical significance demonstrated for mean number of participants in weeks 3 and 4 is not sustained in the full study (reported in the following pages) which supports the interpretation that there is a single team, geographically distributed, rather than a large group connecting with additional people.

10.4.1 Analysis of all 343 PCDs

The overall weekly mean length for a case discussion for 19 of the 20 meetings that were recorded, containing 343 cases, is given in Table 10.2, together with the mean duration for co-located and teleconference discussions. The mean overall length of a case discussion, of the 343 cases, is 242.2 seconds. The shortest discussion is recorded as 41.12 seconds and the longest is 780.39 seconds. The shortest case is a query

about a chest x-ray from a patient with a benign disease; it is straightforward and is not a full discussion in the usual sense of the term. Teleconference cases take longer. Levene's test for equality of variances, F, is satisfied and statistical significance is demonstrated at the 0.01 level (2-tailed) for the time taken in co-located and teleconference case discussions. Full results are given in Table 10.2.

It is noted in the MDTM proceedings that the number of PCDs can vary from meeting to meeting. For the weeks that were video recorded, there is a range from 7 to 26 patient cases with a mean of 19.61. As well as variability in the number of cases at each MDTM, the duration of an MDTM varied too. The mean duration of an MDTM is approximately 1 hour and 40 minutes with a range from 1.5 to 2 hours. The meeting starts at 0800 and lasts for, at least, 80 minutes. Due to time constraints set by other commitments, e.g. out-patient clinics at 0930, meetings rarely ever extend beyond 0945. Thus, although the number of cases on the agenda can vary as much as threefold, the overall MDTM duration is rarely over 1.75 hours.

Table 10.2: Mean length of case discussion (secs).

Scenario	N	Mean	Std. Dev.	F	Sig. (F)	t	Sig. (p)
Overall	343	242.2	133.02				
Co-located	282	230.81	124.84				
Teleconference	61	294.95	156.32	4.72	0.03	-3.47	0.001

It is apparent from observation that MDTMs in which teleconferencing is incorporated take longer than co-located MDTMs. This observation is supported in the quantitative measurements reported in Table 10.2. Results in Table 10.2 confirm that extra time is associated with actual discussion of patient cases and is not explained by the connection time nor 'openings' and 'closings' with the remote sites described in Chapter 5.

It can be expected that the joint activity through speech described by Clark & Krych (2004), whose product will determine the length of a case discussion, will be influenced by the number of cases on the agenda for the meeting. In other words, the number of cases on the agenda can be expected to influence the time spent on an individual PCD. In order to investigate if this is true, i.e. that the vocal activity adjusted to accommodate the volume of work on the agenda, the duration for each of the 343 cases is correlated with the number of cases on the agenda for the 19 weeks in which the cases were discussed. For each of the 19 weeks, a mean duration of a PCD is calculated and a note taken of the number of cases on that agenda. The number of cases per agenda is checked for correlation with the mean weekly duration of a PCD. The number of cases on the agenda is also correlated with the actual length of each of the 343 PCDs. Results of the correlations between the number of cases on the agenda for a meeting and the amount of time given to a PCD, and between the number on the agenda and the weekly means are given in Table 10.3.

To explore this finding further and investigate if the flexibility demonstrated holds true in teleconference, a separate mean duration for a PCD held in teleconference and for a PCD conducted without teleconferencing is calculated for each week. Correlations are checked between the number of cases discussed each week, and the mean duration of the PCD for the week in each scenario. Thus, the number of

cases on the agenda is correlated with the mean duration for PCDs in teleconference that week, and with the mean duration of co-located PCDs, for each of the 19 weeks. The result is shown in Table 10.4. While there is a statistically significant correlation demonstrated for co-located discussions for the mean length of a co-located PCD for that MDTM ($p = 0.000$), there is no statistical correlation for teleconference discussions.

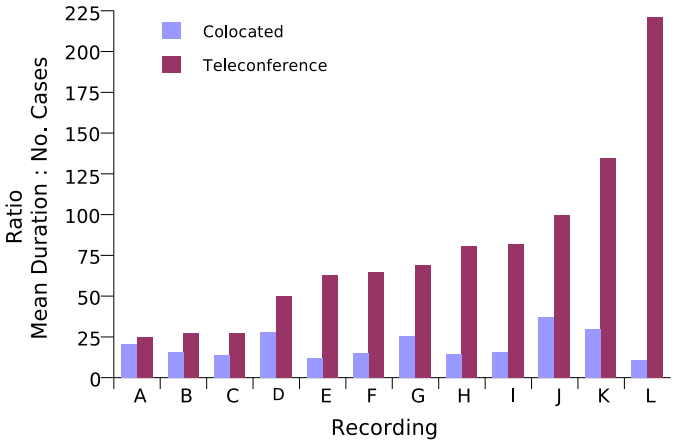


Figure 10.1: Ratio between the mean duration of PCD and the No. of Cases discussed in teleconference and co-located settings for each of 12 MDTMs.

Figure 10.1 shows the ratio between the mean duration and the number of cases discussed in teleconference and co-located scenarios for a set of recordings. Although statistical correlation (of the ratios) is not demonstrated within this sample, the figure shows that adjustment to the length of time given to a PCD, in consideration of the number of PCDs on the agenda, is more likely made in co-located PCDs than in teleconference. The ratio is relatively stable for co-located discussions and there appears to be an underlying trend for the ratio in co-located PCDs to be smaller when the ratio for PCDs in teleconference is large (i.e. when comparing ratios in Week A and L in Table 10.1).

These data are interpreted to mean that the participants are unable to make those adjustments necessary to accommodate the busier agenda in the teleconference discussions. It is not being assumed at this stage that the effect is due solely to teleconferencing. However, these data suggest that while the co-located PCDs seem to manage the length of the discussion to accommodate the agenda, the behaviour

Table 10.3: Correlation between the number of cases on an MDTM agenda for discussion and the mean PCD duration for that MDTM.

		Total Number of Cases 343	Mean PCD Duration for Week for each of 19 weeks
No of Cases on the Agenda for an MDTM for each of 19 weeks	Pearson Correlation		-0.731
	Sig. (2-tailed)		0.000

Table 10.4: Correlation between the PCD length and the number of cases on the MDTM agenda for teleconference and co-located discussions.

	Mean Duration PCD		
	Overall per week	Co-located per week	Teleconference per week
Total Number of cases	343	282	61
Pearson Correlation	-0.731	-0.790	0.005
Sig. (2-tailed)	0.000	0.000	0.969
Total Number of weeks	19	19	13

did not hold true for teleconference discussions.

A straightforward case of T.B. and a case of advanced small cell lung cancer will have differences. The T.B. case may only have one or two D-Stages and the number of specialists involved will be limited to a physician along with radiology and pathology. The advanced small cell lung cancer, by comparison, will have four D-Stages, may take much more specialist interaction to determine the extent of the tumour and will involve the medical and radiation oncologist in the discussion. Given that this asymmetry is expected in case discussions, because of the different disease types and the nature of the patient circumstances, it could be argued that examples such as the 41 second case (described on page 181) are skewing the data and that there is no difference between co-located and teleconference case discussions. In order to investigate if the difference noted in the data set of 343 case discussions is true, a sample of cases was selected for more in-depth analysis. The sample was selected by reviewing all cases discussed in teleconference (which are the minority of cases) and matching them with comparable co-located case discussions. Features for comparison are based solely on the patient's presentation and the specialist to whom the case was referred in discussion. For example, a patient with a limited stage small cell carcinoma who was referred for radiation therapy and whose managing consultant was on the remote side of the teleconference interface was matched with another patient with the same presentation (limited stage, small cell carcinoma) and same specialist for referral (radiation therapy) but whose case was being managed in the co-located setting, i.e. St. James's hospital. As far as possible cases are matched on tumour type, disease staging (T, N, M classification), presenting specialist and the decision outcome based on written patient notes and without reference to the audio-visual recordings.

After selection for the in-depth study was complete, the sample consisted of 54 PCDs and represented the types of cases discussed in teleconference. Of these 54 cases, 27 are discussed in teleconference and 27 in co-located setting, using the same room and equipment, over the period April 25th 2005 to February 5th 2007.

The group of 343 patient cases have much more variability in the nature of the discussion than the 54 cases selected for detailed study. Patients discussed at co-located MDTMs span a wider range of respiratory diseases than those examined within the group of 54 cases. But for the purpose of establishing if there is a difference in the nature of a patient discussions in teleconference, the narrower selection is made to match those cases presented from the remote site.

The disease profiles of the cases are summarised in Table 10.5 and shows an equal numbers of cases

Table 10.5: Disease category of the 54 selected cases for in-depth analysis.

Staging	N
T1	10
T2	14
T3	2
T4	6
Limited small cell	5
Extensive small cell	5
Pending diagnosis	2
Cancer unspecified	10

for each T stage and for cases pending diagnosis and where cancer is 'unspecified'. When cases from teleconference sessions were being matched with co-located cases it became apparent that cases whose origin was the remote site tended to present at a more advanced stage of disease than many of the co-located cases. Cases presented in teleconference from the remote sites tend to be either advanced cancers (T4 and extensive small cell tumours) or early cancers in patients with significant co-morbiditity that would make them unsuitable for surgery. For example, a relatively early cancer that might be technically operable becomes a case for palliative care if the patient has a very low ECOG score and poor pulmonary function tests. Furthermore there are relatively few cases from the local catchment area whose clinical stage of disease is as advanced as those referred from rural hospitals. There is no exact 'match' for one of the extensive stage small cell cancer cases and it is paired with a very complex limited stage small cell case in order to balance the level of medical complexity. This finding is a reflection on the distribution of lung cancer in Ireland and health service use in rural vs. city areas and is of medical interest. However, for the purposes of this study on how teleconference affects PCDs, this finding is not being explored further here.

Before proceeding to the analysis, the discussion length for the 54 cases is examined with respect to the number of cases on the agenda at that meeting to see if the correlation demonstrated in Tables 10.3 and 10.4 is maintained. There is no correlation between the length of time given to the 54 cases and the number of cases to be discussed on the agenda for that meeting. Neither is any relation demonstrated when the 27 co-located and teleconference PCDs are examined separately. The lack of measurable correlation supports the validity of this sample to investigate if teleconferencing impacts on the nature of the case discussions.

10.4.2 Results

Results of the video analysis of the PCDs is given in the following order. Firstly, the overall statistics are examined. Analysis at the level of D-Stages is presented next, followed by the presentation of findings on vocalisation. Then follows an examination of the pattern of silence. Role and vocalisations are finally examined with an analysis of Role contribution differences overall and at D-Stage level. Each variable characterising a PCD is examined, i.e. PCD duration, No. of participants, vocalisation, silence, D-Stages and role contributions, for co-located and teleconference scenarios.

When case lengths are examined for the 54 cases to be included in the detailed investigation, the

difference between teleconference and co-located discussions is statistically significant, $p = 0.000$. The mean duration of a teleconference case discussion is 56% longer than the mean duration for a co-located case discussion on the matched set of 54 cases. The results are illustrated in Table 10.6 and show statistical significance, $p = 0.000$. Figure 10.2 is a boxplot illustrating the statistical differences between PCDs in co-located and teleconference settings.

Table 10.6: Mean duration for the 54 selected cases for in-depth analysis.

Discussion		Time in seconds						Sig. p
Scenario	N	Min.	Max.	Mean	Std. Dev.	t	df	(2-tailed)
Overall	54	75.86	780.39	318.25	158.5			
Co-located	27	75.86	601.41	248.56	128.0			
Teleconf.	27	172.01	780.39	387.94	157.2	3.57	49.95	0.000

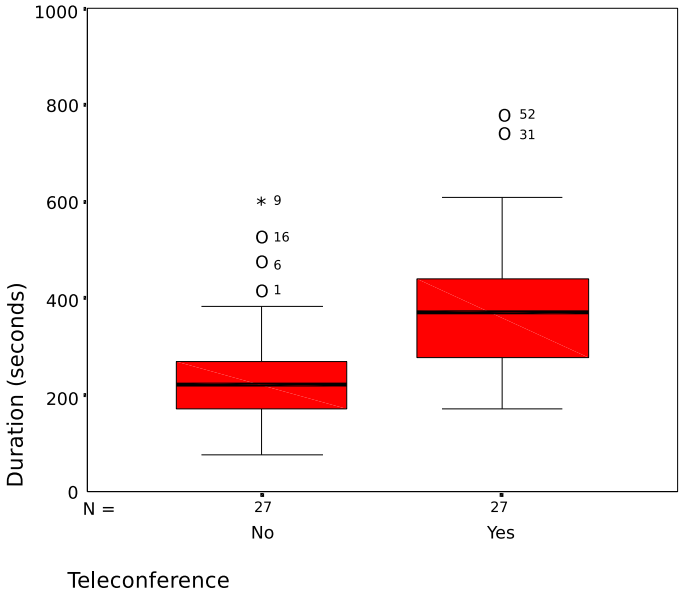


Figure 10.2: Case discussion duration in co-located and teleconference settings. The value 'o' is a mild outlier and '*' represents an extreme outlier case.

Of the 'case types' included, 50% (27 cases), or 4, 10 and 13 cases, came from three remote hospitals 1, 2 and 3 respectively. The 'internal' 27 cases are distributed as follows: 12 are 'house medical' cases, i.e. from the local catchment area and the remainder (15) were referred from rural hospitals (other than hospitals which connect in teleconference) and are categorised as 8 medical and 7 surgical referrals.

The number of active participants is measured and compared for co-located and teleconference case discussions. Results are shown in Table 10.7. When comparing means, there is no statistical significance to the observed difference between the two scenarios. But given that there are additional participants in the teleconference cases, by definition, a decrease in the number of contributors to the discussion from the main site is suggested in the results. This result prompts the description of a single team working over multiple locations, rather than multiple teams collaborating over a teleconferencing interface. This interpretation is reinforced by the analysis of Role on page 195. In the teleconference scenario, some of

the MDT roles are occupied on the remote side of the interface.

Participant data and summary pattern of vocalisation is presented in Table 10.8 and Silence is detailed in Table 10.14. There is no significant difference calculated between the number of participants, which conflicts with those studies that found *less* involvement in computer mediated settings (McGrath 1992, O'Conaill, Whittaker & Wilbur 1993, Cohen 1982). The number of vocalisations is not significantly different in teleconference, a finding in agreement with Sellen (1992). Neither is there any significant differences recorded in the number of vocalisations per person per case, nor the proportions of speech and silence in both settings, which differs from results reported by Isaacs & Tang (1993). However, similar to the findings of O'Conaill, Whittaker & Wilbur (1993), the length of vocalisation in teleconference is significantly increased.

Discussion Stages

It is described in Chapter 5, how phases can be identified within the patient case discussion. A case discussion can be subdivided into two main phases, or parts, each of which can be further sub-divided into two D-Stages. Thus, four discussion stages (D-Stages) can usually be identified in a case discussion.

The overall durations of these D-Stages are examined for the 54 cases selected for detailed study and the results are presented in Table 10.9 and graphically in Figure 10.3. When the mean D-Stage durations are compared overall, between those held in teleconference and in a co-located setting, a significant difference is found at the 0.05 level: $F = 11.34$, Sig $F = 0.001, t = -2.45, df = 195, p = 0.014$.

It is explained in Section 10.3.1 that not all PCDs have 4 D-Stages and the distribution of D-Stages among the 54 cases is shown overall in Table 10.9. D-Stage statistics for co-located and teleconference PCDs are also given in Table 10.9 and 10.10. Table 10.9 gives the mean number of D-Stages in co-located and teleconference discussion. It is statistically significant that there are more D-Stages identified in teleconference, reflecting the more orderly proceedings observed for teleconference PCDs. Table 10.10 shows D-Stages as proportions of the PCD, represented graphically in Figure 10.3.

Results show a statistically significant difference in the smaller number of D-Stages in a co-located PCD. This implies either more clear presentation in D-Stage 1, less reason to question in D-Stage 2, less need to consider options in D-Stage 3, greater understanding of the decision made in D-Stage 4, or a combination of these factors being in operation. Figure 10.3 and Table 10.10 show that D-Stages 1, 2 and 4 are shortened in teleconference PCDs and D-Stage 3 is extended, suggesting that the diagnosis may be clearer in teleconference cases, perhaps reflecting greater 'work-up' before the patient is brought for discussion. More time is certainly spent in teleconference PCD weighing up the best option for the patient. The reduced time spent in D-Stages 1 and 2 of the meeting could also reflect a reluctance on the part of

Table 10.7: The number of active participants in co-located and teleconference patient case discussions.

Discussion Scenario	Cases N	No. of Participants Min.	Max.	Mean	Std. Dev.	Significance p
Co-located	27	4	12	7.44	1.717	
Teleconference	27	4	11	6.89	1.672	No Sig.

Table 10.8: Overall characterisation of selected Patient Case Discussions.

Parameter	Mean		Significance
	Co-located	Teleconference	p
Participants	7.44	6.89	no sig.
Number of Vocalisations per case	36.85	32.89	no sig.
Number of Vocalisations per participant per case	4.9	4.78	no sig.
% Speech	93	95	no sig.
% Silence	7	5	no sig.
Silence instances	5.37	6.93	no sig.
Mean Duration Vocalisation (secs)	5.9	9.7	$p = 0.000$
Mean Total Vocalisation per case (secs)	230.7	367.5	$p = 0.001$
Mean PCD Duration (secs)	248.56	387.94	$p = 0.001$
	equal variances not assumed, $t = -3.6$, $df = 49.95$		

Table 10.9: Descriptive Statistics for Case Discussion Stages (D-Stages).

Discussion Stage	N	Duration Minimum	Duration Maximum	Mean	Std. Deviation
1	55	4	377.5	148.8	76.5
2	40	4.1	232.6	64.7	59.3
3	48	6.4	514.3	96.6	102.5
4	44	1.5	58.95	11.87	11.0
12	2	147.4	242.03	194.7	66.9
34	8	11.9	221.6	107.8	77.4

No. of D-Stages in co-located and teleconference discussions.

Setting	N	Min.	Max.	Mean	Std. Dev.	t	df	Sig (2-tailed)
Co-located	27	2	4	3.37	0.88			
Teleconference	27	2	4	3.85	0.72	-2.197	50	0.03

Table 10.10: D-Stages as a Proportion of the Patient Case Discussion (PCD).

	Mean Proportion of PCD Length (%)					
Discussion Scenario	D-Stage 1	2	3	4	12	34
Co-located	53	21	25	4.5	70	25
Teleconference	50	17	29	3.5	31	45.4

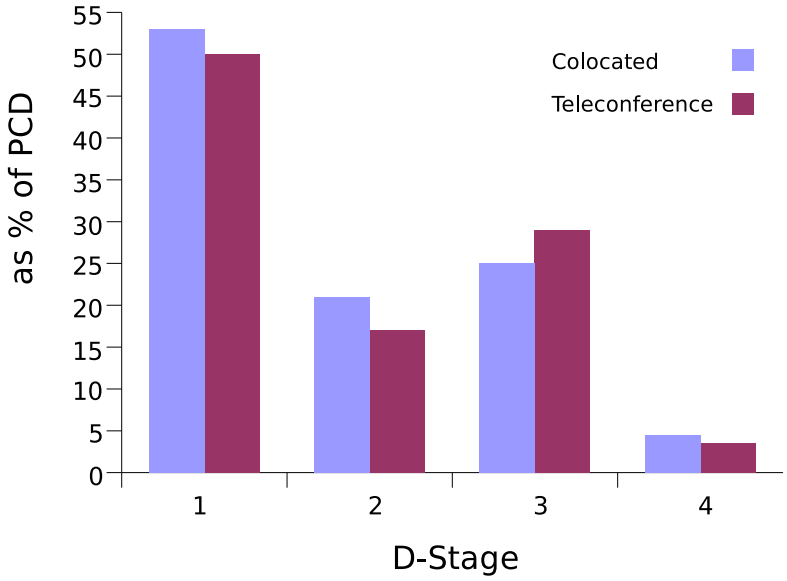


Figure 10.3: D-Stages as a proportion of the overall patient case discussion (PCD) in co-located and teleconference scenarios.

the main site to question the remote speakers and is accounted for in the reduced Role contributions of the radiologist and pathologist in D-Stages 1 and 2 (discussed on page 199 and differences are shown in Table 10.18). The shorter D-Stage 3 for co-located meetings is interpreted as reflecting a greater shared understanding among the larger group of the recommended treatment strategy for the patient, or greater common ground, among the group at the larger hospital.

No significant differences are calculated for D-Stages 2 and 3 in teleconference, but data suggests there is slightly less questioning of presenters in D-Stage 2 and slightly more discussion on management options in teleconference in D-Stage 3.

Results of more detailed examination of the individual D-Stages in teleconference and co-located discussions is presented in Table 10.11, and provides more detail for the pattern shown in Figure 10.3, with a statistically significant difference in D-Stage 1 in teleconference. A significant difference is also shown for D-Stage 34. The difference observed in D-Stage 1 will be reviewed in conjunction with results reported on Role and D-Stage on page 199.

The difference calculated for D-Stage 34 can be explained by the anomalies in those cases when a clear decision was not explicitly articulated after the decision was made. It is already reported that co-located case discussions tend to be less formal. Because of a greater shared understanding among the co-located participants, it can be commonly understood what the course of management for a patient will involve and the individuals concerned assume their responsibilities without necessarily verbally articulating their intention in conversation. The statistical significance observed in D-Stages 34 (Table 10.11) may not seem relevant, since D-Stage 34 is not a very common occurrence, but the result is revealing. The number of instances when the latter part of the case discussion became 'blurred' are much fewer in teleconference, and relatively high for co-located PCDs. This finding is interpreted to mean that a.) there is clearer articulation of the patient management plan in PCDs in teleconference (as described in Section 5.5) and that b.) in

co-located discussions active participants do not feel the same need for formal articulation, as they have a greater understanding among them of the decision they just agreed. In other words, participants at the main site are demonstrating greater general, or common, understanding in the discussions.

Differences in D-Stage 4 in teleconference are small and not statistically significant. However, in teleconference it has been observed (and reported in Section 5.5) that the remote parties are usually more explicit in stating their plan for treatment, i.e. the remote MDT member articulates to which of the specialists at the main site the patient will be referred.

Table 10.11: D-Stage level analysis of case discussions in Co-located and Teleconference scenarios.

		Discussion Stage (D-Stage) Duration							Sig. p
D-Stage	Scenario	N	Min.	Max.	Mean	S.D.	t test	df	(2-tailed)
All	Co-located	89	1.5	422.8	75.4	72.3			
	Teleconf.	99	3.8	514.3	105.8	99.1	-2.38	186	0.018
						F test of equal variance satisfied, $p = 0.001$			
1	Co-located	28	47.21	267.24	127.07	51.48			
	Teleconf.	27	80.7	377.5	187.71	74.12	-3.425	44.55	0.001
							Equal variance not assumed		
2	Co-located	19	4.4	200.1	62.4	51.8			
	Teleconf.	21	4.1	232.6	73.28	71.67			no sig
3	Co-located	21	13.5	422.8	78.6	97.14			
	Teleconf.	27	6.4	514.3	125.79	105.63			no sig
4	Co-located	19	1.5	46	9.8	10.35			
	Teleconf.	25	3.8	59	13.5	11.45			no sig
12	Co-located	1	147.4	147.4	147.4				
	Teleconf.	1	242	242.0	242				no sig
34	Co-located	6	11.9	159.3	76.2	58.8			
	Teleconf.	2	183.8	221.6	202.7	26.7	-4.14	4.5	0.01‡
							Equal variance not assumed		

Table 10.11 shows differences in D-Stages in co-located and teleconference scenarios. Although four D-Stages can be identified in a typical PCD, a mean of 3.61 is recorded. Among the 54 cases, 1 co-located and 1 teleconference PCD exhibited ambiguity between D-Stages 1 and 2. In those cases participants started questioning the radiologist on his result before the pathologist had made her presentation, and it is not possible to annotate according to the definition in Section 5.3.

For 8 cases, of which 6 are co-located and 2 in teleconference, there is ambiguity between D-Stages 3 and 4 and the second part of the discussion is labelled D-Stage 34. In other words, there is no clear D-Stage 4, but the decision is evident on inspection of the interactions. The fact that there is more ambiguity in the co-located PCDs, supports the proposition that co-located PCDs are less formal, i.e. less structured, than PCDs in teleconference. These atypical PCDs account for the classes of D-Stage 12 and D-Stage 34 in Table 10.9.

The significant differences identified in teleconference discussion have implications for technological support. Firstly, being more structured suggests that teleconference discussions would be easier to support. Presenter tools are used mostly in D-Stages 1 and 2, although not exclusively. Decision support in diagnosis and TNM staging would be most worthwhile in D-Stage 2, and clinical practice guidelines could be channelled into D-Stage 3, appropriate to the TNM agreed, when the options are being evaluated. Providing support for TNM staging would serve to reassure participants and safeguard against errors of categorisation; and the provision of current clinical practice guidelines to participants would allow attention to be focussed on the assessment of the individual patient's suitability for the different treatment approaches. Technological efforts to capture the final decision for record-keeping purposes could be focussed on D-Stage 4.

Vocalisation

The main parameters used to study vocalisation in this exercise are the number of vocalisations, their duration (i.e. length of vocalisation, or talk spurt) and the number of participants. The number of vocalisations per person and the total amount of 'talk' from each role is calculated.

The overall mean duration of a single vocalisation is found to be increased in teleconference and this is significant at the 0.01 level ($p = 0.000$). Table 10.12 gives the mean, max. and min. duration of a vocalisation in co-located and teleconference PCDs and t test result. The statistical difference in vocalisation duration is consistent in all D-stages in teleconference, except for D-Stage 4 and results are detailed in Table 10.12(b). D-Stage 4 is a short D-Stage and a small proportion of the PCD with relatively few participants. But there is a difference in talk demonstrated in D-Stage 4 in the discussion of 'Role' and it is shown in Table 10.19 to have significantly more silence (as a proportion of D-Stage 4) in teleconference.

The statistical significance for the duration of a vocalisation is shown to hold true for all D-Stages, except D-Stage 4, in Table 10.12 (b). However Table 10.13 shows that neither the number of vocalisations per D-Stage nor the number of vocalisations per person per D-Stage is significantly different in teleconference. These data are interpreted to mean that the duration of a single vocalisation is significantly greater in teleconference with a resulting greater amount of 'talk' in a PCD in teleconference. This pattern persists across all the main parts of a PCD and the structure of a PCD is relatively stable in both conditions (co-located and teleconference scenarios).

These data on vocalisation in PCDs are interpreted to mean that individual participants speak for longer in teleconference without any significant effect on the structure of the talk or conversational interactions. These results will be discussed later after the presentation of results on role and vocalisation on page 201.

Silence

During discussions it is not unusual for speakers to pause while articulating a point or there may be pauses between different speakers. From observation, it was postulated that analysis of silence would reveal difficulties in interactions across the teleconference interface and that analysis of vocalisation would be incomplete without including an analysis of silence during case discussions. The total amount of silence is calculated together with the number of instances of silence because, for example, a total silence of 10 seconds could represent a single pause of 10 seconds, or several pauses of shorter duration. Results for

Table 10.12: Descriptive statistics for vocalisations (talk spurts).

(a)

Scenario	Duration of vocalisation (talk spurt)							
	N	Min.	Max.	Mean	Std. Dev.	*t*	*df*	Sig.
Co-located	1140	1	123	5.9	9.1			
Teleconference	1075	1	158	9.7	18.3	-6.34	2213	0.000

(b)

		Vocalisation (secs)						
Scenario	D-Stage	N	Mean	Std. Dev.	Std. Err.	t	df	Sig. (p)
Co-located	1	407	8.13	13.2	0.65			
Teleconference	1	303	16.52	28.3	1.63	-5.265	708	0.000
Co-located	2	258	4.36	5.7	0.36			
Teleconference		222	6.86	10.0	0.67	-3.42	478	0.001
Co-located	3	334	4.42	4.7	0.25			
Teleconference		437	6.9	9.7	0.47	-4.338	769	0.000
Co-located	4	46	4.38	5.2	0.77			
Teleconference		61	4.96	8.1	1.04	-0.446	102.6	0.657
Co-located	12	18	8.19	8.5	2.01			
Teleconference		10	24.20	38.5	12.17	-1.715	26	0.098
Co-located	34	77	5.94	6.1	0.70			
Teleconference		42	9.02	17.2	2.65	-1.422	117	0.158

Table 10.13: Mean No. of vocalisations per D-Stage and the mean No. of vocalisations per person per D-Stage (calculated on a D-Stage by D-Stage basis) in Co-located and Teleconference case discussions.

		No. Vocalisations per D-Stage		No. Vocalisations per person per D-Stage		
D-Stage	N	Mean	Std. Dev.	Mean	Std. Dev.	Sig. (p)
D-Stage 1						
Co-located	28	11.2	6.5	2.24	0.94	
Teleconference	27	8.4	5.1	2.14	0.86	No Sig.
D-Stage 2						
Co-located	19	12.1	8.9	2.77	1.69	
Teleconference	21	8.9	7.4	2.2	1.2	No Sig.
D-Stage 3						
Co-located	21	14.8	15.0	2.98	2.04	
Teleconference	27	13.9	10.2	3.05	1.22	No Sig.
D-Stage 4						
Co-located	19	2.4	2.4	1.2	0.52	
Teleconference	25	2.2	1.3	1.13	0.37	No Sig.
D-Stage 12						
Co-located	1	18	-	3	-	
Teleconference	1	26	-	6.5	-	No Sig.
D-Stage 34						
Co-located	6	1	6.75	3.64	2.01	
Teleconference	2	2.67	3.67	3.17	0.71	No Sig.

silence in case discussions is given in Table 10.14. Overall, there is no statistically significant difference in the amount of silence in teleconference compared with co-located case discussions. Neither the number of instances, the total duration, nor the mean duration of a silence is significant in teleconference discussions.

When the D-Stages are examined, however, the proportion of silence in all D-Stages is greater in co-located discussions, but is only statistically significant in D-Stage 4 (Table 10.14 (b)). Closer inspection of the case details revealed that this result may be misleading as the data are based on a single co-located instance of silence and 7 instances of silence in D-Stage 4 in teleconference. Further study utilising a larger sample is necessary to examine the differences in silence in different D-Stages of a PCD.

Table 10.14: Statistics of 'Silence' in a Patient Case Discussion.

(a) Mean per patient case discussion (PCD)

Discussion Scenario	Min.	Max.	Instances Silence	Total (Secs) Silence	Duration (Secs)	Proportion (%) Silence
Co-located	1	12	5.4	17.8	3.3	7
Teleconference	1	13	6.9	20.1	2.9	5
	No significant differences calculated (for above)					

(b) Number and mean duration of 'Silence' events at D-Stage level of PCD.

Discussion Scenario	D-Stage	N	Mean (secs)	Std. Deviation	Significance
Co-located	1	89	3.66	2.3	No Sig.
Teleconference		80	3.23	2.1	
Co-located	2	28	3.23	2.2	No Sig.
Teleconference		33	2.94	1.9	
Co-located	3	26	2.27	0.9	No Sig.
Teleconference		61	2.65	1.8	
Co-located	4	1	4.42	0.4	$p = 0.001$
Teleconference		7	1.85	0.99	

Table 10.14 (b) shows that most of the silence events occur during D-Stage 1, a stage dominated by the radiology, pathology and clinical presentations (Table 10.18). There is no statistical differences noted in co-located and teleconference cases but these instances of silence are noteworthy in their number, and represent a high frequency of this sort of event in D-Stage 1. These silences represent pauses during the presentation of the radiologist while the relevant images are being located. Pauses are not apparent during the clinical presentations. These silences, particularly in D-Stages 1 and 2 mostly occurred during the radiologist's presentation and this interpretation is verified in the analysis of Role contribution of the radiologist discussed later in Section 10.4.2 and shown in Tables 10.18 and 10.19.

For the 54 recorded cases selected for detailed analysis, radiology images were either on film or CD / DVD. Typically the radiologist had to quickly review sets of images on film to find the point to illustrate

in his presentation. For image sets submitted on disc, there were time delays while the group waited for the images to load onto the PC.

The PACS system was implemented over the course of this study (discussed in Chapter 11, Section 11.6) but did not impact any of the 54 cases selected for the analysis in this chapter. Microscope slides were used to demonstrate pathology in the 54 cases. Over the period of study, the practice of photographing the relevant images pre-meeting and demonstrating features to the meeting as a presentation became popular. This practice is discussed in Chapter 11, Section 11.6 and cases in this analysis are unaffected.

There is no significant difference between the number of silence events in co-located and teleconference meetings, except in D-Stage 4. The silence in D-Stage 4 is explained by the pauses observed to allow for the remote clinician to articulate his plan for his patient having listened to the advice given by his MDT colleagues.

Role and PCDs

To further characterise the PCDs and explore differences in teleconference discussions, an analysis is undertaken to quantify the role contributions to the discussion. Table 10.15 outlines the roles that demonstrate significant differences and shows the mean duration of their vocalisations in co-located and teleconference settings. The roles are grouped to show the differences more clearly. The mean vocalisation duration for the roles of the surgeon, pathologist, radiologist and radiation oncologist is significantly longer in teleconference. The surgical registrar, a more junior role, demonstrates a very short mean vocalisation duration in teleconference but this calculation is affected by the small contribution of that role in teleconference discussions which is seen more clearly in Table 10.16. Data for the respiratory physician and the medical registrar are given for comparison purposes.

In Table 10.15, figures show that the surgeon, the radiologist, pathologist and radiation oncologist have approximately doubled their mean vocalisation duration in teleconference. It could be interpreted that some individual or role difference may be responsible for this doubling of vocalisation measure, so the data are examined at a finer grained level of detail at the individual level. Table 10.15 also shows the individual differences for the radiologist, pathologist and surgeon roles. There are two male radiologists, two surgeons (1 male, 1 female) and two female pathologists. The radiologists and surgeons are all at consultant level. One of the two pathologists is a consultant and the second is a more junior role. Examination of the results shows how both radiologists exhibit similar behaviour patterns, both statistically significant. In both cases the individual approximately doubled the duration of a vocalisation, 97.3% and 103.1% respectively. Similarly the surgeons can be seen to increase their duration of vocalisation. Surgeon 1 significantly increased his mean vocalisation duration (94.9%) and even though Surgeon 2 does not demonstrate a statistically significant difference, her mean vocalisation duration is increased by 39.6%. Pathologist 1 (female consultant) increased her mean vocalisation duration by 165.4%. Pathologist 2 shows a slight increase that is not significant.

If sex differences are responsible for the calculated differences, then both pathologists would exhibit the same change in behaviour. However, the pattern differs between the two pathologists and suggests that status or role differences influences this behaviour among the pathologists. Pathologist 2 is a more junior member of the team, and is given responsibility to explain findings at co-located meetings. In teleconference

Table 10.15: Mean duration of vocalisation for different roles and at individual level in Co-located and Teleconference case discussions in seconds.

Role	Mean vocalisation Duration		Significance
	Co-located	Teleconference	p
Cardio-thoracic Surgeon	5.6	9.79	0.000
Radiologist	9.84	17.46	0.002
Pathologist	5.44	11.74	0.005
Radiation Oncologist	4.42	9.53	0.009
Surgical Registrar	18.078	1.4	0.003
Respiratory Physician	4.37	4.66	0.595
Medical Registrar	11.4	5.2	0.221
Individuals			
Radiologist 1	11.43	22.55	0.021
Radiologist 2	7.97	16.19	0.009
Surgeon 1	6.183	12.05	0.000
Surgeon 2	3.89	5.43	0.293
Pathologist 1	4.56	12.1	0.005
Pathologist 2	9.6	10.1	0.867
Radiation Oncologist	4.4	9.5	0.009
Respiratory Physician 1	3.88	4.79	0.075

discussions the more senior pathologist is more active, and this may partially explain some of the differences. For the Radiologists and Surgeons and Pathologist 1, all demonstrated the same 'doubling effect' and all occupy the same consultant status.

These data also bear evidence to the lack of social equity exhibited by this group in teleconference. Pathologist 2 and surgical registrar, both more junior roles, have a shorter mean vocalisation duration in teleconference and a much reduced contribution. Of the roles listed in Table 10.15 all are male with the exception of the radiation oncologist, the pathologists and Surgeon 2. These findings are contrary to the greater equality in teleconference reported by Bordia (1997). Sex may be a factor influencing behaviour in PCDs, given that Surgeons 1 and 2 occupy the same roles but contribute differently to PCDs. (Surgeon 2 has a mean vocalisation much less than Surgeon 1.) But since both surgeons more than double their mean vocalisation in teleconference, suggests that the doubling effect is not due to sex differences. Furthermore individual role differences can be discounted given that this doubling effect is seen in both radiologists, both surgeons and the consultant pathologist.

Table 10.16: Role contributions, group talk and silence in PCDs, based on mean and proportion of vocalisation (talk spurts) per case for co-located and teleconference PCDs.

Role	Proportion of Time in Discussion (%)		Sig.
	Co-located	Teleconference	p
Respiratory Physician	12.6	7.8	0.002
Cardio-thoracic Surgeon	22.7	11.5	0.016
Medical Registrar	7.6	0.2	0.002
Surgical Registrar	3.5	0.03	0.013
Radiologist	28.7	22.5	-
Pathologist	6.6	5.04	-
Medical Oncologist	8.7	2.7	0.048
Radiation Oncologist	0.9	3.6	-
Oncology SHO	0.2	0.2	-
Nurse	0.6	0.06	-
MDT co-ordinator	0.05	-	
Remote Physician	-	15.9	
Remote Oncologist	-	24.3	
Remote Medical Registrar	-	0.5	
Technical Operator	-	0.1	
Group talk	0.6	0.4	0.048
Silence	7.2	5.2	0.000

Results so far suggest that there may be something about the functioning of these roles that differs in teleconference and may be responsible for the increased duration in vocalisation. The overall contribution of the different roles to the discussion is calculated as a proportion of a PCD and the results are given in Table 10.16 which shows the proportion of a PCD that the various roles occupy. Some roles from the main centre are significantly displaced by contributions from the remote sites. The displacement of the respiratory physician, medical and surgical registrars and medical oncologist can be explained by the fact that the remote parties occupy part of these roles. The overall proportion of the contributions from the radiologist and pathologist roles are not significantly affected in teleconference.

Although the mean vocalisation duration is affected (being longer in teleconference), the longer contributions do not result in a domination of the discussion by any particular role or individual. As a proportion

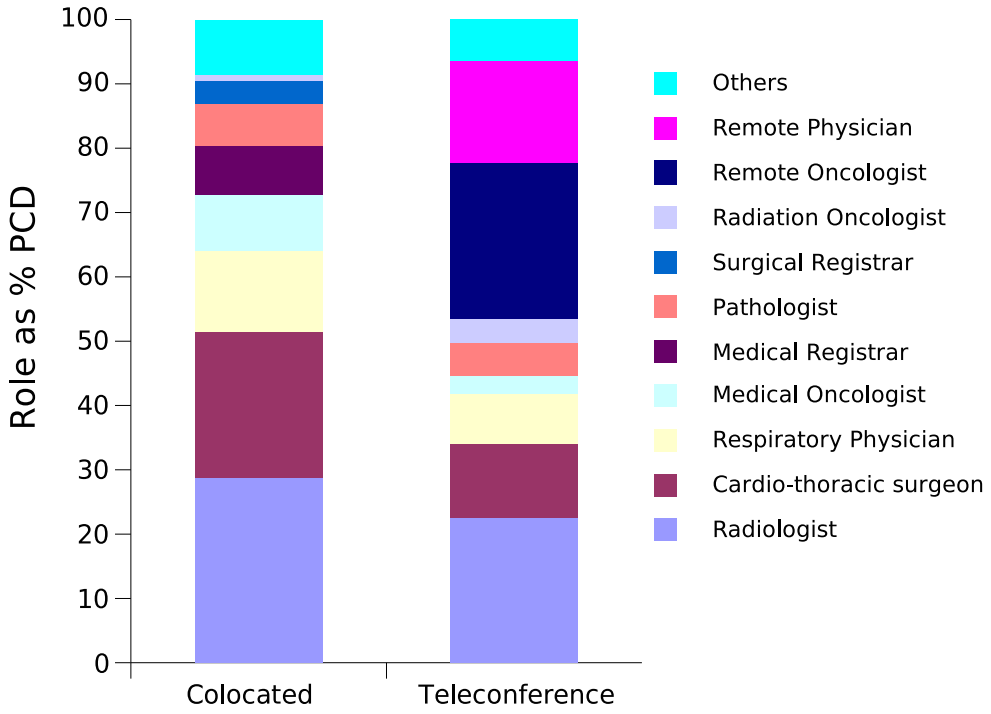


Figure 10.4: Role participation differences in co-located and teleconference case discussions.

of the case discussion the contributions are fairly similar, given that some of the roles are occupied on the remote side of the interface. Results in Table 10.15 show how some roles take longer in a single vocalisation, but this longer duration does not represent a greater role contribution in teleconference and shown in Table 10.16. The results suggest that there may be difficulty being experienced by the people in achieving the floor and that when they do, they command it for longer. To explore this possibility, more detailed statistics on the contributions of the radiologists, pathologists and surgeons are detailed in Table 10.17. Roles that might be occupied on both sides of the interface are excluded from the table. Only those roles that contribute from the main site are included.

Results in Table 10.17 support the proposition that there may be some difficulty for these roles in gaining the floor and that when they do, they maintain it for longer. Apart from the radiation oncologist, there are only slight differences observed between the two scenarios for the surgeon, pathologists and radiologists. Data for the pathologists and radiologists illustrate this point most clearly, since the contribution of these roles is the same in all PCDs. In other words, all cases have pathology and radiology input, whereas not all cases require surgical opinion or input. Differences in the total pathology contribution for teleconference PCDs is less than 88 seconds over 27 cases which is approximately 3 seconds per case. For radiology the difference in total contribution is approximately 15 seconds per teleconference case, or 0.7% and 3.9% of the PCD duration for pathology and radiology respectively. These data suggest that although the number of vocalisations is decreased in teleconference, the radiologists and pathologists actually speak more in teleconference, while the surgeon speaks less (overall). The radiologists and pathologists are notable in that they both demonstrate features in images in their presentations. While other members of the MDT might question, offer opinions or challenge other team members, the radiologists and pathologists

Table 10.17: Role contribution differences in Teleconference, based on mean duration of vocalisation (talk spurts) per case.

Role	Scene	N	Mean	Sum	Med.	Max.	Std Dev	*t*	*df*	Sig
Surgeon	Co-loc	272	5.6	1523.8	3.3	69	7.1			
	Telec	123	9.8	1203.7	3.9	104	15.4	-3.7	393	0.000
Pathologist	Co-loc	81	5.4	440.2	2.0	37	8.0			
	Telec	45	11.7	528.2	6.1	80	17.0	-2.83	124	0.005
Radiologist	Co-loc	196	9.84	1929	4.6	123.0	15.4			
	Telec	135	17.5	2357.2	4.7	158.3	29	-3.10	329	0.002
Rad. Onc.	Co-loc	14	4.4	61.94	3.24	12.9	3.45			
	Telec	39	9.5	371.57	5.22	47.8	10.19	-2.723	50.96	0.009

have a particular specialist role unlike any other in their consistent use of artefacts to accompany their contributions. These results will be reviewed later in conjunction with the further analysis at the D-Stage level in the next section.

Role and D-Stage

In this section, the differences seen in Table 10.16 and Table 10.17 are investigated in the analysis of 'Role' at the level of D-Stages. When the role contribution differences are examined for each of the D-Stages, the results show some differences that are given in Tables 10.18 and 10.19. Firstly, the findings are given as proportions of the PCD. The tests of significance reported are based on the amount of vocalisation for that role, within each D-Stage. Although there is no significant difference demonstrated between the role contributions in teleconference and co-located settings for many of the roles involved, differences are observed and are described here. The duration structure of the D-Stages is already shown in Section 10.4.2 to be relatively stable in teleconference (Table 10.10 and Figure 10.3).

Role differences observed in D-Stages are as follows:

D-Stage 1 All contributions at the main site are reduced to some extent to accommodate the remote participants, with the more junior roles being most affected. The radiology and pathology contributions, as a proportion of D-Stage 1 of a PCD, are significantly reduced in teleconference, by approximately 17% and 44% respectively. It is already shown in Tables 10.15 and 10.17 that these roles demonstrate the 'doubling effect' in the duration of their vocalisation and that while they also have a reduced number of vocalisations, the overall contribution to a case discussion is not markedly reduced. However, Table 10.18 suggests that the differences are most evident in D-Stage 1, the D-Stage in which both these roles make presentations of their findings to the group.

The remote oncologist occupies over one quarter of D-Stage 1 in teleconference and between the remote physician and remote oncologist they occupy almost half of this D-Stage. While this may sound high, it must be remembered that cases from the remote site (i.e. all of the 27 teleconference cases) are presented by the remote participants, and that the remote physician and oncologist incorporate the roles of medical registrar and surgical registrar that present during co-located PCDs. However, if the data are examined

with regards to the (radiologist + pathologist) vs. (the others) we can see that in co-located PCDs the ratio is approximately 50:50 but in teleconference that ratio is altered to 40:60 and suggests that clinical presentations from remote clinicians takes longer.

D-Stage 2 The surgeon, medical registrar and medical oncologist contribute less in teleconference. The reasons for these differences are probably role related. For the medical oncologist, for example, his role is also occupied on the remote side of the interface, and the reduction at the main site likely reflects a distribution of that role over both sides of the interface rather than any real reduction in the role to the discussion.

For the surgeon, the reduction probably represents a reluctance to question findings that are presented in teleconference by the remote site.

Talk by radiologists and pathologists in D-Stage 2 represents responses to questions on their presentations in D-Stage 1. The reduction (although not statistically significant) supports the interpretation that there is less questioning by main site participants of the remote presenters. It could also mean that the extra time taken by remote presenters in D-Stage 1 gives less reason to question their presentations in the second D-Stage. But if this is the case, one would expect that there would be significantly less time spent in D-Stage 2 in teleconference and this is not true (see Table 10.11).

D-Stage 3 Here, when the management options are being weighed, the surgeon exhibits less involvement in teleconference discussions and the radiation oncologist contributes more. The three main approaches to treatment are radiation therapy, chemotherapy and surgery, either alone or in combination. In D-Stage 3 the consideration of one of these options will displace discussion on the others. In these data, the extra time for the radiation oncologist displaces the surgical contribution. This is explained by the fact that the teleconferencing practice was established in the first instance to facilitate radiation therapy treatment planning. Remote participants have more questions for the radiation oncologist with respect to radiation treatment possibilities for the patient.

The differences demonstrated in this D-Stage are also a reflection on the nature of the cases presented and discussed on page 185. Surgery is more appropriate for patients with early stage disease, while radiation therapy is most often given to those with advanced disease.

Results also show that the contribution from the pathologist and radiologist is increased in D-Stage 3 in teleconference (Table 10.19). This represents more questions being asked of the radiologist and pathologist about the tumour classification and location and reflects less satisfactory presentation of findings in D-Stage 1 in teleconference by those roles using artefacts (i.e. the radiologist and pathologist). It is worth noting that the increase in contribution of the pathologist, relative to the radiologist, is related to their reduced contribution in D-Stage 1. Table 10.18 shows that the pathologist's contribution is almost halved in teleconference compared to the radiologist with an approximate 10% reduction, while in D-Stage 3 the pathologist more than doubles her contribution and the radiologist exhibits a smaller increase (approximately 10%). This adds further evidence to the fact that PCDs are highly structured discussions and predictable in the amount of contributions from the various specialist roles involved. It also highlights difficulties for both of these roles when presenting their findings in D-Stage 1 in teleconference.

D-Stage 4 The proportion of silence calculated for D-Stage 4 in teleconference is significantly increased in teleconference. As noted in page 195 this can be explained by a pause commonly taken to allow the

remote clinician to articulate his management decision following the advice given in D-Stage 3, should he wish.

Table 10.18: Role and contribution in Case Discussions (First part).

	Contribution Proportion %		Amount of Vocalisation Tests of Significance			
	Co-located	Teleconference	F	Sig. F	t, df	Sig. p
D-Stage 1						
Respiratory Physician	8.0	3.3				
Cardio-thoracic Surgeon	6.9	4.6				
Medical Registrar	13.9	0.3				
Surgical Registrar	6.5	0.02				
Radiologist	42.03	34.9	26.9	0.000	3.34, 171	0.001
Pathologist	9.1	5.2	4.9	0.03	-1.95, 67	0.056
Medical Oncologist	2.7	0.2				
Nurse	0.6	0.12				
Remote Respiratory Physician	-	16.7				
Remote Oncologist	-	28.5				
Remote Medical Registrar	-	0.94				
Group talk	0.4	0.06				
Silence	9.9	5.2				
D-Stage 2						
Respiratory Physician	13.9	15.3				
Cardio-thoracic Surgeon	27.7	12.5	8.2	0.005	-2.05, 93	0.043
Medical Registrar	1.24	0.16			3.05, 5	0.028
Nurse	0.5	-				
Radiologist	32.2	14.2				
Pathologist	8.0	5.3				
Medical Oncologist	7.0	0.9			2.47, 35	0.018
Radiation Oncologist	-	3.4				
Oncology SHO	-	0.2				
Remote Respiratory Physician	-	17.3				
Remote Oncologist	-	23.2				
Remote Medical Registrar	-	0.07				
Technical operator	-	0.8				
Group talk	1.5	0.4				
Silence	8.1	6.4				

Role and Vocalisation

The overall vocalisation during case discussions is examined with respect to role contribution. Results are summarised in Table 10.16. Significant differences are calculated for the respiratory physician, cardio-thoracic surgeon, medical registrar, surgical registrar and medical oncologist. No significant differences are calculated for radiology or pathology contributions. The amount of group talk and silence is also noted as significantly less in teleconference PCDs. When 'Role' is examined within each phase of the case discussion, a picture emerges that shows that some roles predominate within certain D-Stages in discussion. Results are documented in Tables 10.18 and 10.19. Comparing 'Role' contribution in co-located and teleconference meetings, a slightly different picture emerges showing that the contribution of some roles differs in teleconference. The significant results are given in Table 10.17.

Table 10.19: Role and contribution in Case Discussions (Second part).

	Contribution Proportion %		Amount of Vocalisation Tests of Significance			
	Co-located	Teleconference	F	Sig. F	t, df	Sig. p
D-Stage 3						
Respiratory Physician	21.7	12.0				
Cardio-thoracic Surgeon	43.0	18.1	12.97	0.000	-2.565, 173	0.011
Medical Registrar	2.6	0.05				
Surgical Registrar	-	0.05				
Radiologist	7.2	8.5				
Pathologist	1.3	5.9				
Medical Oncologist	17.1	7.6				
Radiation Oncologist	1.4	9.0			-2.47, 25	0.021
Oncology SHO	0.9	0.5				
Nurse	0.7	-				
Remote Respiratory Physician	-	16.5				
Remote Oncologist	-	15.7				
Remote Medical Registrar	-	0.2				
Group talk	0.3	0.7				
Silence	4.0	5.4				
D-Stage 4						
Respiratory Physician	28.8	12.4				
Cardio-thoracic Surgeon	34.9	32.3				
Radiologist	1.1	2.6				
Pathologist	0.5	-				
Medical Oncologist	30.1	0.3				
Radiation Oncologist	-	3.3				
Oncology SHO	-	1.2				
MDT Co-ordinator	1.7	-				
Remote Respiratory Physician	-	11.2				
Remote Oncologist	-	30.4				
Group talk	0.7	2.0				
Silence	2.2	4.3			5.71, 6	0.001

Table 10.20: Chi Square (χ^2) tests on the number of vocalisations for Surgeon, Radiologist and Pathologist in D-Stage 1, in co-located and teleconference settings.

Role	Teleconference (Observed)	Co-located (Expected)	Chi-Square χ^2 Tests	Value	df	Asymp. Sig.
D-Stage 1						
Cardio-thoracic						
Surgeon	19	42	Pearson's			(2-sided)
Pathologist	21	48	Chi-Sq χ^2	134.63	12	0.000
Radiologist	65	108	Liklihood Ratio	167.66	12	0.000
D-Stage 2						
Cardio-thoracic						
Surgeon	24	71				
Pathologist	8	19	Pearson's			
Radiologist	23	59	Chi-Sq χ^2	137.9	14	0.000
Medical Reg.	2	6	Liklihood Ratio	168.9	14	0.000
D-Stage 3						
Cardio-thoracic						
Surgeon	63	112				
Pathologist	15	10				
Radiologist	39	22	Pearson's			
Resp. Physician	73	77	Chi-Sq χ^2	164.4	14	0.000
Rad. Oncologist	26	5	Liklihood Ratio	207.9	14	0..000

Table 10.17 results showing vocalisation for different roles in the D-Stages show four roles, the surgeon, radiologist, pathologist and radiation oncologist, that show significant differences in teleconference. These are also the main roles that are only ever occupied on one side of the teleconferencing interface and warrant closer inspection. As reported earlier, all these roles exhibit a 'doubling effect' on the duration of their vocalisation in teleconference and, with the exception of the radiation oncologist, do *not* result in any greater contribution to teleconference PCDs. However, when the number of vocalisations (N) is examined for these roles, a significant reduction in the number of vocalisations is observed. Chi-square (χ^2) tests are conducted and results are given in Table 10.20. Significant difference is demonstrated between the observed and expected number of vocalisations in teleconference discussion in the different D-Stages of a PCD. Given that there are 27 PCDs in each sample, (co-located and teleconference PCDs), one would expect that the number of vocalisations in teleconference would be approximately the same as for co-located PCDs. However, the number of contributions is less for almost all of these roles in Table 10.20 in teleconference (There is a small number of exceptions that will be discussed later).

Table 10.21 gives the role contribution differences shown in Table 10.17 in D-Stage detail.

The number of vocalisations (N) together with the Minimum, Maximum, Mean, Standard Deviation and the Sums are given in co-located and teleconference discussions for each D-Stage. A number of points deserve highlighting. In D-Stage 1, the total amount of talk by the surgeon is almost exactly the same for the 27 teleconference and 27 co-located cases, even though the number of contributions is halved. The radiology and pathology contributors exhibited similar behaviour in that the Number of vocalisations is significantly reduced (almost halved), but while the pathology total contribution is reduced by approximately 13%, the radiology sum of contributions is increased by 26%.

Table 10.21: Vocalisation statistics for Surgeon, Radiologist and Pathologist in D-Stage 1, in co-located and teleconference settings.

D-Stage	Role	Scenario	N	Min.	Max.	Mean	Std. Dev.	Sum
1	Surgeon	Co-located	42	1.0	68.8	5.47	10.70	229.586
		Teleconf.	19	1.1	91.5	12.02	21.66	228.437
	Pathologist	Co-located	48	1.0	36.6	6.27	8.64	301.093
		Teleconf.	21	1.0	76.6	12.37	17.48	259.795
	Radiologist	Co-located	108	1.0	123.0	12.87	19.32	1389.925
		Teleconf.	65	1.0	158.3	26.86	35.71	1746.148
2	Surgeon	Co-located	71	1.0	39.5	4.38	5.41	310.753
		Teleconf.	24	1.1	45.8	7.91	11.27	189.832
	Pathologist	Co-located	19	0.9	35.3	4.72	7.73	89.690
		Teleconf.	8	1.5	22.4	10.06	7.41	80.467
	Radiologist	Co-located	59	1.0	36.5	6.12	7.23	361.308
		Teleconf.	23	1.0	54.0	9.42	15.36	216.558
	Medical Reg.	Co-located	6	1.0	3.8	2.32	0.89	13.940
		Teleconf.	2	1.2	1.2	1.21	0.00	2.420
3	Surgeon	Co-located	112	1.0	33.1	5.66	5.99	633.575
		Teleconf.	63	1.0	50.9	8.70	9.69	548.011
	Pathologist	Co-located	10	1.0	4.7	1.95	1.30	19.480
		Teleconf.	15	1.1	80.4	11.81	21.01	177.089
	Radiologist	Co-located	22	1.0	11.8	4.80	2.82	105.620
		Teleconf.	39	1.0	42.2	6.58	7.89	256.577
	Resp. Physician	Co-located	77	1.0	24.3	4.15	3.86	319.396
		Teleconf.	73	1.0	20.1	4.95	4.47	361.658
	Rad. Oncologist	Co-located	5	1.1	7.7	4.12	2.98	20.590
		Teleconf.	26	1.1	47.8	10.41	11.06	270.581

In D-Stage 2, the four roles depicted in Table 10.21 all showed reduced Number of vocalisations by $> 50\%$. Not all roles showed the same behaviour: while the surgical and radiology contributions are reduced by approximately 40%, the pathologist spoke for about the same amount of time. The medical registrar's contribution is significantly reduced but, as mentioned earlier, this role is also occupied on the remote side of the interface in teleconference and is affected by more factors than the other roles listed.

In D-Stage 3, a similar pattern is exhibited for the surgeon and the pathologist, but the radiologist contributes more vocalisations and doubles the radiology contribution in doing so. The radiation oncologist contributes significantly more vocalisations and increased her total contribution tenfold (and supports the finding discussed on page 199 that this is due to expectations of the remote participants that their patient may be suitable for radiation therapy). When considering options for future action in this D-Stage, the specialists at the main site tend to spend more time *explaining* their specialist point of view, and the remote participants tend to query, or negotiate, on the options advised, which accounts for the extra time taken for D-Stage 3 in teleconference.

10.4.3 Summary Results

Table 10.22: Summary findings per case discussion in co-located and teleconference settings.

Measure	Result
Case duration	is influenced by the number of cases on the agenda for the MDTM.
Case duration	is 56% longer in teleconference
Case discussion	is structured in 4 D-Stages that remain relatively stable in teleconference.
Case discussion	loss of flexibility in teleconference, i.e. sensitivity to accommodate agenda seems lost in teleconference.
Participation	No significant differences in participation in teleconference.
Participation	Evidence of increased inequity, rather than equity.
D-Stage 1	is the single most affected D-Stage in teleconference and is the part when artefacts are mostly used
Radiology	contribution is greater in PCDs in teleconference but is reduced as a proportion of a PCD in teleconference
Pathology	contribution is greater in PCDs in teleconference but is reduced as a proportion of a PCD in teleconference
Surgeon	contribution is less of PCD in teleconference and is reduced as a proportion of a PCD in teleconference
Vocalisation	Duration is 64% longer in teleconference
Vocalisation	the longer duration is demonstrated throughout all D-Stages in teleconference except in D-Stage 4 (Table 10.12 (b))
Vocalisation	per person per PCD or per D-Stage is not significantly different in teleconference
Vocalisation	Extended duration of vocalisation for key roles correlates with reduced number of instances of vocalisation
Vocalisation	People speak for longer without significant effect on the D-Stage structure.
Silence	patterns are similar in both scenarios

The results in the analysis of the video recordings support (Sacks, Schegloff & Jefferson 1974)'s view

that interaction in talk is a product of joint activity and that while it exhibits a formal context-free apparatus, it is sensitive to local instances of operation. A PCD is a product of joint activity, and its flexibility is evidenced in accommodating large variations in the number of cases on the agenda within a fairly limited time frame for each meeting. However, this flexibility seems to be lost in teleconference case discussions.

An internal structure can be identified for PCDs that is relatively stable in teleconference. PCDs can be characterised based on objective measures: its D-Stage structure, number of participants, number of vocalisations, number of vocalisations per participant and the amount of vocalisation and these measures are not significantly affected in teleconference.

PCDs in teleconference take longer and this can be attributed to extra time taken for a vocalisation in teleconference. Differences are statistically significant in D-Stage 1, the part of the PCDs in which more formal presentations are made to the meeting by the radiologist and pathologist, using artefacts. Results suggests that there is something about presenting, or 'explaining', for participants that influences the extra time taken for a vocalisation in teleconference.

Through observation it is noted that explicit efforts to ground conversation is more evident in teleconference discussions. In teleconference, participants tend to check they are being understood, address one another directly and explicitly hand over the floor, a finding shared with Sellen (1995) and O'Conaill, Whittaker & Wilbur (1993).

10.5 Discussion

While several of these results support some findings already reported in literature, many of the results are at variance with reported studies on several parameters. In their entirety, they do not agree with any single study. When considered in conjunction with previously reported work, however, they help explain some of the conflicts in earlier studies and serve to add to understanding on interpersonal communication and the effect of video-mediation on person-to-person interactions.

Clear differences are demonstrated for cases discussed in teleconference compared with co-located PCDs and while the nature of the cases being discussed may influence proceedings to some small extent, the changes demonstrated are shown to be a result of the use of teleconferencing. Case differences are controlled for, as far as possible, in the selection of co-located cases to 'match' those PCDs in teleconference. For the purposes of examining the effect of teleconference on the PCD, it is appropriate to examine other work that studied conversation practice, especially in non-physical tasks, conducted over a video link, (e.g. Sellen 1995).

Efficiency: Unlike many studies that found no difference, other than participant satisfaction, between tasks conducted in teleconference and in a co-located setting (Olson & Olson 2003, Williams 1975), these results show that PCDs conducted in teleconference are less efficient than co-located PCDs, using 'time' as a measure of efficiency. It might be argued that extra time is not necessarily a good measure of a successful discussion, however, 'time' has been used to measure efficiency in Clark & Krych (2004) and others (Bordia 1997, Olson & Olson 2003, Fussell, Kraut & Siegel 2000). Although Bordia (1997) found that groups mediated by communication took more time, Bordia's (1997) groups communicated through

text, rather than voice, and he attributes the extra time needed to be due to time taken in typing. McGrath (1992) states that groups mediated by teleconference take more time and Fussell, Kraut & Siegel (2000), whose task involved bicycle repair, also claim that extra time is needed in teleconference. Fussell, Kraut & Siegel (2000) attribute the extra time needed to a deficiency in video support for shared visual space and lack of visual feedback on what the remote person is looking at. In this study, deficiency in visual feedback on what the remote person is looking at is considered to be one of the factors responsible for the extra time being taken in teleconference.

Orderliness: Like the MDT meetings of Delaney et al. (2004), the MDTMs in this study are observed to be more formal and orderly, similar to communication in teleconference reported by Cohen (1982) and O'Conaill, Whittaker & Wilbur (1993) among others (Sellen 1995, Rutter, Stephenson & Dewey 1981).

This orderliness in MDTMs is reflected in the shorter duration observed for D-Stage 2, a stage where presenters are usually challenged on their findings. The more structured proceedings facilitate the capture of information, reported in Chapter 9, and may also help in the quality of the decision-making but this would need to be explored in a further study.

Social equity: Unlike the greater equality of participation found by Bordia (1997), the results here show the opposite: there is less participation by more junior members of the team in teleconference. Perhaps greater stratification in the socialisation of the medical profession may account for these differences. Communication practices among healthcare teams can be complicated because communication is rooted in distinct and often conflicting professional identities and is bounded by a culture that is traditionally and persistently hierarchical (Lingard et al. 2004).

Flexibility: The overall data on the duration of PCDs in teleconference provides support for the assertions of Sacks, Schegloff & Jefferson (1974) on the flexibility that people have in conversation by showing that the time given to a discussion is strongly influenced by the number of cases on the agenda for that MDTM. This flexibility seems to be lost in PCDs in teleconference however, suggesting that there is something about this setting that affects the speech interactions of the participants.

Participation: Similar to the Sellen studies reported in 1992 and 1995, the number of participants, vocalisations per PCD and vocalisation per participant per PCD, is fairly constant overall.

The identification of the internal participation structure in D-Stages and the analysis of objective measures within those structures, i.e. PCD duration, number of participants, duration and number of vocalisations helped achieve a better understanding of the proceedings than would have been achieved through analysis of the overall PCD alone. Although PCDs in teleconference take longer than co-located PCDs, the case discussion structure is relatively stable, evidenced in the relative proportions of D-Stages in teleconference (Figure 10.3) and the similarity in the number of vocalisations per person per D-Stage at each D-Stage (Table 10.13).

Overall there is little difference between the number of vocalisations in teleconference compared with co-located settings. But analysis at the D-Stage level reveals less *instances* of vocalisations in teleconference for D-Stages 1 and 2 (Table 10.13). Although not statistically significant in this study, the trend supports the findings of O'Conaill, Whittaker & Wilbur (1993) and others (e.g. McGrath 1992) and Cohen (1982) who report fewer events in teleconference. D-Stages 1 and 2 are characterised by the presentation and discussion around patient facts and the trend towards reduction in events is probably associated with the

difficulty demonstrated for pathologists and radiologists when using artefacts.

The significantly longer mean duration of a vocalisation in teleconference persists through all the main D-Stages (1, 2 and 3) suggesting that the cause of the increase is not associated with any particular D-Stage activity but permeates through the entire discussion.

D-Stages: The proportion of the radiology and pathology contributions is reduced for teleconference PCDs from approximately 50% to 40% of D-Stage 1 and accounts for the reduced time spent in D-Stage one in teleconference. The contributions of the surgeon, medical oncologist and registrar are shown to be reduced in D-Stage 2, the part of the meeting that clarifies the patients details given in D-Stage 1 (Table 10.18). These differences suggest that the presentations made by the participants in D-Stage 1, when co-located, prompt more specific questions from these observer participants. The results suggest there is less need, or a reluctance, to question the presenters and questions seem to be directed from the main site to the remote clinicians across the teleconferencing interface, and a resultant less pronounced need for the pathologist and radiologist to answer questions in this stage.

One might be tempted to conclude that the presentation in D-Stage 1, which is longer in teleconference, is so good that there is little need to question in D-Stage 2. However, for D-Stage 2 in teleconference the remote participants contribute over 40% and the contributions of pathology and radiology are decreased. Although the decrease for pathology and radiology they are not statistically significant, it suggests that there is more clinical information being sought of the remote contributors in D-Stage 2. This is despite the fact that there are substantial contributions from the remote participants in D-Stage 1, (accounting for over 40% of the duration of that D-Stage) and there is less questioning of pathology and radiology in teleconference, than is usual for co-located PCDs. Furthermore, the contribution in D-Stage 3 in teleconference is increased for radiology and pathology which suggests that questions are raised that concern the tumour diagnosis and location and that the presentations are not fully satisfactory in the earlier part of the discussion (D-Stages 1 and 2).

The small difference in the relative duration of the first two D-Stages compared to the third D-Stage in teleconference is probably due to two factors: a) a reluctance by team members to question presenters, and b) less 'shared understanding' of treatment protocols between the remote and main site participants. The relatively larger D-Stage 3 in teleconference counteracts the differences in the first two D-Stages and thus an analysis of the PCDs overall would not have detected these differences.

In the third D-Stage the surgeon had significantly less contribution to make to the discussion, suggesting that usefulness of surgery is not being assessed as much as in co-located PCDs. The amount of vocalisation by the radiation oncologist is tenfold and statistically significant (Table 10.19). The fact that the remote participants may have expectations for radiation therapy for their patient (explained in page 200) may explain this difference.

Vocalisation: There is significant difference in the amount of vocalisation and the length of a vocalisation in a PCD in teleconference (Table 10.12). The length of vocalisation mostly explains the extended PCD duration in teleconference (56%) by a vocalisation in teleconference taking approximately 64% longer (Table 10.12). These results are in marked contrast to Sellen's (1995) that showed that 'turns' were unaffected and are closer to those of O'Conaill, Whittaker & Wilbur (1993) or Cohen (1982) using video communication with an audio and visual lag.

The laboratory experiments reported by Sellen (1995) used informal debates with a fixed length of 16 min. each. By limiting the duration of the exercise, Sellen probably inadvertently masked the extra time it takes to conduct the task in teleconference. It is also plausible that the purposeful nature of the PCD task, requiring structured input from a number of different specialists, is not comparable with the informal debate that Sellen (1995) studied and that the cognitive task conducted by the radiologist, pathologist, surgeons and radiation oncologist is different in nature to the task of debate.

Even though the Telesynergy® system utilises full duplex audio and high quality video (over ISDN lines) the results here bear some similarity to O'Conaill, Whittaker & Wilbur (1993)'s initial findings for half duplex audio and poor visual support, in that the duration of a vocalisation is longer in teleconference. But they differ in that O'Conaill, Whittaker & Wilbur (1993) demonstrated a reduction in the number of turns and there is no overall difference in the number of vocalisations, for teleconference or co-located settings, in this study (Table 10.8), although reductions in the number of turns are demonstrated from some roles within some of the D-Stages. O'Conaill, Whittaker & Wilbur (1993) believed that improved visual and audio would bring the results closer to the findings for face-to-face conversations and they found full duplex audio and good quality video to be similar to the face-to-face scenario.

The results which O'Conaill reported involved real business meetings of a wide and varied nature which ranged from appraisal, idea generation, problem solving, decision-making to work-related gossip. It is plausible that if O'Conaill, Whittaker & Wilbur's (1993) results were examined separately for each type of meeting, their results would have been different.

Cohen (1982) reported that meetings held over a voice-switched teleconferencing system exhibited fewer turns of greater length. Sellen speculates that Cohen's (1982) results might be due to the fact that Cohen introduced a 250 millisecond delay in order to simulate round trip transmission conditions, and that the use of voice-activated cameras implies that the whole group cannot be seen simultaneously at remote centres thereby impairing co-ordination mechanisms based on visual feedback. In this study, which has a set-up similar to Cohen's, in that video links are shared by an entire co-located group, but has no perceived transmission delay or voice-activated cameras, there are also longer vocalisations in teleconferencing. Therefore it appears that, contrary to Sellen's hypothesis, the difference is not likely to be caused by delays of a technical nature but rather by subtler visual space and group dynamics factors. Findings by O'Conaill, Whittaker & Wilbur (1993) that meetings held over ISDN links are characterised by fewer turns of greater length lend further support to this conclusion.

A decrease in the absolute number of vocalisations is demonstrated in the 54 cases analysed, from 1140 to 1075. This reduction of 65 over 54 cases (i.e. a little over 1 per case) is small and supports the predictable nature of the PCD discussion. This reduction is shown in Table 10.17 and while it is statistically significant it is of little relevance in the context of a single PCD, or unit of the MDTM. But when the number of vocalisations is examined at the level of role, significant differences are revealed in vocalisation patterns for co-located and teleconference PCDs. These results at the role and D-Stage levels give more support to those studies who report fewer vocalisations (Whittaker & O'Conaill 1997, Isaacs & Tang 1993). Perhaps there is an element in the task of those studies that is in common with the roles of surgeon, pathologist and radiologist. Although Isaacs & Tang (1993) reported shortened duration for vocalisations in teleconference, there is no evidence for shortened vocalisations in this study. An investigation into the type of discussions

studied by Isaacs & Tang might explain their difference with the results in this study.

Schachter (1951) suggested that when an issue is more relevant there will be longer communications, fewer interruptions and fewer pauses. By matching the objects of discussion in this study of 54 cases, any differences in relevance would have been controlled. Therefore it is reasonable to conclude that the extended duration of vocalisations in teleconference is associated with the medium, or technology, of communication.

The explanation of extended length of vocalisation is not straightforward and it is likely that there are at least a couple of factors responsible for this finding. While examination of vocalisation overall does not help resolve the differences observed with reported studies, more detailed analysis at role and individual level is more revealing.

Role: The analysis of the contributions that individual specialists make in the different parts of the discussion is useful because it provides more insight into possible explanations for the longer duration of vocalisation observed. The roles that warrant discussion are the radiology, pathology, surgeon and radiation oncologist. These particular roles exhibit significant changes in their vocalisation duration in teleconference.

The difference in the vocalisation duration is not explained by individual, role or sex differences, since there are different roles, both sexes, and more than one individual occupies some of the roles that demonstrate similar behaviour. However, the only roles that consistently use artefacts in their presentations are the pathologists and radiologists, so it is likely that the use of artefacts partially accounts for the differences. The co-ordination of visual attention on the basis of verbal contact alone has been shown by Richardson, Dale & Kirkham (2007) to be influenced by knowledge in the common ground and the coupling of eye movements between speaker and listener. The coupling of eye movements is not merely an epiphenomenon of language processing but also plays a causal role in comprehension. In a spontaneous interactive dialogue relating to a common visual scene, conversants' eye movements are found to be tightly coupled (Richardson, Dale & Kirkham 2007). It is plausible, given that radiologists and pathologists both gaze at the image artefact while describing their interpretation, that the epiphenomenon identified by Richardson, Dale & Kirkham (2007) is damaged in teleconference and affects their ability to gain feedback on comprehension from their addressees.

Interpreting the 'Doubling effect' exhibited by the surgeons is difficult as they don't use image artefacts. Occasionally surgeons may show a video of an operation, but there are none of these occurrences among the 54 cases examined. Neither the surgeons nor the radiation oncologist used any artefact in any of the 54 PCDs analysed at this level. The surgeons and the radiation oncologist do have a commonality however, in that they both potentially are part of the patient's treatment strategy, unlike the medical roles who are more involved in the diagnosis and disease staging. Contributions from the surgeon and radiation oncologist roles are most frequent in D-Stage 3, when the treatment options are being weighed. It is observed that less shared understanding of treatment policies may account for the longer duration in D-Stage 3 and this interpretation is supported by the fact that the surgeon and radiation oncologist roles contribute significantly to D-Stage 3 in teleconference (Table 10.21). The surgeon and radiation oncology contributions are more than the sum of the others' contribution in the table (818 vs. 795), when they *explain* to the meeting why the patient should or shouldn't have a specific treatment. Given that coupling of eye movements plays an important role in comprehension it is possible that the reduced visual support

in teleconference makes it more difficult for these specialities to assess the comprehension of their proposed treatment strategy to their addressees across the teleconference interface.

Both complex social and emotional factors are responsible for these findings as well as technical difficulties associated with the articulation of ideas. While teleconferencing is identified to be responsible for most of the observed behaviour, role and status differences are also factors, with a lesser effect, that need to be differentiated in order to determine what it is about teleconferencing that accounts for its effect. Furthermore, while teleconference accounts for the main differences, there is more than a single factor responsible.

The radiologists, pathologists and surgeons, all exhibit the 'doubling effect', and all contribute proportionally less in teleconference, but only those who use artefacts actually increase their vocalisation, in absolute terms, to the PCD. This finding suggests that while there may be difficulties in monitoring addressees for understanding in teleconference, there is increased difficulty for those who use artefacts and cannot see the faces of the remote participants, i.e. the radiologists and pathologists.

It is not possible to conduct in-depth analysis for all roles, because some roles at the main site contributed little in teleconference (or not at all) and no data is available for participants from the remote sites at co-located meetings (because these situations never occurred). It could be argued that certain individuals tended to speak more in teleconference and this accounts for the differences, but the data do not support this proposition. Although remote participants fulfil multiple roles and contribute significantly to the teleconference PCDs, the data suggest that there is an effect on speech patterns for participants in teleconference. The fact that radiologists, surgeons and pathologists all demonstrated similar behaviours (i.e. approximate doubling the duration of a vocalisation) supports the hypothesis that the observed differences are associated with the teleconferencing technology and the nature of their contribution.

Achieving agreement: McGrath (1992) suggested that it would be more difficult for the group to achieve consensus in teleconference, but there is no evidence in this analysis to support his hypothesis.

10.5.1 Conversation and Common Ground

The flexibility that Sacks, Schegloff & Jefferson (1974) identified in conversation to accommodate a wide range of interactions, local contexts and changing circumstances is supported in these results. Tables 10.3 and 10.4 that show how the duration of a case can be influenced by the number of cases on the agenda provide evidence to that effect. But this ability of the participants to adjust their discussion is lost in teleconference. It would be tempting to attribute this loss of control to the remote participants and attribute their control of the proceedings to account for the differences, and the lessening of common ground between the local and remote participants would support this interpretation. However, the asymmetry across the interface with the large group on the side that demonstrate this ability interacting with a single participant at each of the remote sites suggests that there is something more fundamental in this loss of flexibility that is introduced by the teleconferencing technology.

Clark & Krych (2004) and Clark & Brennan (1991) discuss how people co-ordinate their speech content and achieve common ground in communication and Clark & Krych (2004) demonstrate the importance of being able to monitor addressees and others' workspace. It is possible that the reason for the longer duration for a vocalisation in teleconference is a deficiency in the teleconferencing technology to support

the level of common ground that the face-to-face meetings achieve. The fact that other parameters such as the number of vocalisations per case and the number of vocalisations per person per case is unaffected (overall) supports this interpretation, i.e. that there is something in the nature of the talking that causes difficulty for participants. The fact that participants exhibit a need to see remote participants, rather than artefacts, (reported in Section 6.3.3) further supports this interpretation.

Undoubtedly, these results support the view of Veinott et al. (1999) who found that subtle forms of negotiation tasks, when people have to negotiate meaning in conversation, benefited from the people being able to see each other. Working on the principle of least collaborative effort of Clark & Wilkes-Gibbs (1986) suggests that the use of noun phrases and deictic reference (Clark & Krych 2004) represent speaker effort in achieving communication. O'Conaill, Whittaker & Wilbur (1993) and Sellen (1995) both noted in their results that speakers are more likely to hand over turns formally by using a question or naming the next speaker. Although neither Sellen (1995) nor O'Conaill, Whittaker & Wilbur (1993) considered that the issue related to efforts in gaining common ground, their results support this proposition. Sellen (1995) suggested that implicit cues people use in co-located settings are perceived to be relatively powerless in the remote situation and people use more explicit devices for interaction. O'Conaill, Whittaker & Wilbur (1993) further reported that listeners are less likely to anticipate turn changes or interrupt the speaker, adding support to the idea that people expend more collaborative effort when communicating over a teleconference link in order to achieve common ground. More investigation is required to establish with certainty if common ground is more difficult to achieve across the teleconference interface at MDTMs. Observations in this study suggest that participants address one another more directly, seek clarification of understanding and explicitly hand over the floor to one another at MDTMs in teleconference. Measures to indicate the level of common ground, such as the use of noun phrases, deictic reference, use of questions and naming of the next speaker, will be incorporated into future work to investigate the sustenance of common ground in teleconference at MDTMs.

The fact that pathologist's and radiologist's contribution are most affected in teleconference, and that this effect transcends the individual level invites closer examination of their role to deduce the processes that underlie this behaviour. These roles have one striking commonality in that both mediate their contributions through the use of artefacts. During these periods, the remote site are *not* in face-to-face view: the artefact under discussion has been substituted. However, it is not so simple to conclude that the artefact alone may be responsible, since the same condition pertains in co-located PCDs. Peripheral vision of the presenter in the co-located setting allows the presenter to monitor the addressees for understanding and may help in grounding (Clark & Krych 2004). This need for visual monitoring may be related to the need to monitor what the remote party is looking at in Fussell, Kraut & Siegel's (2000) bicycle repair task. Other explanations may also pertain, such as slight audio feedback in teleconference. If audio feedback is responsible it is unlikely to be totally responsible. If it is, all speakers would be equally affected. Nonetheless, these results suggest that there is something associated with the presentation of artefacts in teleconference that causes extra difficulty for the presenters.

The 'doubling effect' demonstrated for the surgeon and radiation oncologist, who do not tend to use artefacts, suggests that there may be some issue about *describing*. Unlike the radiologist and pathologist, when they make their contribution they tend to be in face-to-face view across the teleconference interface.

When they talk they tend to be involved in *explaining* or *describing* features; a feature they share with the radiologist and pathologist. In their contributions they conceptualise the problem at hand and describe it to their colleagues. For the surgeons, they tend to describe the anatomical position and extent of the tumour, and its relation to other structures (the aorta, the heart, etc.) and describe the approach and the procedure they might take, or not take, in the circumstances. Similarly, the radiation oncologist is regularly observed describing the angles at which the radiation fields might be applied, the number of radiation fields and the structures that might complicate treatment. It is likely that these roles are (subconsciously) monitoring addressees for understanding when making their contributions and find it more difficult to achieve in teleconference.

It is interesting that while the number of vocalisations are fewer and of longer duration for some roles, the sum of the vocalisation for these roles is not very much affected. This finding suggests that there is something about the use of teleconferencing technology that is affecting the speech behaviour of these roles. The results show that these roles talk for longer in teleconference, when they talk. In other words, the number of times that they contribute to the discussion is less in teleconference and the total of their contributions seems to be much the same. These data are interpreted to mean that there may be some difficulty for participants in 'taking the floor' and that when they do, they do not give it up so easily. There could be two explanations for this finding: difficulty in taking the 'floor', or difficulty in knowing when to relinquish the 'floor' and conclude the vocalisation. If there are difficulties being experienced in gaining the 'floor', then it would be anticipated that there would be more overlapping speech in teleconference. Although overlaps in speech are not measured in this analysis, the proceedings are relatively formal and overlapping speech is not evident in a review of the recordings. Furthermore, independent studies by Sellen (1995) and O'Conaill, Whittaker & Wilbur (1993) found fewer overlaps in teleconference, a point that is generally accepted in literature. In this study, the presentations by the pathologist and radiologist are often followed by a silence which suggests that there may have been more difficulty in deciding when to finish their vocalisation rather than any competition to capture the floor, supporting the explanation that the speakers may be monitoring their addressees for understanding.

In conclusion, difficulties are experienced in PCDs in teleconference and teleconference is proved less efficient than face-to-face, co-located, PCDs. It is likely that the audio and visual support are both critically necessary to help maintain common ground for a satisfactory discussion across the interface. These results do not identify a single mode as being critical. Rather, results suggest that both audio and visual sources are important in achieving successful conversation in teleconference and that there is an aspect of the conversational processes, not yet fully elucidated, that is interrupted in the computer-mediated scenario.

Chapter 11

Conclusion

At the outset of this study of multidisciplinary medical team meetings the aim was to identify technological solutions that would support the work of the MDTM, or suggest ways that the existing technology might be improved, and make the team more effective. Although the existence of the MDTM practice is identified in Chapter 4 to improve patient services, and a continuous quality improvement intervention, it needs support for two reasons: a.) to maintain its existence, and b.) improve the internal and external process.

Given that the system relies on the co-operation and goodwill of many individuals in order to function effectively, it is vulnerable to any disruption in the related work processes and interpersonal dynamics among the people involved. External factors, such as a Bank Holiday coinciding with MDTM arrangements, add strain on the system. Recovery is only possible through additional effort being expended within the team. It can be anticipated that if the external factors adding pressure to the system are greater than the forces of effort within the team, the MDTM practice will be discontinued.

Internal structures within the PCD, and related external functions, have the capacity to stabilise the MDTM system. If those structures and processes are strengthened, the MDTM system can be made more effective.

Having reviewed the work of the team, their work processes and the context and functions of the MDTM, it is apparent that a single solution would not be appropriate in this situation and a series of initiatives have the potential to improve the process. In this chapter, solutions will be proposed based on the findings presented.

In the course of this work, a number of system requirements emerged through investigation of the role of the MDTM and review of policy documents, observing work practices and work processes, talking to team members and in responses to questionnaires distributed among the team. Table 11.1 lists those requirements.

It is useful to consider potential solutions in the context of the framework introduced in Chapter 3, Section 3.9 and Figure 3.5. In generating solutions, the perspectives of the organization, the individuals (people) and the use of technology will be considered in the context of the MDTM functions and the pre-meeting work, the meeting proceedings and post-meeting needs.

Table 11.2 summarises factors that have been identified to contribute to a successful meeting. This list

Table 11.1: System Requirements to support MDT meetings.

Requirements
Before MDTMs:
Allow patients be easily identified for discussion and placed on agenda†
Integrate routine work activities in radiology and pathology to be available during MDTM: i.e. allow location marking and annotation of images (microscopic and PACS)
Allow option to record voice and /or text summary with image
Allow video and still images from bronchoscopy to be filed and stored for review at MDTM
Allow video and still images be captured in surgery, filed and available to MDTM
Access to filed images and annotations at MDTM
Access to clinical practice guidelines during discussion
At MDTMs:
Support user control over data sources during discussion
Support pointing and annotation for all attendees, particularly active participants
Allow real time update to electronic patient records during PCD†
Allow for update of clinical practice guidelines, based on consensus during MDTMs, if required
Rapid access to large image files on PACS, for MDTM duration
Allow simultaneous review of multiple radiological and pathology images during discussion
Facilitate automatic recording of individuals' attendance at MDTM
Formal record of specific images and artefacts reviewed during a particular discussion
Formal record of MDTM discussion as part of hospital and patient records†, including date, disease stage and decision available
Formal record of MDTM discussion for hospital teaching material
Record should be available for review as required by individual team members and others
Personal note-taking device at MDTMs for post-MDTM tasks
During teleconference:
Allow high resolution image of remote speaker and observers at all times during discussion
Allow high resolution image of participants at the main centre, to the remote site throughout discussion, especially when remote party is speaking
Facilitate pointing and annotating across interface
Facilitate synchronisation of PACS on both sides of interface
Allow remote control of remote PACS systems
Facilitate eye-to-eye contact across the teleconference interface
After MDTMs:
Device to record action on tasks assigned at MDTM
Notification to MDTM of satisfactory execution of tasks agreed.
Weekly, monthly, quarterly, etc. audit of cases discussed, as required
†Specific criteria remain to be identified in future work

was generated through conversations with participants as well as through observation and interpretation of the results presented. Inevitably, a mixture of behaviour and technological solutions are being proposed because it is difficult to separate the use of communication technology and human-human interaction. There is an expectation that communication technology should support human-human interaction, if not actually enhance it and any proposed tool should not make communication *more* difficult.

Interpersonal communication can be difficult to achieve in the best of conditions and problems in interpersonal communication at work have probably influenced the development of many of the work processes that are secured through paper processing. Traditionally, an organization's design was evidenced in the paper trails of work processes through the organization. When computers were being installed, systems were modelled on 'the paper trail'. Security of work processes was transferred from being paper based to being computer database driven and the front-ends of databases on computer screens were designed analogous to the paper forms that might have existed in the paper-based system. Focus has shifted from traditional information processing systems to utilising the people in the process and improving interpersonal communication between different roles in the organization.

Team working has been broadly accepted to be efficient, especially in healthcare, and modern management has embraced the notion of team-building as a model to be achieved. It is mentioned in Chapter 2, Section 2.3, that the empowerment of individuals through collective autonomy in work groups has become known as high-performance work systems (Buchanan & Huczynski 2004) and enhancing interpersonal communications within the workplace has become part of management objectives (Gabarro 1990).

Advances in communication technologies offer the potential for the development of new work systems that will reduce the challenges of communication and co-ordination among individual work tasks and processes. These developments in communication technologies are challenging traditional work systems. Rather than clinical staff interacting individually with their patients and only communicating with other clinicians through the exchange of formal letters, as in the past, clinicians are now working in close collaboration with one another for the betterment of the patient (who may not be physically present). Work structures are changing, communication technology has become more pervasive at work, and opportunities are being afforded for greater communication among clinicians. Teleconferencing has added further potential to extend teams geographically and deliver services in new ways.

Interpersonal communication, social structure, information exchange and communication technology are intrinsically linked. Thus, it is appropriate to recognise the interplay between those factors at work and seek solutions that will enhance communication and serve to make the overall process more effective for the individuals, the team and the hospital. Table 11.2 lists factors that contribute to a successful MDTM and it can be seen that no one factor is singularly responsible for a successful meeting. Technology breakdown will cause the MDTM attempt to fail. But if MDT members are unwilling to co-operate, or feel reluctant to contribute their information, then the MDTM will not be possible. Even if the group is highly motivated and the technology is perfectly suitable, the pre-MDTM work must be conducted satisfactorily and the data available at the MDTM, or failure will result. Thus, the people, technological and organizational processes must work in tandem for the MDTM to be a success.

Table 11.2 shows that the factors for success involve support for the people, the work processes and technology involved in the MDTM. This support for the MDT and its meeting is achieved through be-

Table 11.2: Factors that contribute to a successful meeting

Support for	Method	Factor for success
People	*Behavioural*	All MDT members present
		All MDT members arrive on-time
	Interpersonal	Members feel positive towards the group
	Communication	Members feel free to make contribution
		Members get opportunity to contribute as they wish
		All contributions are understood
People	*Responsibility*	Post-MDTM tasks are successfully conducted
and		Individuals are clear on their post-MDTM responsibilities
Process	*Feedback*	The MDT receives regular performance feedback
Process	*Data availability*	Necessary data are brought to meeting
		All patient test results are available
	Co-ordination	Necessary pre-MDTM work is successfully completed
		Appropriate size of agenda
		Refreshments are on time
	Outcome	TNM staging agreed and recorded
		Clear management decision
		Decision recorded
Technology	*Technical*	Clear audio
		Clear visual
		Speedy access to PACS
		Satisfactory decompression of images on PACS
		No technical breakdowns

haviour influences as well as the co-ordination of work and the provision of appropriate technological tools. The People and Process are intrinsically linked and some issues such as *Responsibility* and *Feedback* can be seen to be an integration of the individual roles, work contracts and work process issues.

This study does not attempt to address all the organizational and behavioural factors that can affect the MDTM, and is primarily concerned how technology might make the process more efficient. In proposing technological solutions, however, the complexity of the situation is borne in mind and, where possible, effort towards supporting the socio-emotional and process issues is attempted. Well-designed technological solutions have the capability to improve motivation and performance through enhancing the user experience, as well as making the work process more efficient.

The design of appropriate technological solutions for the MDTM has the potential to improve interpersonal communication among the team. MDT members should feel comfortable using the technology available at meetings; they should feel encouraged in making their contributions and feel satisfied that the technology will help them to be understood. It can be seen from the results reported in Chapter 8 that

the more participants contribute to the discussion, the more benefit is gained as a result. The knowledge generated from discussion at MDTMs is greater than the sum of the individual contributions. It has been shown that making a diagnosis can be an iterative process (Cicourel 1990), that is refined through individual specialist interaction using questions, revising opinion and differentiation of features before a definitive diagnosis is reached in collaboration. This collaboration and pooling of information in the MDTM has a synergistic effect from which the hospital, the patient, the active participants and observers will benefit. Identifying how technology could improve specialist interactions at MDTM can be expected to deliver real benefits. Interaction between team members needs to be supported, and artefacts need to be easily handled, or manipulated, and useable for the different role purposes. As well as supporting the MDTM interactions, the information and decisions discussed at the MDTM need to be available to MDT members in their post-meeting tasks and responsibilities.

From the description of the MDTM as a system that adds dependability to the overall patient management process (or system), in Chapter 4, the importance of integrating the work of the MDTM into the tasks in other parts of the patient management system is explained. Furthermore, it is suggested in the description of the PCD, in Chapter 5, that integration of the MDTM at the unit of work level, i.e. the PCD, is appropriate, will improve dependability and make the process more efficient. How this integration might be achieved will be discussed in the following sections. Solutions will be discussed first in consideration of a co-located MDTM. The particular issues introduced by the teleconferencing technology will be addressed separately.

11.1 MDTM preparation

All participants at the MDTM have some pre-MDTM tasks, from printing the agenda that does not require time, to reviewing substantial material that may involve a day's work, in pathology for example. The pre-MDTM work for the roles of MDT Co-ordinator, radiologists and pathologists are critically important for a successful meeting as they bring information together that is necessary for a meaningful discussion. Technological support for these roles, in particular, has the potential to significantly impact on the MDTM and other associated work processes.

It is critically important that radiology images and pathology samples are available for discussion at the MDTM, along with the considered opinion of the expert radiologist and pathologist. Neither radiologists nor pathologists like to be 'put on the spot' for an opinion at the MDTM and consider it important to have had time to review all the material that will be discussed at the meeting. They also like to be provided with relevant clinical information, or any special question that an MDT colleague may have in mind, for example:

> 'do you think there is a possibility that this is a secondary tumour from the breast cancer that was treated 15 years ago?', or,
>
> 'does it cross the fissure?'

In such cases there will be time for the specialist to reconsider the material in the light of the specific questions. Both pathology and radiology are specialities that interpret image data in the context of clinical information. Unless appropriate information is provided, the value of the opinion will be compromised.

Imagine a channel of information flow that starts with a clinician in his, or her, workplace setting and allows the input of information (in process) that will be available to the radiologist and pathologist (and any other specialist who may have an interest in that information). This information channel is loosely associated with the patient record, but is more appropriately considered as part of the workflow of the hospital. When in-putting the clinical information a flag could be generated to indicate that this patient is to be tabled for discussion when the results of the investigations are ready. If the patient case is one on which it would be useful to have the PCD with a remote site in teleconference, that request could be flagged also and departmental work could be scheduled accordingly. In this way the patient would be automatically scheduled for the appropriate week (when connected to Centre B, for example). Workflow in radiology and pathology could be flagged with these markers, that were generated by clinical staff, throughout all worksheets (or lists) generated by the laboratory information system (LIS) or radiology information system (RIS).

Within the pathology department, when microscopic slides are being examined for the first time, the slide information could be incorporated into an electronic form and the 'virtual' slide could be maintained as part of the laboratory record, linked to an electronic patient record system. When examined, areas of special interest or features used in making the diagnosis could be 'marked' with co-ordinates to allow easy retrieval afterwards. These marks would not alter the image, but be associated with it. In a similar way, radiological images could be 'marked' on the PACS system. Currently, PACS systems allow for annotation of images, but sharing annotations between different users and workstations can be difficult.

Marking images in this way would allow for junior staff, in training, to review points with more senior colleagues. Marks could be removed or added as appropriate, if a better example was located of a particular feature, or if a question was satisfied and the mark is no longer of interest.

Depending on the work practices within the individual departments, workflow could be constructed so that the virtual slide, or image set, could be available within the channel of information flow (being shared with the other specialists, either in the main channel or in a sub-channel for the department). Given the necessity to build-in quality systems of work, explained in Chapter 7, the pre-meeting work process can be more formally incorporated into a departmental level quality review. An MDTM associated work space, AWS, at departmental level would support the MDTM preparation work and also serve as part of the internal departmental quality process, identified in Chapter 7.

An extension of the concept of Common Information Spaces (CIS) of Schmidt & Bannon (1992) and Bossen (2002), and ideas underpinning the design of 'TeamRooms' of Roseman & Greenberg (1996), to incorporate a MDTM space with an associated work space (AWS), or shelter, can be usefully applied for the MDTM system. The extended CIS, with associated workspaces, called MDTM Information Space (MDTM IS), would connect the workflow within individual departments with the MDTM, support the activities and interactions at the MDTM and link to the post-MDTM work. The MDTM would draw from items in its AWS to become part of the meeting space and the items discussed, together with the input from the MDT interactions would serve as the foundation of the MDTM record. The MDTM record would then be linked to individual patient records and post-MDTM work processes through the post-MDTM AWS. The post-MDTM workspace would support the tasks and responsibilities to be carried out after the meeting, as well as providing a mechanism for feedback, audit and the revision of clinical practice

guidelines for the MDT. Figure 11.1 is a representation of a proposed set of information spaces, for the MDTM and its associated work processes, that would make the MDTM processes more efficient.

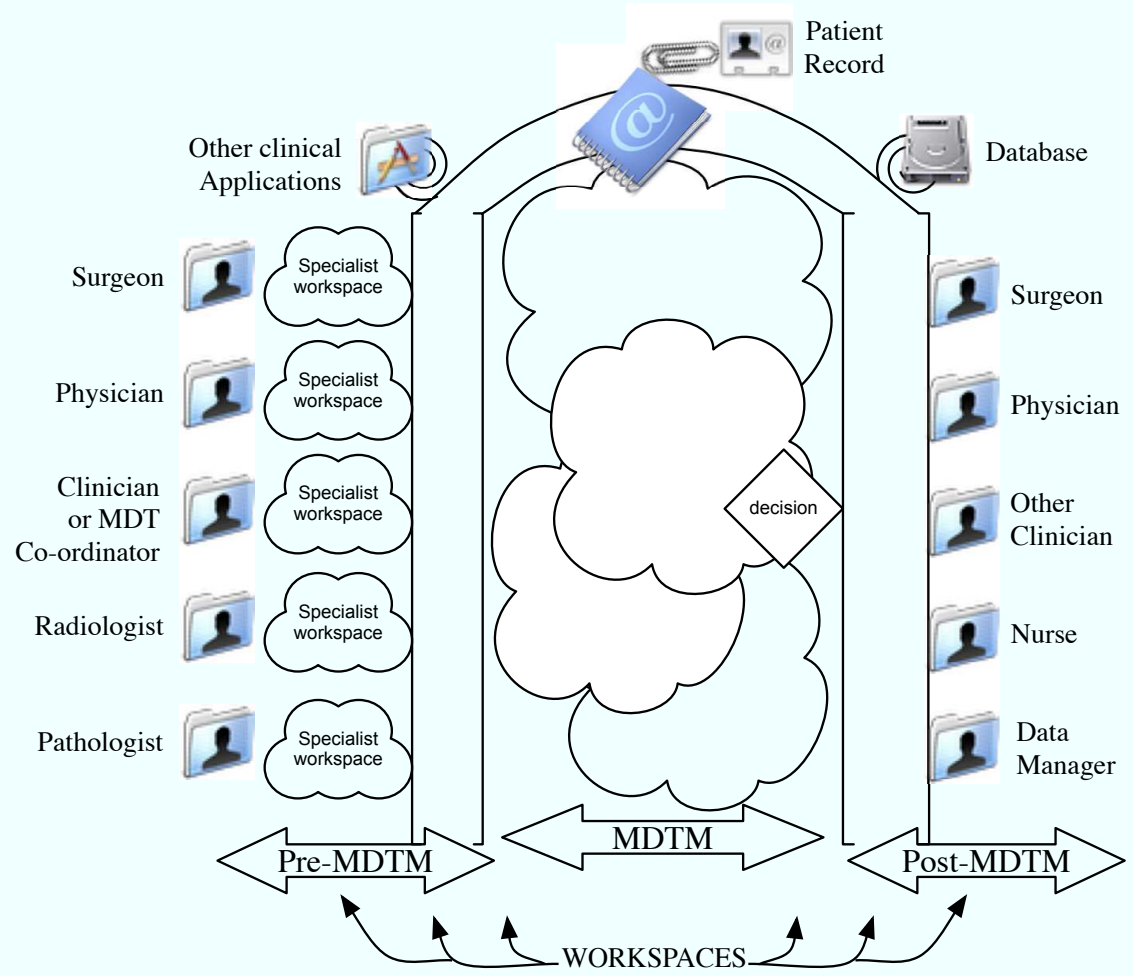


Figure 11.1: Creating Common Information Workspaces for the MDTM and its processes.

The clouds in the centre of the figure represents the CIS of the interactions at the MDTM, through the 4 D-Stages of a patient case discussion (PCD), described in detail in Chapters 5 and 10. On either side of this MDTM IS are two columns representing the 'work channels', called Associated Work Spaces (AWS) where information flows between individual specialists in their individual work processes. The left hand side represents Pre-MDTM work and the right hand column represents the Post-MDTM tasks and responsibilities. The term 'vestibule' is useful to help conceptualise this antechamber space (AWS) between the HIS, the LIS, RIS, the bronchoscopy system, or other system in use in the hospital and the MDTM IS.

For the radiologist and pathologist in their Pre-MDTM work they have an available space for any items they feel they may wish to show at the MDTM. The whole image set, or the virtual slide, could be left here with features marked electronically. Given that the unit of work at the MDTM is the PCD and that the departmental work processes also conduct the tasks at individual patient level, suggests that the unit of space within the vestibule, or antechamber, should be on an individual patient case basis. This material would not be part of the formal patient record, but linked to it as a sort of scrapbook, or page, within the

formal record.

The MDT Co-ordinator, as well as other clinicians, can contribute information. Images from the bronchoscopy system, or video clips from theatre could be placed there, as well as additional clinical information that might be added by any member of the MDT, including the MDT Co-ordinator. These 'working pages' could be generated from the information provided by the clinical team members following their encounter with the patient (or with correspondence on the patient). The individual page per patient, i.e. their MDTM 'rough work' page, could be generated on first encounter of the patient with a member of the MDT.

For patients that were being tabled for multiple MDTMs, discussed in Chapter 7, the preparation work could be stored in the MDTM AWS and available for several MDTMs as often as needed. Work already reviewed would be more accessible. Different pathologist and radiologist specialists (e.g. urology vs. breast) could access the problematic materials without having to do all of the preparation work 'from scratch' for themselves, likely saving valuable time. When a patient is tabled for re-review the original materials will be easily available for comparison with newer material.

11.2 The MDTM event

Information in this pre-MDTM vestibule would be accessed at the MDTM and brought into the MDTM Information Space (MDTM IS). As each specialist makes their contribution, items of information would be drawn from the vestibule and added to the discussion area in the MDTM IS. For each PCD event, the vestibule page could be put in one area of a large screen display and the items of information made available, one at a time onto a main display area for discussion. As items of information were examined they could be 'parked' in a corner, or to one side of the MDTM IS. It is unlikely that all the information in the vestibule would be used. It can be expected that the pre-MDT work will gather more information than will be necessary for the work of the PCD, as individuals will require more information in their individual work tasks when forming their opinion. Once formed, their professional opinion may not need so much information to explain the points to other specialists. Additional information however, is likely to be placed there in case of any additional query or sceptical colleagues. The virtual slide could also be accessible, if needed, via the vestibule to the main LIS.

A large MDTM IS would allow the comparison of images together - a task that is not adequately supported at this time. It is not possible, for example, to load two separate images and compare them. Regularly during PCDs the process of reviewing the radiology or pathology includes early and current material. Changes in features over time are clinically significant. Currently comparison is achieved with difficulty. If both images are on film, radiologists have been observed to try and project two images onto the screen at the same time - one from each sheet of images. After PACS was installed, it was noted that sometimes an image on the PC would be compared with an image from the document reader and the operator was asked to switch back and forth between the two inputs to try and allow the participants to see the changes. No more than one image at a time can be reviewed from the PACS on a single PC and only one PC is currently connected to the hospital network. If an image set is provided on DVD, the disk can be loaded onto another PC allowing the DVD image and the PACS images to be compared by

switching the display between the two PCs.

11.2.1 The Ideal Meeting Room

A purpose-built meeting room can be predicted to be a feature of hospitals in the future. An intelligent meeting room equipped with tools to support interactionally rich meetings between remote and local MDT members, such as 'Magiclounge' Bernsen et al. (1998), with additional functionality to support the MDTM work is predicted for the future. The room for the MDTM will have a high speed wireless network of minimum of 54Mbps, utilise ubiquitous devices to record the presence of individuals, will maximise the visual display area potential of the space and have enhanced audio support. Built-in ubiquitous computing devices could record attendees as they enter the MDTM space and note their seat and location in the room.

The room would be equipped with enough visual display area to allow the comparison of several images at once, and allow for the simultaneous display of the bronchoscopy image, microscopic image and/or a video taken in the operating theatre. It may be proven useful, for example, to compare a radiological image with a picture taken at bronchoscopy to allow the image seen on radiological imaging to be examined for the extent, if any, of bronchial invasion. The post-resection tissue margins (in the pathology sample) could also potentially be visualised with comparison to the anatomic positioning of the tumour (using radiology and/or surgical images). Two walls, or even three, could be used as screen displays, for a primary display and secondary display areas. The secondary (or tertiary) space would be reserved for items (or people) on which awareness was desired, such as remote observers. Depending on seating arrangements, attendees could visually access both walls within their field of view. The secondary display could be reserved for related background information only; to display details of the patient under discussion, for example. The primary display area would display the objects under direct discussion and be the main focus for attention.

Awareness is a complex matter. Participants have shown that they gather visual information from their periphery, (as in the exercise reported in Chapter 9). As well as providing a source of work-related data, awareness can also affect our sense of privacy (Fish et al. 1993) and can help promote trust (Gaver et al. 1992). The desire for knowledge when someone is seeing or hearing oneself implies reciprocity and likely explains why participants want to know if they are connected in teleconference. Awareness need not be confined to visual awareness, and could be reinforced through audio cues (Gaver 1991). As visual displays were changed, for example at the start of a PCD or connecting to remote site, the change could be announced with a *ping*.

Acoustics in the room could be enhanced through the installation of several microphone arrays and speakers placed in different locations providing coverage throughout the room. MDT members have reported difficulty in hearing, particularly at co-located meetings.

Furniture design could be improved by the development of a 'meeting chair' analogous to those in common use in seminar rooms. The ideal chair would swivel (like an office chair) to allow the meeting attendee to rotate and look around at co-attendees, if desired. There would be a suitable rest incorporated into the chair to facilitate the use of a PDA, or laptop, during PCDs. A drawing tool, analogous to a graphics tablet, could be embedded in the armrest of the chair, to facilitate pointing, annotation, or drawing, on the main screen. Individual members could interact with the main display via the tool

embedded in the chair, or their personal device: pointing, annotating and/or drawing. Haptic devices in the room could provide an additional alternative support for interaction with the displays, i.e. for pointing and moving images on the display. An MDT member might, for example, want to move an image out of mid-screen position and replace it with another object to bring that item under active discussion. Selected participants could be afforded the facility to move the cameras in teleconference. Individual control of the information sources would reduce reliance on the technical operator, and provide greater autonomy for the group. Figure 11.2 represents a swivel seat that might be used in the ideal meeting room.

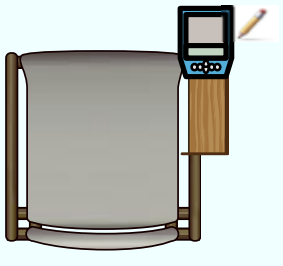


Figure 11.2: A swivel chair in the meeting room designed to comfortably use a PDA or laptop, with interactive devices embedded in armrest.

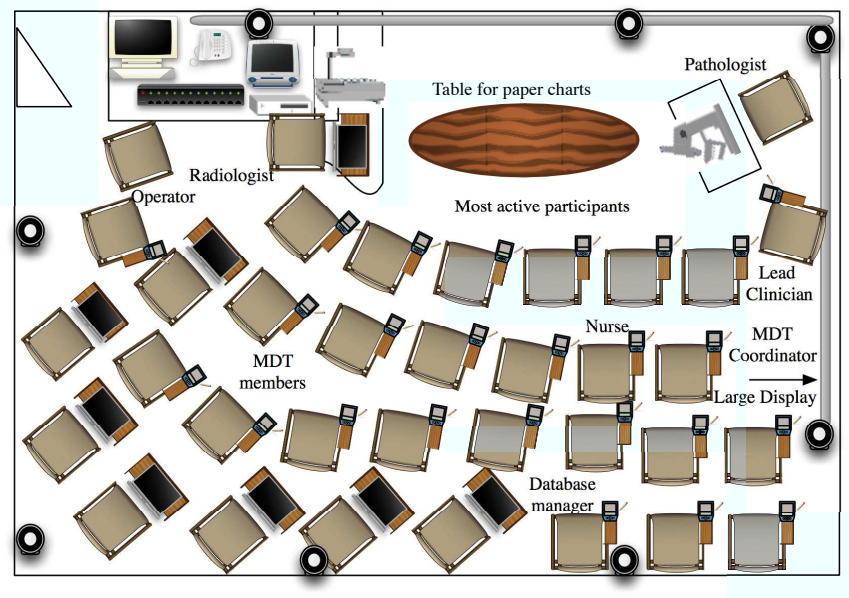


Figure 11.3: Modification of current room so that radiologist and pathologist can face the group.

11.2.2 The PCDs

In the ideal meeting room, all participants would have the ability to connect via wireless connection to the data displayed on screen, save a copy on their personal device, to annotate and/or take personal notes. Personal notes could be used for reference purposes in post-MDTM tasks and responsibilities and also

support educational and research interests. Such a tool was developed in conjunction with this project (Cameirano, Kane & Luz 2007). Using information gained from the questionnaire in Appendix F and interviews with some MDT members, software was developed and a prototype was satisfactory when tested. The software allows the user to connect via PDA to the server supporting the screen display, take screen prints (of the screen display) and save those screen shots on the PDA. Text, speech recording and drawing tools are available as part of the software and allows for the text, speech or drawing annotation to be saved with the image. Notes are filed in a separate folder for each PCD and retrievable through the patient identifier. Further development would enable participants to interact with the display screen via their personal device and allow for annotation of the large screen display, if desired.

Seating arrangements would be flexible enough so that MDT members can look around the meeting room should they wish. Members should be encouraged to ask questions and interact with the senior participants. Invitations from time to time by active participants would help in encouraging junior staff to actively participate. Tools to support interaction (pointing, annotating and drawing) with the main display would be beneficial. MDT members demonstrated the ability to gain information from both text and image data simultaneously (Chapter 9) so screens should display text data on the patient under discussion as well as the display of radiological and pathological images.

MDT members should be able to hear one another clearly, and be able to see image artefacts as needed, including the ability to compare sets of images from different time periods. During the PCD all useful images could be placed to one side, to be saved together later as part of the PCD record. Images used to support the definitive diagnosis and disease TNM stage would be useful for review, as a matter of record. Images used to support the decision on the appropriate surgical approach would be useful to compare with any subsequent imaging, by surgical team members prior to surgery.

When deciding on the TNM staging, a TNM checker (support tool) could be available based on current clinical practice guidelines. Items of data needed for the definitive TNM stage could be prompted and agreed staging checked before proceeding to D-Stage 3. The tool could be developed to prompt the recommended treatment approach, which could save MDTM time. This would allow for more discussion on the patient management decision, in D-Stage 3, and identified by MDT members as one of the critical items to be discussed (Figure 6.1). The extra time could be dedicated to more discussion on weighing the individual patient circumstances, in the light of the current CPGs.

Once D-Stage 4 has been reached the screen display could be saved as a record of that PCD, together with the summary of the decision. Other forms of meeting record, that would be acceptable to users, could be explored through the testing of prototypes with the potential users. The results from this study suggest that the multimedia record proposed here, that would contain the items discussed and the final decision, would be valued by the group. This type of individual PCD record would serve as part of the patient's EPR and could also contribute to a database for educational purposes.

11.3 Post-MDTM follow-up

Once back in their offices, and connected to their personal computers at their desks, the individual team members' saved notes would be downloaded into a post-MDTM space, similar to the vestibule for the

pre-MDTM work. Here notes would be saved and shared as necessary among team members, on a PCD by PCD basis, with a link to the individual patient's chart. Similar to the concept of the pre-meeting workspace, this is a post-meeting work space. This AWS is intended primarily for organizational purposes and to make post-MDTM work more dependable. Access to individual patient data could be made available via the patient's electronic patient record and the Post-MDTM AWS could also be used for educational purposes.

The set of records saved, i.e. the PCDs, during a single MDTM could constitute a permanent MDTM record and each PCD file linked to that individual's electronic patient record (EPR).

Tasks decided at the MDTM could be 'itemised' in some way and following their satisfactory completion, could be marked accordingly as part of the MDTM IS. Comments or updates could also be made in this space, such as changing the time-scale for a procedure that was agreed, or cancelling a task that had become redundant (if the patient died, for example). This tracking of outstanding and completed tasks could be designed to serve as a useful feedback mechanism to the MDT.

After the meeting has concluded, almost all participants have some tasks following the MDTM, ranging from filing the physical items used to conducting clinical tasks with an individual patient. A different set of roles generally carry most of the responsibilities for tasks generated at the meeting, compared to those roles that conduct the main pre-MDTM work. The MDT Co-ordinator, specialist nurse, database managers and individual clinicians all have special tasks for which they are responsible. The pathologist and radiologist may also have duties such as a special staining method on biopsy material to investigate a particular feature. Or they may need to collaborate and co-ordinate with a physician or surgeon, to perform a CT-guided fine needle aspiration, or biopsy, on a particular patient.

The views of MDTM participants on having MDTM records were reported in Chapter 6 and while there was a general agreement that a record of the PCD would be desirable, and necessary, there was no clear agreement on the form that this should take.

Results of question 8 in Questionnaire 1 (Appendix D) are summarised in Table 11.3 showed that while most people were in agreement with the need to have a recording for general record purposes, and no-one disagreed, over one quarter had reservations. Respondents comments included a wish to discuss this question with fellow team members, that a recording should include images of radiology and pathology and that Data Protection and privacy issues would need to be addressed.

Table 11.3: MDT members' view of having a recording of the meeting for general record purposes

Would agree to a recording of the MDTM for general records	%
Yes	73
No	0
Don't Know	27

One respondent expressed an interest in recording the written opinion of each expert in attendance. Another felt that recording all conversation would be difficult.

11.3.1 The potential for a meeting record

It is current practice that a paper record is generated following the MDTM for each PCD, and file in the patient's chart (Jeffries & Chan 2004). While this is a useful practice, it has its limitations. Current practice guidelines (NCCAC 2005) recommend that all patients diagnosed with lung cancer should be offered information, both verbal and written, on all aspects of their diagnosis, treatment and care. This information should be tailored to the individual requirements of the patient, and audio and videotaped formats should also be considered. It can be anticipated that patients in the future will have the expectation to have access to a recording of the discussion on their case at the MDTM. Such a development would be compatible with on-going efforts to involve patients in decisions affecting them (Frosch & Kaplan 1999).

Chapter 10 demonstrated that the PCD is a highly structured event which suggests that the MDT could potentially harness computer technology to serve its needs even further. The predictable structure of a PCD allows for the investigation of novel methods of recording and retrieval of data. For example, if there was an audio-visual recording of a PCD, with individual speakers identified, it would be possible to:

- access the decision directly in each case, by using a 'flag' or marker at D-Stage 4;
- identify through the pattern of role interaction if the discussion was standard, or non-standard;
- identify through differences from the Norm in D-Stages 1, 2 and D-Stage 3 if there were issues with the diagnostic material (D-Stage 1), the interpretation of the data (D-Stage 2) or the treatment options (D-Stage 3);
- determine the case type (medical or surgical) through the relative inputs of the various roles;
- identify the treatment considered through the relative contributions of the surgeon, medical oncologist and radiation oncologist in D-Stage 3;
- predict the tumour type and TNM staging through the relative inputs of the surgeon, clinical and radiation oncologist; and
- identify particular issues with the case through patterns of interaction in different D-Stages. For example, if there is a lengthy D-Stage 2 and the radiologist had more than the usual input into D-Stage 3, it is likely that the possibility of an image guided biopsy being performed, on the patient under discussion, is being assessed.

Potentially, cases could be retrieved from a database of case discussions based on features of the discussion. This would be potentially useful for teaching purposes. Such records would also serve to protect individual patient privacy compared with traditional storage methods using patient identifiers.

11.4 Hospital Interests

A key difference in the technological solution proposed here to support the MDTM event is the conceptualisation of the MDTM with important processes that extend beyond the duration of the actual meeting and the creation of a common work space to enable communication and collaboration among team members *outside of the actual meeting*. Typically, electronic records in a hospital are patient-centred, to mirror the efforts to provide patient-centred services. In the effort to create perfect record systems, sometimes work spaces for interaction among colleagues can be neglected. When a patient is being investigated for disease,

it is not unusual for provisional diagnoses to be made that may change or get updated as more information becomes available (Hardstone et al. 2004). Unless a diagnosis is confirmed, many EHR systems do not support the provisional, pending or working diagnosis that may be in use at any particular time. The workspace proposed is analogous to a scrapbook of items that serve particular purposes for possibly a limited period of time such as the post-it notes that might be found in a patient's chart from time to time, a memo on a wall-board, or a background job on a computer that supports the use of the system without becoming part of the actual files themselves.

An issue with regard to the status of an individual pathology or radiology written report in a patient chart, and the relative status of the MDTM record, has been resolved through highlighting the status of the MDTM report over the past few years. A potential area of confusion can arise when radiological tests recognise the presence of metastatic disease (i.e. M1 disease) (Hollywood 2007). TNM disease staging is mainly based on the pathology report, and this pathology staging has a sub-script pT, e.g. pT2N1M0. In some circumstances, CT, or MRI or PET may recognise additional M1 disease. When this happens it is desirable that there be a mechanism for 'upstaging' the patients TNM status for the hospital's clinical audit team and the National Cancer Registry (NCR). Both the hospital's audit team and the NCR have traditionally relied on the written pathology report to determine the TNM stage of the patient. The MDTM is now considered the best place to capture these data and the MDTM record is now consulted for this information at Centre A. Thus, the MDTM record has become a key item of information in the patients medical record that will need to be accommodated in future EHR systems. As the practice of MDTMs continues to grow, this practice to place the highest value on the MDTM report can be predicted to become the 'industry standard'.

Another scenario that can cause difficulties with regard to reporting was identified. Suppose an external institution (to Centre A) reports that a patient has definite cancer, but on review of the histopathological material, or radiological imaging, the specialist radiologist and/or pathologist agree that the patient does *not* have cancer after all and no further action is necessary. Further suppose that the particular patient is discovered to have advanced disease in a few years' time and investigation reveals the 'malignant' report in the patient's file dated to the few years previously. It could be (wrongly) interpreted by non-medical observers that the cancer was 'missed' by the team and it could be difficult to resolve, medico-legally. There is a concern among those who decide that there is no cancer that there should be a clear record at the time of deciding *'no cancer'* to know the basis for the decision. The MDTM multimedia record proposed here that contains a record of the items discussed and the basis for the decision would alleviate many of these concerns and also satisfy many hospital and National database purposes.

11.4.1 Feedback, Guidelines and Database Responsibilities

Results of question 6 in Questionnaire 1 (Appendix D) showed that clinical practice guidelines (CPGs) are developed among MDT members with reference to personal professional experience, the academic literature, advice from professional bodies and discussion among colleagues, in approximately equal measure. The MDTM is an ideal opportunity to update CPGs through audit of the information available through the MDTM and the AWS processes.

Currently information is gathered at the MDTM to serve long-term information needs of the hospital

audit team and the National Cancer Registry. Shorter term interests of the MDT could be met through facilitating feedback on work-in-progress as well as supporting and developing research ideas.

If MDT members in their post-MDTM work used the MDTM AWS to record progress on their tasks, as suggested in Section 11.3, regular reports on work completed and work in progress would enrich the group by providing feedback on work performance of the team. From the job design model of Hackman & Oldham (1980) outlined in Chapter 2, Section 2.3, feedback to the MDT would serve to enhance the job satisfaction and reduce stress that is often evident in highly specialised medical teams (Sharma et al. 2007, Catt et al. 2005).

Feedback to the team on the volume of work-in-progress and tasks satisfactorily completed would also reduce vulnerability in the system, identified as a challenge in Table 7.6.

11.5 Teleconferencing

In this chapter, solutions have been proposed with respect to the MDT and their meeting in the co-located setting, without any reference to teleconferencing. For MDTMs in teleconference the same issues apply, but the addition of teleconference to the proceedings poses particular challenges that will be addressed in this section.

With regard to the overall system, the pre-MDTM work is affected because the co-ordination of materials for pathology and radiology is more difficult. In the absence of a National grid, images are transferred on disk or on film between centres and there are problems with sharing these images that are unresolved (discussed in Chapter 7).

Quantitative data from the video-recording of the MDTM, and the information capture exercise, reveal a number of phenomena introduced with the use of teleconferencing:

- Greater psychological distance for observer participants (Chapter 9)
- Greater effort being made to achieve collaboration (Chapter 10)
- Greater difficulty in monitoring addressees for understanding (Chapter 10)
- Less common ground across the interface (Chapter 10)
- Loss of flexibility in conversation (Chapter 10)

The most visible effect on the proceedings is the additional time that it takes to discuss a case in teleconference and it is shown here that both technological and socio-emotional issues are responsible for this additional cost. There are complex issues associated with video-mediated communication that are unresolved in literature. The results here do not solve the mystery, and may even add to the complexity, but they make a contribution to the body of knowledge in the effects of teleconferencing. Two significant effects are introduced by teleconference. First is a loss of flexibility in conversation to adjust the length of the discussion and accommodate a varying number of PCDs on an agenda (in Chapter 10). The second and most dramatic result in Chapter 10 comes from the case controlled study that demonstrates that the use of the teleconferencing technology impacts proceedings by taking significantly more time.

The additional time is shown to be due to the doubling of vocalisation duration when artefacts are being described (by the pathologist and radiologist) or circumstances explained (by the surgeon and radiation

oncologist) in teleconference. The difficulty in *describing* or *explaining* by key roles is shown to be associated with greater effort being expended in speech collaboration and monitoring addressees for understanding both of which are associated with a reduction in common ground. Technological solutions that are aimed at providing better support for speech interaction, the manipulation of artefacts while providing greater visual access to the remote participants would help. Other initiatives such as the involvement of remote participants in the MDT annual review meeting; the development and dissemination of a local policy document and a greater understanding by remote participants of treatment approaches at the main centre would help increase common ground and thus, save time.

For the radiologist and pathologist the loss of peripheral vision in teleconference is the only remarkable difference between the two scenarios, since in co-located MDTMs they sit with their back to the audience while looking at the artefact on the overhead screen display. The doubling of vocalisation, which is consistent for both radiologists in the case controlled study, suggests that the importance of background, or 'peripheral information' has been underestimated. The results suggest that support for 'peripheral vision' in teleconference by having greater visual access to the remote parties in conversation would likely improve the team's performance.

It was explained in Chapter 6 that participants consider it essential that radiology and pathology images can be shared; the artefacts are considered critical for a successful discussion. In teleconference they demonstrated their wish to see the remote participants as well as seeing the artefacts. In fact, they placed a high importance on seeing remote clinicians when talking about an artefact; and an even higher importance on seeing the artefact when talking about the patient's symptoms with clinicians across the interface. These requirements can be explained by the need to monitor remote clinicians for understanding and also their need to conceptualise the patient's illness in the context of image data. Thus, MDT participants articulated a need for multi-channel visual display in teleconference.

To support multiple screen displays in the meeting room, the placement of cameras is important to achieve a sense of visual reciprocity across the interface. Participants in teleconference assume common frames of reference, but visual reciprocity, where a person assumes that *"If I can see and hear you, then you can hear and see me"* is not always respected in teleconference (Carles 2001). A lack of reciprocity of views in a video-mediated scenario makes it difficult to regulate conversation and engage in eye-contact (Fish et al. 1993). The problem of building visual reciprocity for the MDTM is exacerbated because people expect to see *eye to eye* when they look at the screen to see the person on the remote side. But unless the camera is placed close to the centre of the screen, the person seems to be looking away, from the remote party's perspective. As the remote party follows the apparent gaze of the person trying to engage, eye contact becomes even more difficult. When artefacts are introduced into the scenario and people are switching eye gaze between the artefact and the addressees, conversation becomes difficult. The 'doubling effect' observed for the radiologists and pathologist in teleconference is attributed to the fact that they do *not* have the ability (in teleconference) to glance at the remote party as they describe the features in the image.

As PACS systems are installed in hospitals, interaction and manipulation across the interface becomes more important. The incident described on page 92 when Centre D loaded an image on their local PACS and expected that Centre A should be able to see it too, highlights the point. High resolution images

are needed to interpret radiology and microscopy images and this is not always possible in teleconference. Control over PACS images is currently confined to the person on the PACS side of the interface. Ideally tools would be available that would allow for synchronous manipulation of images on two PACS systems in different geographic locations. For example, an image on the local PACS in Centre D could be manipulated in sync with the same image on the PACS system in Centre A, by the radiologist at Centre A. This would allow for much improved image resolution and introduce a redundancy that would enhance the overall system. Thus, if the PACS on the radiologist's side of the interface fails, he or she could manipulate the image on the remote PACS system for all the MDTM to see.

Clear benefits are identified with the extension of the MDTM service via teleconferencing that are not disputed (Section 7.1). Despite the decrease in technical performance brought about by its introduction, teleconferencing has no significant impact on the structure of a discussion. This suggests a resilience in the structure that absorbs any impact of the technology.

11.6 Use of PACS

The use of PACS was mentioned from time to time over the course of these chapters. It was explained at the outset that the PACS system was implemented at Centre A, over the period of study. The quantitative investigation of the 54 PCDs in Chapter 10 did *not* include the use of PACS, nor did the analysis of the use of artefacts described in Chapter 6. There are several reasons for those decisions. The implementation of the PACS project was delayed and by the time of its introduction, in Autumn 2006, data collection for the analysis of display screen use was almost complete. Immediately following its introduction there were frequent system failures that caused disruption of the MDTM proceedings. These disrupted PCDs were avoided for quantitative data collection purposes.

There was no fundamental change in the use of artefacts observed following the introduction of PACS. Important issues to note, however, are 1) the time taken to load images is unsatisfactory; 2) images produced externally and provided on disk may not contain the full image set; 3) incompatible software may have been used to save the external image, or 4) different imaging protocols may have been used when making the image. Furthermore, DICOM standards have changed over the past 10 years, (and are being continually updated) so hospitals with early PACS installations find that they cannot exchange electronic images with newer systems. These technical issues are being addressed at time of writing.

There is a substantial concern with regard to the lack of facility to review more than one image at a time. Display of multiple images, concurrently, is a requirement and a standard to be achieved for MDTMs. A high performance PACS system will be necessary to satisfy the need of the MDTMs and is currently a matter in progress.

There are many advantages to the PACS implementation that are well recognised such as multiple access and availability (when system is functioning) and the lack of need for the management of hard copy film. Hard copy radiological images are notorious for being mislaid and misfiled. Also the physical space needed for storage is significant. For a typical MDTM of the respiratory team, with 20 patients on the agenda, it could be predicted that the weight of the films alone would be over 15kg. It was found that the minimum imaging a patient was likely to have was 5 sheets of film, which weight 0.2kg. For an oncology

patient with a number of investigations, it was not unusual to have 60 sheets of film which weight almost 3kg. Carrying these heavy films, while maintaining them in the order of the agenda, across a large campus was not without its difficulties and necessitated the co-ordination of helpers from time to time to bring them to the MDTM.

11.7 Time and Work Rhythms

The maintenance of MDTM system integrity is critical if reliable services are to be provided and *time* is identified to be one of the key factors affecting MDTM dependability. Temporal organization of work activities, or rhythms, have probably one of the greatest contributions to make towards the MDTM being effective. MDTM dependability will be enhanced through embedding existing work rhythms and defining others more clearly. Unless people co-operate, participate and facilitate the team meeting, and all the pre-meeting tasks are completed on time, the system will fail. However, once the rhythms are embedded, the routines create their own momentum. Clinics come to rely on the outcomes from the MDTM to help in day-to-day decisions, so users' dependence on the system increases once the system is in place. This reliance of workers on outputs from the MDTM has the effect of supporting the continuance of work rhythms and actually makes the MDTM more dependable. There are four issues related to *time* arising from this study: the synchronisation of work routines, extra time needed for case discussion in teleconference, time to co-ordinate materials and time for preparation.

Extra time taken for case discussion in teleconference may suggest that decisions from these discussions may have more dependable outcomes. There is no evidence in this study to suggest that there is improved service for case discussions in teleconference. Given that time is finite within weekly rhythms of the MDTM there is, in fact, added time pressure at Centre A as a result of the additional time spent in teleconference discussion, that may actually pose a threat to performance at Centre A.

11.8 Privacy and Confidentiality

A number of issues have been identified with respect to the working of the MDTM and the introduction of teleconferencing. Time issues, and the interactions among participants are emphasised, and are very important to this study. Another important issue is confidentiality, which was alluded to in Chapter 3. Confidentiality is managed by the MDTM through professional codes of conduct, employment contracts and group cohesiveness. Entry to the meeting is controlled by the key participants. Attendees at the meeting are always known to the group. Access to inputs to the meeting rests with individual departments and all participants have access to the patient details through their main work processes. If any member of the group were to behave in an unprofessional manner by not respecting the patient's privacy and the confidentiality of the meeting, they would be sanctioned by the group through expulsion and ultimately sanctioned through their employment contract.

The issue of privacy and confidentiality is an issue of concern in healthcare in most parts of the world. Individuals, when attending a health professional normally expect their privacy to be protected. For many, there is a mistaken belief that data is anonymised to protect their identity and fail to understand why this is not common practice. The reason why it is not practice to anonymise is because of difficulties

in communication and the danger that would be introduced if there is any ambiguity with respect to the patient being treated. In practice, three items are typically used when patients are being managed (discussed in Chapter 2, Section 2.4). These items are the name, date of birth and the medical record number (MRN) and when information on a patient is being passed from one person to another, it is normal practice to check all 3 'critical identifiers'. In most systems, if 2 out of 3 items match, then the information is accepted. The acceptance of a patient's specimen in pathology is an example of this sort of check. If the data do not match, the sample is not accepted. In special circumstances, for patients who require greater levels of protection, aliases are used when processing data. However, the alias is normally linked to a master file with the patient's true identity.

11.9 Interpersonal Communication

For many clinicians, and hospitals, multidisciplinary team working is a relatively new idea. Traditionally, hospital work systems were clearly established before being introduced and were embedded slowly over time. Modification was a slow process. However, recent technological advances, especially the adoption of communication technologies, have brought rapid changes, for many of which the consequences have not been fully explored. The development of a set of MDTM skills, following the ideas of the 'non-technical skills for surgeons' developed in Flin et al. (2006) would enhance dependability in the MDTM system. Non-technical skills are cognitive (e.g. decision-making) and interpersonal (e.g. teamwork) skills and a set for surgeons were developed in recognition of the fact that non-technical aspects of performance (e.g. communication failures) are an underlying cause of adverse events in operating theatres that impact patient safety (Lingard et al. 2004). A skills taxonomy of Situation Awareness, Decision-making, Communication and Teamwork and Leadership was identified (Flin et al. 2006) (See Table 11.4). Although the taxonomy was developed for the operating theatre, there are many elements that are applicable in other situations where high levels of co-operation and collaboration are needed such as the MDTM.

Table 11.4: Taxonomy of Non-Technical Skills for Surgeons (NOTSS) in the operating theatre, *from (Flin et al., 2006)*

Category	Elements
Situation Awareness	Gathering information Understanding information Projecting and anticipating future state
Decision Making	Considering options Selecting and communicating option Implementing and reviewing decisions
Communication and Teamwork	Exchanging information Establishing a shared understanding Co-ordinating team activities
Leadership	Setting and maintaining standards Supporting others Coping with pressure

Lingard et al. (2004) identified late communication of information and lack of consistent, complete and accurate information to underlie ineffective team communications that are frequently at the root of medical error. The provision of timely and accurate information for the MDT underpins effective service delivery.

'Good' and 'poor' behaviours were identified by Yule (2006) to improve communication between surgeons in operating theatres, high stress situations where eye-to-eye contact may be difficult to achieve (because of goggles, visors, etc.) and speech may be made more difficult because of surgical masks. The development of a skill-set for the MDTM is proposed and can be expected to enhance communications between participants at the MDTM. For example, it could be agreed in principle that

> *'all patients diagnosed with x, or y, or z be discussed within 1 month of first contact with a team member.'*

and that

> *'for all patients being tabled for discussion at an MDTM should have the results of* [o]*,* [p] *and* [q] *tests available for discussion. All relevant or chest radiology should be available for review, including a reported chest radiograph that is not more than 1 month old.'*

If such 'Good behaviours' were identified, then technological systems to support monitoring and checking could be put in place. Audits of the performance of the *MDTM system* could then be used to refine the procedures and protocols of 'Good behaviour', all of which would serve to add *dependability* and *trust* to the system.

A measure of MDTM efficiency and effectiveness is difficult to establish. It is now generally accepted that MDTMs add value and add quality to the patient management system. Teleconference adds clear benefit for the patient and for the remote clinicians. But considering the element of time alone, it could be argued that teleconference meetings are "less efficient" than co-located meetings in the sense that cases discussed over teleconferencing take considerably longer and have a time cost for the main centre. This decrease in performance is caused by technical as well as socio-emotional and organizational factors. Technical difficulties relate to co-ordination and awareness issues in video-mediated communication and are evidenced in this study by an increase in mean duration of vocalisation and a decrease in the number of interaction events in teleconference meetings. Organizational and emotional factors are evidenced, for instance, in the simpler turn structure and near lack of informal exchanges (Table 10.1) which characterise teleconference meetings. Similarly to Hardstone et al. (2004), findings in this study show the necessity to accommodate informal discussion and interaction between professionals as well as provisional and differential diagnoses within the diagnostic and patient management processes. Opportunity for professionals to meet and talk together, such as at the MDTM, facilitates greater understanding and enables other parts of the process, where professionals work more isolated, to be improved.

Improvements in the MDTM will likely be achieved through a combination of behavioural interventions, including work process harmonisation, and technological innovation. On-going technological developments in communication technologies suggest that technologies can be introduced into the MDTM system to save time, make it more efficient and add dependability to the overall process.

11.9.1 Future developments

As MDT working continues to develop and the demand for MDTMs grows, some issues will need to be resolved that are currently limiting the advancement of the MDTM practice. Issues of timing and scheduling identified in this work and others (Bauman, Winqiust & Chin 2005, Delaney et al. 2004) are probably the most immediate problems. Efforts to enhance interactions among MDT members at MDTMs through the development of annotation tools and note-taking devices should benefit users and make MDTMs more efficient. The development of audit tools will also provide important information and feedback to the group and should help motivate and enhance the team-working experience.

While additional resources will help alleviate the immediate problems of scheduling, there will remain issues in developing systems of work through 'hub and spoke' models connected via teleconference. The impact of communication technology developments, such as teleconferencing, on medical decision-making and advice-giving need to be more fully investigated. Although already adopted into routine, the numbers of cases discussed in teleconference are still small, and there is time to investigate belief and psychological distance issues before a system of managing large numbers of patients in teleconference is fully introduced. The results presented here in Chapters 9 and 10 particularly, that show psychological distance being increased in teleconference need to be more fully explored to examine if professional opinions are offered more readily in teleconference. If it is found that opinion is offered more 'easily' in teleconference, the implications this may have on patient care and healthcare practices should be investigated. Safeguards will likely be needed to be put in place to ensure those opinions are valid and based on all the information available.

The findings here with respect to the effect of teleconferencing on the interactions of specialists at MDTMs prompt further investigation. Improving the sense of 'presence' in teleconferencing technology through the provision of enhanced visual support will likely improve team performance. Strengthening common ground and reducing the collaborative effort currently required for interaction across the teleconference interface will improve the current situation, reduce the psychological distance and improve the sense of presence and need to be explored. As well as technological solutions, initiatives to support interpersonal communication among team members should be borne in mind.

Record keeping is important and the development of an electronic multimedia record is becoming an important issue. As the vision of an electronic patient record becomes a reality, the incorporation of multimedia into the record as well as multidisciplinary interactions need to be addressed. The identification of structures within PCDs offers the potential for novel technological solutions to be investigated. Recognition of the synergistic effect of team development initiatives in conjunction with technological tools and organisational processes will provide incentive to explore innovative supports to enhance multidisciplinary medical team working.

Two incidental findings arose in this study which also warrant investigation. The first issue is prompted in the difficulties experienced when gathering suitable cases for the case-controlled part of this study (described on page 184) suggested that there is a big imbalance between the health status of rural and city dwellers and that there may be an increased incidence of extensive stage small cell lung cancer in the midlands.

The second curious, and incidental, finding is that described in relation to the play of PET scans video

clips on a PC. It was mentioned on page 5.2 that PET scans on DVD can be played in a video clip to demonstrate features in a 3-dimensional view, and how this image rotates through 360 degrees. For some participants in the audience it was revealed that the image appeared to be rotating anti-clockwise while for the majority of attendees the image rotates in a clockwise direction. This likely represents a visual illusion, but it is not documented and warrants further investigation. While the rotation direction is of no consequence, most of the time, there is a real potential to wrongly interpret an abnormality to be on the opposite side of the body to its actual location, when the video player is stopped. The perceived orientation of the image, as either facing or turned away, will depend on how the image appeared to be rotating. Labelling right or left side of the patient is not currently standard in PET videos, but would need to be incorporated into electronic medical imaging if this phenomenon is widespread. The finding has potentially wide implications in human-computer interaction, but needs to be fully explored.

Appendix A

Abbreviations

Abbreviation	Expansion
CME	Continuing Medical Education
CPC	Clinical Pathology Conference
CPG	Clinical Practice Guideline
CPD	Continuing Professional Development
CQI	Continuous Quality Improvement
CRC	Clinical Radiology Conference
CT	Computed Tomography
CSCW	Computer Supported Co-operative Work
CT surgeon	Cardio-Thoracic surgeon
CXR	Chest x-ray
DICOM	Digital Imaging and Communications in Medicine is a comprehensive set of standards for handling, storing and transmitting information in medical imaging. It includes a file format definition and a network communication protocol.
D-Stage	Discussion Stage
ECG	Electro-Cardio Graph
EEG	Electro-Encephalo Graph
ECOG	Eastern Co-operative Oncology Group
EPR	Electronic Patient Record
HIS	Hospital Information System
KI	Karnovsky Index
LIS	Laboratory Information System
MDT	Multidisciplinary team
MDTM	Multidisciplinary team meeting
MPS	Motivating Potential Score
MRI	Magnetic Resonance Imaging
MRN	Medical Record Number
NCHD	Non-Consultant Hospital Doctors
NCR	National Cancer Registry
PCD	Patient Case Discussion
PET	Positron Emission Tomography
RIS	Radiology Information System
SCLC	Small Cell Lung cancer
SOP	Standard Operating Procedure
S-VHS	Super-Video Home System
TNM	Cancer categorisation based on ***T***umour type and size, Regional Lymph ***N***ode involvement and ***M***etastases findings.
US	Ultrasound
VATS	Video-Assisted Thoracic Surgery

Appendix B

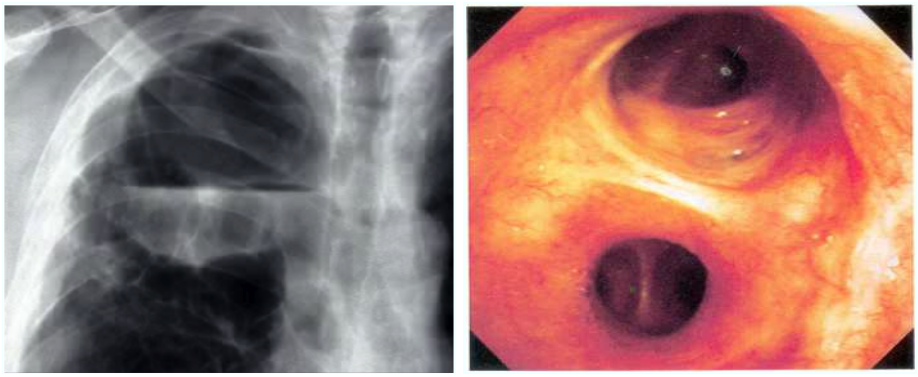


Figure B.1: Above: Radiological (L) and bronchoscopy (R) images.

Figure B.2: Movie clips and still images from surgical procedures.

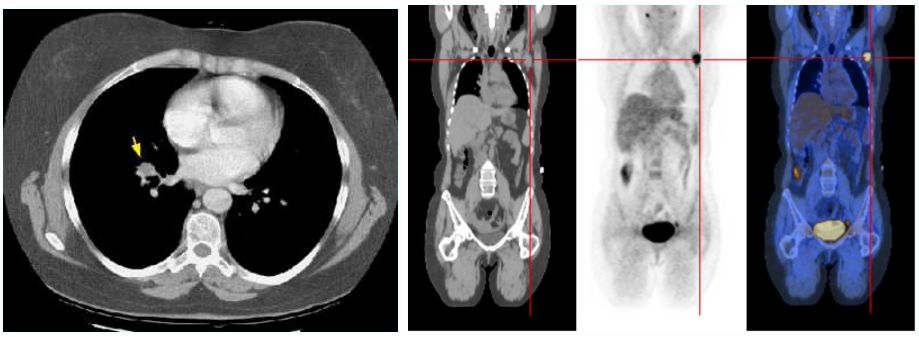


Figure B.3: Above: CT (L) and PET (R) scan images.

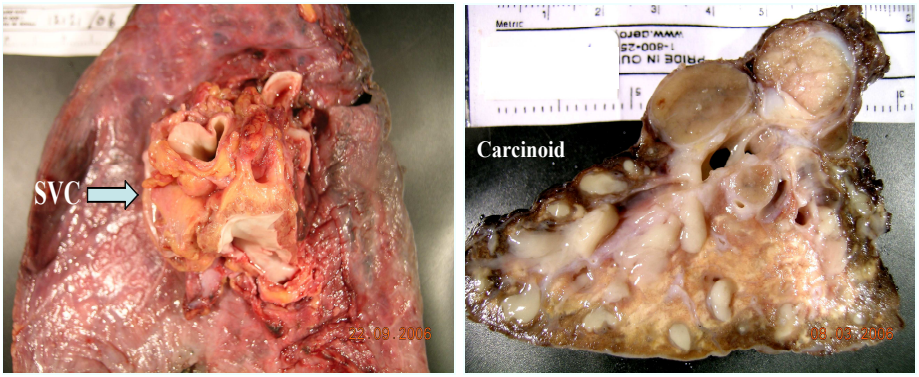


Figure B.4: Annotated images of resected tissue.

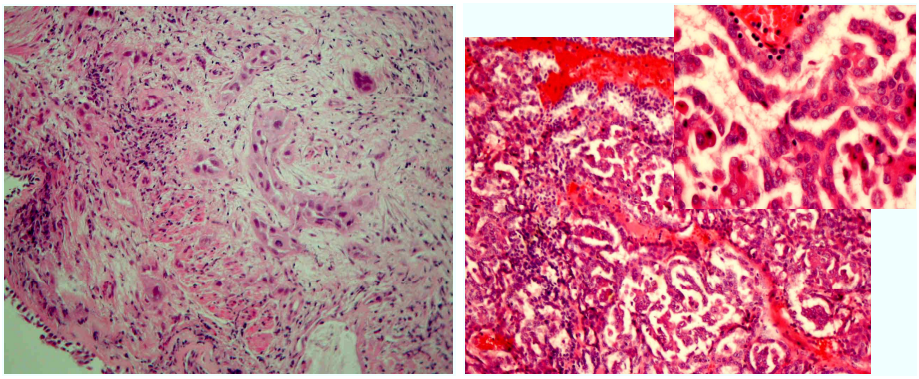


Figure B.5: Above: Microscopic images at different magnifications.

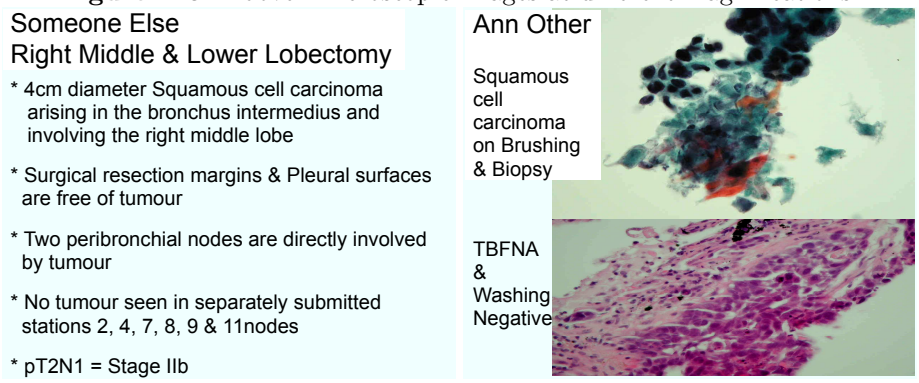


Figure B.6: Text summary of pathology (L) and text explanation of images (R), for demonstration.

Appendix C

TNM Staging of Lung Cancer

Cancer classification and staging allows the physician to determine treatment more reliably, to evaluate results of management more accurately and to compare worldwide statistics (AJCC 1992). The anatomic extent of the disease provides the primary basis for staging. The histopathologic grade and age of the patient are factors in some tumours. It is likely that developments in molecular biology and proteomics research will play a part in staging in the future.

Clinical, radiological and pathological staging are conducted independently and recorded as distinct entities. The TNM staging system provides a consistent and reproducible description of the extent of anatomic involvement (Lababede, Meziane & Rice 1999). This is achieved by defining the characteristics of the primary tumour (T), regional lymph node involvement (N) and metastasis (M). For example, a cancer stage described as T1N0M0 represents a small tumour, no greater than 3cm in maximum diameter, with no lymph node involvement and no metastases. Through a combination of radiological imaging and histopathological findings the T, N and M scores are deduced.

The TNM system is used for all lung cancers except small cell lung cancers (SCLC), which are staged separately. For SCLCs the most important categorisation is whether the tumour is 'limited stage' or 'extensive stage'. TNM staging can be difficult to determine at times and there are some situations in which additional investigations will be undertaken before the TNM stage is finally established. Sometimes, for example, it might be difficult to differentiate between a T1N1 and a T4 in a situation with an apparent small tumour on histopathology (a T1) with possible 'widespread lymphatic involvement' on radiology (which would define it as T4). There are situations from time to time when a patient may have *two* primary tumours, both of which are T1N1, and very difficult to distinguish from a T4 with 'widespread lymphatic involvement'. The treatment approach and prognosis is very different for the two scenarios.

TNM also has a system of sub-classification: a pre-treatment clinical classification (cTNM or TNM) and a post-surgical histopathologic pathological classification (pTNM). There is also a 'yTNM' representing the disease stage, post-treatment with chemotherapy, or radiation therapy. All classifications are retained unaltered in the patient's record.

While pathological staging is considered the definitive staging (because it is determined by direct examination of the tumour), it is only possible with early stage disease, or post-mortem. Clinical staging

uses indirect observations of a tumour but is often the only means available and clinical decisions are guided by the clinical staging for advanced disease. The cTNM will influence the possible selection for adjuvant[1] chemotherapy and is used as an estimation of prognosis.

Pathological staging is most valuable in early stage disease. The TNM classification replaces another staging system called, Stage l, Stage lla and llb, Stage llla and lllb and Stage IV. It is common practice for both categorisations to be used when discussing cases, but it is the TNM staging that is considered the one on which guideline and treatment decisions are based. The classification of lung cancers is given in Figure C.1 and shows the relationship between the two systems of classification.

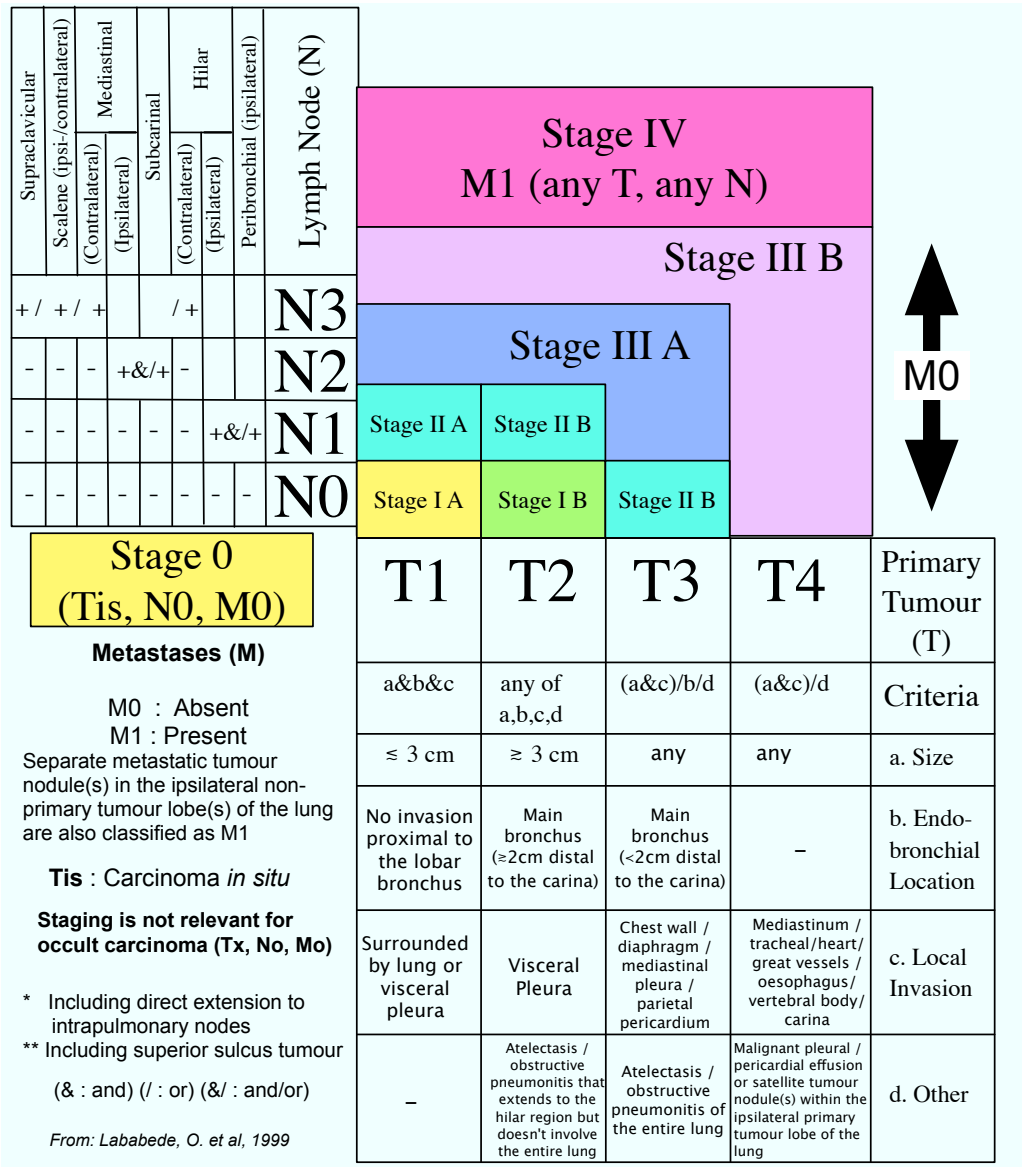


Figure C.1: TNM Staging of Lung Cancer

[1] Adjuvant chemotherapy is the use of chemotherapy as an *additional* treatment.

Appendix D

Questionnaire for MDTM participants 2004

1. How would you describe your experience of computer technology?

None ◯ Some ◯ Average ◯ Above Average ◯ Very Experienced ◯

2. Do you personally use computer technology in the performance of your work tasks, currently?

Yes ◯ No ◯

If YES, please indicate the uses you have for computers, as follows:

Documents / Letters	◯	Spreadsheets	◯	Lists	◯
Databases	◯	Contacts	◯	Pictures/Images	◯
Email	◯	Appointments / Diaries	◯	Notes	◯

Other, please state: .....

3. Do you think you might use any of the following if available, and if training were provided, in the future?

Documents / Letters	◯	Spreadsheets	◯	Lists	◯
Databases	◯	Contacts	◯	Pictures / Images	◯
Email	◯	Appointments / Diaries	◯	Notes	◯

Other, please state: .....

4. What technologies are available to you in the performance of your work tasks?

Desktop Computer (PC / Mac)	◯	Dumb terminal / Thin Client	◯
Laptop Computer (PC / Mac)	◯	Personal Digital Assistant (PDA)	◯
Email	◯	Computer network (at institution)	◯
Dictaphone	◯	Tape recorder	◯
Digital Camera	◯	Analogue Camera	◯
DVD Player	◯	DVD Recorder	◯
Video Player	◯	Video Recorder	◯
Digital Scanner	◯	Electronic White Boards	◯

Other, please state: .....

5. Generally speaking, do you use any of the following, and approximately how often (please tick ✓)

	Never	Seldom (Less than once per year)	Occasionally (Once every few months)	Sometimes (Once per month)	Regularly (More than once / month)	Daily
Computer (PC / Mac)						
Laptop computer						
Email						
Internet						
Video Player						
Microwave						
Computer games						
Mobile phone						
Digital camera						
Camcorder						
Digital scanner						
Personal Digital Assistant (PDA)						

6. With regard to Clinical Practice Guidelines and/or protocols, do you refer to such protocols in the course of your work?

Yes ◯ No ◯

6a. If 'Yes', how do you select the guideline you choose?

From own experience	◯	After discussion with colleagues in St. James's	◯
From Medical Literature	◯	After discussion with colleagues in other centres	◯
From Professional Bodies	◯	I did not choose, it was given to me	◯

7. Suppose a Clinical Pathology Conference where the conference was taking place over one or more sites with electronic communication tools at each site.
Please indicate your view of the following statements:

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
I want to be able to see all x-rays or scans discussed	◯	◯	◯	◯	◯
I want to be able to see all Microscopic images discussed	◯	◯	◯	◯	◯
I would like to discuss Specific clinical findings	◯	◯	◯	◯	◯
I would be good to be able to review Video/DVD of procedures or exams	◯	◯	◯	◯	◯
I would be good to be able to review sounds from clinical exams e.g. cough	◯	◯	◯	◯	◯
I would like to discuss or agree the patient management decision	◯	◯	◯	◯	◯
I want to be able to see all participants 'live' on video	◯	◯	◯	◯	◯

Is there another point you wish to specify for the CPC? (please state) .....

.....

.....

.....

8. Would you agree to recording of the Clinical Pathology Conference for general files and records, available to anyone who has authorization to review the patient's chart?

Yes ◯ No ◯ Don't No ◯

9. Suppose a Clinical Pathology Conference where the proceedings were **recorded** for respiratory team, or pathology, purposes only. Please indicate your view of recording items as a record of the CPC:

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
X-rays or scans discussed	◯	◯	◯	◯	◯
Microscopic images discussed	◯	◯	◯	◯	◯
Clinical findings e.g. symptoms	◯	◯	◯	◯	◯
Video/DVD of procedures or exams e.g. bronchoscopy	◯	◯	◯	◯	◯
The patient management decision	◯	◯	◯	◯	◯
Clinical exams e.g. cough	◯	◯	◯	◯	◯
Still images of participants	◯	◯	◯	◯	◯
Live Video recording of participants	◯	◯	◯	◯	◯
Record all conversation at CPC	◯	◯	◯	◯	◯
Record Voices of participants for specific items or statements only	◯	◯	◯	◯	◯
Record other items (please state)	◯	◯	◯	◯	◯

Other comments: .....

.....

.....

Your particulars: Male ◯ Female ◯

Age Range 20-29 ◯ 30-39 ◯ 40-49 ◯ 50-59 ◯ 60 + ◯

Your Role Med Student ◯ Intern ◯ SHO ◯ Registrar ◯
Consultant ◯ Other ◯ Please Specify .....

Your Speciality Surgery ◯ Medicine ◯ Pathology ◯ Other ◯
If 'other', please specify .....

Thank you for your cooperation

Please return completed questionnaire to Bridget Kane,
c/o Pathology Dept., Central Pathology Laboratory, St. James's Hospital, Dublin 8.
Please phone 086 8252530 if you've any queries about this questionnaire.

Appendix E

Questionnaire for MDTM participants May 2005

This questionnaire is designed to review your priorities and views on technical configurations at MDT meetings. Your cooperation and views will be very much appreciated. If you have any special comments to make they will be welcomed. Please use the back of this page.

1. Suppose a Clinical Pathology Conference (or MDT) where the conference was taking place over one or more sites with electronic communication tools at each site.
Please indicate your view of the following statements:

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
I want to be able to see all x-rays or scans discussed	◯	◯	◯	◯	◯
I want to be able to see all Microscopic images discussed	◯	◯	◯	◯	◯
I want to be able to see all participants live on video	◯	◯	◯	◯	◯

2. When linked to remote sites in teleconference, do you wish to be **made aware** when connected?

No ◯ No Opinion ◯ Only if in conversation with remote site ◯ Always ◯

3. When linked to remote sites in teleconference, do you wish to **see** what remote viewers are looking at?

No ◯ No Opinion ◯ Only if in conversation with remote site ◯ Always ◯

4. Given a teleconference with two remote sites connected and given a choice of what you can see **when discussing patients presenting symptoms and clinical findings,** how do you rank the following:

	No Value									Value High
See doctor who is presenting case from remote site	0	1	2	3	4	5	6	7	8	9	10
See radiology image / pathology slide of patient being presented	0	1	2	3	4	5	6	7	8	9	10
See people at second remote site (observing)	0	1	2	3	4	5	6	7	8	9	10
See the image that remote participants can see	0	1	2	3	4	5	6	7	8	9	10

5. Given a teleconference with two remote sites connected and given a choice of what you can see **when discussing radiology images / pathology slides**, how do you rank the following:

	No Value									Value High
See doctor who is presenting case from remote site	0	1	2	3	4	5	6	7	8	9	10
See radiology image / pathology slide of patient being presented	0	1	2	3	4	5	6	7	8	9	10
See people at second remote site (observing)	0	1	2	3	4	5	6	7	8	9	10
See the image that remote participants can see	0	1	2	3	4	5	6	7	8	9	10

6. Suppose a scenario where remote sites are observing, for educational interest, an in-house case being discussed. How do you rank the following?

	No Value									Value High
See all remote observers	0	1	2	3	4	5	6	7	8	9	10
See the image that remote participants can see	0	1	2	3	4	5	6	7	8	9	10

7. Do you value seeing patient details on screen?

	No Value									Value High
During regular meetings (without video conference)	0	1	2	3	4	5	6	7	8	9	10
During teleconference	0	1	2	3	4	5	6	7	8	9	10

Please return completed questionnaire to
Bridget Kane,
Dept of Computer Science (AIG),
Trinity College,
or leave it behind at the end of the meeting.

Appendix F

Questionnaire for MDTM participants November 06

Role Please indicate your role by circling as appropriate:

Physician	Surgeon	Pathologist	Radiologist
Clinical oncologist	Radiation oncologist	Nurse	Research
Database manager	Other *(please describe)*	.....	.....

Experience Please describe your level and length of experience (*please circle*):

Consultant	Specialist Registrar	Registrar	SHO	Student	Other
>20years	11 - 20 years	6 - 10 years	1 - 5 years	under 1 year	None

Providing Information and Receiving Information

Generally speaking how much does your role ***contribute*** information to the case presentation and discussion, in your opinion?

Don't Contribute any		Moderate amount		Contribute a lot
○	○	○	○	○

Generally speaking how much does your role ***gain*** information from the case presentation and discussion, in your opinion?

Don't Gain any		Moderate amount		Gain a lot
○	○	○	○	○

Information Provided and Received

1. The information provided by your role can be described as, or is contained in, *(please circle)*

Patient Images Tissue pictures Patient symptoms Findings on examination

Experience Professional knowledge Other .....

2. Generally speaking, are you satisfied in the presentation of information from your role to the meeting? 'Yes' or 'No'? If 'No', is this because of

Technical difficulty ◯ Preparation Time needed *prior* to meeting ◯ Time needed at meeting ◯

Other reason ◯ Please outline: ....

3. I would welcome more information from .....

Please state the role from which you would like more information

Post-Meeting needs

With regard to reviewing notes, or looking up detail, after the meeting could you indicate the type of information you currently consult, the level of difficulty you experience, and information your would like to be able to access *(Please mark in the columns below)*:

ITEM	Currently Consult	Level of Difficulty									Would like to Access
		Lo								Hi	
Clinical presentation	◯	◊	◊	◊	◊	◊	◊	◊	◊	◊	◯
Radiology Images	◯	◊	◊	◊	◊	◊	◊	◊	◊	◊	◯
Radiology report	◯	◊	◊	◊	◊	◊	◊	◊	◊	◊	◯
Pathology images	◯	◊	◊	◊	◊	◊	◊	◊	◊	◊	◯
Pathology report	◯	◊	◊	◊	◊	◊	◊	◊	◊	◊	◯
Staging summary	◯	◊	◊	◊	◊	◊	◊	◊	◊	◊	◯
Decision agreed.	◯	◊	◊	◊	◊	◊	◊	◊	◊	◊	◯
Personal Action point as an outcome of the discussion	◯	◊	◊	◊	◊	◊	◊	◊	◊	◊	◯
Other	◯	◊	◊	◊	◊	◊	◊	◊	◊	◊	◯

If you are interested in further discussion on the points above, please provide your contact details: ..

Please return completed questionnaire to Bridget Kane, Dept of Computer Science (AIG), Trinity College, or leave it behind at the end of the meeting.

Appendix G

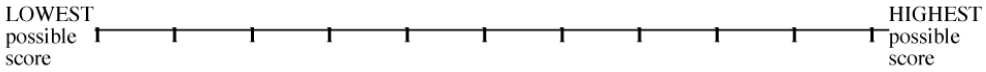
MDTM evaluation exercise, late 2005 and early 2006

Dear Colleague

Your cooperation is appreciated in giving an evaluation score for today's meeting.

On the following scale, please mark you overall level of personal satisfaction with this meeting. Please complete the sentences over by underlining your choice.

On the following scale, please mark you overall level of personal satisfaction with today's meeting.



At the end of the meeting I would appreciate if you could return this page to me. If you have any queries or points you'd like to make at any stage, I will welcome hearing your comments, in person or by email. The outcome of this study will be made available in due course.

Thanking you, in advance, for your cooperation.

Bridget Kane, Researcher

Department of Computer Science, O'Reilly Institute,

Trinity College, Dublin 2.

email: kaneb@tcd.ie

Regarding initial clinical findings	would have liked more detail, About right amount described, Too much said No opinion
Regarding radiology	would have liked more detail, About right amount described, Too much said No opinion
Regarding pathology	would have liked more detail, About right amount described, Too much said No opinion
Regarding bronchoscopy finding	would have liked more detail, About right amount described, Too much said No opinion
About the patient management discussion	would have liked more detail, About right amount described, Too much said No opinion

Appendix H

MDTM, Information Retrieval exercise,

Nov 2005 - Jan 2006

Dear Colleague

Your cooperation is appreciated in retrieving the following information, as far as possible, during the case discussion this morning. You are *not* expected to answer all questions. But if you can, that's great and a bonus to this study. Please complete as many questions as you can comfortably answer during the case presentation and discussion. The information you provide will be used for work process research purposes only. Inaccuracies or incomplete items will not affect any patient management processes.

For each patient discussed you are asked to fill out the answer to these questions, and to use a separate page for each patient discussed. This is *not* a test of your knowledge and individual responses will be anonymous and confidential to this research study. Collective data will be used when analysing results. I emphasize that if you only manage to fill in some answers, that's fine. It is important to start a new page for each patient case being discussed. Partially completed, as well as completed forms, are appreciated.

At the end of today's meeting I would appreciate if you could return these sheets to me, or leave them behind on your chair, or on the side table. If you have any queries or points you'd like to make at any stage, I will welcome hearing your comments, in person or by email. Thanking you, in advance, for your cooperation.

Bridget Kane

Researcher
email: kaneb@tcd.ie

PS. If you are interested in a personal copy of the results of this study, please provide your contact details - either email or postal address here:

Case discussion #

What is the patient's first name?	
What age is the patient?	
Is the patient Male, Female or unknown sex	M or F or U or Don't know
Is he or she a *current* smoker?	'Yes' or 'No' or 'Don't know'
Does the patient have cancer?	'Yes' or 'No' or 'Don't know'
If 'no' to above question (? cancer), what is the diagnosis?	
If cancer, what is the histological type? *(Please underline type)*	Squamous Cell Carcinoma, Adenocarcinoma, Small Cell Carcinoma Other Don't know
What sign or symptom do you think was probably most significant in arriving at this patient's *diagnosis*?	
What sign or symptom do you think is likely most significant in predicting this patient's *prognosis*?	
Are the radiological findings clear to you?	Not at all Fully ○ ○ ○ ○ ○
Are the pathology findings clear to you?	Not at all Fully ○ ○ ○ ○ ○
Are the clinical findings clear to you?	Not at all Fully ○ ○ ○ ○ ○
What is the Clinical Stage of disease?	
Will this patient have chemotherapy?	'Yes', 'No' , 'Don't know'
Will this patient have radiation therapy?	'Yes', 'No' , 'Don't know'
If 'Yes' for radiation therapy, will treatment start	'Before surgery' or 'After surgery' or 'Not applicable'
Will the patient have surgery?	'Yes', 'No' , 'Don't know'
Is it likely that the patient will be cured as a result of this procedure?	'Yes', 'No', 'Maybe'
Do you agree with the management strategy for this patient?	'Yes', 'No' or 'to some extent'
Do you understand the basis for this decision?	'Yes', 'No' or 'to some extent'
On a scale of 1 to 10, where 1 is *HIGHEST*, and 10 is *lowest* ranking, rate this discussion from an educational perspective	

Appendix I

Original template for display

The template overleaf was designed by the team to display key items of patient information during a patient case discussion. It was first introduced into meetings in January 2005. Note that the patients medical record number (MRN) is in the top left hand corner, followed by the name, abbreviated address and date of birth. In this example, the MRN for Ann Other is 1234567, and her date of birth is 21 December 1946. Neither her age nor sex is not on display. The term 'Pack Years' refers to smoking history. A smoker of 20 cigarettes per day (1pack) for 1 year has a pack history = 1. Acronyms are frequently used and there is a set of acronyms in common usage, e.g. CXR for chest x-ray or RLL to refer to the right lower lobe of the lung. Following the use of this page for several months the template was revised because it is difficult to read the clinical details in the original and it was felt that a 'clinical summary' would be more useful.

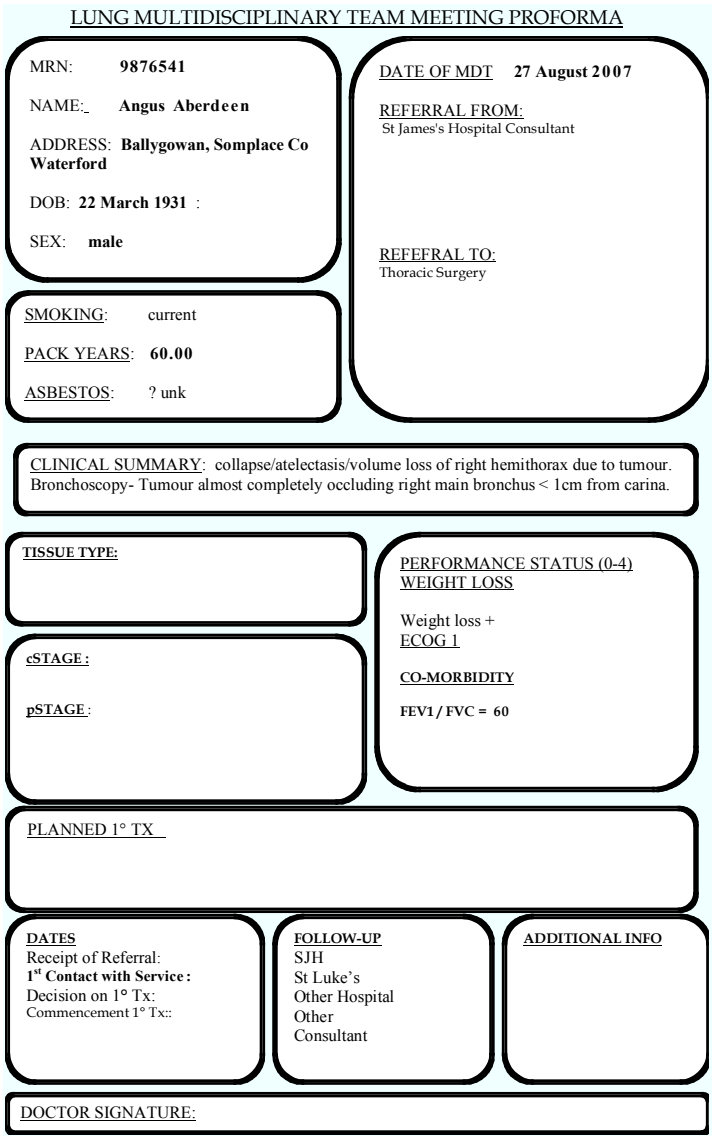
The revised template, given in Appendix J, is currently in use. It is planned to make further changes because the space in the top left hand area tends to be wasted. The team would like to have more prominence given to the display of clinical summary information and less importance given to the referral details.

The page generated from the template for each case being discussed is also used by attendees at the meeting. Data made known during discussion is noted in the relevant section of the page. The MDT Co-ordinator has responsibility to prepare a completed, typed, copy for the patient's paper chart after the MDTM.

Lung Cancer MDT meeting 4 April 2005 **1234567 Ann Other Dublin 8 21 December 1946**	
Reason for Presentation: R chest pain. Abnormal CXR showing RLL collapse.	
Managing Consultant: Dr. E. Zorro	**Patient Pathway Timing:** **Post Bronchoscopy SJH**
Referred to SJH: 19 March 2005	**ECOG: 1**
Referred From: SJH Consultant ST. James's Hospital	**Medical History:** Cardiac Disease and Respiratory Diseas e
Smoking Status: Current Smoker of Cigarette s	**Pack Years: 80.00**
Asbestos Exposure: No	
History of Malignancy: Yes Ca Colon, Ca Breast	**Symptoms:**
Duration of Symptoms (in weeks): 3	**Chest X Ray Result:** **A small opacity in LUL**
CT Thorax Result: small lesion in both lung field, A 1.6 cm lesion in LUL, A 3.2 cm pre carinal mass.? Mets in L1.	
C Stage:	
P Staging:	
Type of Surgery:	
Surgeon:	
Post op Complications:	
MDT Sequence	

Appendix J

Revised template for display



LUNG MULTIDISCIPLINARY TEAM MEETING PROFORMA

MRN: **9876541**

NAME: **Angus Aberdeen**

ADDRESS: **Ballygowan, Somplace Co Waterford**

DOB: **22 March 1931** :

SEX: **male**

DATE OF MDT **27 August 2007**

REFERRAL FROM:
St James's Hospital Consultant

REFEFRAL TO:
Thoracic Surgery

SMOKING: current

PACK YEARS: **60.00**

ASBESTOS: ? unk

CLINICAL SUMMARY: collapse/atelectasis/volume loss of right hemithorax due to tumour. Bronchoscopy- Tumour almost completely occluding right main bronchus < 1cm from carina.

TISSUE TYPE:

cSTAGE :

pSTAGE :

PERFORMANCE STATUS (0-4)
WEIGHT LOSS

Weight loss +
ECOG 1

CO-MORBIDITY

FEV1 / FVC = 60

PLANNED 1° TX

DATES
Receipt of Referral:
1st Contact with Service :
Decision on 1° Tx:
Commencement 1° Tx::

FOLLOW-UP
SJH
St Luke's
Other Hospital
Other
Consultant

ADDITIONAL INFO

DOCTOR SIGNATURE:

Appendix K

Associated Publications

Journal Articles

Kane, Bridget, Saturnino Luz, D Sean O Briain & Ronan McDermott. 2007. "Multidisciplinary team meetings and their impact on workflow in Radiology and Pathology Departments." *BMC Medicine* 5(15).
URL: *http://www.biomedcentral.com/1741-7015/5/15*

Kane, Bridget & Saturnino Luz. 2006*a*. "Multidisciplinary Medical Team Meetings: An Analysis of Collaborative Working with Special Attention to Timing and Teleconferencing." *Computer Supported Cooperative Work (CSCW)* 15(5-6):501 – 535.
URL: *http://www.springerlink.com/content/u733357235260g23/*

Published Conference Proceedings

Kane, Bridget & Saturnino Luz. 2006*b*. Probing the Use and Value of Video for Multi-Disciplinary Medical Teams in Teleconference. In *Proceedings of the 19th IEEE International Symposium on Computer-Based Medical Systems*. IEEE Computer Society pp. 518-523.

Kane, Bridget, Saturnino Luz, Gerard Menezes & Donal P Hollywood. 2005. Enabling Change in Healthcare Structures through Teleconferencing. In *Proceedings of the 18th IEEE International Symposium on Computer-Based Medical Systems*. IEEE Computer Society pp. 76–81.

Kane, Bridget & Saturnino Luz. 2004. A study of the impact of collaborative tools on the effectiveness of Clinical Pathology Conferences. In *6th Asia Pacific Conference, APCHI*, Vol. 3101 of *Lecture Notes in Computer Science* Springer.

Workshop papers

Kane, Bridget & Saturnino Luz. 2006. "'Referring on': Passing responsibility for patient care." *European Computer Supported Cooperative Work (ECSCW)* Workshop on "Handover: Collaboration for Continuity of Work"

URL: *http://www.ecscw07.org/workshop6.html*

Bibliography

AJCC. 1992. *Manual for Cancer Staging*. 4th ed. American Joint Committee on Cancer.

Alberts, W Michael. 2007. "Diagnosis and Management of lung cancer executive summary: ACCP Evidence-based clinical practice guideline." *Chest* 132(3 supplement):1–19.

Alberts, W Michael, Gerold Bepler, Todd Hazelton, John C Ruckdeschel & James H Williams. 2003. "Practice Organization." *Chest* 123(1 Supplement):332S – 337S.

Anderson, A. H., R. McEwan, J. Bal & J. Carletta. 2007. "Virtual team meetings: An analysis of communication and context." *Computers in Human Behavior* 23(5):2558–2580.

Arnaudova, Albena & Elke Jakubowski. 2005. "Eight Futures Forum on governance of patient safety." WHO, Copenhagen, Denmark: .

Arrow, Holly, Marshall Scott Poole, Kelly Bouas Henry, Susan Wheelan & RIchard Moreland. 2004. "Time, Change and Development. The Temporal Perspective on Groups." *Small Group Research* 35(1):73–105.

Avižienis, A., J. C. Laprie, B. Randell & C. Landwehr. 2004. "Basic concepts and taxonomy of dependable and secure computing." *IEEE Transactions on Dependable and Secure Computing* 1:11–33.

Balding, Cathy & JulieAnne Anderson. 2007. Clinical excellence in cancer care. A model for safety and quality in Victorian cancer services. Technical report Metropolitan Health and Aged Care Services Division, Victorian Government, Australia.

Bales, Robert F. 1950. Reprinted 1976. *Interaction Process Analysis. A method for the study of small groups.* The University of Chicago Press.

Bannon, Liam & Susanne Bødker. 1997. Constructing Common Information Spaces. In *Proceedings of the Fifth European Conference on Computer-Supported Co-operative Work*. Shared Information Spaces pp. 81–96.

Batchelor, Ivor & Jean McFarlane. 1980. "Multi-Disciplinary Clinical Teams." Based on working papers of the Royal Commission on the NHS, King's Fund, RC12.

Bauman, Glenn, E. Winqiust & J. Chin. 2005. "A pilot study of regional participation in a videoconferenced multidisciplinary genitourinary tumor board." *Canadian Journal of Urology* 12(1):2532–2536.

Berg, Marc. 1997. *Rationalizing medical work: Decision support techniques and medical practice*. Cambridge: MIT Press.

Bernsen, N. O., T. Rist, J. C. Martin, C. Hauck, D. Boullier, X. Briffault, L. Dybkjaer, C. Henry, Masood Masoodian, F. Néel, H. J. Profitlich, E. André, J. Schweitzer & J. Vapillon. 1998. Magic Lounge: A Thematic Inhabited Information Space with "Intelligent" Communication Services. In *International Conference on Complex Systems, Intelligent Systems, & Interfaces*. Nîmes, France.: .

Birchall, M., D. Bailey & P. King. 2004. "Effect of process standards on survival of patients with head and neck cancer in the south and west of England." *British Journal of Cancer* 91(8):1477–1481.

Bly, Sara. 2003. "Talking about Talking about Things." *Human-Computer Interaction* 18:181 – 191.

Board of the Faculty of Clinical Radiology. 2005. "Cancer Multidisciplinary Team Meeting - Standards for Clinical Radiologists." London: .

URL: *http://www.rcr.ac.uk/docs/radiology/pdf/MDTM2005Webprint.pdf*

Bordia, Prashant. 1997. "Face-to-Face Versus Computer-Mediated Communication: A Synthesis of the Experimental Literature." *Journal of Business Communication* 34(1):99–118.

Bossen, Claus. 2002. "The Parameters of Common Information Spaces: the heterogeneity of Co-operative Work at a hospital ward." *Proceedings of the CSCW '02* .

Bowker, Geoffrey C. & Susan Leigh Star. 1999. *Sorting Things Out: Classification and its Consequences*. MIT Press.

Boyle, Frances M., Emma Robinson, Paul Henrich & Stewart M. Dunn. 2004. "Cancer: Communicating in the Team Game." *Anz Journal of Surgery* 74:477–481.

Bradley, P J, B Zutshi & C M Nutting. 2005. "An audit of clinical resources available for the care of head and neck cancer patients in England." *Clinical Oncology* 17(8):604–9.

Buchanan, David & Andrzej Huczynski. 2004. *Organizational Behaviour, An Introductory Text*. 5th ed. London: Prentice Hall International.

Calman, Kenneth & Deirdre Hine. 1995. *A Policy Framework for Commissioning Cancer Services*. Department of Health, Welsh Office.

Cameirano, Serena, Bridget Kane & Saturnino Luz. 2007. Demonstration: Mobile annotation and recording at Multidisciplinary medical team meetings. In *ECSCW 2007*. Limerick: ACM.

Carles, Laure. 2001. Benefits and limits of video channel on mediated interactions. Technical Report 1 Geneva Interaction Lab.

Carter, S., P. Garside & A. Black. 2003. "Multidisciplinary team working, clinical networks, and chambers; opportunities to work differently in the NHS." *Quality and Safety in Health Care* 12(Supplement):i25–i28.

Catt, S, L Fallowfield, V Jenkins, C Langridge & A Cox. 2005. "The informational roles and psychological health of members of 10 oncology multidisciplinary teams in the UK." *British Journal of Cancer* 93(10):1092–1097.

Center for Information Technology & National Institutes for Health. 2007. "Telesynergy - A telemedicine partnership.".

URL: *http://telesynergy.nih.gov/index.html*

Chapanis, A. 1975. "Interactive Human Communication." *Scientific American* 232(3):36–42.

Cicourel, Aaron V. 1990. The integration of distributed knowledge in collaborative medical diagnosis. In *Intellectual Teamwork: Social and Technological Foundations of Co-operative Work*, ed. Jolene Galegher, Robert E. Kraut & Carmen Egido. Hillsdale, New Jersey: Lawrence Erlbaum Associates pp. 221–242.

Clark, Herbert H. & Deanna Wilkes-Gibbs. 1986. "Referring as a collaborative process." *Cognition* 22:1–39.

Clark, Herbert H. & Susan E. Brennan. 1991. Grounding in Communication. In *Perspectives on Socially Shared Cognition*, ed. Lauren B. Resnick, John M. Levine & Stephanie D. Teasley. Washington, DC: American

Psychological Association pp. 127–149.

Clark, H.H. & M.A. Krych. 2004. "Speaking while monitoring addressees for understanding." *Journal of Memory and Language* 50(1):62–81.

Cohen, K M. 1982. "Speaker Interaction: Video teleconferences versus face-to-face meetings." *Proceedings of Teleconferencing and Electronic Communications* pp. 189 – 199.

Coiera, Enrico. 2000. "When Conversation is Better than Computation." *Journal of the American Infrormatics Association* 7(3):277 – 286.

Coiera, Enrico. 2003*a*. *Guide to Medical Informatics, the Internet and Telemedicine*. 2nd ed. Arnold.

Coiera, Enrico. 2003*b*. "Interaction Design theory." *International Journal of Medical Informatics* 69:205 – 222.

Collins, Allan. 1996. Design Issues for Learning Environments. In *International perspectives on the psychological foundations of technology-based learning environments*, ed. S. Vosniadou, E. De Corte, R. Glaser & H. Mandl. Hillsdale NJ: Lawrence Erlbaum Associates pp. 347–361.

Corrie, Pippa, Justin Shaw & Roy Harris. 2003. "Rate limiting factors in recruitment of patients to clinical trials in cancer research: descriptive study." *British Medical Journal* 327:320–1.

Crabtree, Andy. 2003. *Designing Collaborative Systems: A Practical Guide to Ethnography*. Springer-Verlag.

Dabbs, James M & R Barry Ruback. 1987. "Dimensions of Group Process: Amount and Structure of Vocal Interaction." *Advances in Experimental Social Psychology* 20:123 – 169.

Daft, Richard L. 2001. *Organization theory and design*. 7th ed. Cincinnati: South-Western College Publishing.

Data Protection Act. 1988. "The Data Protection Act." Government Publications.

Data Protection Act. 2003. "The Data Protection (Amendment) Act." Government Publications.

Delaney, G., S. Jacob, R. Iedema, M. Winters & M. Barton. 2004. "Comparison of face-to-face and videoconferenced multidisciplinary clinical meetings." *Australasian Radiology* 48(4):487–492.

Department of Health and Children. 2001. "Quality and Fairness: A health system for you." The Stationary Office, Dublin.

Dourish, Paul. 2004. "What we talk about when we talk about context." *Pers Ubiquit Comput* 8:19 – 30.

Dourish, Paul & Graham Button. 1998. "On "Technomethodology": Foundational Relationships between Ethnomethodology and System Design." *Human Computer Interaction* 13(4):395–432.

Edwards, A. & G. Elwyn. 2001. "Developing professional ability to involve patients in their care: pull or push? Editorial." *Quality in Health Care* 10:129–134.

Egido, Carmen. 1990. Teleconferencing as a technology to support co-operative work: Its possibilities and limitations. In *Intellectual Teamwork: Social Foundations of Co-operative Work*, ed. R.E. Kraut J. Galegher & C. Egido. Hillsdale, New Jersey: Lawrence Erlbaum Associates pp. 351–371.

Fielding, R. G., M. Macnab, S. Swann, I. H. Kunkler, J. Brebner, R. J. Prescott, J. R. Maclean, U. Chetty, G. Neades, A. Walls, A. Bowman, J. M. Dixon, T. Gardner, M. Smith, M. J. Lee & R. J. Lee. 2005. "Attitudes of breast cancer professionals to conventional and telemedicine-delivered multidisciplinary breast meetings." *Journal of Telemedicine and Telecare* 11(Supplement 2):S2:29–34.

Finn, Kathleen E, Abigail J Sellen & Sylvia B Wilbur. 1997. *Video-Mediated Communication*. Lawrence Erlbaum Associates, Inc.

Fish, Robert S., Robert E. Kraut, Robert W. Root & Ronald E. Rice. 1993. "Video as a Technology for Informal Communication." *Communications of the ACM* 36(1):48–61.

Fleissig, Anne, Valerie Jenkins, Susan Catt & Lesley Fallowfield. 2006. "Multidisciplinary teams in cancer care: are they effective in the UK?" *Lancet Oncology* 7:935–943.

Flin, Rhona, Steven Yule, David Rowley, Simon Paterson-Brown & Nikki Maran. 2006. The Non-Technical Skills for Surgeons (NOTSS) System Handbook. Technical report University of Aberdeen.

Forrest, L M, D C McMillan, c S McArdle & D J Dunlop. 2005. "An evaluation of the impact of a multidisciplinary team, in a single centre, on treatment and survival in patients with inoperable non-small cell lung cancer." *British Journal of Cancer* 93:977–978.

Frosch, Dominick L. & Robert M. Kaplan. 1999. "Shared Decision Making in Clinical Medicine: Past Research and Future Directions." *American Journal of Preventative Medicine* 17(4):285–294.

Fussell, Susan R., Robert E. Kraut & Jane Siegel. 2000. Co-ordination of communication:Effects of shared visual context on collaborative work. In *CSCW '00*. Philadelphia, Pennsylvania: ACM pp. 21–30.

Gabarro, J.J. 1990. The development of working relationships. In *Intellectual Teamwork: Social Foundations of Co-operative Work*, ed. R.E. Kraut J. Galegher & C. Egido. Hillsdale, New Jersey: Lawrence Erlbaum Associates pp. 79–110.

Galbraith, Jay. 1973. *Designing Complex Organizations*. Reading, Mass.: Addison-Wesley.

Gale, S. 1989. Adding audio and video to an office environment. In *Proceedings of the 1st European Conference on Computer Supported Co-operative Work (EC-CSCW '89)*. Gatwick, U.K.: Computer Sciences House, Sloug, UK.

Galegher, J., R. Kraut & C. Egido, eds. 1990. *Intellectual teamwork: Social and technological foundations of co-operative work*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Gaver, William, Thomas Moran, Allan MacLean, Lennart Lovstrand, Paul Dourish, Kathleen Carter & William Buxton. 1992. Realizing a Video Environment: EuroPARC's RAVE System. In *Proceedings of ACM CHI'92 Conference on Human Factors in Computing Systems*. Studies of Media Supported Collaboration pp. 27–35.

Gaver, William W. 1991. Sound Support for Collaboration. In *Proceedings of the Second European Conference on Computer-Supported Co-operative Work*, ed. L. Bannon, M. Robinson & K. Schmidt. Amsterdam, The Netherlands: Kluwer Academic Publishers pp. 293–308.

Gergle, Darren, Robert E. Kraut & Susan R. Fussell. 2004. "Language efficiency and viaual technology:Minimizing collaborative effort with visual information." *Journal of Language and Social Psychology* 23(491):492–516.

Goffman, Erving. 1990. *The presentation of self in everyday life*. Reprint ed. London: Penguin.

Goodwin, Charles. 1994. "Professional vision." *American Anthropologist* 96(3):606–633.

Goodwin, Paul & George Wright, eds. 2004. *Decision Analysis for Management Judgement*. Third ed. Chichester: John Wiley & Sons Ltd.

Greenberg, S. 1990. Sharing views and interactions with single-user applications. In *Proceedings of the ACM/IEEE Conference on Office Information Systems*. Cambridge, Massachusets: pp. 227–237.

Hackman, J. Richard & Greg R. Oldham. 1980. *Job Redesign*. Reading, Mass: Addison-Wesley.

Hackman, Richard J. 1980. *Work redesign*. Addison Wesley.

Hadelich, Kerstin, Holly P. Branigan, Martin J. Pickering & Matthew W. Crocker. 2004. Alignment in Dialogue: Effects of visual versus verbal-feedback. In *8th Workshop of the Semantics and Pragmatics of Dialogue,*

Catalog. Barcelona, Spain: pp. 35–40.

Hall, P & L Weaver. 2001. "Interdisciplinary education and teamwork: a long and winding road." *Medical Education* 35(9):867–875.

Hardstone, Gillian, Mark Hartswood, Rob Proctor, Roger Slack & Alex Voss. 2004. Supporting Informality: Team working and Integrated Care Records. In *CSCW Chicago 2004*. ACM ACM Press.

Harper, R H R. 2000. "The Organization in Ethnography." *Computer Supported Co-operative Work (CSCW)* 9:239 – 264.

Hartswood, Mark, Rob Proctor, Mark Rouncefield & Roger Slack. 2003. "Making a case in Medical Work: Implications for the Electronic Patient Record." *Computer Supported Co-operative Work (CSCW)* 12:241 – 266.

Hatch, Mary Jo. 1997. *Organization Theory: Modern, Symbolic and Postmodern Perspectives*. First ed. New York: Oxford University Press.

Hoadley, Christopher M. & Peter G. Kilner. 2005. "Using technology to transform communities of practice into knowledge-building communities." *ACM SIGGROUP Bulletin* 25(1).

Hollywood, Donal. 2003. *The Development of Radiation Oncology services in Ireland*. Department of Health and Children, The Stationary Office, Dublin.

Hollywood, Donal. 2007. "TNM staging with metastases." Personal Communication August 20th.

Horn, Daniel B., Thomas A. Finholt, Jeremy P. Birnholtz, Dheeraj Motwani & Swapnaa Jayaraman. 2004. Six Degrees of Jonathan Grudin: A Social Network Analysis of the Evolution and Impact of CSCW Research. In *CSCW 2004*, ed. Jim Hersleb & Gary Olson. Chicago: ACM pp. 582–591.

Housley, William. 2000. "Category work and knowledgeability within multidisciplinary team meetings." *Text and Talk* 20(1):83–108.

Houssami, Nehmat & Richard Sainsbury. 2006. "Breast cancer: Multidisciplinary care and clinical outcomes." *European Journal of Cancer* 42:2480–2491.

Howell, William C. 1991. Human Factors in the Workplace. In *Handbook of Industrial and Organizational Psychology*, ed. Marvin D. Dunnette & Leaetta M. Hough. Vol. 2 Consulting Psychologists Press.

Hughes, John A., Ian Somerville, Richard Bentley & Dave Randall. 1993. "Designing with ethnography: making work visible." *Interacting With Computers* 5(2):239–253.

Hynds, S., E. O'Shea & D. Hollywood. 2006. "Radiation Therapists Linked by TELESYNERGY®." *Ireland-Northern Ireland-National Cancer Institute Cancer Consortium* Publications.

Isaacs, Ellen A. & John C. Tang. 1993. What Video Can and Can't Do for Collaboration: a Case Study. In *Proceedings of ACM Multimedia '93*. Anaheim, California: pp. 199–206.

Jack, Andrew. 2005. "Organisation of neoplastic haematopathology services: a UK perspective." *Pathology* 37(69):479–492.

Jaffe, Joseph & Stanley Feldstein. 1970. *Rhythms of Dialogue*. Academic Press.

Jefford, Michael, Ross Jennens, Tony Speer & Vicky Thursfield. 2007. "Different professionals' knowledge and perceptions of the management of people with pancreatic cancer." *Asia-Pacific Journal of Clinical Oncology* 3:11–51.

Jeffries, H. & K. K. Chan. 2004. "Multidisciplinary team working: is it both holistic and effective?" *International Journal of Gynecological Cancer* 14:210–211.

Jordan, Brigitte & Austin Henderson. 1995. "Interaction Analysis: Foundations and Practice." *The Journal of the Learning Sciences* 4(1):39 – 103.

Kane, Bridget & Saturnino Luz. 2006. "Multidisciplinary Medical Team Meetings: An Analysis of Collaborative Working with Special Attention to Timing and Teleconferencing." *Computer Supported Co-operative Work (CSCW)* 15(5-6):501 – 535.

URL: *http://www.springerlink.com/content/u733357235260g23/*

Kathleen E. Finn, Abigail J. Sellen & Sylvia B. Wilbur, eds. 1997. *Video-Mediated Communication*. Lawrence Erlbaum Associates, Inc.

Katzenback, Jon R. & Douglas K Smith. 1993. *The Wisdom of Teams*. Harvard: Harvard Business School Press.

Kee, Frank, Tracy Owen & Ruth Leathem. 2004. "Decision making in a multidisciplinary cancer team: does team discussion result in better quality decisions?" *Medical Decision Making* 24:602–613.

Kempner, K M, D Chow, P Choyke, J R Cox, J E Elson, C A Johnson, P Okunieff, H Ostrow, J C Pfeifer & R L Martino. 1997. "The development of an ATM-based Radiology Consultation workstation for radiotherapy treatment planning." *Medical Imaging 1997: Image Display* 3031:550–511.

Kirk, David, Tom Rodden & Danae Stanton Fraser. 2007. Turn it This Way: Grounding Collaborative Action with Remote Gestures. In *CHI 2007*. San Jose, California: ACM pp. 1039–1047.

Koppel, Ross, Joshua Metlay, Abigail Cohen, Brian Abaluck, A. Russel Localio, Stephen E. Kimmel & Brian L. Strom. 2005. "Role of Computerized Physician Order Entry Systems in Facilitating Medication Errors." *Journal of the American Medical Association* 293(10):1197–1203.

Koschmann, T. 2002. Dewey's contribution to the foundations of CSCL research. In *Computer Support for Collaborative Learning (CSCL)*. Boulder, Colorado, USA: ICLS.

Kraut, Robert E., Susan R. Fussell & Jane Siegel. 2003. "VIsual Information as a conversational resource in collaborative physical tasks." *Human Computer Interaction* 18:13–49. Reprinted from S. Oskamp and S. Spacapan (Eds.), People's Reactions to technology in Factories, Offices, and Aerospaces, The Claremont symposium on Applied Social Psychology, PP 145-199, 1990, Sage Publications, Inc.

Kunkler, Ian, Guy Fielding, Michele Macnab, Sally Swann, John Brebner, Robin Prescott, Ross Maclean, Udi Chetty, Angela Bowman, Glyn Neades, Mike Dixon, Melanie Smith, Andrew Walls, John Cairns, Robert Lee, Amanda Lee & Tom Gardner. 2006. "Group dynamics in telemedicine-delivered and standard multidisciplinary team meetings: results from the TELEMAM randomised trial." *Journal of Telemedicine and Telecare* 12(Supplement 3):55–58.

Lababede, Omar, Moulay A. Meziane & Thomas W. Rice. 1999. "TNM Staging of Lung Cancer, a quick reference chart." *Chest* 115:233–235.

Langlotz, C P, O Evenshoshan, S S Seshadri, I Brikman, S Kishore, H L Kundel & J S Schwartz. 1995. "A Methodology for the economic-assessment of Picture Archiving and Communication-Systems." *Journal of Digital Imaging* 8(2):95–102.

Lingard, L., S. Espin, S. Whyte, G Regehr, R. Baker, R. Reznick, J. Bohnen, B. Orser, D. Doran & E. Grober. 2004. "Communication failures in the operating room: an observational classification of recurrent types and effects." *Quality and Safety in Health Care* 13:330–334.

Luff, Paul, Christian Heath, Hideaki Kuzuoka, Jon Hindmarsh, Yamazaki. Keiichi & Oyama. Shinya.

2003. "Fractured Ecologies: Creating Environments for Collaboration." *Human Computer Interaction* 18(1/2):51–84.

Luff, Paul, Jon Hindmarsh & Christian Heath. 2000. *Workplace Studies: Recovering Work Practice and Informing System Design*. Cambridge: Cambridge University Press.

Macaskill, E. J., S. Thrush, E. M. Walker & J. M. Dixon. 2006. "Surgeons' views on multi-disciplinary breast meetings." *European Journal of Cancer* 42:905–908.

Martino, R L, K M Kempner, F S McGovern, D Chow, M E Steele, J E Elson & C N Coleman. 2003. A Collaborative Telemedicine Environment for the Ireland - Northern Ireland - National Cancer Institute International Partnership in Cancer Care. In *25th Annual International Conference of the IEEE EMBS*. IEEE Computer Society.

Masoodian, Masood, Mark Apperley & Lesley Frederickson. 1995. "Video Support for Shared Work-Space Interaction: An Empirical Study." *Interacting with Computers* 7(3):237–253.

Matarazzo, Giacinto & Abigail Sellen. 2000. "The value of video in work at a distance: addition or distraction." *Behaviour and Information Technology* 19(5):339–348.

McAleer, J, D O'Loan & D Hollywood. 2001. "Broadcast quality teleconferencing for oncology." *Oncologist* 6(5):459–462.

McGrath, Joseph E. 1976. *Handbook of Industrial and Organizational Psychology*. Rand McNally chapter Stress and Behaviour in Organizations.

McGrath, Joseph E. 1984. *Groups: Interaction and Performance*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

McGrath, Joseph E. 1988. *The Social Psychology of Time*. Sage Publications.

McGrath, Joseph E. 1992. Groups Interacting with Technology: The Complex and Dynamic Fit of Group, Task, Technology, and Time. In *Proceedings of ACM CSCW'92 Conference on Computer-Supported Co-operative Work*. Closing Plenary p. 4.

MPI. 2005. "ELAN: Eucido Linguistic Annotator." Max Planck Institute for Psycholinguistics. http://www.mpi.nl/tools/elan.html.

Munkvold, Glenn, Gunnar Ellingsen & Eric Monteiro. 2007. From plans to planning: the case of nursing plans. In *Group '07*. Florida: ACM.

Murphy, Judy Irene. 2004. "Using focused reflection and articulation to promote clinical reasoning." *Nursing Education Perspectives* 25(5):226–231.

NCCAC. 2005. *The diagnosis and treatment of lung cancer*. Vol. CG24 NICE.
URL: *www.rcseng.ac.uk*

Newman, Erika A., Amy B. Guest, Mark A. Helvie, Marilyn A. Roubidoux, Alfred E. Chang, Celine G. Kleer, Kathleen M. Diehl, Vincent M. Cimmino, Lori Pierce, Daniel Hayes, Lisa A. Newman & Michael S. Sabel. 2006. "Changes in Surgical Management Resulting From Case Review at a Breast Cancer Multidisciplinary Tumor Board." *Cancer* On-line September 2006:2346–2351.

Nicholls, John. 2007. "Editorial: The inflammatory bowel disease unit and the multidisciplinary team meeting." *Colorectal Disease* 9:477.

Norman, Donald A. 2004. *Emotional Design*. Communications of the ACM New York: Basic Books.

Norman, M. A. & P. J. Thomas. 1991. "Informing HCI design through conversation analysis." *International*

Journal of Man Machine Studies 35:235–250.

Ochsman, Robert B. & Alphonse Chapanis. 1974. "The Effects of 10 Communication Modes on the Behavior of Teams During Co-Operative Problem-Solving." *International Journal of Man-Machine Studies* 6(5):579–619.

O'Conaill, Brid, Steve Whittaker & Sylvia Wilbur. 1993. "Conversations Over Video Conferences: An Evaluation of the Spoken Aspects of Video-Mediated Communication." *Human-Computer Interaction* 8(4):389–428.

O'Connell, Finbar. 2004. "Guidelines for the Clinical Management of Lung Cancer." *Irish Medical Journal* 97(2):Supplement.

O'Higgins, Niall. 2006. "Developing Quality Care for Breast Services in Ireland.".

Olson, Gary M. & Judith S. Olson. 2003. "Mitigating the effects of distance on collaborative intellectual work." *Economics of innovation and new technology* 12(1):27–42.

Olson, Gary M, Judith S Olson & David Meader. 1995. What mix of audio and video is useful for small groups doing real-time design work? In *CHI '95*. New York: ACM Press pp. 362–368.

Olson, Gary M, Judith S Olson & David Meader. 1997. Face-to-Face Group Work compared to Remote group Work With and Without Video. In *Video-medicated Communication*, ed. Kathleen E. Finn, Abigail J. Sellen & Sylvia B. Wilbur. Mahwah, New Jersey USA: Lawrence Erlbaum Associates pp. 157–172.

Olson, Judith S., Gary M. Olson & David Meader. 2000. Distance Matters. In *Video-Mediated Communication*, ed. Abigail J. Sellen Kathleen E. Finn & Sylvia B. Wilbur. ACM Press chapter Face-to-Face Group Work compared to Remote Group Work with and without Video.

Øvretveit, John. 1999. *Integrated quality development for public healthcare*. Norwegian Medical Association.

Øvretveit, John. 2000. "System negligence is at the root of medical error." *International Journal of Health Care Quality Assurance* 13(3):103–105.

Paternò, Fabio. 2000. *Model-Based Design and Evaluation of Interactive Applications*. Applied Computing Springer-Verlag.

Pinelle, David, Carl Gutwin & Saul Greenberg. 2003. "Task analysis for groupware usability evaluation: Modeling shared-workspace tasks with the mechanics of collaboration." *ACM Trans. Comput.-Hum. Interact.* 10(4):281–311.

Pingree, Raymond J. 2007. "How Messages Affect Their Senders: A more general model of message effects and implications for deliberation." *Communication Theory* 17:439–461.

Poltrock, Steven & Jonathan Grudin. 2005. Videoconferencing: Recent Experiments and Reassessment. In *38th International Conference on System Sciences*. System Sciences 2005. HICSS '05 Hawaii: IEEE p. 104.

Preece, Jenny, Yvonne Rogers & Helen Sharp. 2007. *Interaction Design beyond human-computer interaction*. 2nd edition ed. New York: John Wiley & Sons.

Raab, Stephen S, Frederick A Meier, Richard J Zarbo, Chris Jensen, Kim R Geisinger, Christine N Booth, Uma Krishnamurti, Chad H Stone, Janine E Janosky & Dana Marie Grzybicki. 2006. "The "Big Dog" Effect: Variability Assessing the Causes of Error in Diagnoses of Patients With Lung Cancer." *Journal of Clinical Oncology* 24(18):2808–2814.

URL: *http://www.jco.org/cgi/reprint/24/18/2808*

Randall, Dave, Richard Harper & Mark Rouncefield. 2007. *Fieldwork for Design*. Springer.

Rasmussen, P C & S Bulow. 2005. "[Future organisation of colorectal cancer surgery in Denmark]." *Ugeskr Laeger* 167(44):4191–2.

Reddy, Madhu C, Paul Dourish & Wanda Pratt. 2006. "Temporality in Medical Work: Time also Matters." *Computer supported Co-operative Work (CSCW)* 15(1):29–53.

Reddy, Madhu & Paul Dourish. 2002. A Finger on the Pulse: Temporal Rhythms and Information Seeking in Medical Work. In *CSCW '02*. ACM CSCW ACM Press pp. 344 – 353.

Richardson, Daniel C., Rick Dale & Natasha Z. Kirkham. 2007. "The Art of Conversation is co-ordination." *Psychological Science* 18(5):407–413.

Roseman, Mark & Saul Greenberg. 1996. TeamRooms: Network Places for Collaboration. In *Proceedings of ACM CSCW'96 Conference on Computer-Supported Co-operative Work*. Cambridge Ma USA: ACM pp. 325–333.

Ruhleder, Karen & Brigitte Jordan. 2001. "Co-Constructing Non-Mutual Realities: Delay-Generated Trouble in Distributed Interaction." *Computer Supported Co-operative Work* 10:113–138.

Ruhstaller, Thomas, Helen Roe, Beat Thürlimann & Jonathan J Nicholl. 2006. "The Multidisciplinary meeting: An indispensable aid to communication between different specialities." *European Journal of Cancer* 42:2459–2462.

Rutter, D R, G M Stephenson & M E Dewey. 1981. "Visual communication and the content and style of conversation." *British Journal of Social Psychology* 20(1):41–52.

Sacks, Harvey. 1984. Notes on Methodology. In *Structures in Social Action: Studies in Conversation Analysis*, ed. J. M. Atkinson & J. Heritage. Cambridge: Cambridge Universtiy Press.

Sacks, Harvey, Emanuel A. Schegloff & Gail Jefferson. 1974. "A simplest systematics for the organization of turn taking in conversation." *Language* 50(4):696 – 735.

Sainsbury, Richard, Bob Haward, Lesley Rider, Colin Johnston & Caroline Round. 1995. "Influence of clinician workload and patterns of treatment on survival from breast cancer." *Lancet* 345:1265–1270.

Santoso, J T, B Schwertner, R L Coleman & E V Hannigan. 2004. "Tumor board in gynaecologic oncology." *International Journal of Gynecological Cancer* 14(2):206–209.

Schachter, S. 1951. "Deviation, rejection and communication." *Journal of Abnormal Psychology* 46(2):190–207.

Schein, Edgar H. 2003. "On Dialogue, Culture, and Organizational Learning." *Reflections* 4(4):27–38.

Schmidt, K. & L. Bannon. 1992. "Taking CSCW seriously: Supporting articulation work." *Computer Supported Co-operative Work* 1(1/2):7–40.

Sellen, Abigail J. 1992. Speech patterns in video-mediated conversations. In *Proceedings of the Computer Human Interactions (CHI) '92*, ed. ACM.

Sellen, Abigail J. 1995. "Remote Conversations: The Effects of Mediating Talk with Technology." *Human-Computer Interaction* 10(4):401–437.

Shannon, Claude E & Warren Weaver. 1949. *The mathematical theory of communication*. Urbana, Il.: University of Illinois Press.

Sharma, A., D. M. Sharp, L. G. Walker & J. R. T. Monson. 2007. "Stress and burnout among colorectal surgeons and colorectal nurse specialists working in the National Health Service." *Colorectal Disease* published on-line.

Shekelle, Paul, Martin P Eccles, Jeremy M Grimshaw & Steven H Steven H Woolf. 2001. "When should clinical

guidelines be updated?" *British Medical Journal* 323:155–157.

Short, John, Ederyn Williams & Bruce Christie. 1976. "Visual Communication and Social Interaction." pp. 153–164.

Sidhom, M. A. & M. G. Poulsen. 2006. "Multidisciplinary care in oncology: medicolegal implications of group decisions." *Lancet Oncology* 7(11):951–954.

Siegel, Jane, V. Dubrovsky, S. Kiesler & T. W. McGuire. 1986. "Group processes in computer-mediated communication." *Organizational behavior and human decision processes* 37(2):157–187.

Siggins, Lorna. 2007. "Review ordered over cancer misdiagnosis." *The Irish Times* Aug 6:1.

Solberg, L. I., T. E. Kottke, M. L. Brekke, C. A. Calomeni, S. A. Conn & G. Davidson. 1996. "Using continuous quality improvement to increase preventive services in clinical practice." *Preventive Medicine* 25:259–267.

Soukop, M., A. Robinson, D. Soukop, C. L. Ingham-Clark & M. J. Kelly. 2006. "Results of a survey of the role of multidisciplinary team co-ordinators for colorectal cancer in England and Wales." *Colorectal Disease* 9:146–150.

St. James's Hospital. 2006. "An information guide to how services are administered in St. James's Hospital.".
URL: *http://www.stjames.ie/aboutthehospital/freedomofinformation/section15and16manuals/file,-8237,en.doc*

Stahl, Gerry. 2002. "Can community knowledge exceed its members?" *SIGGROUP Bulletin* 23(3):3–7.

Star, S. L. & J. R. Griesemer. 1989. "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-1939." *Social Studies of Science* 19:387–420.

Steijn, Bram. 2001. "Work systems, quality of working life an attitudes of workers: an empirical study towards the effects of team and non-teamwork." *New Technology, Work and Employment* 16(3):191–203.

Straus, Susan G. & Joseph E. McGrath. 1994. "Does the medium matter? The interaction of task type and technology on group performance and member reactions." *Journal of Applied Psychology* 79(87-97).

Strickland, Nicola H. 2000. "Current topic: PACS (picture archiving and communication systems): filmless radiology." *Arch Dis Child* 83(1):82–86.
URL: *http://adc.bmjjournals.com/cgi/content/abstract/archdischild;83/1/82*

Suchman, Lucy A. 1987. *Plans and Situated Action*. Cambridge University Press.

Symon, Gillian, Karen Long & Judy Ellis. 1996. "The Co-ordination of Work Activities: Co-operation and Conflict in a Hospital Context." *Computer Supported Co-operative Work (CSCW)* 5(1):1 – 31.

The ASC Executive Board. 2000. "Cervical Cytology Practice Guideline." Delaware, USA: American Society for Cytopathology.
URL: *http://www.cytopathology.org/website/article.asp?id=387*

The Irish Medical Council. 2007. "Continuing Medical Education/ Continuing Professional Development.".

Tuomainen, Jyrki, Tobias S. Andersena, Kaisa Tiippanaa & Mikko Sams. 2005. "Audio–visual speech perception is special." *Cognition* 96:B13–B22.

van der Veer, G.C., B.F. Lenting & B.A.J. Bergevoet. 1996. "GTA: Groupware Task Analysis - Modeling Complexity." *Acta Psychologica* 91:297–322.

Veinott, Elizabeth S., Judith Olson, Gary M. Olson & Xiaolan Fu. 1999. Video helps remote work: speakers

who need to negotiate common ground benefit from seeing each other. In *CHI '99: Proceedings of the SIGCHI conference on Human factors in computing systems*. ACM Press pp. 302–309.

Wall, Martin. 2007. "Team of experts to investigate cancer test error.".

Walther, Joseph B. & Natalya N. Bazarova. 2007. "Misattribution in Virtual Groups: The Effects of Member Distribution on Self-Serving Bias and Partner Blame." *Human Communication Research* 33:1–26.

Wenger, Etienne. 1999. *Communities of Practice: Learning, Meaning, and Identity*. Cambridge University Press.

Whittaker, Steve. 2003. "Things to talk about when talking about things." *Human-Computer Interaction* 18:149 – 170.

Whittaker, Steve & Brid O'Conaill. 1997. The role of vision in face-to-face and mediated communication. In *Video-Mediated communication*, ed. Kathleen E. Finn, Abigail J. Sellen & Sylvia B. Wilbur. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Williams, Ederyn. 1975. "Coalition Formation Over Telecommunications Media." *European Journal of Social Psychological* 5(4):503–507.

Windsor, A. & A. Forbes. 2007. "The inflammatory bowel disease unit and the multidisciplinary team meeting.".

Wong, K & D Birks. 2004. "Surgical risk management: the value of a weekly surgical radio-pathological meeting." *Anz J Surg* 74(4):205–209.

Wright, F. C., C. De Vito, C. Langer, A. Hunter & the Expert Panel on Multidisciplinary Cancer Conference Standards. 2007. "Multidisciplinary cancer conferences: A systematic review and development of practice standards." *European Journal of Cancer* 43:1002–1010.

Zuiderent, Teun, Brit Ross Winthereik & Marc Berg. 2003. "Talking about distributed communication and medicine: On bring together remote and local actors." *Human-Computer Interaction* 18:171–180.