Health Information and Quality Authority

An tÚdarás Um Fhaisnéis agus Cáilíocht Sláinte

Evidence summary for asymptomatic transmission of COVID-19

21 April 2020

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The Health Information and Quality Authority (HIQA) has developed a series of 'Evidence Summaries' to assist the Clinical Expert Advisory Group (EAG) supporting the National Public Health Emergency Team (NPHET) in their response to COVID-19. These summaries are based on specific research questions. This evidence summary was developed to address the following research question:

What is the evidence for asymptomatic transmission of COVID-19?

The processes as outlined in the protocol were followed. Below is the summary of all relevant evidence from 30 December 2019 until 2 April 2020.

This report includes information on both asymptomatic transmission, where the infector has no symptoms throughout the course of the disease, and pre-symptomatic transmission, where the infector develops symptoms after transmitting the virus to another individual.

Results

This report includes evidence from 32 studies, of which 18 are case studies [1-18] one is a cross sectional study [19] and 13 are modelling studies.[20-32]

Case studies

Details of these 18 studies can be found in Table 2.

Of the 18 case studies, ten were case studies of transmission during the pre-symptomatic phase of the disease,[2, 3, 6, 8, 10-12, 14, 17, 18] four were studies on transmission from asymptomatic carriers[1, 4, 5, 9] and one included asymptomatic and pre-symptomatic transmission.[7] In three studies it was unclear who the index patient was and it potentially could have been pre-symptomatic or asymptomatic transmission.[13, 15, 16]

Pre-symptomatic transmission

Of the studies on pre-symptomatic transmission, eight out of 11 were from China,[3, 6, 7, 10-12, 17, 18] with one each from Germany,[2] Taiwan [8] and Singapore.[14] Six of the studies were based on transmission through families (either sharing a house or at family dinners),[3, 6-8, 10, 18] two were through the workplace (a business meeting and dinner meeting),[2, 11] one was a dinner party with friends [17] and one was in the hospital setting between a visitor and a patient.[12] In Wei et al[14] seven clusters were included, of which three were household clusters, two were between friends, one was due to proximity in a church and one appeared to be environmental contamination of a church pew.

The numbers of cases reported to be caused by pre-symptomatic transmission per case was between one and six, most (nine out of eleven studies) reported between

one and three cases (infectees) per index case (infector).[2, 3, 7, 8, 10-12, 14, 17] Very little information was provided on the characteristics of pre-symptomatic transmissions beyond basic descriptions of age and gender, with three studies including details of existing chronic illnesses in the infectors and infectees.[10, 12, 18]

The length of time between transmission from the index patient to the infectee and the onset of symptoms in the index case was between 1 and (up to) 39 days.[7] However, for most studies it was less than five days.[2, 6, 8, 11, 12, 14, 17, 18] It should be noted however, that in many of these case studies, contact between potential infectors and infectees consisted of sustained contact over several days. In these situations it was not possible to ascertain when exactly the transmission took place.

The length of time between transmission and symptom onset in the infectee or the index case (incubation time) varied from less than five days [2, 6, 8, 10-12, 17] to eight days or more.[3, 6, 7, 10] Among 11 patients included by Zhang et al. incubation period ranged from 3 and 17 days (median 5.5. days), including two patients who were asymptomatic throughout.[18] In Wei et al.[14] the incubation period varied between 1 and 15 days depending on the cluster.

Generally, among studies reporting on pre-symptomatic transmission the most common risk factor was family/household contact,[3, 6, 8, 10, 14, 18] with transmission at dinner parties also commonly reported. [6, 11, 17, 18]

Asymptomatic transmission

All five studies reporting on asymptomatic transmission (i.e.patient remained asymptomatic throughout the course of the disease or the length of the study), were based in China[1, 4, 5, 7, 9] and involved transmission of COVID-19 between family members. The numbers of cases reported to be caused by asymptomatic transmission per case was between one[5, 7] and up to five (it was unclear in one particular study how many transmissions had been caused).[4] Most commonly, in these five studies, each asymptomatic case caused three further cases.[1, 7, 9]

Unclear transmission type

In Wu et al.,[15] the index case could have been one of two people, one of whom was asymptomatic and the other pre-symptomatic at the time of transmission. All four infectees were in close contact with the index cases within a confined space (e.g. in a car, karoke room, playing cards). Similarly, in Qian et al.[13] the index case for three infectees may have been either an asymptomatic or a pre-symptomatic case. These three infectees (two pre-symptomatic and one asymptomatic) went on to infect three more family members during pre-symptomatic/asymptomatic phase.[13]

Other outcomes and Quality apprasial

The demographics of the asymptomatic and pre-symptomatic index cases were frequently not well described, but all appeared to be adults.

Overall, for their study design, the quality of the studies were moderate to low. The quality of one study was moderate to high.[14] As is the nature of case reports, the studies tended to be letters or brief reports and therefore limited information was often presented. It was sometimes unclear the type of test for COVID-19 that had been administered and how symptoms had been elucidated.[5, 6, 9, 11] Eight of the studies were not peer reviewed,[1, 5, 7, 9, 15-18] and it was unclear in two of the studies if there was a formal peer review process,[12, 14] raising additional concerns around the quality of these studies.

Cross sectional studies

Lu et al carried out a cross sectional study with 459 COVID 19 patients and reported that 7.8% had no link to Wuhan city but had contact with individuals from Wuhan city who had no symptoms.[19] These contacts could have been pre-symptomatic or asymptomatic.

This study was not peer reviewed and was of low to moderate quality.

Modelling Studies/Epidemiological parameter estimation

Thirteen modelling/epidemiological parameter estimation studies are included in thisreport. Eleven of these studies provide evidence for pre-symptomatic transmission.[20-25, 27, 30-33] Table 1 provides an overview of the transmission characteristics for pre-symptomatic transmission from these studies. Data extraction for all 13 studies is provided in Table 2.[20-32]

Pre-symptomatic transmission

Of the 11 studies providing evidence for pre-symptomatic transmission, five of the studies had their authors infer that pre-symptomatic transmission is occurring due to shorter serial intervals (the time between symptom onset in an infector-infectee pair) than incubation periods (time between moment of infection and symptom onset)[23, 24, 27, 28] or due to negative serial intervals.[21]

Du et al.[21] estimated that 12.6% of transmission occurs in the pre-symptomatic period. Tindale et al.[23] estimate that transmission occurs between two and three days days before symptom onset. The reported incubation period was shorter earlier in the pandemic than in cases that occurred later but, it is unclear in this study why this would be. Ma et al.[27] used similar methodology to Tindale et al. but used data from seven different countries. However, the majority (91%) of the data were from China and there may be considerable overlap with the data sets used in other studies. The authors estimated that in 44% of infector-infectee pairs transmission occurs before the symptom onset of infectors' and that, on average, the time point of exposure ranged from 9 days before symptom onset to 13 days after. Xia et al.[24] estimated that 73% of secondary cases were infected before symptom onset of first generation cases, particularly in the last three days of the incubation period. In Nishiura et al.[28] the authors conclude that it is likely that substantial asymptomatic transmission is occurring.

For four other studies on pre-symptomatic transmission, different methodologies were used to infer and quantify the proportion of pre-symptomatic transmission. In Ganyani et al.[22] the authors estimate the proportion of pre-symptomatic transmission based on clusters of confirmed cases from Singapore and China. From this, they state that pre-symptomatic transmission ranged from 48% (95% CI 32 – 67%) to 66% (95% CI 45-84%) for Singapore and from 62% (95% CI 50-76%) to 77% (95% CI 65-87%) for Tianjin, China depending on whether their model allows for negative serial intervals or not. He et al.[20] reported a mean serial interval of 5.8 days and they estimated that 44% of transmission takes place before symptom onset. They also report that infectiousness started 2.5 days before symptom onset and peaked around 0.6 days. Interestingly, the authors reported that they detected high viral load around the time of symptom onset which gradually decreased towards the detection limit at about 21 days after onset. Liu et al.[32] estimate the proportion of pre-symptomatic transmission without active case finding as 12-28%, and estimated that with active case finding (and isolation) the number of secondary infections caused by symptomatic cases is reduced and thereby the proportion of pre-symptomatic transmissions increases to 21-46%. In Ferretti et al.[25] the authors use a deterministic mathematic model of infectiousness to determine the reproductive number (R0, the average number of infections caused by an infectious individual) for pre-symptomatic transmission (R0=0.9) and asymptomatic transmission (R0=0.1), as well as symptomatic transmission (R0=0.7) and environmental transmission (R0=0.2). They conclude that a large proportion of all transmissions occur before individuals develop symptoms.

Siwiak et al.[31] use a modified Susceptible, Infected and Recovered/removed (SIR) model and propose a set of parameters for a COVID-19 Global epidemic and Mobility Model (GLEaM). This model includes both pre-symptomatic and asymptomatic transmission (although asymptomatic is modelled with mild symptomatic). The model predictions are compared with confirmed cases in 16 countries, and on this basis, report a latent non-infectious period of 1.1 days followed by 4.6 days of pre-symptomatic infectious period fit well to observed data.

Only one study Zhou et al.[30] found little evidence for an infectious pre-symptomatic period. In their study, they compared a standard epidemiological model (Susceptible Exposed Infectious Recovered) and added a state for pre-symptomatic, that is assumed to be infectious. They found the model without pre-symptomatic transmission fitted the data better and concluded that there was little evidence for pre-symptomatic transmission based on their models.

Asymptomatic transmission

Three studies modelled asymptomatic transmission.[25, 26, 29] Ferretti et al.[25] concluded that even if asymptomatic infections are common, onward transmission from this state is uncommon (R0=0.1), compared to pre-symptomatic transmission (R0=0.9). Zhang et al.[29] developed a novel stochastic dynamic model and estimated that while approximately 30% of those infected remain asymptomatic,

patients with symptoms are about twice as likely to pass on the pathogen as asymptomatic patients. Based on logistic regression, Luo et al.[26] estimated that the risk of transmission increases as the symptoms of the source case worsen and report that of 305 close contacts of an asymptomatic patient, only one was infected, a rate of 0.33%.

Other outcomes and Quality Appraisal

Two studies specifically looked at the risk of transmission in different settings (i.e. household, other family, healthcare, public transport). In each case, the biggest risk for pre-symptomatic or asymptomatic transmission was in household/family settings.[21, 26]

It is important to note that only one of the modelling studies was peer reviewed.[33] In general, the relevance of the studies to the Irish setting was considered low, as they mostly included patients from China, where cultural, demographic and geographical differences may have had an effect on transmission. In addition, as most of the included datasets are from China an overlap of data is likely. It is probable that the studies by Tindale et al. and Ganyani et al. used the same datasets.[22, 23] This report assessed the quality of all included studies in this review and judged the quality of Tindale et al., Ma et al. and Zhang et al. to be good. However, these studies were not without limitations; including the lack of peer review, thus they were judged as being of moderate overall quality.[23, 27, 29] Studies by Du et al., Nishiura et al., Ferretti et al., Siwiak et al., Luo et al. and He et al. were judged as being of low to moderate quality,[20, 21, 25, 26, 28, 31] while those by Zhou et al., and Xia et al. were judged as being of low quality.[24, 30]

Ganyani et al.[22] and Liu et al.[32] had the highest quality of the included studies (moderate to high). These studies were downgraded due to the relevance of the population and the lack of peer review.

Table 1: Overview of transmission characteristics for pre-symptomatic transmission

Author	Number of cases	Ro	Mean/median incubation period	Mean/median serial interval	Proportion pre-symptomatic transmission	How long before symptom onset transmission occurs	Data and date
Du et al[21]	N=752 cases	1.32 (95% CI 1.16-1.48)	NR	3.96 days (95% CI 3.53-4.39)	12.6%	NR	China, up to February 8th
Tindale et al[23]	Singapore: 93 Tianjin: 135	Singapore: 1.97 (1.45, 2.48) Tianjin: 1.87 (1.65, 2.09)	Singapore: 7.1 (6.13, 8.25) days, median 6.55 days Tianjin: 9 (7.92, 10.2) days. Median 8.62 days	Singapore: 4.56 (2.69, 6.42) days. SD 0.95 Tianjin: 4.22 (3.43, 5.01) days. SD 0.40	Probability that the incubation period minus the serial interval is negative: Singapore: 0.7 Tianjin: 0.8	Singapore: average 2.55 days Tianjin: 2.89 days	Singapore data: Jan.19-Feb.26. Tianjin: Jan.21-Feb.22
Ma et al[27]	N=1,155 cases	1.70 and 1.78 based on two different formulas	Mean 7.44 days (95% CI: 7.10, 7.78)	Mean 6.70 (SD 5.20) days	43.78%	-0.19 day (95% CI: -0.62, 0.25) Approx. 1 day before symptom onset	China, Japan, Singapore, South Korea, Vietnam, Germany and Malaysia Up to 3rd March
Xia et al[24]	N=106 cases for incubation period N=50 first generation and 74 second generation cases for serial interval	NR	Mean 4.9 days (95% CI, 4.4 to 5.4) days Range (2.5th to 97.5th percentile): 0.8 to 11.1 days	Mean 4.1 (SD 3.3) days. Range (2.5th to 97.5th percentile): -1 to 13 days	73%	66.2% of secondary cases were infected within 3 days before symptom onset of first generation cases	China (outside Wuhan and Hubei)
Nishiura et al[28]	28 infector-infectee pairs	NR	NR	Median: 4.0 days (95% credible interval [CrI]: 3.1, 4.9)	NR	NR	6 countries (Vietnam, South Korea, Germany, Taiwan, China, Singapore)
Ferretti et al[25]	40 transmission pairs	Overall Ro = 2.0 pre-symptomatic: 0.9 symptomatic: 0.7 asymptomatic: 0.1 environmental: 0.2	Mean (SD): 5.5 days (2.1), Median: 5.2 days	NR	Mean probability that transmission occurred before symptoms 37% (95% CI: 27.5% - 45%)	NR	7 countries (Vietnam, South Korea, Germany, Taiwan, China, Singapore, Italy)

Ganyani et al[22]	Singapore: 91 China: 135	NR	NR	5.21 (95% CI -3.35to 13.94) for Singapore 3.95 (95% CI -4.47 to 12.51) for Tianjin	Singpore: 0.48 – 0.66 depending on assumptions China: 0.62 to 0.77 depending on assumptions	NR	Singapore and China
He et al[20]	77 infector-infectee pairs	NR	NR	5.8 days (95% CI = 4.8 to 6.8) and median of 5.2 days (95% CI = 4.1 to 6.4)	Proportion of transmission before symptom onset was 44% (46–52% in sensitivity analysis)	Infectiousness started 2.5 days before symptom onset and peaked at 0.6 days before symptom onset	China, Guangzhou region
Liu et al[32]	Used published estimates	NR	NR	NR	Without active case finding 12-28% of transmission during pre-symptomatic period. With active case finding 21-46% of transmission during pre-symptomatic period	NR	China
Siwiak et al[31]	NR	Ro 4.4	NR	NR	NR	4.6 days of pre-symptomatic infectious period	Uses a number of different sources
Zhou et al[30]	NR	Ro 2.12 (95% CI 2.04, 2.18) SEIR model (no pre-symptomatic transmission) Ro 2.05 SEAIR model (with infectious pre-symptomatic stage	NR	NR	NR	0 days	China (evacuees): Jan 29th to Feb 2nd

Discussion

Case studies

Based on the case studies identified, there is some evidence that pre-symptomatic and asymptomatic transmission is occurring. In this report we have included more studies reporting on pre-symptomatic transmission (eleven) than asymptomatic transmission (five), but this may be due to the difficulties in identifying asymptomatic carriers as index cases. The major limitation associated with case reports or case series reports is that they are open to significant bias. In most cases, the transmission was assumed, usually based on an individual travelling from an area (most often Wuhan) that was known to be in the midst of the COVID-19 epidemic or when the index case was known to be in contact with a confirmed COVID-19 case. However, in all cases, those infected could have caught the infection from another source. Recall bias is an issue as symptoms are often ascertained from the patient by interview weeks after the transmission has occurred. In some of the studies on asymptomatic transmission, the patient reported no symptoms, but CT scans and bloods suggested they had an infection, whether these patients can be considered truly asymptomatic is debatable. Also, some patients may not report mild symptoms. One study that is often quoted in the literature, Rothe et al.,[2] has recently been criticised and thus needs to be interpreted with caution.

Of note, although children generally present with mild or even asymptomatic disease, none of the case studies included here had a child as an index case. This could be for many reasons, including that most of these studies involve the index case travelling from a highly infected area to an area with low levels of infection and this is less likely to be the case with children.

The one cross sectional study that was identified provided limited evidence of pre-symptomatic/asymptomatic transmission.

Modelling Studies/Epidemiological parameter estimation

The proportion of transmission events that occur before symptom onset is central to understanding how to control the spread of an infection. Ten of the studies presented here suggest that pre-symptomatic transmission is taking place and the proportion of pre-symptomatic transmission is reported to be between 12.6%[21] and over 70%.[24] Four of the studies suggested that transmission occurs between one [27] and three days[20, 23, 24] before symptom onset. However, as noted, these studies have not been peer reviewed (except for Nishiura et al.) and may have used similar datasets. For Ganyani et al.[22], the inter-country variability in their results makes it difficult to know if this study would be applicable to Ireland. It may be that the generation interval and serial interval is country/culture-specific and use of data from another country may be markedly different and could give rise to inaccurate estimates of R/Ro and rates of infection for Ireland. As data becomes available from European countries, the methods used by Gunyani et al. may be applied to a population that would have more relevance to Ireland.

Only three modelling studies focussed on transmission from asymptomatic patients.[25, 26, 29] The results from these modelling studies suggest that transmission from asymptomatic carriers may not be a major driver for transmission.However, as noted, none of these studies is peer-reviewed and their quality is considered to be low to moderate.

In addition to the modelling studies presented, a further 16 modelling studies were identified but not included in this report. These studies used modelling to either predict the number of cases and deaths occurring in each country or predict the effectiveness of measures such as contact tracing and isolation in containing the spread of COVID-19.[34-50] In these models, asymptomatic transmission was either assumed or various values were included in sensitivity analysis to try and determine the effect of asymptomatic transmission on spread. Although these studies have not been included in this evidence summary, full citations are included in the reference list.

Conclusion

This review identified and summarised 18 case studies reporting pre-symptomatic or asymptomatic transmission. However, their level of evidence is low and is subject to a number of potential sources of bias and therefore they should be interpreted with caution.

A single cross sectional study was included that provided potential evidence of asymptomatic/pre-symptomatic transmission

Modelling/epidemiological parameter estimation studies provide an additional source of evidence for pre-symptomatic and asymptomatic transmission. However, the quality of the studies is variable and they may be based on overlapping datasets.

Based on the totality of the evidence presented in this report, it seems likely that pre-symptomatic transmission is occurring. Evidence of asymptomatic transmission from asymptomatic carriers, is more limited (perhaps due to difficulties in identifying truly asymptomatic carriers); it appears plausible, but it may not be a driver of transmission.

Overall, based on data from the included case reports and modelling studies, the setting with the highest risk of transmission was the household and or family setting.

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Table 1 Data extraction page numbers

Below is the extracted detailed data from the studies included in this evidence summary. Each study is presented in a separate table, the page numbers of which are listed below.

Author	Title	Page number of data extraction table
Bai et al.	Presumed Asymptomatic Carrier Transmission of COVID-19	39
Du et al.	The serial interval of COVID-19 from publicly reported confirmed cases	57
Ferretti et al.	Quantifying dynamics of SARS-CoV-2 transmission suggests that epidemic control and avoidance is feasible through instantaneous digital contact tracing	74
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Table 2 Data extraction table: Case studies

Author Country Study design Study URL	Population setting	Primary outcome results
Huang et al **China** **Case study (cluster)** **Type of transmission** Pre-symptomatic **https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(20)30147-X/fulltext#seccestitle10**	Familial cluster. Living in same household as well as eating dinners together. **Patient demographics** Index Patient: female. Patient 1: female, sister of index patient. Patient 2: female, sister of index patient. Patient 3: female, mother of index patient, Patient 4: Male, brother of index patient. Patient 5: female, wife of patient 4. Patient 6: male, brother of index patient Patient 7: female, wife of patient 6 Patient 8: male, brother of patient 7	**Pre-symptomatic transmission details:** The index patient was the only family member to have travelled to Wuhan. It is believed she infected 6 family members (patients 1, 2, 3, 4, 6 and 7) while she was pre-symptomatic. Patients 6 and 7 are thought to have infected three other family members at a family dinner while they were pre-symptomatic. **Numbers of cases reported to be caused by pre-symptomatic transmission** Index case thought to have transmitted to six other family members. Patients 6 and 7 thought to have transmitted to three other family members. **Characteristics of pre-symptomatic transmissions (age, gender, health status and health status of those infected)** Very little detail provided beyond the gender of the patients. **Proportion pre-symptomatic patients that become symptomatic and how long before symptom onset transmission occurred** All patients in this study became symptomatic. Time between transmission to infectees and symptom onset in index patient(s): For patients 1, 2, 3 and 4 between 5 and 7 days. For patient 6 and 7 around 5 days

	Patient 9: female, sister of patient 7 Patient 10: male, husband of patient 9 **Clinical characteristics** All of the patients developed symptoms including fever, cough, diarrhoea, fatigue.	Patient 6 and/or 7 were the infectors for patients 8, 9 and 10. For patients 8, 9 and 10 between 3 and 4 days depending on who was the infector. <u>Incubation time for infector and infectees:</u> For patient 1: 3-5 days. Patient 2: 2-4 days, Patient 3: 8 to 10 days. Patient 4: 2 to 4 days. Patient 5: unclear. Patient 6: 5 days, Patient 7: 4 days. Patient 8: 8 days, Patient 9: 4 days. Patient 10: 7 days. **Any risk factors for asymptomatic transmission e.g. family/household contacts** Family transmission. Household contacts and family dinner. **Other outcomes of interest -** NR **Comments** **Overall quality** Moderate

Author Country Study design **Study URL**	Population setting	**Primary outcome results**
Liu et al **Taiwan** **Case study (Cluster)** **Type of transmission** **Pre-symptomatic** **https://www.nejm.org/doi/pdf/10.1056/NEJMc2001573?articleTools=true**	Familial cluster **Patient demographics** Patient 1(index case): Female, 52 years of age, history of type 2 diabetes Patient 2(infected, husband of patient 1): male, 50 years of age. **Clinical characteristics** Patient 1(index case): On admission: fever and myalgia. Chest radiograph showed diffuse infiltrates in the bilateral lower lungs. Cough, rhinorrhoea and sore throat developed on day 5. Patient 2 (infected): On admission: rhinorrhoea, followed by myalgia two days after admission	**Pre-symptomatic transmission details:** Patient 1 (the index case) flew back to Taiwan from Wuhan. At the time there were only a few cases of COVID 19 in Taiwan. Her husband (patient 2) did not travel with her, but they both developed symptoms five days after she returned home and were diagnosed with COVID 19 at the hospital. **Numbers of cases reported to be caused by pre-symptomatic transmission** One, patient 1 and patient 2 developed symptoms of disease at same time, patient 1 is presumed to be the index case. **Characteristics of pre-symptomatic transmissions (age, gender, health status and health status of those infected)** Patient 1(index case): Female, 52 years of age, history of type 2 diabetes. Patient 2(infected): male, 50 years of age. **Proportion pre-symptomatic patients that become symptomatic and how long before symptom onset transmission occurred** Transmission from the index case to the infectee occurred between 1 and 4 days before symptom onset in the index case. The infectee developed symptoms between 1 and 4 days after transmission **Any risk factors for asymptomatic transmission e.g.**

		family/household contacts Family/household. **Other outcomes of interest -** NR **Comments** This was the fifth reported case of COVID-19 in Taiwan. It is not described as pre-symptomatic transmission in the study but it is implied as both husband and wife developed symptoms on the same day. **Overall quality** Moderate

Author Country Study design Study URL	Population setting	Primary outcome results
Luo et al **China** **Case study (Cluster). Part of larger case series** **Type of transmission** Presymptomatic **https://journals.lww.com/cmj/Citation/publishahead/A_confirmed_asymptomatic_carrier_of_2019_novel.99353.aspx**	Pre-symptomatic transmission occurred at home between husband (Patient B who was pre-symptomtic) and his wife (patient A) **Patient demographics** **Patient A**: Infected by her husband. Female 50 years of age. Healthy, no prior history. **Patient B**: Transmitted infection in pre-symptomatic phase. Male age 44.	**Pre-symptomatic transmission details:** Patient B is thought to be the index patient and is believed to have transmitted COVID-19 to his wife Patient A while pre-symptomatic. Patient A was asymptomatic throughout the study. **Numbers of cases reported to be caused by pre-symptomatic transmission** One case (out of 81 cases) reported to be due to transmission during pre-symptomatic stage. **Characteristics of pre-symptomatic transmissions (e.g. age, gender, health status and health status of those infected)** Patient A (infected): was healthy, no prior history. Asymptomatic throughout the course of the illness. Despite largely normal laboratory and chest CT findings, her persistent positivity of the virus nucleic acid in her throat swabs and anal swabs for at least 17 days suggested that she was very likely a healthy carrier. Patient B (Index patient): No information on health history. Mildly symptomatic after admission to hospital, including low fever and diarrhoea. On admission to hospital CT scan revealed ground glass opacity in lower right lung. **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred**

	Clinical characteristics **Patient A**: was healthy, no prior history. Asymptomatic throughout the course of the illness. Despite largely normal laboratory and chest CT findings, her persistent positivity of the virus nucleic acid in her throat swabs and anal swabs for at least 17 days suggested that she was very likely a healthy carrier. **Patient B**: No information on health history. Mildly symptomatic after admission to hospital, including low fever and diarrhoea. On admission to hospital CT scan revealed ground glass opacity in lower right lung.	In this case both patients Patient A and B were asymptomatic at time they were admitted to hospital. Patient B became symptomatic 12–15 days after exposure. During this time (11-14) days he infected his wife. **Any risk factors for pre-symptomatic transmission e.g. family/household contacts** This was a household contact pre-symptomatic transmission. **Other outcomes of interest** Viral shedding Patient A virus nucleic acid tests of throat swabs and anal swabs for at least 17 days were positive – she was still in hospital when article published. Asymptomatic proportion Asymptomatic case identified out of 81 cases (8 asymptomatic cases at test confirmation, but 7 subsequently developed symptoms). **Comments** Treatment Patient A was treated with aerosolized interferon (IFN) α2β, and two lopinavir/ritonavir tablets (200 mg/50 mg) twice a day for 10 days between February 6 and 16. Then lopinavir/ritonavir was discontinued, and intravenous ribavirin 0.5 g every 12 hours were administered. This may have affected course of the disease in this patient. Inconsistencies It states that patient A caught COVID-19 from patient B, while patient B was in the pre-symptomatic phase of the disease. The figure

		showing when each of the patients A, B, C and D had symptom onset doesn't match the table given in the supplementary appendix. **Overall Quality** Moderate

Author Country Study design Study URL	Population setting	Primary outcome results
Rothe et al **Germany** **Case study (Cluster)** **Type of transmission** Pre-symptomatic **https://www.nejm.org/doi/pdf/10.1056/NEJMc2001468?articleTools=true**	Transmission occurred during business meeting and in the workplace **Patient demographics** Index patient: Chinese, female. Patient 1: German, Male, 33 years of age. Healthy. Patients 2, 3 and 4: No demographic information **Clinical characteristics** Index patient: Mild symptoms, including fever, mild muscle pain, localised chest pains, cough. Patient 1: sore throat, chills, myalgias, fever and productive cough. Patients 2 – 4: No severe illness up to time of paper publication	**Primary outcome results** **Pre-symptomatic transmission details:** This case of COVID-19 infection was diagnosed in Germany and transmitted outside Asia. It is notable that the infection appears to have been transmitted during the incubation period of the index case, in whom the illness was brief and non-specific. Patient 3 and patient 4 only had contact with patient 1 during pre-symptomatic period and patient 1 and 2 had contact with index case during pre-symptomatic period. **Numbers of cases reported to be caused by Pre-symptomatic transmission** Unclear, at least three (patient 1, patient 2 and patient 3). **Characteristics of pre-symptomatic transmissions (age, gender, health status and health status of those infected)** Index patient: Female, Chinese. Patient 1 (infected and potentially infector): Male, 33 years of age, healthy. Patient 2,3 and 4 (Infected): No information provided. **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred** All five patients became symptomatic.

		Time between transmission to infectees and symptom onset in index patient(s): Patient 1: 1 to 2 days; Patient 2: 1 day. Patient 1 is thought to be the infector for patients 3 and 4. Time between transmission and symptom onset in patient 1: Patient 3: 3 to 4 days, Patient 4: unclear if transmission occurred before symptom onset in patient 1: 0 to 3 days Incubation time: Patient 1: 3 to 5 days. Patient 2: 2 to 4 days. Patient 3: 4 to 5 days. Patient 4: 2 to 5 days. **Any risk factors for pre-symptomatic transmission e.g. family/household contacts** Workplace transmission. **Other outcomes of interest -** NR **Comments** Since this paper was published it has received criticism that the index patient was not asymptomatic, but did have mild symptoms that they had not previously reported. https://www.sciencemag.org/news/2020/02/paper-non-symptomatic-patient-transmitting-coronavirus-wrong **Overall Quality** Moderate

Author Country Study design Study URL	Population setting	Primary outcome results

Yu et al **China** **Case study (Cluster)** **Type of transmission** Pre-symptomatic https://academic.oup.com/jid/advance-article/doi/10.1093/infdis/jiaa077/5739751	Family – shared accommodation **Patient demographics** Patient 1 (infected): male, 88 years of age, incapacitated, hypertension, heart disease and chronic obstructive pulmonary disease. Lives in Shanghai Patient 4 (wife of Patient 1): female, 75 years of age, lives in Shanghai Patient 2 (sister of patient 4): female, 65 years of age, from Wuhan. Patient 3 (husband of patient 4): male, 69 years of age, from Wuhan. **Clinical characteristics** Patient 1: developed poor appetite, a dry cough and fever. Normal white cell count, lymphocytes and c-reactive protein levels.CT scan showed interstitial hyperplasia with infection in both lungs. Patient died 4 days after admission to hospital Patient 2: Had fever and chills, blood tests were normal, CT	**Pre-symptomatic transmission details:** Patients 2 and 3 visited Shanghai from Wuhan on 15 January. They stayed with patients 1 and 4 in their apartment. Four days after arrival patients, 1 and 2 started to experience symptoms and where taken to the hospital by ambulance. Patients 3 and 4 started having symptoms on the 23 January. Patient 1 had limited mobility and had not left his apartment for at least 2 weeks before onset of the illness. Patients 2, 3 and 4 had no symptoms in previous 2 weeks. It is assumed that patient 1 caught COVID 19 from patient 2, 3 or 4. As patients 2 and 3 came from Wuhan, the epicentre of the outbreak, they are thought to be the index patients. **Numbers of cases reported to be caused by pre-symptomatic transmission** Two, both patient 1 and patient 4 are thought to have caught the illness from patients 2 and/or 3. **Characteristics of pre-symptomatic transmissions (age, gender, health status and health status of those infected)** Patient 1(infected): male, 88 years of age, incapacitated, hypertension, heart disease and chronic obstructive pulmonary disease Patient 4 (infected): female, 75 years of age Patient 2 (possible index case): female, 65 years of age Patient 3 (possible index case): male, 69 years of age **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred** All cases were symptomatic in this study. Time between transmission to infectees and symptom onset in index patient(s):

	scan showed ground-glass opacities on one lung Patient 3 and 4: had fever	Depends on index patient. If patient 2 is index: up to 5 days, if patient 3 is index: up to 8 days Incubation time: Patient 1:Transmission occurred up to 5 days before symptom onset. Patient 4: Transmission occurred up to 8 days before symptom onset **Any risk factors for Pre-symptomatic transmission e.g. family/household contacts** Family cluster. All members were staying in same apartment at time of transmission. **Other outcomes of interest -** NR **Comments** **Overall Quality** Moderate (to high)

Author Country Study design Study URL	Population setting	Primary outcome results
Zhen-Dong, Tong et al **China** **Case study (cluster)** **Type of**	Pre-symptomatic transmission through workplace/dinner meeting **Patient demographics** Patient W (presumed index patient): Male, 45 years old. Lives in Wuhan.	**Pre-symptomatic transmission details:** First two cases of COVID-19 in Zhoushan was two teachers (patients A and D) who met the presumed index case (patient W) for dinner on 6th January , where they ate from common serving plates. Person W was from Wuhan and after returning to Wuhan on the 7th January he experienced the onset of fever, cough, sore throat and malaise on the 8th January. He was diagnosed with COVID-19 by the local office of the

transmission Pre-symptomatic https://wwwnc.cdc.gov/eid/article/26/5/20-0198_article	Patient A (infected): Male, 29 years old, lives in Zhoushan. Patient D (infected): Male, 42 years old, lives in Zhoushan. Person A and D also infected 3 additional family members. Who were all asymptomatic at time of publication. **Clinical characteristics** Patient W: fever, cough, sore throat, and malaise. Patient A: fever, cough, and skin tingling. Chest radiograph revealed bilateral invasive lesions. Patient D: low-grade fever, cough, and myalgia	Chinese CDC. On January 10th patient A experienced the onset of symptoms and was confirmed COVID-19 positive on 19th January. On 12th January person D experienced the onset of symptoms and was confirmed COVID-19 positive on 19th January. **Numbers of cases reported to be caused by Pre-symptomatic transmission** Two patients A and D. **Characteristics of pre-symptomatic transmissions (e.g. age, gender, health status and health status of those infected)** Patient W (Presumed index case): Male, 45 years old. Patient A (infected): Male, 29 years old. Patient D (infected): Male, 42 years old **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred** Patients W, A and D were all symptomatic. However, the three relatives they infected where positive for the virus but had no symptoms, by the end of the study two of these relatives had cleared the virus. Time between transmission to infectees and symptom onset in index patient(s): Patient A and D: 2 to 3 days Incubation time: Patient A: transmission occurred 4 to 5 days before symptom onset. Patient D: transmission occurred 6 to 7 days before symptom onset. **Any risk factors for pre-symptomatic transmission e.g. family/household contacts** It is thought transmission occurred during a dinner where the three

		men shared serving plates. **Other outcomes of interest -** NR **Comments** **Overall Quality** Moderate

Author Country Study design Study URL	Population setting	Primary outcome results
Li et al. **China, source case came through Wuhan to Xuzhou** **Case study (cluster)** **Type of transmission** Pre-symptomatic https://wwwnc.cdc.gov/eid/article/26/7/20-0718_article	Hospital ward. Cluster from index patient who travelled through Wuhan. Passed to second family visit to a hospital ward **Patient demographics** Source case: Male, 56 years old Patient 1: Female, 32 years old, pregnant Patient 2:Female, 21 years old Patient 3:Male, 42 years old Patient 4:Male, 62 years old, hypertension	**Pre-symptomatic transmission details:** On January 14, index patient travelled through Wuhan to Xuzhou. During January 14–22, he had close contact with his 2 daughters, a 32-year-old pregnant teacher (patient 1) and a 21-year-old undergraduate student (patient 2). Between January 15 and 23 he visited his 42-year-old son-in-law (patient 3, husband of patient 1) in hospital. Meanwhile, a 62-year-old man (patient 4) stayed in the hospital during January 2–19 because of pancreatic surgery; he shared the same ward with patient 3 and was cared for of by his 34-year-old son (patient 5). During January 15–January 18, patients 4 and 5 had close contact with the index patient, who was asymptomatic during that time. On January 19, patient 4 was discharged to home and had close contact with his 56-year-old wife (patient 6). On January 19 index case had symptom onset and on 25 the index case was hospitalised and confirmed to have COVID 19.

	Patient 5:Male 34 years old Patient 6: Female, 56 years old, diabetes, breast cancer and cervical cancer **Clinical characteristics** All developed symptoms including fever, sore throat and cough.	**Numbers of cases reported to be caused by pre-symptomatic transmission** Two (patients 4 and 5). Possibly up to 6. Index patient appears to have infected up to 5 others while pre-symptomatic (only two of these patients he had no contact with after becoming symptomatic). Patient 6 was infected by her husband, unclear if he was symptomatic at the time. **Characteristics of pre-symptomatic transmissions (age, gender, health status and health status of those infected)** 21-63 years: 3 male, 3 female; one was in hospital for another reason when he had contact with index patients; another shared the ward with this patient and was cared for by his son (both of these became symptomatic); One patient was pregnant, one had hypertension and one had diabetes, breast cancer and cervical cancer **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred** Describes 5 patients who became infected due to contact with index patient. A sixth patient did not have contact with the index patient but with Patient 5, who probably transmitted the virus to her. All, including index patient became symptomatic. <u>Time between transmission to infectees and symptom onset in index patient:</u> For patient 4 and 5: between 1 and 4 days <u>Incubation time:</u> Patients 1-3 became symptomatic between 2 and 11 days from contact with index case and tested positive between 3 and 13 days from

		contact with the index case. (Note: contact with index case lasted 8 days) Patient 4 became symptomatic between 2 and 6 days from contact with index patient and tested positive between 9 and 13 days from contact. (Note: contact with index patient lasted 8 days) Patient 5 became symptomatic between 5 and 8 days from contact with index case and tested positive between 13 and 16 days of contact with index case. (Note contact with index case lasted 3 days) Patient 6 became symptomatic 9 days after the discharge from hospital of her husband (Patient 4), and tested positive one day later **Any risk factors for pre-symptomatic transmission e.g. family/household contacts** Two family clusters – infection transmitted to second family through contact in hospital **Other outcomes of interest** Describes in detail the lab results of all patients. Seems to indicate they all became symptomatic after the index case. **Comments** Treatment Described in detail in article. **Overall Quality** Moderate

Author Country	Population setting	Primary outcome results

Study design Study URL		
Wei et al. **Singapore** **Case studies (7 cluster)** **Type of transmission** Pre-symptomatic **https://www.cdc.gov/mmwr/volumes/69/wr/mm6914e1.htm#suggestedcitation**	**Cluster A** – Transmission occurred at a church, appears to have been environmental transmission. **Cluster B** – Transmission between friends **Cluster C** – Household transmission **Cluster D** – Household transmission **Cluster E** – Household transmission **Cluster F** – In church, infectees sat in row behind infector **Cluster G** – Transmission between friends **Patient demographics**	**Pre-symptomatic transmission details:** Seven clusters identified from Singapore records of the first 243 cases of COVID 19 in Singapore that indicated pre-symptomatic transmission may have occurred. **Cluster A:** Man and woman in their 50s who arrived in Singapore as tourist from Wuhan. They visited a local church on 19 Jan and developed symptoms on the 22 and 24 Jan. Three other persons went to the church that day developed symptoms on the 23, 30 January and 3 February. From CCTV it was clear that one of the infectees had sat in the same seat in the church as the index cases. No other church attendees appeared symptomatic that day. **Cluster B:** A woman attended a dinner event on 15 February where she was exposed to a confirmed COVID 19 case, on 24 herself and a friend attended a singing class. On 26 February index patient developed symptoms, her friend developed symptoms three days later. **Cluster C:** A woman was exposed to confirmed case of COVID 19 on February 26 and passed infection onto husband. Both developed symptoms on March 5. **Cluster D:** A man was in contact with potential source February 23-2 March. Transmitted to his wife and both developed symptoms on March 8. **Cluster E:** A man travelled to Japan (February 29 – March 8) where he was likely infected. Passed infection to his housemate. Both developed symptoms on March 11. **Cluster F:** A woman exposed to confirmed COVID 19 case on 27 February. Attended a church service on March 1, where she is thought to have infected two other people who were sat one row behind her.

	Cluster A (index) – female, 55 years of age and male, 56 years of age. (infectees) - Patient A3, male, 53 years of age; patient A4, female, 39 years of age; Patient A6, female, 52 years of age. **Cluster B** (index) – female, 54 years of age. (infectee) – patient B2, female, 63 years of age. **Cluster C** (index) – female, 53 years of age. (infectee) – patient C2, male, 59 years of age. **Cluster D** (index) – male, 37 years of age. (infectee) – patient D2, female, 35 years of age. **Cluster E** (index) – male, 32 years of age. (infectee) – patient E2, female, 27 years of age. **Cluster F** (index) – female, 58 years of age. (infectees) – patient F2, female, 26 years of age; patient F3, male, 29 years of age. **Cluster G** (index) – male, 63 years of age. (infectee) –	She developed symptoms on 3 March and the infectees developed symptoms on March 3 and March 5. **Cluster G:** A man travelled to Indonesia during March 3 – 7, He met a woman and most likely transmitted the virus to her. He developed symptoms on march 9 and infectee developed symptoms on March 12. **Numbers of cases reported to be caused by pre-symptomatic transmission** Cluster A: potentially three people caught SARS CoV-2 from two potential index cases. Cluster B: One person Cluster C: One person Cluster D: One person Cluster E: One person Cluster F: Potentially two people Cluster G: One person **Characteristics of pre-symptomatic transmissions (age, gender, health status and health status of those infected)** See demographics section for age and gender of infectors and infectees. Health status was not reported. Symptoms reported in Clinical characteristics section. **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred** In this study only pre-symptomatic cases were included, therefore all infectors developed symptoms. Time between transmission to infectees and symptom onset in index patient(s):

	patient G2, female, 36 years of age **Clinical characteristics** **Cluster A:** Patient A1 to A3 fever only, patient A4 fever and cough and patient A5 fever and sore throat **Cluster B:** Patient B1 cough, headache and myalgia, patient B2 fever, cough, headache and myalgia **Cluster C:** Patient C1 itchy throat, chills, patient C2 cough. **Cluster D:** patient D1 cough, blocked nose, patient D2 fever, sore throat and sneezing. **Cluster E:** patient E1 fever, Patient E2 cough **Cluster F:** patient F1 sore throat, blocked nose, patient F2 cough, patient F3 cough, runny nose, sore throat and myalgia **Cluster G:** patient G1 fever, patient G2 sore throat.	**Cluster A:** depends on who index is, if patient A1, 3 days, if patient A2 its 5 days **Cluster B:** 2 days **Cluster C:** between 1 and 7 days **Cluster D:** between 1 and 5 days **Cluster E:** between 1 and 2 days **Cluster F:** 2 days **Cluster G:** 1 day Incubation time: **Cluster A:** Patient A3 4 days, patient A4 11 days, patient A5 15 days. **Cluster B:** Patient B2 5 days **Cluster C:** Patient C2 between 1 and 7 days **Cluster D:** Patient D2 between 1 and 5 days **Cluster E:** Patient E2 between 1 and 2 days **Cluster F:** Patient F2 2 days, patient F3 4 days **Cluster G:** Patient G2 4 days **Any risk factors for pre-symptomatic transmission e.g. family/household contacts** In three clusters, household transmission occurred, In two clusters transmission occurred between friends. In one transmission occurred in church between people sitting near each other. In one cluster transmission appeared to be environmental where infector was in same chair as infectees earlier in the day. **Other outcomes of interest** Of 243 cases of COVID 19 in Singapore, 157 were locally acquired. 10 of the 157 (6.4%) are included in the clusters and were attributed to pre-symptomatic transmission **Comments**

		Although in two of the clusters there was potentially more than one person infected by the index cases, it's not clear if the infectees knew each other and one of them could have been the source for the others. Investigation of clusters was performed and no other sources identified for the clusters **Overall Quality** Moderate to high

Author Country Study design Study URL	Population setting	Primary outcome results
Zhang et al. **China, Zhejiang** **Case study (Cluster)** **Type of transmission** Pre-symptomatic **https://www.preprints.org/manuscript/202003.0160/v1**	Transmission occurred during dinner party **Patient demographics** Patient 1-45 year old male Patient 2-72 year old male (father of patient 1) Patient 3- 36 year old male who had attended dinner party with patients 1 and 2 **Clinical characteristics**	**Pre-symptomatic transmission details:** Patient 1 admitted to hospital after developing symptoms. Contact tracing undertaken which identified patients 2 and 3. Patient 1 and 3 had attended a dinner party together two days before patient 1 developed symptoms. Patient 2 developed symptoms after patient 1. **Numbers of cases reported to be caused by pre-symptomatic transmission** One (patient 3) **Characteristics of pre-symptomatic transmissions (age, gender, health status and health status of those infected)** Patient 3- 36 year old male who had attended dinner party with patient 1

	Patient 1- two days after dinner party developed severe respiratory symptoms (fever, dry cough, nasal congestion), 3 days later presented to local hospital, CT showed bilateral ground glass opacities indicative of pneumonia, tested positive with RT-PCR, worsened seriously on Jan 28 (10 days after dinner party), greatly improved by February 3. Patient 2-'chills, chest tightness, myalgia etc.' 2 days after Patient 1 admitted CT showed unilateral ground-glass opacities in lower right lung and multi-focal ground glass opacities dispersed from middle lobe to lower lobe of left lung. Verified by RT-PCR. Recovered well Patient 3- 'discontinuously dry coughing' which had commenced on 23 January (5 days after dinner party). Normal blood parameters. CT showed inflammatory focus of middle lobe of right lung, implying viral infection and a small pulmonary nodule was seen on left lower	**Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred** All patients in this study developed symptoms. Time between transmission to infectees and symptom onset in index patient: Patient 1 (index case) developed symptoms 2 days after likely transmission to patient 3. Incubation time: Patient 3 developed symptoms 5 days after contact with patient 1. **Any risk factors for pre-symptomatic transmission e.g. family/household contacts** Dinner party **Other outcomes of interest** Of 243 cases of COVID 19 in Singapore, 157 were locally acquired. 10 of the 157 (6.4%) are included in the clusters and were attributed to pre-symptomatic transmission **Comments** Authors interpretations 'More importantly, this underscores the urgency and importance of additional concerns with cryptic/asymptomatic/mild cold-like syndromes in the earlier recognition of COVID-19 cases, decreasing the miss diagnosis by biased screen and even leading to favourable prognosis by its supportive therapy'(sic) **Overall Quality** Moderate

	lobe of lung. Tested positive with RT-PCR. Temperature remained normal	

Author Country Study design Study URL	Population setting	Primary outcome results
Zhang et al. **China, Nanjing** **Case study (Cluster)** **Type of transmission** Pre-symptomatic **https://assets.researchsquare.com/files/rs-18077/v1/manuscript.pdf**	Family cluster, transmission thought to occur during two family dinners **Patient demographics** 4 males, 6 females, Index case female. Median age of 10 patients was 61.5 (38 to 95 years) **Clinical characteristics** Patient 7 had idiopathic thrombocytopaenia and hypertension. Patient 9 had chronic hepatitis B, cirrhosis and post-operative hepatocellular carcinoma	**Pre-symptomatic transmission details:** Index case lived in Hubei and travelled to Nanjing. Attended a dinner with 6 family members. Two of these family members went on to infect 4 other family members at a separate dinner a day later. All potential infectees were asymptomatic at the time of the diners.10 family members were infected through two family feasts, while infectees was pre-symptomatic **Numbers of cases reported to be caused by pre-symptomatic transmission** 10 cases caused by pre-symptomatic transmission. Index case caused 6 cases and two of these cases went on to infect 4 additional people **Characteristics of pre-symptomatic transmissions (age, gender, health status and health status of those infected)** 4 males, 6 females, index case female. Median age of 10 patients was 61.5 (38 to 95 years). 2 remained asymptomatic, including the 95 year old. Most common symptoms were fever and dry cough. Also fatigue, chest tightness, muscle pain, shortness of breath, poor appetite, expectoration, muscle soreness, nausea and diarrhoea. All displayed

		lesions on chest CT- all except one had multiple lesions in both lungs. 40% had leucopaenia, neutropaenia and lymphopaenia (full lab results given). Patient 7 had idiopathic thrombocytopaenia and hypertension. Patient 9 had chronic hepatitis B, cirrhosis and post-operative hepatocellular carcinoma **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred** 2 out of 11 patients were asymptomatic throughout. Time between transmission to infectees and symptom onset in index patient: 2 to 3 days for index patient. 3 days for patients C5 and C6 as infectors. (assuming diners were time of transmission) Incubation period: varied from 3 to 17 days (median 5.5) **Any risk factors for pre-symptomatic transmission e.g. family/household contacts** Family diners **Other outcomes of interest** After anti-virus treatment, all recovered **Comments** **Overall Quality** Moderate

Author Country Study design Study URL	Population setting	Primary outcome results
Bai et al **China** **Case Study (Cluster)** **Type of transmission** Asymptomatic **https://doi.org/10.1001/jama.2020.2565**	Home setting for transmission **Patient demographics** Patient 1 (asymptomatic carrier): 20 year old, female. Patients 2-6: age range 42 – 57 years. 4 female, 1 male **Clinical characteristics** Patient 1: no symptoms throughout study period. No abnormalities with chest CT scan or laboratory bloods (c reactive protein, Eosinophils, lymphocytes, Neutophils, white blood cell count.) Patients 2-5: fever and respiratory symptoms. Patient 6: fever and sore throat. All had ground glass opacities on chest CT. All had elevated C reactive protein and reduced lymphocyte count	**Details of transmission:** Familial cluster of five patients with symptoms and one asymptomatic family member. Only the asymptomatic carrier had been to Wuhan, no other family member in contact with COVID 19 affected area. Unusually patient tested negative for COVID 19 after family members developed symptoms, but then tested positive a few days later. It is thought that first PCR test may have been a false negative. All or none of the transmission may have been caused by asymptomatic patient 1. **Numbers of cases reported to be caused by asymptomatic transmission** Unclear. One asymptomatic carrier may have infected up to 5 other family members. Or may have infected one other family member. **Characteristics of asymptomatic transmissions (e.g. age, gender, health status and health status of those infected)** Patient 1 (transmitter): no symptoms throughout study period. No abnormalities with chest CT scan or laboratory bloods (c reactive protein, Eosinophils, lymphocytes, Neutophils, white blood cell count.) Patients 2-5 (potential infectees): fever and respiratory symptoms. Patient 6: fever and sore throat. All had ground glass opacities on chest CT. All had elevated C reactive protein and reduced lymphocyte count. **Proportion asymptomatic patients that become symptomatic**

		and how long before symptom onset transmission occurred N/A **Any risk factors for asymptomatic transmission e.g. family/household contacts** This was familial cluster. **Other outcomes of interest** N/A **Comments** Patient 1 was originally negative when tested after family members showed symptoms. This is thought to be a false negative as tested positive a few days later. However it is possible another family member contracted COVID 19 from another source and patient 1 was asymptomatic as still in the incubation period. **Overall Quality** Moderate

Author Country Study design Study URL	Population setting	Primary outcome results
Hu et al **China** **Case study (cluster)** **Type of**	Household transmission between family members **Patient demographics** Patient 13 (asymptomatic carrier): Male, 67 years old	**Asymptomatic transmission details** 1 patient (patient 13). In brief, Case 13, believed to be an asymptomatic COVID-19 carrier, transmitted the virus to his cohabiting family members (wife, son and daughter-in-law). 1 of the infected individuals developed severe COVID-19 pneumonia and was admitted

transmission Asymptomatic **https://ssrn.com/abstract=3543598**	Relative 1 (wife): female, 64 year old, healthy. Relative 2 (son): male, 35 years old Relative 3 (daughter-in-law): Female, 36 years old **Clinical characteristics** Patient 13: asymptomatic throughout but had an abnormal blood test and typical signs of viral infection on CT scan. Also abnormal c reactive protein levels, abnormal creatinine levels and abnormal procalcitonin levels Relative 1: fever, cough, fatigue, vomiting, ended up in ICU. Relative 2: fever and cough. Relative 3: fever, cough and arthralgia	to ICU. **Numbers of cases reported to be caused by asymptomatic transmission** One asymptomatic case is thought to have caused 3 additional symptomatic cases. **Characteristics of asymptomatic transmissions (e.g. age, gender, health status and health status of those infected)** Patient 13 (asymptomatic transmitter): Male, 67 years old. No symptoms, had an abnormal blood test and typical signs of viral infection on CT scan. Blood tests also suggested viral infection. Relative 1 (infected): Wife of patient 13, female, 64 years of age, was healthy prior to infection. Relative 2 (infected): son of patient 13, male, 35 years old. Relative 3 (infected): daughter-in-law, female, 36 years of age. **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred** In this family cluster only patient 13 was asymptomatic and was still in hospital by the end of this study. **Any risk factors for asymptomatic transmission e.g. family/household contacts** Familial cluster. **Other outcomes of interest** The study included 24 asymptomatic patients in total. Five developed typical symptoms. 7 (29.2%) cases had normal CT images and no symptoms during hospitalisation. Young cases (<15 years old) were prone to be asymptomatic.

		Case 13 had no symptoms but remained positive for the COVID-19 virus till Feb 18, 2020, which indicated that the communicable period could be as long as 29 days. **Comments** This paper was not peer reviewed. Although the patient reported no symptoms, their CT scan and bloods indicated a viral infection. **Overall Quality** Moderate

Author Country Study design Study URL	Population setting	Primary outcome results
Qiu et al **China** **Case study (Cluster)** **Type of transmission** Asymptomatic https://www.medrxiv.org/content/10.1101/2020.03.04.20026005v1	Family clusters **Patient demographics** Patient C'3 (suspected asymptomatic index case): female Patient C'4(suspected asymptomatic index case): female **Clinical characteristics** None given.	**Asymptomatic transmission details:** Two familial clusters. Patient C'3 is a suspected asymptomatic index case, return to Shaoyang city from Wuhan on 19th January. She is believed to be an asymptomatic carrier but this was not confirmed by PCR test. She is thought to have infected three relatives, her sister in law, her sister and her mother (all confirmed to have COVID 19). The second cluster patient C'4 is a suspected asymptomatic index case, confirmed by PCR but not part of the study group. Patient C'4 is thought to have infected three family members, her mother, her father in law and her daughter. **Numbers of cases reported to be caused by asymptomatic transmission** Patient C'3 – is thought to have infected 3 family members.

		Patient C'4 – is thought to have infected 3 family members. **Characteristics of asymptomatic transmissions (age, gender, health status and health status of those infected)** None given. **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred** N/A **Any risk factors for asymptomatic transmission e.g. family/household contacts** Both were family clusters. **Other outcomes of interest** Of 104 patients, five asymptomatic infections were found. **Comments** **Overall Quality** Low

Author Country Study design Study URL	Population setting	Primary outcome results
Zhu et al **China** **Case study (cluster)** **Type of asymptomatic transmission** Possible asymptomatic **https://www.preprints.org/manuscript/202002.0403/v2**	Family **Patient demographics** Patient: Male, 44 years of age. Not obese and no history of disease **Clinical characteristics** Patient : Fever, nasal congestion, cough, sputum and pleuritic chest discomfort. Respiratory rate of 19-21 breaths per minute, a pulse of 62-88 per minute, and a blood pressure of 76/128 mmHg. The initial chest radiography showed glass density shadow of both lungs	**Asymptomatic transmission details:** Patient did not come into contact with a known COVID-19 carrier or anyone who appeared to be symptomatic. The patient's brother and nephew had visited Wuhan during the outbreak and were thought to possibly be the source of the infection but it is unclear. **Numbers of cases reported to be caused by asymptomatic transmission** One **Characteristics of asymptomatic transmissions (age, gender, health status and health status of those infected)** Patient (Infected): Male, 44 years of age. Not obese and no history of disease. **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred** N/A **Any risk factors for asymptomatic transmission e.g. family/household contacts** Likely household contacts. **Other outcomes of interest** **Comments**

		In this paper it is assumed that the patient caught COVID-19 from a family member, most likely, his brother or his nephew as they had both been to Wuhan during the initial outbreak of COVID-19. The family lived in Nanchang region of China. However, none of the relatives tested positive for COVID-19 and it is unclear where and when transmission occurred. **Overall Quality** Low

Author Country Study design Study URL	Population setting	Primary outcome results
Liao et al **China** **Case study (clusters)** **Type of transmission** Pre-symptomatic (1 case) and asymptomatic (2 cases) **https://www.medrxiv.org/content/10.1101/2020.03.10.20032136v1.full.pdf**	Family clusters **Patient demographics** This study focuses on adolescents (age 10-24 years, n=14) and young adults (age 25-35 years, n=32). It is not clear the ages or gender of the asymptomatic patients **Clinical characteristics** Two out of four of the asymptomatic cases showed no symptoms or abnormalities on chest CT scans (patients 2 and 3). One case developed shortness of breath, difficulty breaking and chest tightness 17 days after admission (patient 1). The other case developed dry cough, phlegm and nausea 6 days after admission (patient 4)	**Transmission details:** Three out of four of the asymptomatic patients were index cases in their family and it was assumed they transmitted the disease to other family members. Patient 1 was pre-symptomatic on admission, he had transmitted the virus to two family members, who had symptom onset before the date of patient 1 admission (patient 1 was assumed to be the index patient as had travelled home from infected area). Patient 2 had contact with a known case and had transmitted the disease to three other family members before admission. Patient 3 had contact with a known case and had transmitted the illness to one family member before admission. **Numbers of cases reported to be caused by pre-symptomatic/asymptomatic transmission** Patient 1 = 2 cases. Patient 2 = 3 cases. Patient 3 = 1 case **Characteristics of pre-symptomatic/asymptomatic transmissions (age, gender, health status and health status of those infected)** No details given other than the transmitter was aged between 10 and 35 years in each case. **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred**

		Two (out of 4) asymptomatic cases developed symptoms. Only one of these transmitted disease to other family members. Time between transmission to infectees and symptom onset in index patient: For patient 1: between 29 and 39 days Incubation time: Relative 1 and relative 2: 10 days. **Any risk factors for pre-symptomatic/asymptomatic transmission e.g. family/household contacts** All three clusters were family clusters. **Other outcomes of interest** There were 4 asymptomatic cases out of 46 patients. Two developed symptoms after diagnosis. **Comments** Although it was assumed that the three asymptomatic patients were the index cases in their family, it is difficult to know if the family could have been infected through another source. Treatment All patients including asymptomatic patients received antiviral therapy. It is unclear the effect this would have on the course of the disease. **Overall Quality** Low – Moderate (very little information given about the transmission, not main focus of the study)

Author	Population setting	Primary outcome results

Country Study design Study URL		
Yang et al. **China, Beijing** **https://www.medrxiv.org/content/medrxiv/early/2020/03/03/2020.02.28.20028068.full.pdf** **Case series** **Study reported characteristics of 55 Covid-19 patients with and without pneumonia, patient A and B are two of these who were reportedly infected by asymptomatic transmission.** **Type of transmission**	**Patient demographics** Not reported. **Clinical characteristics** Not reported	**Transmission details:** **Numbers of cases reported to be caused by asymptomatic transmission** Two **Characteristics of asymptomatic transmissions (age, gender, health status and health status of those infected)** Patient A was long-time bed-ridden who only had contact with only 4 healthy family members within two weeks of onset. Family members did not have direct or indirect exposure history. She had been brought to another hospital to have her gastric tube replaced and highly suspected to be infected there. Patient B did not have any exposure history in last month. Nor did her family, though her sister and her sister's husband from Wuhan visited the family and lived in the same buildings. Six days later she became ill. **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred** Not reported **Any risk factors for asymptomatic transmission e.g. family/household contacts** Not reported **Other outcomes of interest** Mean incubation period was calculated using data of 31 cases – in those without pneumonia 9.06 (95%CI 6.11 to 10.29) and in those with pneumonia 7.54 (95% CI 5.29 to 9.79), however, this was not specific to those patients infected by asymptomatic transmission. **Comments**

Uncertain as index case(s) are unknown (asymptomatic or pre-symptomatic)		**Treatment** Of 55 patients, 52 received antiviral treatment, mostly with lopinavir/ritonavir and/or arbidol. **Overall Quality** Low, as extracted two cases are a small part of overall study.

Author Country Study design Study URL	Population setting	Primary outcome results
Wu et al. **China, Loudi** **Case report of cluster of six people with two potential source cases** **https://assets.researchsquare.com/files/rs-18053/v1/manuscript.pdf** **Type of transmission** Uncertain as index case(s) is uncertain (asymptomatic or pre-symptomatic)	**Patient demographics** 4 females and 2 males, aged 35 to 56 years **Clinical characteristics** Case 1:dry cough, WBC 2.69x10^9,lymphocyte absolute value 0.42, Ct multi-focal GGO and mixed exudation and consolidation Case 2:fever, sore throat, fatigue, chills Case 6:asymptomatic Others not reported except Case 6 (asymptomatic)	**Transmission details:** Two potential sources, Case 1 and Case 6 who drove together Case 1 had close contact with cases 2,3,4,5 and 6. Case 6 had close contact with 1,2,3,4 Transmission would have been pre-symptomatic if Case 1 is source Transmission would have been asymptomatic if Case 6 is source **Numbers of cases reported to be caused by asymptomatic transmission** At least four. **Characteristics of asymptomatic transmissions (age, gender, health status and health status of those infected)** Case 2: Male, 55 years old Case 3: Female, 39 Years old Case 4: Female, 32 years old Case 5: Female, 56 years old **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred** Case 1 became symptomatic 2 or 3 days after close contacts events which were 1 day apart Case 6 never developed symptoms For case 2 to 5 transmission occurred between 2 and 3 days before symptom onset of index case (if index is case 1)

		Any risk factors for asymptomatic transmission e.g. family/household contacts Contact was close (in a car, playing cards in confined space, karaoke in a small space). Other contacts at a large party were not reported as developing symptoms according to a survey carried over a month later. **Other outcomes of interest** Case 6, who never developed symptoms, tested negative for SARS-CoV-2 nucleic acid but positive for SARS-CoV-19 IgG **CommentsTreatment** Not reported **Overall quality** Low to moderate

Author Country Study design Study URL	Population setting	Primary outcome results
Qian et al **China, Zheijiang** **Case study (cluster)** **https://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciaa316/5810900** **Type of transmission** Uncertain as index case is unclear (asymptomatic if Index 2 is source, pre-symptomatic if Index 1 is source)	**Patient demographics** Cases 1-7: 3 Male, 5 Female; 13 months to 76 years **Clinical characteristics** Fever, cough, fatigue, headache	**Transmission details:** Index 1 and 2 visited temple during Spring Break, 19 Jan. Between visits and onset of symptoms they stayed with family (Cases 1-4). Cases 1-4 had dinner with Cases 5-7 on 23 January. Index 1 fell ill on 24 Jan, Index 2 never developed symptoms. Case 1 presented to hospital with fever and cough on 27 Jan. Cases 1-4 tested RT-PCR after Index 1 tested positive. Index 2 tested positive but never developed symptoms. Case 1 and 2 developed symptoms and tested positive. Their children (6 years old and 13 months) were asymptomatic but negative and positive respectively. Case 5 -7 tested positive and became sick, Case 6 was transferred to ICU. **Numbers of cases reported to be caused by asymptomatic transmission** Uncertain as index cases are unclear. Index 1 (pre-symptomatic) or 2 (asymptomatic) infected cases 1 to 4. Cases 1 or 3 or 4 (pre-symptomatic) or 2 (asymptomatic) infected cases 5 to 7. **Characteristics of asymptomatic transmissions (age, gender, health status and health status of those infected)** Case 1: Female, 56 years old Case 2: Male, 60 years old Case 3: Female, 6 years old Case 4: Female, 13 months old (remained asymptomatic)

		Case 5: Female, 57 years old Case 6: Male, 57 years old Case 7: Female, 76 years old **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred** All developed symptoms except Index 2 and case 4. Index 1 and 2 stayed with family from 20 to 24 January. Cases 1-4 developed symptoms between 10 and 12 days of first contact or between 6 and 8 days of Index 1 developing symptoms. Cases 5-7 developed symptoms between 6 and 11 days of first contact with cases 1-4 or between 2 and 5 days of cases 1-4 developing symptoms. **Any risk factors for asymptomatic transmission e.g. family/household contacts** Family/household contact **Other outcomes of interest** Not reported **Comments** **Treatment** Not reported **Overall quality** Moderate

Cross sectional study

Author Country Study design Study URL	Population setting	Primary outcome results
Lu J. **China, Wenzhou** **Cross-sectional** **https://assets.researchsquare.com/files/rs-14506/v1/manuscript.pdf** **Type of transmission** Asymptomatic or pre-symptomatic	**Patient demographics** 459 patients with confirmed Covid-19 in Wenzhou. Median age 48 years, 46.8% female, 37.5% 'had a history of residence in Wuhan' (all patients not just asymptomatic) **Clinical characteristics** Reported for all patients not specifically asymptomatic	**Transmission details:** **Numbers of cases reported to be caused by asymptomatic transmission** 4.4% of total confirmed patients were asymptomatic; 7.8% of confirmed patients had no link to Wuhan city but contact with individuals from Wuhan who had no symptoms, 10.7% patients who have no link to Wuhan nor any history of intimate contact with patient or individuals from Wuhan without any symptoms which suggests the possibility of asymptomatic carriers. **Characteristics of asymptomatic transmissions (age, gender, health status and health status of those infected)** Not reported **Proportion asymptomatic patients that become symptomatic and how long before symptom onset transmission occurred**

		7.8% of confirmed patients had no link to Wuhan city but contact with individuals from Wuhan who had no symptoms 10.7% of confirmed patients had no link to Wuhan nor any history of intimate contact with patient or individuals from Wuhan without any symptoms **Any risk factors for asymptomatic transmission e.g. family/household contacts** Not reported **Other outcomes of interest** Not reported **Comments** **Treatment** Not reported **Overall quality** Low to moderate

Modelling studies

	Transmission Details	Primary outcome results
URL for paper https://wwwnc.cdc.gov/eid/article/26/6/20-0357_article Author	**Where transmission took place for dataset?** Reports all infection events and those in which both infector and infectee were in same city.	**Numbers of cases reported to be caused by asymptomatic/pre-symptomatic transmission** 59 of 468 (12.6%) **Reproduction number(Ro) (the average number of infections caused by an infectious individual)**

Du, Zhanwei Country **China** Region or any other details about dataset location **93 Chinese cities** Study design **Modelling study** Type of Model **Modelled distributions are effectively the model types, model equation used to generate R0 is presented** **Data source (and date)** **Data fom websites of public health departments, up to February 8th** **Type of transmission (infector is pre-**	**Population details** Number of patients in dataset? 752 cases/468 transmission events Other relevant population details? **Patient demographics (age/sex, travel history)** 1-90 years; (mean 42.5 years and SD 17.21years) **Clinical characteristics** N/A **Were all cases confirmed via laboratory testing** States confirmed cases, doesn't specify what this means **Authors interpretation of results** 12.6% of reports indicating pre-symptomatic transmission	1.32 (95% CI 1.16-1.48) of all cases, not just asymptomatic **Generation interval (Time between infection events in an infector-infectee pair)** Not reported **Serial Interval (The time in days between symptom onsets in an infector-infectee pair)** All 3.96 (95% CI 3.53-4.39) proportion serial intervals<0 (i.e. asymptomatic 12.61%) Locally infected index case 3.66 (95% CI 2.84-4.47) proportion serial intervals<0 (i.e. asymptomatic 14.75%) Imported index case 4.06 (95% CI 3.55-4.57) proportion serial intervals<0 (i.e. asymptomatic 11.85%) Household secondary infection 4.03 (95% CI 3.12-4.94) proportion serial intervals<0 (i.e. asymptomatic 16.35%) Non-household secondary infection 4.56 (95% CI 3.85-5.37) proportion serial intervals<0 (i.e. asymptomatic 11.11%) **Incubation period(time between moment of infection and symptom onset)** Not reported. **Proportion of pre-symptomatic/asymptomatic transmission?** 12.6% **How long before symptom onset transmission occurred?** Not reported. **Any other useful information** N/A **Any risk factors for asymptomatic/pre-symptomatic transmission e.g. family/household contact**

symptomatic or asymptomatic throughout disease) **Serial intervals calculated 12.6% were pre-symptomatic transmission**		See above – highest proportion of asymptomatic transmission is household secondary infection. **Quality assessment** (low, moderate, high) Low/moderate

	Transmission Details	Primary outcome results
URL for paper **https://doi.org/10.1101/2020.03.03.20029983** Author Tindale Country and region **Singapore and Tianjin, China** Study design **Modelling study** **Type of Model Modelled distribution** **Data source (and**	**Where transmission took place for dataset?** Singapore: Many of the initial case were imported from Wuhan, China. Tianjin: Many cases traced to a department store (customers and staff). For both regions presumed infection date and presumed reason for infection known **Population details** Number of patients in dataset? Singapore: 93 confirmed cases Tianjin: 135 confirmed cases Other relevant population	**Numbers of cases reported to be caused by asymptomatic/pre-symptomatic transmission** NR **Reproduction number(Ro) (the average number of infections caused by an infectious individual)** Singapore: 1.97 (1.45, 2.48) secondary cases per infective Tianjin: 1.87 (1.65, 2.09) secondary cases per infective **Generation interval (Time between infection events in an infector-infectee pair)** NR **Serial Interval (The time between symptom onsets in an infector-infectee pair)** Singapore: Mean 4.56 (2.69, 6.42) days. SD 0.95 Tianjin: Mean 4.22 (3.43, 5.01) days. SD 0.40 **Incubation period(time between moment of infection and symptom onset)** Singapore: Mean incubation time 7.1 (6.13, 8.25) days, median 6.55 days.

date) **Publicly available data was used to identify datasets for two COVID19 clusters.** **Singapore data: Jan.19 (first known case in Singapore)- Feb.26.** **Tianjin: Jan.21-Feb.22** **Type of transmission (infector is pre-symptomatic or asymptomatic throughout disease)** **Pre-symptomatic**	details? **Patient demographics (age/sex, travel history)** NR **Clinical characteristics** NR **Were all cases confirmed via laboratory testing** Includes confirmed cases, but not clear how they were confirmed **Authors interpretation of results** The fact that serial intervals are shorter than incubation periods is robust in our sensitivity analysis. The shorter serial than incubation time could indicate the portion of transmission that occurs before symptom onset, but it makes the strong assumption that incubation period and onset of symptoms occur independently and it does not take the growth curve of the outbreak, or censoring or truncation, into account.	Tianjin: Mean incubation time 9 (7.92, 10.2) days. Median 8.62 days. (Based on Weibull distribution) **Proportion of pre-symptomatic/asymptomatic transmission?** In both sets of estimates, samples of the incubation period minus serial interval are negative with probability 0.8 or higher (Tianjin) and 0.7 or higher (Singapore), suggesting that a substantial portion of transmission may occur before symptom onset. **How long before symptom onset transmission occurred?** Early in the outbreaks, infection was transmitted on average 2.55 and 2.89 days before symptom onset (Singapore, Tianjin). The incubation period is different for early- and late-occurring cases, on average transmission for early-occurring cases is 2.79 and 1.2 days before symptom onset (Tianjin, Singapore) and 8.2, 3.3 days before (Tianjin, Singapore) for late-occurring cases. **Any other useful information** NR **Any risk factors for asymptomatic/pre-symptomatic transmission e.g. family/household contacts** NR **Comments** All datasets and R code are available on GitHub (github.com/carolinecolijn/ClustersCOVID19) In both Singapore and China the incubation period was shorter in earlier cases and longer in later cases, unclear why this would be. Mean serial interval and incubation time calculated in same population is a strength of this study. **Quality assessment** (low, moderate, high) Moderate

	Transmission Details	Primary outcome results
URL for paper **https://doi.org/10.1101/2020.03.06.20031955** **Author** **Xia et al** **Country and region** **China (not Wuhan city of Hubei province)** **Study design** **Modelling study** **Type of Model** **Modelled distribution** **Data source (and date)** **From Chinese officials, included cases outside Wuhan city and Hubei province.**	**Where transmission took place for dataset?** Included if they had a short travel history to Wuhan or had a contact history with a confirmed case, and had no other potential source of infection **Population details** Number of patients in dataset? 106 cases included for analysis of incubation period. For assessing the potential of transmission during pre-symptomatic period: 50 first-generation cases and 74 secondary cases in 50 clusters included in the analysis. Other relevant population details? **Patient demographics (age/sex, travel history)** Of 106 confirmed COVID 19 cases: Median age 41 years (range 19 to 73). 70 (66.0%) male. Majority had travelled to Wuhan (67.9%).Exposure period of 1-2 days (82.1%) Of 50 clusters infected with SARS-CoV-	**Numbers of cases reported to be caused by asymptomatic/pre-symptomatic transmission** NR. **Reproduction number(Ro) (the average number of infections caused by an infectious individual)** NR. **Generation interval (Time between infection events in an infector-infectee pair)** NR. **Serial Interval (The time between symptom onsets in an infector-infectee pair)** Mean 4.1 (SD 3.3) days. Range (2.5th to 97.5th percentile): -1 to 13 days **Incubation period(time between moment of infection and symptom onset)** Mean 4.9 days (95% CI, 4.4 to 5.4) days Range (2.5th to 97.5th percentile): 0.8 to 11.1 days **Proportion of pre-symptomatic/asymptomatic transmission?** The majority of the secondary cases 73% were infected before the symptom onset of the first generation cases. 18.9% infected on the same date as symptom onset of first generation cases and 8.1% were infected after symptom onset of first generation cases.

Cases limited to these with accurate exposure period of no more than 3 days. Up to February 16 for clusters and January 25 for cases used to estimate incubation time **Type of transmission (infector is pre-symptomatic or asymptomatic throughout disease)** **Pre-symptomatic**	2: median age 47 years (range 21 to 73), 58% male, 82% had a travel history to Wuhan. Of 74 secondary cases: median age 45 years (range 7-83), 45% male. **Clinical characteristics** **Were all cases confirmed via laboratory testing** Described as confirmed In study limitations they state that virus detection were not available for those asymptomatic persons in their incubation period **Authors interpretation of results** The results indicated the transmission of COVID-9 occurs among close contacts during the incubation period	**How long before symptom onset transmission occurred?** 66.2% of the secondary cases were infected within three days before the symptom onset dates of the first-generation cases. **Any other useful information** **Any risk factors for asymptomatic/pre-symptomatic transmission e.g. family/household contacts** NR **Comments** Different data sets were used to estimate mean incubation time and serial interval. **Quality assessment** (low, moderate, high) Low.

	Transmission Details	Primary outcome results
URL for paper **https://www.medrxiv.org/content/medrxiv/early/2**	**Where transmission took place for dataset?** **Population details** Number of patients in dataset?	**Numbers of cases reported to be caused by asymptomatic/pre-symptomatic transmission** In 102 (43.78%) infector-infectee pairs, transmission occurred before infectors' symptom onsets

020/03/24/2020.03.21.20040329.full.pdf **Author** **Ma et al** **Country and region** **China, Japan, Singapore, South Korea, Vietnam, Germany and Malaysia** **The cases from China covered 151 cities of 30 provinces out of 34 in total.** **Study design** **Modelling study** **Type of Model Modelled distribution** **Data source (and date)** **Publicly available datasets searched up to**	1155 cases included in final analysis (1054 China, 39 Japan, 37 Singapore, 11 South Korea, 7 Vietnam, 4 Germany and 3 Malaysia Other relevant population details? **Patient demographics (age/sex, travel history)** Age range 5 days to 90years, mean 46.26 (SD 17.19). Most (80.48%) aged 19-64, 4.83% aged 0-18 yrs and 14.69% ≥65 years. Male 48.58%. 12.92% had a travel history to Hubei (further details contained in table) **Clinical characteristics** Fever most common symptom (73.92%), followed by cough (24.06%), followed by fatigue (7.49), malaise (7.20%) and chills (4.03%). **Were all cases confirmed via laboratory testing** yes **Authors interpretation of results**	**Reproduction number(Ro) (the average number of infections caused by an infectious individual)** R0 1.70 and 1.78 based on two different formulas. **Generation interval (Time between infection events in an infector-infectee pair)** NR **Serial Interval (The time between symptom onsets in an infector-infectee pair)** From 689 pairs (ranged from -5 to 24 days) Mean 6.70 (SD 5.20) days, median 6 days **Incubation period(time between moment of infection and symptom onset)** From 587 cases. (ranged from 0 to 23 days) Mean 7.44 (95% CI: 7.10, 7.78); SD 4.39 (95%CI 3.97, 4.49) days, Median 7 days (based on lognormal model) **Proportion of pre-symptomatic/asymptomatic transmission?** 43.78% infector-infectee pairs, transmission occurred before infectors' symptom onsets In 27 (3.92%) infector-infectee pairs, infectees' symptom onsets occurred before those of infectors. The percentages of negative serial interval (3.92%) and negative time point of exposure(43.78%)can be viewed as the lower and upper limits of probability of pre-symptomatic transmission, respectively. **How long before symptom onset transmission occurred?** From 233 pairs (range -9 to 13 days) -0.19 day (95% CI: -0.62, 0.25) (i.e., 0.19 day before infector's symptom onset) SD 3.32 days (95% CI: 2.97, 3.68) for time point of

Feb 20 for mainland China, March 3rd for Hong Kong, Macau and Taiwan. For other countries, the information was retrieved from the Ministry of health (Japan and Singapore) or public media reports (Malaysia and Vietnam). For these 4 countries the search date varied from Feb 29th to March 2nd (complete list of data sources available). Additional searches of Pubmed and other databases searched up to 27th February.	The estimates of serial interval, time point of exposure and latent period provide consistent evidence on pre-symptomatic transmission. Time point of exposure is -0.19 days i.e. On average, a person catches the virus from someone 0.2 days before he or she develops symptoms, This together with asymptomatic transmission and the generally longer incubation and serial interval of less severe cases suggests a high risk of long-term epidemic in the absence of appropriate control measures .	exposure. **Any other useful information** Based on 11 pairs, the upper limit of latent period was mean 2.52 days (SD 3.95 days) (Defined as the interval between the exposure of infector and that of infectee in a transmission chain, which was used to estimate the longest possible latent period of an individual infector). For 39 (6.64%) cases, the incubation periods were longer than 14 days. **Any risk factors for asymptomatic/pre-symptomatic transmission e.g. family/household contacts** Stratified analysis showed that incubation period and serial interval were consistently longer for those with less severe disease and for those whose primary cases had less severe disease. **Comments** Of 329 cases, 49 (14.89%) were asymptomatic. **Quality assessment** (low, moderate, high) Moderate

List of included studies provided. **Type of transmission (infector is pre-symptomatic or asymptomatic throughout disease)** **Pre-symptomatic and asymptomatic**		

	Transmission Details	Primary outcome results
URL for paper **https://www.ijidonline.com/article/S1201-9712(20)30119-3/fulltext** **Author** **Nishiura et al** **Country and region** **6 countries (Vietnam, South Korea, Germany, Taiwan, China, Singapore)** **Study design** **Modelling study** **Type of Model** **Data source (and date)** **Previously published data and official reports** **Up to 12 February**	**Where transmission took place for dataset?** 12 pairs were family clusters **Population details** Number of patients in dataset? 28 infector-infectee pairs (18 certain pairs) Other relevant population details? **Patient demographics (age/sex, travel history)** NR. **Clinical characteristics** NR. **Were all cases confirmed via laboratory testing** **Authors interpretation of results** The median serial interval is shorter than the median incubation period, suggesting a substantial proportion of pre-symptomatic transmission	**Numbers of cases reported to be caused by pre-symptomatic/ asymptomatic transmission** NR **Reproduction number(Ro) (the average number of infections caused by an infectious individual)** NR **Generation interval (Time between infection events in an infector-infectee pair)** NR **Serial Interval (The time between symptom onsets in an infector-infectee pair)** All pairs (n=28) Median: 4.0 days (95% credible interval [CrI]: 3.1, 4.9) Mean: 4.7 days (95% CrI: 3.7, 6.0) and SD 2.9 (95% CrI: 1.9, 4.9) Certain pairs (n=18) Median: 4.6 days (95% CrI: 3.5, 5.9). Mean: 4.8 days (95% CrI: 3.8, 6.1) and SD 2.3 days (95% CrI: 1.6, 3.5) **Incubation period(time between moment of infection and symptom onset)** NR **Proportion of pre-symptomatic/asymptomatic transmission?** NR **How long before symptom onset transmission occurred?** NR **Any other useful information**

Type of transmission (infector is pre-symptomatic or asymptomatic throughout disease) Pre-symptomatic		NR **Any risk factors for pre-symptomatic/ asymptomatic transmission e.g. family/household contacts** NR **Comments** **Quality assessment** (low, moderate, high) Low to moderate

	Transmission Details	Primary outcome results
URL for paper https://www.medrxiv.org/content/10.1101/2020.03.05.20031815v1 **Author** Ganyani, T **Country** Singapore and China **Region or any other details about dataset location** Singapore and Tianjin, China **Study design** Modelling study **Type of Model** Markov Chain Monte Carlo (MCMC) to estimate generation interval distribution	**Where transmission took place for dataset?** For Singapore dataset, assumes that those with no infector information were infected by any other case within the same cluster. Cases that are Chinese/Wuhan nationals or known to have been in close contact with those, are labelled as index cases For Chinese dataset, 114 cases can be traced to one of 16 clusters (45 to one shopping mall. Through contact investigations, potential transmission lnks wer identified for cases with close contacts, Travel history used to identify import cases, If no infector information available assumed they were infected by any other case in same cluster. **Population details** Number of patients in dataset 91 in Singapore 135 in China Other relevant population details? N/A **Patient demographics (age/sex,**	**Numbers of cases reported to be caused by pre-symptomatic/asymptomatic transmission** 48% (95%CI 32-67%) for Singapore 62% (95%CI 50-76%) for Tiabjin **Reproduction number(Ro) (the average number of infections caused by an infectious individual)** **Generation interval (Time between infection events in an infector-infectee pair)** 5.20 (95% CI 3.78 to 6.78**) for Singapore** 3.95 (95% CI 3.01to 4.91**) for Tianjin** **Serial Interval (The time between symptom onsets in an infector-infectee pair)** 5.21 (95% CI -3.35to 13.94**) for Singapore** 3.95 (95% CI -4.47 to 12.51**) for Tianjin** **Incubation period(time between moment of infection and symptom onset)** Model assume an incubation period of 5.2 days but does not calculate this themselves it is taken from Zhang et al. **Proportion of pre-symptomatic/asymptomatic transmission?** They describe two values each for Singapore and China. The baseline does not allow for negative serial interval for people without known infectors, the second allows these. • Singapore baseline 0.48 (0.32 to 0.67) • Singapore allow -ve 0.66 (0.45 to 0.84) • China baseline 0.62 (0.50 to 0.76)

Data source Symptom onset dates and cluster information for confirmed cases reported to Singapore' ministry of health and Tianjin's municipal health commission **Type of transmission (infector is pre-symptomatic or asymptomatic throughout disease)**	**travel history)** For 91 Singapore people - age, sex, known travel history, time of symptom onset and known contacts available for 54 of these available on Singapore database For 134 Chinese - age, sex, relationship to other cases, travel history available on Chinese database **Clinical characteristics** NR **Authors interpretation of results** The proportion of pre-symptomatic transmission was 48% (95%CI 32-67%) for Singapore and 62% (95%CI 50-76%) for Tianjin, China. Estimates of the reproduction number based on the generation interval distribution were slightly higher than those based on the serial interval distribution	• China allow -ve 0.77 (0.65 to 0.87) **How long before symptom onset transmission occurred?** N/R **Any other useful information** N/A **Any risk factors for asymptomatic transmission e.g. family/household contacts** N/R **Quality assessment** (low, moderate, high) Moderate to high.

	Transmission Details	Primary outcome results
URL for paper	**Where transmission took place for dataset?** Not reported **Population details** 77 infector-infectee transmission pairs for estimation of serial interval.	**Numbers of cases reported to be caused by pre-symptomatic/asymptomatic transmission** Not Reported **Reproduction number(Ro) (the average number of infections caused by an infectious individual)** Not Reported **Generation interval (Time between infection events in an infector-**

https://www.medrxiv.org/content/10.1101/2020.03.15.20036707v2.full.pdf **Author** **He et al** **Country** **China** **Region or any other details about dataset location** **Guangzhou region** **Study design** **Model** **Type of Model** **Distribution model – calculating serial interval** **Data source (and date)** **Transmission pairs from publicly available sources from**	Other group of patients from the hospital used to estimate viral load n=94 **Patient demographics (age/sex, travel history)** No details on transmission pairs For viral shedding group – 47/94(50%) were male, median age 47 years **Clinical characteristics** None given for transmission pairs. Viral shedding group: 61/93 (66%) of the patients were moderately ill (with fever and/or respiratory symptoms and radiographic evidence of pneumonia) but none were classified as "severe" or "critical" on hospital admission, although 20/94 (21%) of the patients deteriorated to a severe or critical condition during hospitalization. **Were all cases confirmed via laboratory testing** Yes	**infectee pair)** Not Reported **Serial Interval (The time between symptom onsets in an infector-infectee pair)** 5.8 days (95% CI = 4.8 to 6.8) and median of 5.2 days (95% CI = 4.1 to 6.4) **Incubation period(time between moment of infection and symptom onset)** Taken from Li et al 5.2 days **Proportion of pre-symptomatic/asymptomatic transmission?** Proportion of transmission before symptom onset (area under the curve) was 44% (46 -52% in sensitivity analysis) **How long before symptom onset transmission occurred?** Infectiousness started from 2.5 days before symptom onset and reached its peak at 0.6 days before symptom onset. **Any other useful information** A total of 414 throat swabs were collected from these 94 patients (median = 4 swabs per patient), from the day of illness onset up to 32 days after onset. We detected high viral loads soon after illness onset, which gradually decreased towards the detection limit at about 21 days after onset. Infectiousness was estimated to decline relatively quickly within 7 days of illness onset. Viral load data was not used in the estimation but showed similar monotonic decreasing pattern after symptom onset. **Any risk factors for pre-symptomatic/asymptomatic transmission e.g. family/household contacts** Not Reported **Comments**

mainland China and countries/regions outside of China. For viral shedding, patients from a single hospital who were positive for virus between 21 January until 14 February. Type of transmission (infector is pre-symptomatic or asymptomatic throughout disease) Pre-symptomatic	**Authors interpretation of results**	Incubation period was taken from a published estimate, not calculated from this dataset (used Li et al incubation period from Wuhan data) **Quality assessment** Low to Moderate

	Transmission Details	Primary outcome results
URL for paper	**Where transmission took place for dataset?** **Not reported**	**Primary outcome results** **Numbers of cases reported to be caused by asymptomatic transmission**

https://wellcomeopenresearch.org/articles/5-58/v1 **Author** **Liu et al** **Country** **China** **Region or any other details about dataset location** **Shenzen** **Study design** **Model** **Type of Model** **Estimation of epidemiological parameters using mathematical equations** **Data source (and date)** **Used published estimates from Bi et al** **Type of transmission (infector is pre-**	**Population details** Used published data from 391 cases and 1286 contacts **Patient demographics (age/sex, travel history)** Not reported **Clinical characteristics** Not reported **Were all cases confirmed via laboratory testing** Not reported **Authors interpretation of results** We estimated that without active case findings to accelerate isolation in Shenzen 12 to 28% of transmission occurred during the pre-symptomatic period. We further estimated that active case finding reduced the number of secondary infections after symptom onset and thereby increased the percentage of pre-symptomatic transmissions to 21 to 46%. This implies that Shenzen accelerated case isolation has prevented 35 to	Not Reported **Reproduction number (Ro) (the average number of infections caused by an infectious individual)** Not Reported **Generation interval (Time between infection events in an infector-infectee pair)** Not Reported **Serial Interval (The time between symptom onsets in an infector-infectee pair)** Not Reported **Incubation period (time between moment of infection and symptom onset)** Not Reported **Proportion of pre-symptomatic/asymptomatic transmission?** 12 to 28% of transmission would have occurred during the pre-symptomatic period without active case finding and isolation. Active case finding reduced the number of secondary infections after symptom onset thereby increasing the percentage of pre-symptomatic transmissions to 21-46% Estimated percentage of pre-symptomatic transmission is the incubation period and serial interval are 1. Main analysis • uncorrelated: with active case finding 46% -without active case finding 23% • fully correlated: with active case finding 21% -without active case finding 12% • fully anti-correlated: with active case finding 46% -without active case finding 28% 2. Sensitivity analysis

symptomatic or asymptomatic throughout disease) Pre-symptomatic	60% of secondary cases among symptomatic infectees … We also find that … case isolation on days 1,3 or 7 after symptom onset reduces the proportion of or preventable onward transmission by syndromic case finding and case isolation by 60%, 50% and less than 30% respectively.	• uncorrelated: with active case finding 48% without active case finding 27% • fully correlated: with active case finding 38% -without active case finding 1% • fully anti-correlated: with active case finding 47% without active case finding 32% • uncorrelated: with active case finding 48% (using parameters from Nishiura et al.) • fully correlated: with active case finding 38% (using parameters from Nishiura et al.) • fully anti-correlated: with active case finding 47% (using parameters from Nishiura et al.) (The observations of the incubation period and the serial interval may be correlated. In other words, individuals with a long incubation period may not have a serial interval of typical length but may be exactly those who have a long serial interval, or alternatively, exactly those who have a short serial interval) **How long before symptom onset transmission occurred?** Not Reported **Any other useful information** Not reported **Any risk factors for asymptomatic transmission e.g. family/household contacts** Not Reported **Comments** **Quality assessment (low, moderate, high)** Moderate to high

	Transmission Details	Primary outcome results
URL for paper **https://www.medrxiv.org/content/10.1101/2020.03.08.2**	N/R **Population details** 40 transmission pairs with known dates of onset of	**Numbers of cases reported to be caused by pre-symptomatic/asymptomatic transmission** Mean posterior probability that transmission occurred before symptoms (n=40 transmission pairs): 37% (95% CI: 27.5% - 45%)

0032946v1.full.pdf Author **Ferretti L.** Country **7 countries (Vietnam, South Korea, Germany, Taiwan, China, Singapore, Italy)** **Region or any other details about dataset location** Study design **Modelling study** **Type of Model Deterministic** **Data source Published data** **Type of transmission Symptomatic (direct transmission from a symptomatic individual) Pre-symptomatic (direct transmission from an individual that**	symptoms identified from the public sources. **Patient demographics (age/sex, travel history)** N/R **Clinical characteristics** N/R **Were all cases confirmed via laboratory testing** State that confirmed cases but no definition on what a confirmed case is **Authors interpretation of results** Our results suggest that a large fraction of all transmissions occur before individuals develop symptoms. Isolating symptomatic cases and tracking their contacts through classical epidemiological methods is therefore likely to be too slow and resource-intensive to achieve epidemic control. We argue that the reports from Singapore imply that even if asymptomatic infections are common, onward transmission	**Reproduction number(Ro) (the average number of infections caused by an infectious individual)** Overall Ro = 2.0 pre-symptomatic: 0.9 symptomatic: 0.7 asymptomatic: 0.1 environmental: 0.2 **Generation interval (Time between infection events in an infector-infectee pair)** Mean (SD):5.0 days (1.9) Median: 5.0 days **Serial Interval (The time between symptom onsets in an infector-infectee pair)** N/R **Incubation period(time between moment of infection and symptom onset)** Mean (SD): 5.5 days (2.1), Median: 5.2 days **Proportion of pre-symptomatic/asymptomatic transmission?** N/R **How long before symptom onset transmission occurred?** Not reported. **Any other useful information** N/R **Any risk factors for pre-symptomatic/asymptomatic transmission e.g. family/household contacts** N/R **Comments** The authors developed a web interface to explore the uncertainty in

occurs before the source individual experiences noticeable symptoms) Asymptomatic (direct transmission from individuals who never experience noticeable symptoms). Environmental (transmission via contamination)	from this state is probably uncommon	their modelling assumptions. https://bdi-pathogens.shinyapps.io/covid-19-transmission-routes **Quality assessment** (low, moderate, high) Low to moderate.

	Transmission Details	**Primary outcome results**
URL for paper **https://www.medrxiv.org/content/10.1101/2020.03.21.20040444v2.full.pdf** **Author** **Siwiak et al** **Country** **Region or any**	**Where transmission took place for dataset?** Assume a single pre-symptomatic individual based in Wuhan **Population details** Unclear as a number of different datasets are used **Patient demographics (age/sex, travel history)**	**Primary outcome results** **Numbers of cases reported to be caused by asymptomatic transmission** Not applicable **Reproduction number (Ro) (the average number of infections caused by an infectious individual)** Ro $approximately$ 4.4. This was assumed and is within the rage on 2-5 modelled for SARS based on the assumption of a much higher than currently suspected rate of undiagnosed and mild/asymptomatic cases This

other details about dataset location **Study design** **Model** **Type of Model** **Data source (and date)** **Modified SIR Global Epidemic and Mobility Model (GLEaM) framework** **Reference data for number of SARS-CoV-2 diagnosed patients from 22 Jan to 16 March from John Hopkins University GitHub repository** **Information on severity of symptoms and testing rates per country from worldometer website. Other**	Not reported **Clinical characteristics** Not applicable **Were all cases confirmed via laboratory testing** Yes **Authors interpretation of results** "… one may risk a hypothesis that the virus is already more prevalent in the global population than shown in official statistics at the moment, and consequently, its mortality rate is much lower" "The overall global data… seems strongly biased by large regions where official statistics may not reflect accurately the actual state of the epidemic, and by the fact that many COVID-19 cases may go unnoticed."	is the figure that best fits when compared with numbers of diagnosed cases16 selected countries **Generation interval (Time between infection events in an infector-infectee pair)** Not Reported **Serial Interval (The time between symptom onsets in an infector-infectee pair)** Not Reported **Incubation period (time between moment of infection and symptom onset)** Not Reported **Proportion of pre-symptomatic/asymptomatic transmission?** Not Reported **How long before symptom onset transmission occurred?** A latent non-infectious period of 1.1 days, followed by 4.6 days of pre-symptomatic infectious period **Any other useful information** • tDR (the rate of total diagnosed to undiagnosed cases) implies that the vast majority of covid-19 infections are mild and pass unnoticed. A larger tDR describes a larger proportion of diagnosed to undiagnosed cases. This model estimates tDR is 0.0061 • Probability of developing severe symptoms 0.01 • Probability of being diagnosed when presenting severe symptoms 0.6 • Probability of diagnosis for cases with mild symptoms or asymptomatic 0.001

data sources such as commuting patterns and air travel flows embedded in GLEAM software **Type of transmission (infector is pre-symptomatic or asymptomatic throughout disease) 'Merged all mild and asymptomatic cases' called 'Mild symptoms'. 'Presymptomatic infectious' is a population compartment in the model defined as 'infected population , already infectious, but without developed symptoms'**		**Any risk factors for asymptomatic transmission e.g. family/household contacts** Not reported **Comments** Authors describe their motivation thus: models to date only used Chinese data on the number of diagnosed cases but actual prevalence is unknown, which hampers modelling. **Quality assessment (low, moderate, high)** Low to Moderate

	Transmission Details	Primary outcome results
URL for paper **https://www.medrxiv.org/content/medrxiv/early/2020/03/13/2020.03.10.20033803.full.pdf** **Author** **Zhang et al** **Country and region** **China (Beijing, Shanghai, Guangdong, Chongqing, Hunan, Zhejiang)** **Study design** **Modelling study**	Where transmission took place for dataset? **Population details** Number of patients in dataset? Beijing 399 , Shanghai 334, Chongqing 574, Guangdong 1339, Zhejiang 1205, Hunan 1013. Not clear if all of these cases included in the study. Other relevant population details? **Patient demographics (age/sex, travel history)** N/R **Clinical characteristics** N/R **Were all cases confirmed via laboratory testing** Not clear, they mention confirmed	**Numbers of cases reported to be caused by asymptomatic/pre-symptomatic transmission** N/R **Reproduction number(Ro) (the average number of infections caused by an infectious individual)** The controlled reproduction number Rc(transmission ability of the epidemic) was between 2 and 3 at the beginning of the epidemic and has reduced since the implementation of control measures. **Generation interval (time between infection events in an infector-infectee pair)** N/R **Serial Interval (the time between symptom onsets in an infector-infectee pair)** N/R **Incubation period(time between moment of infection and symptom onset)** N/R **Proportion of pre-symptomatic/asymptomatic transmission?** Patients with symptoms are about twice as likely to pass a pathogen

Type of Model **Novel stochastic dynamic model** **Data source (and date)** **Publically available data in China (not Hubei) from 22 January until 21 February** **Type of transmission (infector is pre-symptomatic or asymptomatic throughout disease)** **Asymptomatic transmission.**	cases, but not clear what definition they used. **Authors interpretation of results** From the estimated parameters, the report find that about 30% of the infected are asymptomatic. Patients with symptoms are about twice as likely to pass a pathogen to others as asymptomatic patients.	to others as asymptomatic patients. **How long before symptom onset transmission occurred?** N/R **Any other useful information** About 30% of the infected are asymptomatic. **Any risk factors for asymptomatic/pre-symptomatic transmission e.g. family/household contacts** **Comments** **Quality assessment** (low, moderate, high)

	Transmission Details	Primary outcome results
URL for paper https://www.medrxiv.org/content/medrxiv/early/2020/02/20/2020.02.15.20023440.full.pdf **Author** **Zhou et al** **Country and region** **China (evacuated from Wuhan, China)** **Region or any other details about dataset location** **Wuhan China (evacuees)** **Study design** **Modelling study** **Type of Model** **SEIR model (susceptible, exposed, infected resistant)**	**Where transmission took place for dataset?** Wuhan **Population details** Number of patients in dataset? International evacuees: 58 confirmed cases Evacuated foreign nationals: 2,666 Other relevant population details? 12 have tested positive for COVID19 All evacuees passed at least two rounds of body temperature screening at the airport **Patient demographics (age/sex, travel history)** N/R **Clinical characteristics** Of the 40 cases, on which both the date existing Wuhan and the symptom onset date were available, 57.5% (23 cases) were asymptomatic when leaving Wuhan, 25% (10 cases) developed symptoms before leaving Wuhan, and 17.5% (7 cases) developed symptoms on the same date when leaving Wuhan	**Numbers of cases reported to be caused by asymptomatic/pre-symptomatic transmission** N/R **Reproduction number(Ro) (the average number of infections caused by an infectious individual)** Ro 2.12 (95% CI 2.04, 2.18) based on SEIR model without pre-symptomatic transmission Ro 2.05 based on SEAIR model which assumes an infectious pre-symptomatic stage. **Generation interval (Time between infection events in an infector-infectee pair)** N/R **Serial Interval (The time between symptom onsets in an infector-infectee pair)** N/R **Incubation period(time between moment of infection and symptom onset)** N/R **Proportion of pre-symptomatic/asymptomatic transmission?** N/R **How long before symptom onset transmission occurred?** The estimated most probable asymptomatic infectious period is close to zero and offers little evidence for the presence of asymptomatic

compared to SEAIR model (susceptible, exposed, asymptomatic, infected resistant **Data source (and date)** **Internationally exported cases: 58 cases from 14 countries.** **Foreign nationals 2,666.** **Jan. 29 and Feb. 2, 2020** **Type of transmission (infector is pre-symptomatic or asymptomatic throughout disease)** Unclear	**Were all cases confirmed via laboratory testing** Authors define a confirmed case as: an individual that shows symptoms, which can be detected by temperature screenings or severe enough to require hospitalisation, plus recent travel history to Wuhan **Authors interpretation of results** The SEIR model performed better than the SEAIR model for the current infection data (model without infectious pre-symptomatic period performed better than model with). Based on the data examined, this study found little evidence for the presence of asymptomatic transmissions	transmission in the disease dynamics. **Any other useful information** N/R **Any risk factors for asymptomatic/pre-symptomatic transmission e.g. family/household contacts** N/R **Comments** All the datasets used in this study are hosted on a public repository and made available at https://github.com/HVoltBb/2019nCov. It is assumed in this study that those evacuated provide a representative sample of the population of Wuhan at time of extraction. Makes assumption that asymptomatic if no fever. **Quality assessment** (low, moderate, high) **Low**

	Transmission Details	Primary outcome results
URL for paper	Where transmission took place for	**Numbers of cases reported to be caused by asymptomatic**

https://www.medrxiv.org/content/10.1101/2020.03.24.20042606v1.full.pdf Author **Luo et al** Country **China** **Region or any other details about dataset location Guangzhou** Study design **Modelling study** **Type of Model** **Data source (and date) Between 13 January and 6 March 347 cases diagnosed in Guangzhou and their 4,950 close contacts were identified**	dataset? **Population details** Number of patients in dataset? 4950 close contacts Other relevant population details? **Patient demographics (age/sex, travel history)** median age 38 years males 50.2% **Clinical characteristics** N/R **Authors interpretation of results** The proportion of asymptomatic and mild infections 65 account for almost half of the confirmed cases among close contacts. The 66 household contacts were the main transmission mode, and clinically more 67 severe cases were more likely to pass the infection to their close contacts.	**transmission** • During quarantine,129 (2.6%) were diagnosed, 8 (6.2%) were asymptomatic,49 (38%) mild, 5 (3.9%) severe to critical i.e. almost half confirmed cases among close contacts were either asymptomatic or mild infections • incidence - asymptomatic are a chance of 33 per 100,000 contacts of passing on infection (0.33%) • odds unadjusted in asymptomatic 0.06 (0.01 to 0.40) p=0.0042 • odds adjusted in asymptomatic 0.29 (0.04 to 2.22) p=0.2340 **Reproduction number(Ro) (the average number of infections caused by an infectious individual)** N/R **Generation interval (Time between infection events in an infector-infectee pair)** N/R **Serial Interval (The time between symptom onsets in an infector-infectee pair)** N/R **Incubation period (time between moment of infection and symptom onset)** N/R **Proportion of pre-symptomatic/asymptomatic transmission?** N/R **How long before symptom onset transmission occurred?** N/R **Any other useful information**

Type of asymptomatic transmission (infector is pre-symptomatic or asymptomatic throughout disease) Asympyomatic		Sensitivity of throat swab 71.32% and 92.19% at first to second PCR test. **Any risk factors for asymptomatic transmission e.g. family/household contacts** 'Household contact were the most dangerous in catching the infection' 10.2% With public transport vehicles and healthcare setting 15 and 10% **Quality assessment** (low, moderate, high) Low to moderate

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