

## Rapid Review Report

<b>Review Title:</b>	What proportion of disease transmission is due to asymptomatic, pre-symptomatic and symptomatic cases?
<b>Review ID:</b>	LAB040701v2 RR
<b>Produced:</b>	May 8, 2020
<b>Version:</b>	2
<b>Revision History:</b>	April 8, 2020
<b>Prepared By:</b>	Hui Wang (PGY4 pathology resident), Department of Pathology and Laboratory Medicine, University of Saskatchewan  Brianna Howell-Spooner, Clinical Librarian, Saskatchewan Health Authority Library
<b>Peer Reviewer:</b>	Dr. B. Reeder, College of Medicine, University of Saskatchewan
<b>Contact:</b>	For questions specific to this review, please contact Hui Wang; <a href="mailto:huw546@usask.ca">huw546@usask.ca</a>
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### Key Findings

- COVID-19 is primarily transmitted by symptomatic patients and presymptomatic individuals.
- Moderate grade evidence estimates that approximately 20% of COVID-19 transmission may be due to that from presymptomatic individuals. However, estimates range from 6.4% - 47%.
- Asymptomatic individuals and environmental contamination appear to contribute less to disease transmission, with estimated proportions of 6% and 10%, respectively from modelling studies.

### Limitations

- Some of the literature available is in the state of preprint, pending peer review.
- Given the paucity of definitive empirical studies, the conclusions rely upon disease modelling analyses as well as direct empirical evidence.

**GRADE of Evidence: B - Moderate**

A grade of "B" is assigned when further research is likely to have an important impact on confidence in the estimate of effect and may

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change the estimate. The review may include one high quality study and/or several studies with some limitations.

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## Background

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Reports show about a considerable proportion of people testing positive for COVID-19 may be asymptomatic, some of whom develop symptoms over the subsequent week (and so named presymptomatic). The percentage of asymptomatic and presymptomatic individuals is higher among children and young adults, but also appears high in settings such as long-term care facilities and cruise ships [1-10]. Therefore, symptom-based testing can miss a considerable proportion of cases.

### **Purpose**

The proportion of disease transmission due to asymptomatic, pre-symptomatic and symptomatic cases needs to be determined in order to effectively prevent and control COVID-19 spread.

### **Research Question(s)**

- What proportion of disease transmission is due to asymptomatic, pre-symptomatic and symptomatic cases?

## Method

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This rapid review is produced within 48 hours of request.

### **PICO Statement**

P – Patients/Population	Not applicable
I – Intervention/Indication	Not applicable
C – Comparator/Control	Not applicable
O – Outcome	Not applicable

### **Search Strategy**

MeSH terms: SARSCOV2; COVID; corona virus; asymptomatic; symptomatic; presymptomatic; health workforce; health care worker;

### **Inclusion Criteria**

- Last 2 years

### **Sources**

Medline CINAHL Pubmed MedRxiv Opened Journals  
CMA Joule LitCOVID Google Scholar WHO

## Summary of Evidence

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### Definitions

**Symptomatic transmission:** a symptomatic COVID-19 case is a case who has developed signs and symptoms compatible with COVID-19 virus infection. Symptomatic transmission refers to transmission from a person while they are experiencing symptoms [11].

**Pre-symptomatic transmission:** the incubation period for COVID-19, which is the time between exposure to the virus (becoming infected) and symptom onset, is on average 5-6 days, however, can be up to 14 days. During this period, also known as the “presymptomatic” period, some infected persons may be contagious. Therefore, transmission from a presymptomatic case can occur before symptom onset [11].

**Asymptomatic transmission:** an asymptomatic laboratory-confirmed case is a person infected with COVID-19 who does not develop symptoms. Asymptomatic transmission refers to transmission of the virus from a person who does not develop symptoms [11].

**Environmental transmission:** transmission via contamination of surfaces or objects [12].

### Findings

A statement from the World Health Organization (WHO) indicates that COVID-19 is primarily transmitted from symptomatic people to others who are in close contact through respiratory droplets, by direct contact with infected persons, or by contact with contaminated objects and surfaces [11]. Several studies and case reports [13-19, 30-33] have demonstrated presymptomatic transmission by means of contact tracing and the investigation of clusters of confirmed cases. Based on limited empirical studies, the proportion of disease transmission due to presymptomatic individuals is 6.4%, reported in Singapore [19]. Although asymptomatic laboratory-confirmed cases are frequently reported [20-24, 34-35], to date what little empirical data exists suggest that the transmission rate from asymptomatic individuals may be less than from symptomatic individuals [36].

A major outbreak reported in a skilled nursing facility (long term care facility) in Washington state, USA, is helpful in examining this question [5, 37-38]. Among 76 residents who participated in two point-prevalence surveys 7 days apart at the beginning of the outbreak, 48 (63%) tested rt-PCR positive. Of these 48 residents, 27 (56%) were asymptomatic on the first test; 24 of the 27 (89%) subsequently developed symptoms (hence were presymptomatic at the time of first testing), while 3 (11%) remained asymptomatic. Symptom categories did not differ substantially with respect to viral load measured by rt-PCR Ct values and viral culture (the majority being positive except for only 1 of 3 positive in asymptomatic patients). Although unable to quantify the proportion of transmission due to asymptomatic and presymptomatic individuals in this setting, the investigators suspect it was considerable.

There are a number of modelling studies, published or in press, that estimate the prevalence of COVID-19 and its transmission via symptomatic, asymptomatic, presymptomatic individuals, and environment factors. Based on the early reported data in Wuhan, China, Li et al. estimated that 86% of all infections were undocumented (which means asymptomatic or with mild symptoms) prior to 23 January 2020 travel restrictions, and 79% of documented cases appear to have resulted from contact with undocumented infections [25]. Employing key epidemic parameters from empirical data, Ferretti and

colleagues concluded that although about 40% of test positive individuals were asymptomatic, their ability to transmit the disease was as low as 6%; however, presymptomatic individuals, symptomatic patients and environmental surfaces contributed to 47%, 38% and 10% of disease transmission, respectively [12]. Liu et al. collected data from 391 cases and their 1286 contacts, and estimated that 23% of transmissions in Shenzhen, China may have originated from pre-symptomatic cases [26]. According to the mathematical model developed by Zhang, the percentage of presymptomatic transmission is roughly 19.7% [27].

It should be noted that the proportion of COVID-19 transmission attributable to asymptomatic, pre-symptomatic and symptomatic cases can be expected to vary somewhat in different populations and geographic areas, due to differences in testing protocols (nasopharyngeal vs. oral swabs), laboratory methods, population structure and dynamics [28-29].

## Conclusions

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COVID-19 is primarily transmitted by symptomatic cases and presymptomatic individuals. Studies show up to 47% of disease may be transmitted by presymptomatic individuals. Although a large proportion of cases appear to be asymptomatic, the ability of this population to transmit the disease is limited, accounting for as little as 6% of transmission. Contaminated environmental surfaces may account for up to 10% of COVID-19 transmission.

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## Search Alert Strategies

### PubMed

(((((transmission[Text Word] OR carrier[Text Word] OR carriers[Text Word])) OR (transmission[Title/Abstract] OR carrier[Title/Abstract] OR carriers[Title/Abstract]))) AND (((asymptomatic[Text Word] OR a-symptomatic[Text Word] OR presymptomatic[Text Word] OR pre-symptomatic[Text Word] OR symptomatic[Text Word])) OR (transmission[Title/Abstract] OR asymptomatic[Title/Abstract] OR a-symptomatic[Title/Abstract] OR presymptomatic[Title/Abstract] OR pre-symptomatic[Title/Abstract] OR symptomatic[Title/Abstract]))) AND (((("COVID-19"[Supplementary Concept] OR "severe acute respiratory syndrome coronavirus 2"[Supplementary Concept] OR COVID-19[tiab] OR COVID 19[tiab] OR SARS-CoV-2[tiab] OR 2019-nCoV[tiab] OR 2019 ncov[tiab] OR (Wuhan[tiab] AND coronavirus[tiab]) OR ((2019[dp] OR 2020[dp]) AND (new[tiab] OR novel[tiab] OR pandemic[tiab] OR epidemic[tiab]) AND (coronavirus\*[tiab] OR corona virus\*[tiab])))))

### Medline

- 1 coronavirus/ or exp betacoronavirus/ or coronavirus infections/  
(coronavirus\* or corona virus\* or coronavirus\* or coronaviral or (wuhan adj1 virus) or (wuhan adj1 viral) or cov or covid or WN-CoV or nCoV or 2019ncov or nCoV2019 or nCovid or nCovid2019 or 2019nCovid or covid-19 or covid19 or covid 19 or corvid 19 or HCov-19 or HCov-2019 or hcov19 or hcov2019 or severe acute respiratory syndrome coronavirus 2 or severe acute respiratory syndrome corona virus 2 or SARS Coronavirus 2 or SARS Corona virus 2 or SARS-COV-2 or SARSCOV2 or SARSCOV 2 or SARS2 or SARS-2 or coronavirus disease 2019 or corona virus disease 2019 or 2019 novel coronavirus infection\* or 2019 novel coronavirus disease or 2019-nCoV infection\* or coronavirus disease-19 or new coronavirus or novel corona virus).mp,kf,hw,rn,in.
- 3 1 or 2
- 4 (asymptomatic or a-symptomatic or presymptomatic or pre-symptomatic or symptomatic).tw,kf.
- 5 exp "health care facilities, manpower, and services"/  
(health workforce or health care worker? or healthcare worker? or health-care worker? or health care provider? or healthcare provider? or health-care provider? or medical care provider? or healthcare employee? or health personnel or medical personnel or medical staff or hospitalist? or physician? or doctor? or clinician? or pathologist? or primary care phsycian? or primary care provid! er? or GP or PCP or pulmonologist? or general practitioner? or general practice physician? or nursing staff or nurse? or hospital personnel or hospital staff).tw,kf.
- 7 5 or 6
- 8 3 and 4 and 7
- 9 limit 8 to yr="2020 -Current"
- 10 3 and 4
- 11 limit 10 to yr="2020 -Current"
- 12 11 not 8
- 13 12 or 8

## Shared Library

All fields (a-symptomatic OR asymptomatic OR pre-symptomatic OR presymptomatic)

## Original Search Strategies

MEDLINE - April 6, 2020, 4:23pm

#	Searches	Results
1	coronavirus/ or exp betacoronavirus/ or coronavirus infections/	10084
2	(coronavirus* or corona virus* or coronovirus* or coronaviral or (wuhan adj1 virus) or (wuhan adj1 viral) or cov or covid or WN-CoV or ncov or 2019ncov or ncov2019 or ncovid or ncovid2019 or 2019ncovid or covid-19 or covid19 or covid 19 or corvid 19 or HCov-19 or HCov-2019 or hcov19 or hcov2019 or severe acute respiratory syndrome coronavirus 2 or severe acute respiratory syndrome corona virus 2 or SARS Coronavirus 2 or SARS Corona virus 2 or SARS-COV-2 or SARSCOV2 or SARSCOV 2 or SARS2 or SARS-2 or coronavirus disease 2019 or corona virus disease 2019 or 2019 novel coronavirus infection* or 2019 novel coronavirus disease or 2019-nCoV infection* or coronavirus disease-19 or new coronavirus or novel corona virus).mp,kf,hw,rn,in.	17250
3	1 or 2	18707
4	(asymptomatic or a-symptomatic or presymptomatic or pre-symptomatic or symptomatic).tw,kf.	302831
5	exp "health care facilities, manpower, and services"/	2868418
6	(health workforce or health care worker? or healthcare worker? or health-care worker? or health care provider? or healthcare provider? or health-care provider? or medical care provider? or healthcare employee? or health personnel or medical personnel or medical staff or hospitalist? or physician? or doctor? or pathologist? or primary care phsyician? or GP or PCP or pulmonologist? or general practitioner? or general practice physician? or nursing staff or nurse? or hospital personnel or hospital staff or respiratory therapist?).tw,kf.	906744
7	5 or 6	3343214
8	3 and 4 and 7	93
9	limit 8 to yr="2019 -Current"	21
10	3 and 4	432

11	limit 10 to yr="2019 -Current"	152
12	11 not 8	131

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CINAHL - April 6, 2020, 4:44pm

#	Query	Results
S1	TX coronavirus* or corona virus* or coronovirus* or coronaviral or (wuhan w1 virus) or (wuhan w1 viral) or cov or covid or WN-CoV or ncov or 2019ncov or ncov2019 or ncovid or ncovid2019 or 2019ncovid or covid-19 or covid19 or covid 19 or corvid 19 or HCov-19 or HCov-2019 or hcov19 or hcov2019 or severe acute respiratory syndrome coronavirus 2 or severe acute respiratory syndrome corona virus 2 or SARS Coronavirus 2 or SARS Corona virus 2 or SARS-COV-2 or SARSCOV2 or SARSCOV 2 or SARS2 or SARS-2 or coronavirus disease 2019 or corona virus disease 2019 or 2019 novel coronavirus infection* or 2019 novel coronavirus disease or 2019-nCoV infection* or coronavirus disease-19 or new coronavirus or novel corona virus	7,551
S2	TI ( asymptomatic or a-symptomatic or presymptomatic or pre-symptomatic or symptomatic ) OR AB ( asymptomatic or a-symptomatic or presymptomatic or pre-symptomatic or symptomatic )	67,356
S3	(MH "Health Manpower+")	606,441
S4	TI ( health workforce or health care worker# or healthcare worker# or health-care worker# or health care provider# or healthcare provider# or health-care provider# or medical care provider# or healthcare employee# or health personnel or medical personnel or medical staff or hospitalist# or physician# or doctor# or pathologist# or primary care phsyician# or GP or PCP or pulmonologist# or general practitioner# or general practice physician# or nursing staff or nurse# or hospital personnel or hospital staff or respiratory therapist# ) OR AB ( health workforce or health care worker# or healthcare worker# or health-care worker# or health care provider# or healthcare provider# or health-care provider# or medical care provider# or healthcare employee# or health personnel or medical personnel or medical staff or hospitalist# or physician# or doctor# or pathologist# or primary care phsyician# or GP or PCP or pulmonologist# or general practitioner# or general practice physician# or nursing staff or nurse# or hospital personnel or hospital staff or respiratory therapist# )	621,258
S5	S3 OR S4	1,034,647
S6	S1 AND S2 AND S5	18
S7	S1 AND S2	110
S8	S1 AND S2 [Limit to 2019-2020]	31

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PubMed – April 7, 2020, 9:30am

(((transmission[Text Word] OR carrier[Text Word] OR carriers[Text Word])) OR (transmission[Title/Abstract] OR carrier[Title/Abstract] OR carriers[Title/Abstract])) AND (((asymptomatic[Text Word] OR a-symptomatic[Text Word] OR presymptomatic[Text Word] OR pre-symptomatic[Text Word] OR symptomatic[Text Word])) OR (transmission[Title/Abstract] OR asymptomatic[Title/Abstract] OR a-symptomatic[Title/Abstract] OR presymptomatic[Title/Abstract] OR pre-symptomatic[Title/Abstract] OR symptomatic[Title/Abstract])) AND (("COVID-19"[Supplementary Concept] OR "severe acute respiratory syndrome coronavirus 2"[Supplementary Concept] OR COVID-19[tiab] OR COVID 19[tiab] OR SARS-CoV-2[tiab] OR 2019-nCoV[tiab] OR 2019 ncov[tiab] OR (Wuhan[tiab] AND coronavirus[tiab]) OR ((2019[dp] OR 2020[dp]) AND (new[tiab] OR novel[tiab] OR pandemic[tiab] OR epidemic[tiab]) AND (coronavirus\*[tiab] OR corona virus\*[tiab])))

Results - 448

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Embase – April 7, 2020, 2:59pm

#	Searches	Results
1	(coronavirus* or corona virus* or coronovirus* or coronaviral or (wuhan adj1 virus) or (wuhan adj1 viral) or cov or covid or WN-CoV or ncov or 2019ncov or ncov2019 or ncovid or ncovid2019 or 2019ncovid or covid-19 or covid19 or covid 19 or corvid 19 or HCov-19 or HCov-2019 or hcov19 or hcov2019 or severe acute respiratory syndrome coronavirus 2 or severe acute respiratory syndrome corona virus 2 or SARS Coronavirus 2 or SARS Corona virus 2 or SARS-COV-2 or SARSCOV2 or SARSCOV 2 or SARS2 or SARS-2 or coronavirus disease 2019 or corona virus disease 2019 or 2019 novel coronavirus infection* or 2019 novel coronavirus disease or 2019-nCoV infection* or coronavirus disease-19 or new coronavirus or novel corona virus).mp,hw,rn,in.	22004
2	(health workforce or health care worker? or healthcare worker? or health-care worker? or health care provider? or healthcare provider? or health-care provider? or medical care provider? or healthcare employee? or health personnel or medical personnel or medical staff or hospitalist? or physician? or doctor? or pathologist? or primary care phsycian? or GP or PCP or pulmonologist? or general practitioner? or general practice physician? or nursing staff or nurse? or hospital personnel or hospital staff).tw,hw,mp.	1586277
3	exp "health care facilities, manpower, and services"/	6053263
4	2 or 3	6737484
5	(asymptomatic or a-symptomatic or presymptomatic or pre-symptomatic or symptomatic).tw,hw,mp.	454397
6	1 and 4 and 5	187
7	limit 6 to (human and yr="2019 -Current")	43

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**Search terms for other resources used in various combinations:**

COVID-19 asymptomatic