Norwegian Institute of Public Health

memo

COVID-19-EPIDEMIC :

SARS-CoV-2, MERS-CoV and SARS-CoV and risk of airborne transmission – a rapid review

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Key messages

The findings in this memo are based on rapid searches in the PubMed database. One researcher went through all search records, selected and summarised the the findings. In the current situation, there is an urgent need for identifying the most important evidence quickly. Hence, we opted for this rapid approach despite an inherent risk of overlooking key evidence or making misguided judgements.

Three overviews and 14 primary studies were identified from the literature search and by manual searches in reference lists.

The included studies show that transmission can mainly be traced back to direct or indirect physical contact, but caution must be shown when using certain aerosol generating procedures in hospitals. One study detected virus-containing particles from the air in patient rooms with hospitalized MERS-CoV patients, while another study did not find virus-containing particles in air samples taken 10 cm from the chin to a patient with ongoing SARS-CoV-2 infection. Both studies conducting air testing are subjected to methodological uncertainty.

Contents

Problem

Previously, it was common to view all lung infections as a possible source of airborne transmission (1), but a prerequisite for airborne transmission is that the infectious agent is encapsulated in very small particles (<5 µm) called aerosols. Larger particles and droplets will quickly settle and thus pose no risk of airborne transmission (1). Today we know that tuberculosis is spread through the air[1]. Measles is spread both through the air and by contact transmission. For some other infections, transmission may be airborne under special circumstances, such as in connection with performing aerosol-generating procedures such as intubation (2).

In connection with the ongoing outbreak of SARS-CoV-2, there are discussions about whether the virus can be transmitted through the air. Whether the virus can be transmitted through the air is important for the introduction of infectious disease control measures. In this rapid review we have searched for and summarised studies that can shed light on the risk of airborne transmission of the viruses SARS-CoV-2, MERS-CoV and SARS-CoV.

[1] https://www.fhi.no/sv/smittsomme-sykdommer/tuberkulose/tuberkulose---faktaark/

Method

Searches were carried out for published review articles and other research reports based on real data - not modelling studies. We have undertaken a series of searches in the PubMed database (see attachment). Some studies have also been identified by reviewing other relevant articles and through manual searches of reference lists.

The selection, assessment and summary of studies were conducted by one person (Kjetil G. Brurberg). Research librarian Elisabet Hafstad has assisted with literature searches. Atle Fretheim (Research Director, NIPH) and Hanne-Merete Eriksen-Volle (Antibiotic Resistance and Infection Prevention, NIPH) read through the memo before publication.

Results

The literature search was conducted on 21 March and resulted in 329 unique hits. After reviewing titles, summaries and full texts, three review articles and 14 research articles (primary studies) were included to shed light on the three issues (Table 1). Since we found three review articles that covered the SARS-CoV issue adequately, we chose not to summarise the individual studies for this virus.

Table 1: *Number of relevant hits in literature search*

Issues	Number of review articles	Number of primary studies
SARS-CoV-2	0	4
MERS-CoV	0	3
SARS-CoV	3	7

SARS-CoV-2

We identified four studies that reported data on possible modes of transmission for SARS-CoV-2.

Pung and co-workers published an article in The Lancet on 16 March 2020 summarising the results of actively tracking three infection clusters in Singapore (3). The three infection clusters comprised a total of 36 people with confirmed infection. Each infection cluster comprised five, 11 and 20 individuals, respectively. People who were infected did not always know each other, but to a large extent the transmission of infection could be traced back to physical contact points (3).

Cheng and co-workers carried out contact tracing of health workers at a hospital with confirmed cases of SARS-CoV-2 (4). Eleven health workers were quarantined after performing unprotected procedures on SARS-CoV-2-positive patients, but none of the eleven health workers were infected and the authors observed no nosocomial transmission (4). For one patient, the authors conducted virus testing of the patient's environment. The authors found SARS-CoV-2 in one of 13 environmental samples (a window sill), but not in air samples taken more than ten cm from the patient's chin (4).

Rothe and co-workers published a German case study in the New England Journal of Medicine (5). The case study describes a 33-year-old businessman who develops symptoms after meeting with a Chinese businesswoman. The Chinese business-woman had no symptoms while she was in Germany but developed symptoms on her return trip to China and then tested positive for SARS-CoV-2. The 33-year-old German businessman and three of his colleagues then tested positive for SARS-CoV-2. Only one of the three colleagues had had contact with the Chinese business-woman, so two of them were infected via the 33-year-old (5).

Li and co-workers published an article on infection dynamics in Wuhan province in China (6). The authors analyse 425 SARS-CoV-2 positive patients who developed pneumonia as a result of the virus. The authors conclude that the virus is likely to infect people in close contact with one another. In the first phase, December 2019, many cases can be traced back to the Huanan market (6).

MERS-CoV

Van-Kerkhove and co-workers analysed a cluster of proven MERS cases in Riyadh in 2015 (7). Contact tracing was started after a 27-year-old woman living in a large housing complex for women was found to be infected. Women living in the same housing complex, a total of 828, were included in the study, and 18 people were identified with MERS-CoV in addition to the index patient (7). In a multivariate analysis, having direct contact with a known MERS patient (OR 27.6: 95% CI 8.4 to 91.0) and sharing a bedroom (OR 5.7: 95% CI 1.5 to 22.5) were highlighted as significant explanatory variables. Having a functioning air conditioning system was found to be a protective variable (OR 0.15: 95% CI 0.03 to 0.82).

Kim and co-workers studied a possible relationship between MERS-CoV and air and surface contamination at two hospitals in South Korea (8). Using RT-PCR, the virus was retrieved in four out of seven air samples from two patient rooms. MERS-CoV was also detected in 15 out of 68 surface samples (8). Another South Korean study confirmed that MERS surface contamination could persist for up to five days, but this study did not investigate the risk of airborne contamination (9).

SARS-CoV

We identified three review articles relevant to the issue of risk of airborne infection by SARS-CoV (1,2,10). The report by WHO (10) and Seto (1) writes that SARS-CoV infection between humans primarily occurs via direct contact and droplet transmission, but that virus-containing aerosols can exist over short distances (1,10). Seto points out that the discovery of virus-containing aerosols is not sufficient to confirm airborne infection as aerosols can be non-infectious (1). A systematic, high quality review examines the risk of transmission of SARS-CoV to healthcare professionals in connection with the implementation of aerosol-generating procedures, and tracheal intubation is highlighted as a procedure associated with an increased risk of infection in several consistent studies (2) .

The literature search also resulted in seven primary studies on SARS-CoV (11-17). We have chosen not to summarise the results of these studies in detail, as they do not show anything other than the included reviews.

Discussion and summary

Our literature search has not led to the finding of studies that document airborne infection of SARS-CoV-2, MERS-CoV or SARS-CoV. The included studies show that infection can mainly be traced back to direct or indirect physical contact, but that caution must be exercised using aerosol generating procedures. One study has measured virus-containing particles in the air in patient rooms with hospitalised MERS-CoV patients (8), while another study failed to document virus-containing particles in air samples taken more than 10 cm from the chin of a patient with ongoing SARS-CoV-2 infection. (4). In both studies that have conducted air tests, there is uncertainty about the results as none of them use positive or negative controls, and because it is uncertain whether viruses detected by PCR from air samples are viable and contagious (1).

A study that was recently published in the New England Journal of Medicine has received some attention (18). The researchers showed that virus in aerosols could remain soaring for up to three hours. The aerosols were artificially manufactured, and the study tells us little or nothing about whether normal biological processes like coughing and sneezing produce such long-soaring aerosols. The findings confirm that one must exercise caution in order to avoid becoming infected when using aerosol-generating procedures, but the practical consequences of the findings regarding risk of airborne infection is highly uncertain.

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Appendix

Search strategies

((Coronavirus[mh] OR "SARS virus"[mh] OR "Middle East Respiratory Syndrome Coronavirus"[mh] OR "Coronavirus Infections"[mh] OR "corona virus"[tw] OR coronavirus[tw] OR coronovirus[tw] OR "COVID-19"[tw] OR COVID19[tw] OR CORVID-19[tw] OR CORVID19 OR nCoV[tw] OR "SARS-CoV-2"[tw] OR "SARS-CoV2"[tw] OR SARSCoV19[tw] OR HCoV-19[tw] OR WN-CoV[tw] OR SARS[tw] OR "Severe Acute Respiratory Syndrome"[tw] OR MERS[tw] OR "Middle East Respiratory Syndrome"[tw]) AND ("Disease Transmission, Infectious"[mh] OR transmission[tw] OR spread*[tw] OR propagation[tw]) AND (aerosol[tw] OR airborne[tw] OR air[tw] OR droplet[tw] OR fomites[tw]))

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