

Transmission risk of SARS-CoV-2 to healthcare workers – observational results of a primary care hospital contact tracing

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Summary

BACKGROUND: The coronavirus disease (COVID)-19 epidemic is evolving rapidly. Healthcare workers are at increased risk for infection, and specific requirements for their protection are advisable to ensure the functioning of the basic healthcare system, including the availability of general practitioners (GPs). Understanding the transmission risk is particularly important for guiding evidence-based protective measures in the primary healthcare setting.

METHODS: Healthcare worker contacts of an initially undiagnosed COVID-19 case, who were without personal protective equipment, in particular not wearing facemasks, were screened with nasopharyngeal swabs and polymerase chain reaction tests for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), irrespective of respiratory symptoms or fever seven days after initial contact. The details of exposure to the index case were obtained during routine contact investigation after unintentional pathogen exposure.

RESULTS: Twenty-one healthcare workers reported contacts with the index case. Three healthcare workers reported respiratory symptoms (cough) or low-grade fever within 4 days. None of them tested positive for SARS-CoV-2 at the time of symptom onset. All 21 healthcare workers tested SARS-CoV-2 negative 7 days after initial index case contact, including the three healthcare workers with previous symptoms. Ten of the 21 healthcare workers reported a cumulative exposure time of >15 minutes. Longer cumulative contact times were associated with more individual contacts, reduced contact time per contact and activities with physical patient contact. The closest relative of the index patient tested SARS-CoV-2 positive 2 days after the index case presented at the hospital emergency department.

CONCLUSION: We found a low risk of SARS-CoV-2 transmission in a primary care setting. These findings are

compatible with previous reports of the highest transmission probability in household settings with prolonged close contacts. The current protective measures for healthcare workers, including strict adherence to basic standard hygiene and facemasks, offer considerable protection during short periods of contact with symptomatic COVID-19 cases by diminishing the risk of direct and indirect transmission.

Keywords: SARS-CoV-2, COVID-19, healthcare workers, transmission risk, facemasks, hospital hygiene, droplet precaution

Introduction

Since early March 2020, when the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) epidemic reached Switzerland, symptomatic cases have increased rapidly [1]. Many more cases that are mildly symptomatic are suspected to contribute to the evolving case numbers [2, 3]. Patients seek medical advice irrespective of the epidemic and healthcare workers, in particular general practitioners (GPs), are at the forefront of exposure to as yet undiagnosed or subclinical infectious cases [4]. The association of coronavirus disease (COVID)-19 with certain comorbidities suggests that undiagnosed patients will seek medical advice from their GP or at the emergency department for symptoms other than respiratory complaints [5, 6]. SARS-CoV-2 is mainly transmitted through respiratory droplets and direct contact with contaminated surfaces [7–9]. Many healthcare workers and GPs feel insecure because recommendations for personal protection equipment may vary between public health agencies. In addition, supplies of personal protective equipment such as face masks may be not secure for long. In urgent cases, even in emergency departments, strict adherence to the recommendations may not be possible – in particular for patients initially not presenting with the typical respiratory signs of SARS-CoV-2 infection.

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Here we report the outcomes of a contact investigation of healthcare workers in a primary care hospital that faced this particular scenario of having been exposed to SARS-CoV-2 by a patient initially presenting for cardiac discomfort.

Materials and methods

All healthcare workers were followed up during routine contact investigation after unprotected contact with a COVID-19 index case. All healthcare workers were unaware of the index case's COVID-19 status at the time of contact and as a result none were adhering to the Swissnos guidelines for personal protective equipment [10, 11]. All healthcare workers filled in a standard questionnaire used for unintentional exposures to pathogens transmitted by droplets or aerosols, according to local standard operating procedures, which evaluated their exposure risk by occupation, location of exposure, approximate cumulative exposure time, number of individual contacts during exposure and activities performed during exposure. Nasopharyngeal swabs were taken when healthcare workers reported respiratory symptoms or fever, and for all healthcare workers 7 days after the initial contact. Nasopharyngeal swabs were tested for SARS-CoV-2 by real-time polymerase chain reaction (PCR) (University Hospital Basel). All healthcare workers were reminded to self-assess for respiratory symptoms and to report to the hospital's occupational health representative in the case of even minor symptoms. These procedures are according the National Guidelines (Swissnos) [10] and adapted for the specific situation according the initial risk assessment by the hospital epidemiology team. No additional interventions were undertaken.

Results

Index case and close contacts

The 75-year-old man was admitted to a primary care hospital with angina pectoris and mild respiratory symptoms. He was afebrile at admission. Laboratory evaluation revealed slightly increased troponin but an electrocardiogram showed no signs of an acute myocardial infarction. A chest X-ray was unremarkable. Triggered by the mild cough and shortness of breath, an influenza nasopharyngeal swab was obtained with negative results. At the time of hospital admission, neither the patient nor his close contacts were aware of any SARS-CoV-2 exposure in the preceding weeks according to the testing recommendations of the Federal Office of Public Health (FOPH) at that time (testing by nasopharyngeal swab recommended for symptomatic patients – respiratory symptoms and/or fever – and patients with an epidemiological exposure, such as travel to an epidemic region or close contact with a confirmed COVID-19 case). The patient was admitted to intermediate care. During the overnight observation period he developed a high-grade fever, which was symptomatically treated with paracetamol without any further diagnostic investigation. The following day he was referred to a tertiary hospital for coronary angiography. There he was subsequently diagnosed with COVID-19.

Among his close contacts, his wife fell ill with moderate respiratory symptoms and fever 2 days after the initial pre-

sentation of the index case. She was the only person living in the same household. She was also diagnosed with COVID-19.

In retrospect, it became evident that the patient and his close contact had been in contact with SARS-CoV-2-positive persons attending an international meeting, after which more of the, in the meantime geographically dispersed, attendees were diagnosed with COVID-19.

Three different federal cantons became involved in management that included diagnosis and contact tracing of the case.

Healthcare worker characteristics

In total 21 healthcare workers were exposed to the undiagnosed index case at the primary care hospital (table 1). All contacts were unprotected according to the guidelines of COVID-19 hygiene measures [10, 11]. All healthcare workers adhered to basic hygiene measures, in particular hand hygiene, but none wore a face mask.

Their median age was 40 years (range 18–62) and 14 (66%) were female.

Exposure characteristics

Detailed exposure characteristics are presented in table 1. Ten of the 21 healthcare workers had cumulative exposure of >15 minutes within the same room as the index case. Another five of the healthcare workers had only limited total contact ≤5 minutes. The number of individual contacts increased with the cumulative exposure time. All five healthcare workers reporting prolonged total exposure time >30 minutes had >5 individual contacts and were involved in nursing with direct physical contact. Four of the five healthcare workers with a cumulative exposure time of 15–30 minutes had fewer individual contacts (three to five) and reported fewer activities associated with prolonged physical contact. Only 3 of the 11 healthcare workers with total exposure time <15 minutes had direct physical contact (clinical examination, blood draw, nasopharyngeal swabs) with only one or two individual contacts. Three healthcare workers were exposed for only a short period during activities within the same room.

SARS-CoV-2 testing

Three of the 21 healthcare workers reported upper respiratory tract symptoms within 4 days of initial exposure. All healthcare workers tested SARS-CoV-2 negative by PCR of the nasopharyngeal swab at the time of symptom onset. The three symptomatic and the remaining asymptomatic healthcare workers were all tested 7 days after the initial exposure by means of nasopharyngeal swabs and PCR. All tests were negative, including the repeated tests in the symptomatic healthcare worker. None of the exposed healthcare workers reported to the hospitals' staff physician with respiratory symptoms (shortness of breath, cough, angina) during the remainder of follow-up for up to 2 weeks after exposure.

Discussion

Following exposure without personal protective equipment to an index case presenting with cardiac symptoms in a primary care setting, all 21 healthcare worker contacts tested negative irrespective of their symptomology 7 days af-

ter contact (at the upper 95% confidence interval of the median incubation time [12, 13], although longer incubation periods have been described [14]). We assume that the index case was infectious at the time of the contacts, as evidenced by the clinical presentation with shortness of breath and mild unproductive cough, followed by the development of fever triggering SARS-CoV-2 nasopharyngeal swab testing after an overnight sojourn in the hospital. The only close contact also contracted SARS-CoV-2, fell ill only 2 days after the initial presentation of the index case and was diagnosed SARS-CoV-2 positive. We cannot exclude that the index case and his partner contracted the infection from a common source, although the index patient may have transmitted the virus in the pre-symptomatic phase [15]. The patient underwent routine investigations for ischaemic cardiac disease with clinical examination, blood draws, electrocardiogram and chest X-ray associated with close physical contact. Even nasopharyngeal swabs were taken for mild respiratory distress without any specific precautions; the patient's history did not meet the FPOH criteria for SARS-CoV-2 testing at the time. Although three healthcare workers developed mild respirato-

ry symptoms at the time the results of the index case became available, none tested positive.

These results indicate that routine short clinical examinations and short physical contacts did not place the healthcare workers at risk sufficient for them to have acquired SARS-CoV-2. In a similar investigation of 41 healthcare workers, all of whom wore masks (85% surgical masks, 15% N95 masks during intubation), who were exposed to a potentially aerosol-generating contact with an undiagnosed index patient, none developed any symptoms and all tested SARS-CoV-2 negative by PCR after 14 days of self-quarantine [16]. This observational report and ours support the current Swissnoso and FPFO recommendations for the healthcare worker personal protective equipment measures in Switzerland pertaining to the risk from aerosol generating procedures [10, 11]. In minimal risk settings, such as short physical examinations and limited nursing procedures in which droplet- or aerosol-generating medical interventions are not anticipated, surgical face masks and physical distancing (2 metres) seem adequate to minimise the risk of transmission. A meta-analysis found no addi-

Table 1: Healthcare worker characteristics and transmission risk factors

| Variable | % (total) |
|--|--------------|
| Gender male | 33% (7/21) |
| Age (years), median (range) | 40 (18 – 62) |
| Occupation | |
| – Nursing staff | 67% (14/21) |
| – Physician | 24% (5/21) |
| – Radiology staff | 9% (2/19) |
| – Not available | – |
| Exposure location | |
| – Emergency department | 29% (6/21) |
| – Intermediate care | 57% (12/21) |
| – Radiology | 9% (2/21) |
| – Not available | 5% (1/19) |
| Estimated cumulative duration | |
| – ≤5 min. | 24% (5/21) |
| – 5–15 min. | 28% (6/21) |
| – >15–30 min. | 24% (5/21) |
| – >30 min. | 24% (5/21) |
| – not available | – |
| Estimated individual contacts | |
| – 1–2 contacts | 33% (7/21) |
| – 3–5 contacts | 24% (5/21) |
| – 6–10 contacts | 5% (1/21) |
| – >10 contacts | 19% (4/21) |
| – Not available | 19% (4/21) |
| Activities performed during contacts* | |
| – Anamnesis / conversation | 62% (13/21) |
| – Physical examination | 14% (3/21) |
| – Activity with physical patient contact (e.g., blood pressure measurement, blood draw, ECG) | 33% (7/21) |
| – Nursing activities with prolonged physical contact (e.g., aid with washing) | 24% (5/21) |
| – Nasopharyngeal swab | 5% (1/21) |
| – Radiology | 9% (2/21) |
| – No direct contact / stay in same room | 9% (2/21) |
| – Not available | 5% (1/21) |
| Number of healthcare workers wearing face masks (for any reason) | 0% (0/21) |
| Number of healthcare workers developing respiratory symptoms within 7 days after exposure | 14% (3/21) |
| Number of NPS tested SARS-CoV-2 positive | |
| – Of symptomatic patients at symptom onset | 0% (0/3) |
| – Of all healthcare workers contacts at day 7 | 0% (0/21) |

* More than one answer possible

tional benefit for face masks in conveying higher protection efficacy in influenza and influenza-like illnesses [17]. Our report is in sharp contrast to initial studies in China reporting increased infection rates among healthcare workers [4], and current media and anecdotal reports of COVID-19 cases among healthcare workers in Swiss hospitals. We believe that these reports are not necessarily at odds with each other because transmission risks in the respective settings may completely differ from the risk during nearly continuous exposure in endemic or aerosol-generating settings. Fully in line with this, most transmission events in COVID-19 clusters have occurred within the same household or after enclosed, extended close contact [18, 19].

Our observational study has several limitations of importance for its interpretation. The index case was only coughing mildly and intermittently. Droplet projection was probably limited, which reduced environmental contamination and acquisition risk in close contacts by direct inoculation or by indirect transmission by contaminated hands. The physical contact times were mostly limited to <15 minutes for each individual contact and the exposures took place during the evening and an overnight stay, with limited direct healthcare worker patient contact during the nightshift. Therefore, we cannot exclude, and it may be rather likely, that repeated contacts in high-risk environments such as intensive care units facing epidemic conditions may increase the risk of transmission substantially. The study was performed during routine contact tracing of a COVID-19 healthcare worker exposure at the outset of the pandemic, and investigations not deemed necessary for assessment of the risk for individual healthcare workers were kept to a minimum. The study is therefore limited by its retrospective assessment of exposure risk 1 week after exposure, and the uncertainty of individuals regarding both single and cumulative exposure times. Finally, although the median SARS-CoV-2 incubation period is thought to be 4–7 days [12–14], we cannot rule out the possibility that one or more healthcare workers became asymptomatic carriers after 7 days, because longer incubation periods have been described [14].

Preliminary evidence suggests that brief contacts with an infectious COVID-19 case in a low COVID-19 endemic setting poses only a small risk of SARS-CoV-2 transmission, even without any personal protective equipment, as long as the patient has mild respiratory tract symptoms. We caution against extending this conclusion to longer exposures with symptomatic patients. Guidelines for personal protective equipment should be followed and adapted – if appropriate – to specific situations taking into account factors that increase droplet burden and associated transmission risks, such as patients' disease severity, planned medical intervention and anticipated exposure time.

Disclosure statement

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