

Asymptomatic and pre-symptomatic transmission + on surfaces

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A. Evidence of a- or pre-symptomatic transmission

Research	Main lessons to take away
<p>Wei, W.E. <i>et al</i> (2020) Presymptomatic Transmission of SARS-CoV-2 – Singapore, January 23 – March 16, 2020. <i>Morbidity and Mortality Weekly Report</i>, CDC.</p> <p>April 10, 2020, Vol. 69, No. 14</p> <p>https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6914e1-H.pdf</p>	<p>“This investigation identified seven clusters of COVID-19 in Singapore in which presymptomatic transmission likely occurred. Among the 243 cases of COVID-19 reported in Singapore as of March 16, 157 were locally acquired; 10 of the 157 (6.4%) locally acquired cases are included in these clusters and were attributed to presymptomatic transmission”.</p>
<p>Kimball, A. <i>et al</i> (2020) Asymptomatic and Presymptomatic SARS-CoV-2 Infections in Residents of a Long-Term Care Skilled Nursing Facility – King County, Washington, March 2020. <i>Morbidity and Mortality Weekly Report</i>, CDC.</p> <p>April 3, 2020, Vol. 69, No. 13</p> <p>https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6913e1-H.pdf</p>	<p>Experience from a skilled nursing facility found that 30% of those residents that were tested were positive, but of these over half (57%) did not have symptoms at the time of the test (yet 7 days after testing, 10 out of the 13 had developed symptoms). This study suggests that symptom-based screening in long-term care facilities could fail to identify approximately half of residents with COVID-19.</p>
<p>Arons, M.M. <i>et al</i> (2020) Presymptomatic SARS-CoV-2 Infections and Transmission in a Skilled Nursing Facility. <i>The New England Journal of Medicine</i>.</p> <p>April 24, 2020</p> <p>https://www.nejm.org/doi/pdf/10.1056/NEJMoa2008457?articleTools=true</p>	<p>Experience from a skilled nursing facility found 63% of residents tested positive, and over half of those (57%) did not have symptoms at the time of the test. Infection control strategies solely focusing on symptomatic residents were not enough to prevent introduction of the virus into the facility.</p>
<p>Gandhi, M.P.H. <i>et al</i> (2020) Asymptomatic transmission, the Achilles’ Heel of Current Strategies to Control Covid-19. <i>The New England Journal of Medicine</i>.</p>	<p>Viral loads with SARS-CoV-1 (virus from 2003) were associated with symptom onset, peak a median of 5 days later than viral loads with SARS-CoV-2 (virus from 2020). This is what made symptom-based detection of infection more effective in the case of SARS CoV-1.</p>

<p>April 24, 2020</p> <p>https://www.nejm.org/doi/pdf/10.1056/NEJMe2009758?articleTools=true</p>	<p>With the current virus (SARS-CoV-2), people that don't have symptoms can carry the virus and be infective – e.g. 17 of 24 specimens (71%) from pre-symptomatic persons had viable virus by culture 1 to 6 days before the development of symptoms.</p>
<p>Baggett, T. P. <i>et al</i> (2020) Prevalence of SARS-CoV-2 Infection in Residents of a Large Homeless Shelter in Boston. <i>JAMA</i>. Published online April 27, 2020. doi:10.1001/jama.2020.6887 https://jamanetwork.com/journals/jama/fullarticle/2765378</p>	<p>A total of 147 participants (36.0%) had PCR test results positive for SARS-CoV-2. Among individuals with PCR test results positive for SARS-CoV-2 - cough (7.5%), shortness of breath (1.4%), and fever (0.7%) were all uncommon, and 87.8% were asymptomatic.</p> <p>The majority of individuals with newly identified infections had no symptoms and no fever at the time of diagnosis, suggesting that symptom screening in homeless shelters may not adequately capture the extent of disease transmission in this high-risk setting. These results support PCR testing of all asymptomatic shelter residents if a symptomatic individual with COVID-19 is identified in the same shelter.</p>
<p>Public Health England – April 2020 Report not seen but referenced in the following two articles: https://www.bbc.co.uk/news/uk-52727221 (date: 19 May 2020) https://www.theguardian.com/world/2020/may/18/agency-staff-were-spreading-covid-19-between-care-homes-phe-found-in-april (date: 18 May 2020)</p>	<p>BBC: <i>The study, which was carried out over the Easter weekend, looked at tests of staff and residents and the results were passed to the Department of Health and Social Care before the end of the month. PHE said the results suggested there were "high numbers of asymptomatic or pre-symptomatic cases among staff and residents" and that "infection may be being imported into the homes by staff".</i></p> <p>Guardian: <i>The genome tracking research by PHE into the behaviour of the virus in six care homes in London found that "Infection is spreading from care home to care home, linked to changed patterns of staffing, working across and moving between homes." The infection could be introduced by "bank staff" – floating workers used to fill temporary vacancies in different homes – it said, adding that workers were often asymptomatic so "by the time local health protection teams are informed of an outbreak substantial transmission may already have occurred".</i></p>
<p>Du, Z. <i>et al</i> (2020) Serial Interval of COVID-19 among Publicly Reported Confirmed Cases. <i>Research Letter</i> Volume 26, Number 6—June 2020 https://wwwnc.cdc.gov/eid/article/26/6/20-0357_article</p>	<p><i>"We estimate the distribution of serial intervals for 468 confirmed cases of coronavirus disease reported in China as of February 8, 2020. The mean interval was 3.96 days (95% CI 3.53–4.39 days), SD 4.75 days (95% CI 4.46– 5.07 days); 12.6% of case reports indicated presymptomatic transmission".</i></p> <p><i>"Fifty-nine of the 468 reports indicate that the infectee had symptoms earlier than the infector. Thus, presymptomatic transmission might be occurring".</i></p>

<p>Vetter, P. <i>et al</i> (2020) Clinical features of covid-19: The wide array of symptoms has implications for the testing strategy. Editorial, <i>BMJ</i></p> <p>MJ 2020;369:m1470 doi: 10.1136/bmj.m1470</p> <p>(Published 17 April 2020)</p> <p>https://www.bmj.com/content/bmj/369/bmj.m1470.full.pdf</p>	<p><i>“Available evidence from observational and modelling reports indicates that up to 12% of transmission occurs before an index case develops symptoms. This has important implications for the effectiveness of any testing strategy and for contact tracing and containment measures. To curtail active transmission of SARS-CoV-2, testing should be extended far beyond people who fit a narrow case definition and other populations currently considered at risk. The current strategy will not capture the full picture, missing a substantial number of patients with atypical presentations or few symptoms. Worse, restrictive testing criteria could lead to unrecognised cases transmitting the virus in health care settings or the community and to delays in appropriate patient triage and management”.</i></p>
<p>He, X. <i>et al</i> (2020) Temporal dynamics in viral shedding and transmissibility of COVID-19. Brief Communication, <i>Nat Med.</i> 2020; 26:672–5</p> <p>Epub ahead of print.</p> <p>https://doi.org/10.1038/s41591-020-0869-5</p> <p>https://www.nature.com/articles/s41591-020-0869-5.pdf</p> <p>Published: 15 April 2020</p>	<p><i>“We report temporal patterns of viral shedding in 94 patients with laboratory-confirmed COVID-19 and modelled COVID-19 infectiousness profiles from a separate sample of 77 infector–infectee transmission pairs. We observed the highest viral load in throat swabs at the time of symptom onset, and inferred that infectiousness peaked on or before symptom onset. We estimated that 44% (95% confidence interval, 25–69%) of secondary cases were infected during the index cases’ pre-symptomatic stage, in settings with substantial household clustering, active case finding and quarantine outside the home. Disease control measures should be adjusted to account for probable substantial pre-symptomatic transmission”.</i></p>

B. Smaller case studies of pre- or asymptomatic transmission

<p>Wölfel, R. <i>et al</i> (2020) Virological assessment of hospitalized patients with COVID-2019. <i>Nature.</i> 2020</p> <p>Epub ahead of print.</p> <p>https://www.nature.com/articles/s41586-020-2196-x</p> <p>Published: 1 April 2020</p>	<p><i>“Coronavirus disease 2019 (COVID-19) is an acute infection of the respiratory tract that emerged in late 2019. Initial outbreaks in China involved 13.8% of cases with severe courses, and 6.1% of cases with critical courses. This severe presentation may result from the virus using a virus receptor that is expressed predominantly in the lung; the same receptor tropism is thought to have determined the pathogenicity—but also aided in the control—of severe acute respiratory syndrome (SARS) in 2003.</i></p> <p><i>However, there are reports of cases of COVID-19 in which the patient shows mild upper respiratory tract symptoms, which suggests the potential for pre- or oligosymptomatic transmission. There is an urgent need for information on virus replication, immunity and infectivity in specific sites of the body.</i></p>
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	<p><i>Here we report a detailed virological analysis of nine cases of COVID-19 that provides proof of active virus replication in tissues of the upper respiratory tract. Pharyngeal virus shedding was very high during the first week of symptoms, with a peak at 7.11×10^8 RNA copies per throat swab on day 4. Infectious virus was readily isolated from samples derived from the throat or lung, but not from stool samples—in spite of high concentrations of virus RNA. Blood and urine samples never yielded virus.</i></p> <p><i>Active replication in the throat was confirmed by the presence of viral replicative RNA intermediates in the throat samples. We consistently detected sequence-distinct virus populations in throat and lung samples from one patient, proving independent replication. The shedding of viral RNA from sputum outlasted the end of symptoms.</i></p> <p><i>Seroconversion occurred after 7 days in 50% of patients (and by day 14 in all patients), but was not followed by a rapid decline in viral load. COVID-19 can present as a mild illness of the upper respiratory tract. The confirmation of active virus replication in the upper respiratory tract has implications for the containment of COVID-19”.</i></p>
<p>Jiang, F.C. <i>et al</i> (2020) Detection of Severe Acute Respiratory Syndrome Coronavirus 2 RNA on Surfaces in Quarantine Rooms. <i>Dispatch</i>, Volume 26, Number 9, Sept 2020</p> <p>https://wwwnc.cdc.gov/eid/article/26/9/20-1435_article</p>	<p><i>“We investigated severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) environmental contamination in 2 rooms of a quarantine hotel after 2 pre-symptomatic persons who stayed there were laboratory-confirmed as having coronavirus disease. We detected SARS-CoV-2 RNA on 8 (36%) of 22 surfaces, as well as on the pillow cover, sheet, and duvet cover”.</i></p> <p><i>“Our study demonstrates extensive environmental contamination of SARS-CoV-2 RNA in a relatively short time (<24 hours) in occupied rooms of 2 persons who were pre-symptomatic”.</i></p> <p><i>“Our results also indicate a higher viral load detected after prolonged contact with sheets and pillow covers than with intermittent contact with the door handle and light switch. The detection of SARS-CoV-2 RNA in the surface samples of the sheet, duvet cover, and pillow cover highlights the importance of proper handling procedures when changing or laundering used linens of SARS-CoV-2 patients. Thus, to minimize the possibility of dispersing virus through the air, we recommend that used linens not be shaken upon removal and that laundered items be thoroughly cleaned and dried to prevent additional spread”.</i></p>
<p>Jiang, X.L. <i>et al</i> (2020) Transmission potential of asymptomatic and paucisymptomatic SARS-CoV-2 infections: a</p>	<p><i>“We report a 3-family cluster of infections involving asymptomatic and paucisymptomatic transmission. Eight of 15 (53%) members from 3 families were confirmed with SARS-CoV-2 infection. Of 8 patients, 3 were asymptomatic</i></p>

<p>three-family cluster study in China. <i>J Infect Dis.</i> 2020; jiaa206</p> <p>Epub ahead of print.</p> <p>https://academic.oup.com/jid/advance-article/doi/10.1093/infdis/jiaa206/5823691</p> <p>Published online April 22, 2020</p>	<p><i>and 1 was paucisymptomatic. An asymptomatic mother transmitted the virus to her son, and a paucisymptomatic father transmitted the virus to his 3-monthold daughter. SARS-CoV-2 was detected in the environment of 1 household. The complete genomes of SARS-CoV-2 from the patients were > 99.9% identical and were clustered with other SARS-CoV-2 sequences reported from China and other countries”.</i></p>
<p>Cai J, Sun W, Huang J, Gamber M, Wu J, He G. (2020) Indirect virus transmission in cluster of COVID-19 cases, Wenzhou, China, 2020. <i>Emerg Infect Dis.</i> 2020; Vol. 26 (6).</p> <p>Epub ahead of print.</p> <p>DOI: 10.3201/eid2606.200412</p> <p>https://wwwnc.cdc.gov/eid/article/26/6/20-0412_article</p> <p>Published: 12 March 2020</p>	<p><i>“To determine possible modes of virus transmission, we investigated a cluster of coronavirus disease cases associated with a shopping mall in Wenzhou, China. Data indicated that indirect transmission of the causative virus occurred, perhaps resulting from virus contamination of common objects, virus aerosolization in a confined space, or spread from asymptomatic infected persons”.</i></p>
<p>Rothe, C. <i>et al</i> (2020) Transmission of 2019-nCoV infection from an asymptomatic contact in Germany. <i>N Engl J Med.</i> 2020; 382:970–1.</p> <p>https://www.nejm.org/doi/pdf/10.1056/NEJMc2001468?articleTools=true</p> <p>Published: 5 March 2020</p>	<p><i>“A 33-year-old otherwise healthy German businessman (Patient 1) became ill with a sore throat, chills, and myalgias on January 24, 2020. The following day, a fever of 39.1°C (102.4°F) developed, along with a productive cough. By the evening of the next day, he started feeling better and went back to work on January 27”.</i></p> <p><i>“Before the onset of symptoms, he had attended meetings with a Chinese business partner at his company near Munich on January 20 and 21. The business partner, a Shanghai resident, had visited Germany between January 19 and 22. During her stay, she had been well with no signs or symptoms of infection but had become ill on her flight back to China, where she tested positive for 2019-nCoV on January 26”</i></p>
<p>Yu, P. <i>et al</i> (2020) A familial cluster of infection associated with the 2019 novel coronavirus indicating potential person-to-person transmission during the incubation period. <i>J Infect Dis.</i> 2020; 221:1757–61.</p> <p>https://academic.oup.com/jid/article/221/11/1757/5739751</p> <p>Published: 18 February</p>	<p><i>“We report the epidemiological features of a familial cluster of 4 patients in Shanghai, including an 88-year-old man with limited mobility who was exposed only to asymptomatic family members whose symptoms developed later. The epidemiological evidence has shown possible transmission of 2019 novel coronavirus during the incubation period”.</i></p>
<p>Tong, Z.D. <i>et al</i> Potential presymptomatic transmission of SARS-</p>	<p><i>“In summary, we identified 2 persons with confirmed cases of symptomatic COVID-19 after their exposure to a potentially presymptomatic person who was later</i></p>

<p>CoV-2, Zhejiang province, China, 2020. <i>Emerg Infect Dis.</i> 2020; 26:1052–4. DOI: 10.3201/eid2605.200198 https://wwwnc.cdc.gov/eid/article/26/5/20-0198_article Published: 9 March 2020</p>	<p><i>diagnosed with laboratory-confirmed COVID-19. These 2 persons later transmitted SARS-CoV-2 to 3 family members, who did not report symptoms at the time their SARS-CoV-2 infections were detected”.</i></p>
<p>Wei, W.E. <i>et al</i> (2020) Presymptomatic Transmission of SARS-CoV-2 — Singapore, January 23–March 16, 2020. <i>Morbidity and Mortality Weekly Report</i> 49: 411-416. Published: 10 April 2020</p>	<p><i>“Among the 243 cases of COVID-19 reported in Singapore as of March 16, 157 were locally acquired; 10 of the 157 (6.4%) locally acquired cases are included in these clusters and were attributed to presymptomatic transmission. These findings are supported by other studies that suggest that presymptomatic transmission of COVID-19 can occur”</i></p>
<p>Qian, G. <i>et al</i> (2020) COVID-19 Transmission Within a Family Cluster by Presymptomatic Carriers in China. <i>Clin Infect Diseases</i>, 2020. https://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciaa316/5810900 Published: 23 March 2020</p>	<p><i>“The clinical features were diverse across patients; in particular, there were 2 asymptomatic patients and 1 patient whose symptoms were so severe that he had to be transferred to ICU. Second, this cluster demonstrated that COVID-19 is transmittable during the incubation period, as the daughter and her family caught the disease during the incubation period of index 1 and index 2. Third, patients can stay asymptomatic, such as index 2 and case 4 in this cluster. Given that Zou <i>et al</i> [3] found that the viral load of symptomatic and asymptomatic patients were similar, asymptomatic patients can still infect others. These “silent patients” may remain undiagnosed and be able to spread the disease to large numbers of people. Last, it appears that children may not be as susceptible to this new virus as adults and elderly persons, and they may fare better when they have contracted the virus. As reported in this family cluster, the 6-year-old child was not infected and the 13-month-old was infected but stayed asymptomatic.</i></p> <p><i>In summary, there are variations across individuals in the clinical manifestations of COVID-19, indicating that we should pay attention to how to prevent people from being infected by asymptomatic patients and patients who are in the incubation period.”</i></p>
<p>Zou, L. <i>et al</i> (2020) SARS-CoV-2 Viral Load in Upper Respiratory Specimens of Infected Patients. <i>New England Journal of Medicine</i>, 2020. https://www.nejm.org/doi/pdf/10.1056/NEJMc2001737</p>	<p><i>The viral load that was detected in the asymptomatic patient was similar to that in the symptomatic patients, which suggests the transmission potential of asymptomatic or minimally symptomatic patients. These findings are in concordance with reports that transmission may occur early in the course of infection and suggest that case detection and isolation may require strategies different from those required for the control of SARS-CoV. How SARS-CoV-2 viral load correlates with culturable virus needs to be determined. Identification of patients with few or no symptoms and with modest levels of detectable viral RNA in</i></p>

	<i>the oropharynx for at least 5 days suggests that we need better data to determine transmission dynamics and inform our screening practices.</i>
Bai, Y. <i>et al</i> (2020) Presumed asymptomatic carrier transmission of COVID-19. <i>JAMA</i> , 2020, 323 (14) 1406-1407. https://jamanetwork.com/journals/jama/fullarticle/2762028	<i>A familial cluster of 5 patients with COVID-19 pneumonia in Anyang, China, had contact before their symptom onset with an asymptomatic family member who had travelled from the epidemic center of Wuhan. The sequence of events suggests that the coronavirus may have been transmitted by the asymptomatic carrier. The incubation period for patient 1 was 19 days, which is long but within the reported range of 0 to 24 days. Her first RT-PCR result was negative; false-negative results have been observed related to the quality of the kit, the collected sample, or performance of the test. RT-PCR has been widely deployed in diagnostic virology and has yielded few false-positive outcomes. Thus, her second RT-PCR result was unlikely to have been a false-positive and was used to define infection with the coronavirus that causes COVID-19.</i>
Tong, Z.D. <i>et al</i> (2020) Potential Presymptomatic Transmission of SARS-CoV-2, Zhejiang Province, China, 2020. <i>Emerging Infectious Diseases</i> 26 (5) https://wwwnc.cdc.gov/eid/article/26/5/20-0198_article	<i>“We identified 2 persons with confirmed cases of symptomatic COVID-19 after their exposure to a potentially presymptomatic person who was later diagnosed with laboratory-confirmed COVID-19. These 2 persons later transmitted SARS-CoV-2 to 3 family members, who did not report symptoms at the time their SARS-CoV-2 infections were detected”.</i>
Roxby, A.C. <i>et al</i> (2020) Outbreak Investigation of COVID-19 Among Residents and Staff of an Independent and Assisted Living Community for Older Adults in Seattle, Washington 2020. <i>JAMA Intern Med.</i> doi:10.1001/jamainternmed.2020.2233 https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2766448	<i>“These data demonstrate asymptomatic detection of SARSCoV-2 among older adults in an independent/assisted living community, underlining challenges in protecting residents and staff. The findings of both asymptomatic and mild SARSCoV-2 infection in elderly persons, and in staff providing them assistance, underscore the vital importance of current recommendations for continued social distancing, strict staff screening, and visitor exclusion per current CDC guidance”.</i>

C. CDC Guidance recognising a- or pre-symptomatic transmission

CDC Guidance: https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-covid-spreads.html	<i>“COVID-19 may be spread by people who are not showing symptoms”</i>
CDC Guidance: Key Strategies to Prepare for COVID-19 in Long-Term Care Facilities (LTCFs)	<i>“If COVID-19 is identified in the facility, restrict all residents to their rooms and have HCP wear <u>all recommended PPE</u> for care of all residents (regardless of symptoms) on the</i>

<p>https://www.cdc.gov/coronavirus/2019-ncov/hcp/long-term-care-strategies.html</p>	<p><i>affected unit (or facility-wide depending on the situation). This includes: an N95 or higher-level respirator (or facemask if a respirator is not available), eye protection, gloves, and gown. HCP should be trained on PPE use including putting it on and taking it off”.</i></p> <p><i>“This approach is recommended because of the high risk of unrecognized infection among residents. Recent experience suggests that a substantial proportion of residents could have COVID-19 without reporting symptoms or before symptoms develop”.</i></p> <p><i>“When a case is identified, public health can help inform decisions about testing asymptomatic residents on the unit or in the facility”.</i></p>
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D. Transmission through environment and on PPE

<p>Jiang, F.C. <i>et al</i> (2020) Detection of Severe Acute Respiratory Syndrome Coronavirus 2 RNA on Surfaces in Quarantine Rooms. <i>Dispatch</i>, Volume 26, Number 9, Sept 2020.</p> <p>https://wwwnc.cdc.gov/eid/article/26/9/20-1435_article</p>	<p><i>“We investigated severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) environmental contamination in 2 rooms of a quarantine hotel after 2 pre-symptomatic persons who stayed there were laboratory-confirmed as having coronavirus disease. We detected SARS-CoV-2 RNA on 8 (36%) of 22 surfaces, as well as on the pillow cover, sheet, and duvet cover”.</i></p> <p><i>“Our study demonstrates extensive environmental contamination of SARS-CoV-2 RNA in a relatively short time (<24 hours) in occupied rooms of 2 persons who were pre-symptomatic”.</i></p> <p><i>“Our results also indicate a higher viral load detected after prolonged contact with sheets and pillow covers than with intermittent contact with the door handle and light switch. The detection of SARS-CoV-2 RNA in the surface samples of the sheet, duvet cover, and pillow cover highlights the importance of proper handling procedures when changing or laundering used linens of SARS-CoV-2 patients. Thus, to minimize the possibility of dispersing virus through the air, we recommend that used linens not be shaken upon removal and that laundered items be thoroughly cleaned and dried to prevent additional spread”.</i></p>
<p>Yung, C.F. <i>et al</i> (2020) Environment and Personal Protective Equipment Tests for SARS-CoV-2 in the Isolation Room of an Infant With Infection. <i>Annals of Internal Medicine</i>, 2020 American College of Physicians.</p> <p>https://www.acpjournals.org/doi/10.7326/M20-0942</p>	<p><i>“A 6-month-old infant was admitted for isolation in our hospital because both parents were in the isolation units of other hospitals for confirmed COVID-19. On admission, the infant was asymptomatic, but nasopharyngeal swabs confirmed COVID-19 infection with very high viral load”.</i></p> <p><i>“The infant was generally well throughout admission, with only a single measured temperature of 38.5 °C on day 2 of admission. There were no respiratory symptoms, results of</i></p>

<p>Published on 1 April 2020</p>	<p><i>physical examination were normal and no other abnormal vital signs were noted throughout the infant's stay".</i></p> <p><i>"Our investigation confirmed that a generally well infant with COVID-19 can contaminate the environment with PCR-detectable virus. Although we cannot be certain of virus viability, other coronaviruses have been reported to re-main viable on surfaces for up to 9 days (4). Despite close physical contact with the infant during feeding, we did not detect any evidence of SARS-CoV-2 on the gown of the HCW. A study of mobile adults with COVID-19 who had symptoms found widespread environmental contamination but negative PPE swabs (5).</i></p> <p><i>Although our infant had no respiratory symptoms, the nearby environment could have been contaminated with SARS-CoV-2 through crying or drooling.</i></p> <p><i>There was a downward trend of viral load with increasing distance from the infant (from bedding to cot rail). However, the Ct values at the table 1 meter away from the cot indicated higher viral load. For droplet transmission, one would expect the viral load in the environment to fall with increasing distance from the immobile infant. However, baby formula and other items, such as baby wipes, were placed on it. Therefore, it seems more likely that the contamination was due to indirect contact via HCW hands between baby and table.</i></p> <p><i>These findings suggests that even generally well infants positive for SARS-COV-2 with no respiratory symptoms can easily contaminate nearby environments. Our data also reaffirm the importance of hand hygiene when caring for infants with COVID-19 and potentially in helping to reduce environmental virus contamination.</i></p>
<p>van Doremalen, N. <i>et al</i> (2020) Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. Letter, <i>N Engl J Med.</i> 2020; 382:1564–7. https://www.nejm.org/doi/pdf/10.1056/NEJMc2004973?articleTools=true Published March 17</p>	<p><i>"SARS-CoV-2 remained viable in aerosols throughout the duration of our experiment (3hours), with a reduction in infectious titer from 103.5 to 102.7 TCID50 per liter of air. This reduction was similar to that observed with SARS-CoV-1, from 104.3 to 103.5 TCID50 per milli-liter (Fig. 1A). SARS-CoV-2 was more stable on plastic and stainless steel than on copper and cardboard, and viable virus was detected up to 72 hours after application to these surfaces (Fig. 1A), although the virus titer was greatly reduced (from 103.7 to 100.6 TCID50 per milliliter of medium after 72 hours on plastic and from 103.7 to 100.6 TCID50per milliliter after 48 hours on stainless steel)".</i></p>
<p>Chin, A.W.H. <i>et al</i> (2020) Stability of SARS-CoV-2 in different environmental conditions. <i>Lancet Microbe.</i> 2020;1:e10</p>	<p><i>"No infectious virus could be recovered from printing and tissue papers after a 3-hour incubation, whereas no infectious virus could be detected from treated wood and cloth on day 2. By contrast, SARS-CoV-2 was more stable on</i></p>

<p>https://www.thelancet.com/pdfs/journals/lanmic/PIIS2666-5247(20)30003-3.pdf</p>	<p><i>smooth surfaces. No infectious virus could be detected from treated smooth surfaces on day 4 (glass and banknote) or day 7 (stainless steel and plastic). Strikingly, a detectable level of infectious virus could still be present on the outer layer of a surgical mask on day 7 (~0.1% of the original inoculum)."</i></p> <p><i>"Overall, SARS-CoV-2 can be highly stable in a favourable environment,⁴ but it is also susceptible to standard disinfection methods."</i></p>
<p>Ong, S.W.X. <i>et al</i> (2020) Air, surface environmental, and personal protective equipment contamination by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from a symptomatic patient. <i>JAMA</i>. 2020;323:1610.</p> <p>https://jamanetwork.com/journals/jama/fullarticle/2762692</p> <p>Published: 4 March 2020</p>	<p><i>"There was extensive environmental contamination by 1 SARS-CoV-2 patient with mild upper respiratory tract involvement. Toilet bowl and sink samples were positive, suggesting that viral shedding in stool could be a potential route of transmission. Post cleaning samples were negative, suggesting that current decontamination measures are sufficient".</i></p> <p><i>"Only 1 PPE swab, from the surface of a shoe front, was positive. All other PPE swabs were negative. All air samples were negative".</i></p>