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First Mildly Ill, Nonhospitalized Case of Coronavirus Disease 2019 (COVID-19) Without Viral Transmission in the United States—Maricopa County, Arizona, 2020

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Background. Coronavirus disease 2019 (COVID-19) causes a range of illness severity. Mild illness has been reported, but whether illness severity correlates with infectivity is unknown. We describe the public health investigation of a mildly ill, nonhospitalized COVID-19 case who traveled to China.

Methods. The case was a Maricopa County resident with multiple severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)–positive specimens collected on 22 January 2020. Contacts were persons exposed to the case on or after the day before case diagnostic specimen collection. Contacts were monitored for 14 days after last known exposure. High-risk contacts had close, prolonged case contact (≥10 minutes within 2 m). Medium-risk contacts wore all US Centers for Disease Control and Prevention–recommended personal protective equipment during interactions. Nasopharyngeal and oropharyngeal (NP/OP) specimens were collected from the case and high-risk contacts and tested for SARS-CoV-2.

Results. Paired case NP/OP specimens were collected for SARS-CoV-2 testing at 11 time points. In 8 pairs (73%), ≥1 specimen tested positive or indeterminate, and in 3 pairs (27%) both tested negative. Specimens collected 18 days after diagnosis tested positive. Sixteen contacts were identified; 11 (69%) had high-risk exposure, including 1 intimate contact, and 5 (31%) had medium-risk exposure. In total, 35 high-risk contact NP/OP specimens were collected for SARS-CoV-2 testing; all 35 pairs (100%) tested negative.

Conclusions. This report demonstrates that SARS-CoV-2 infection can cause mild illness and result in positive tests for up to 18 days after diagnosis, without evidence of transmission to close contacts. These data might inform public health strategies to manage individuals with asymptomatic infection or mild illness.

Keywords. COVID-19; SARS-CoV-2; illness severity; viral transmission; serial testing.

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first identified in Wuhan City, Hubei Province, China on 7 January 2020 as the cause of a respiratory illness outbreak, coronavirus disease 2019 (COVID-19), that began in December 2019 [1]. As of 3 April 2020, the World Health Organization reported 972 303 confirmed COVID-19 cases worldwide [2].

Human-to-human transmission of SARS-CoV-2 has been confirmed. Most reproduction number (R_0) estimates range from 2.2 to 3.5, but whether illness severity correlates with viral infectivity is undetermined [3–10]. SARS-CoV-2 causes a range of illness severity, from asymptomatic infection or mild illness to severe or even fatal illness. Most published data have focused on hospitalized patients. Evidence regarding transmission from individuals with asymptomatic infection or mild illness is limited [8–14].

We describe the public health investigation of a mildly ill, nonhospitalized laboratory-confirmed COVID-19 case who presented with only a mild nonproductive cough that began prior to travel to China, including contact tracing and serial SARS-CoV-2 testing of the case and high-risk contacts.

CASE REPORT

On 22 January 2020, a 26-year-old university-affiliated man presented to a university healthcare clinic in Maricopa County, Arizona, reporting a 2-day history of nonproductive cough. He

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denied fever and other symptoms at presentation. The patient traveled to the clinic by bicycle, wearing a facemask throughout the commute and the clinic visit. Clinic triage assessment revealed he returned from travel to China, including Wuhan City, 3 days prior to presentation. He reported returning to Arizona on 19 January after visiting family in Hubei for 12 days, including 3 days in Wuhan City. He had contact with 1 person with cough and fever while in China. He denied contact with any ill person or person who had recently returned from China before his travel. He reported seeing media reports about the COVID-19 outbreak in China and the United States (US), prompting him to visit the clinic.

He was a healthy nonsmoker and took no daily medications. Physical examination revealed an oral temperature of 36.7°C, pulse of 95 beats/minute, blood pressure of 150/89 mm Hg, respiratory rate of 16 breaths/minute, and oxygen saturation of 96% while breathing ambient air. Lung auscultation revealed clear breath sounds bilaterally without wheezing, rales, or rhonchi. The patient did not cough during the clinic visit. Rapid antigen testing for influenza A and B was negative. A nasopharyngeal swab specimen, obtained and sent for viral culture, subsequently demonstrated no viral growth.

The healthcare provider notified the local health department, Maricopa County Department of Public Health (MCDPH), during the patient's medical evaluation. The patient did not meet the US Centers for Disease Control and Prevention (CDC) "person under investigation" testing criteria at that time, because he did not have a fever [15]. MCDPH conferred with the Arizona Department of Health Services (ADHS), which obtained SARS-CoV-2 testing approval through the CDC's Emergency Operations Center based on reported contact with 1 person with cough and fever in China and visiting Hubei. Nasopharyngeal swab, oropharyngeal swab, noninduced sputum, and serum specimens were collected for SARS-CoV-2 testing. Following evaluation and specimen collection, the patient was discharged to home isolation with instructions to remain in his room as much as possible and to wear a facemask if he had to be in the same room as housemates.

On 25 January, CDC confirmed the patient's oropharyngeal swab and sputum specimens tested positive for SARS-CoV-2 by real-time reverse-transcription polymerase chain reaction (rRT-PCR) assay.

METHODS

Epidemiologic Investigation

MCDPH consulted with ADHS and CDC for technical assistance and testing of clinical specimens for SARS-CoV-2. Following diagnostic confirmation of the case, MCDPH and ADHS invited CDC to assist in onsite specimen collection and coordination.

The laboratory-confirmed COVID-19 case was a Maricopa County resident with oropharyngeal and sputum specimens testing positive for SARS-CoV-2 by rRT-PCR collected on 22 January 2020. For contact tracing, contacts were defined as persons exposed to the case on or after the day before case diagnostic clinical specimen collection. Since the patient reported no change in a previously existing mild nonproductive cough, a conservative estimate for the contact tracing period was the day before specimen collection, per consultation with local and state health officials and CDC.

Following the positive SARS-CoV-2 result, MCDPH epidemiologists conducted a case interview to clarify symptom history and determine all known contacts and locations visited during the presumed infectious period. MCDPH collaborated with university partners to identify all healthcare-associated contacts and conducted interviews to determine if healthcare personnel adhered to CDC infection control and personal protective equipment recommendations while interacting with the case [16]. ADHS worked with national companies to identify all rideshare driver contacts.

Contact Exposure Risk Stratification

Contacts were classified as having high-, medium-, or low-risk exposures based on criteria developed by MCDPH. Level of exposure risk guided the type and extent of symptom monitoring by MCDPH or healthcare employer. MCDPH exposure risk guidance was developed prior to availability of CDC interim risk assessment guidance for COVID-19 (Supplementary Materials).

Any contact who developed fever (subjective or confirmed), cough, or shortness of breath during the 14-day postexposure monitoring period was considered a "person under investigation" per CDC's definition. All persons under investigation were isolated and tested for SARS-CoV-2 [15].

Maintaining Case Home Isolation

After case identification, MCDPH worked closely with the university to support the patient in home isolation. The university arranged alternative individual housing for housemates and provided food and social support for the patient and quarantined housemates.

The intimate contact with high-risk exposure was permitted to stay in the same home as the case but was instructed to stay in separate rooms at all times while awaiting the contact's rRT-PCR test results.

Serial SARS-CoV-2 Testing of Case and Contacts

Nasopharyngeal and oropharyngeal swab specimens for the case and all consenting contacts with high-risk exposures were obtained for SARS-CoV-2 testing at CDC (Tables 1 and 2). Household contacts and healthcare personnel with high-risk exposures had serial SARS-CoV-2 testing until the end of the

Table 1. Serial Results of Real-time Reverse-transcription Polymerase Chain Reaction Testing for Severe Acute Respiratory Syndrome Coronavirus 2 in a Mildly Ill, Nonhospitalized Case of Coronavirus Disease 2019[a]

Specimen	Day After Illness Onset												
	1	6	8	10	12	14	16	18	20	22	24	27
Nasopharyngeal swab	Neg	Pos (Ct, 25.1–25.6)	Pos (Ct, 30.3–30.6)	Pos (Ct, 31.7–33.4)	Inc	Inc	Inc	Pos (Ct, 36.8–39.4)	Neg	Inc	Neg	Neg
	…	…	…	…	…	…	…	…	…	…	…	…
Oropharyngeal swab	Pos (Ct, 26.7–28.1)	Pos (Ct, 31.1–31.7)	Pos (Ct, 33.1–34.8)	Pos (Ct, 33.8–34.9)	Pos (Ct, 33.9–37.9)	Pos (Ct, 37.0–38.7)	Pos (Ct, 35.2–36.6)	Neg …	Neg …	Neg …	Neg …	Neg …
Sputum	Pos (Ct, 31.7–32.8)	– …	Pos (Ct, 27.3–27.4)	– …	– …	– …	– …	– …	– …	– …	– …	– …
Serum	Neg	–	Neg	–	–	–	–	–	–	–	–	–

Abbreviations: –, not tested; Ct, cycle threshold.

[a]Lower Ct values indicate higher viral loads. "Pos" denotes positive for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in which 3 of 3 targets were positive. "Neg" denotes negative for SARS-CoV-2 in which zero of 3 targets was positive. "Inc" denotes inconclusive for SARS-CoV-2 in which 1–2 of 3 targets are positive.

14-day monitoring period. Rideshare drivers with high-risk exposure were offered SARS-CoV-2 testing once they were reached and counseled by MCDPH. Clinical specimens for SARS-CoV-2 testing were obtained, shipped, and tested per interim CDC guidance [17] (Supplementary Materials). Cycle threshold (Ct) values were used as a semiquantitative indicator of viral RNA concentration in the clinical specimen.

RESULTS

Case Investigation

On 26 January, MCDPH epidemiologists conducted a follow-up patient interview to begin contact tracing. In this interview, the patient stated that his cough started in mid-December 2019, prior to travel to China, not 2 days before diagnosis as previously reported. His cough was unchanged in character, frequency, and severity at any time during the illness. He denied all additional symptoms, including fever, chills, and shortness of breath (Supplementary Materials). University healthcare clinic records documented that he waited 30 minutes in the waiting room, and then was taken into an examination room for provider evaluation. Local health officials, in coordination with state health officials and CDC, recommended he remain in home isolation with daily monitoring.

Case SARS-CoV-2 Testing

After diagnostic specimen collection on 22 January, the case had paired nasopharyngeal and oropharyngeal specimens collected for SARS-CoV-2 testing at 11 different time points. In 8 pairs (73%) the nasopharyngeal or oropharyngeal specimen tested positive or indeterminate; 3 (27%) tested negative (Table 1). The initial respiratory specimens positive for SARS-CoV-2 on illness day 1 had relatively low Ct values (26.7–28.1 in the oropharyngeal specimen and 31.7–32.8 in the sputum specimen), suggesting higher levels of virus in these specimens, despite the patient's mild illness. Ct values in specimens collected after symptom resolution, on illness days 12, 14, 16, 18, and 22, were > 35, suggesting decreasing levels of virus in these specimens.

On 5 February, the patient reported his cough had resolved. On 19 February, 14 days after symptom resolution, CDC confirmed that the patient's nasopharyngeal and oropharyngeal specimens tested negative for SARS-CoV-2 at 2 consecutive time points ≥ 24 hours apart, and he was released from voluntary isolation.

Contact Investigation

Sixteen contacts were identified. Eleven (69%) had high-risk exposure: 5 rideshare drivers, 3 healthcare personnel, 2 housemates, and 1 intimate contact (Table 2). Five (31%) healthcare personnel had medium-risk exposure. The intimate contact had stayed with the patient for > 36 hours before positive diagnostic testing results were received.

Table 2. Serial Testing for Severe Acute Respiratory Syndrome Coronavirus 2 Among 10 Contacts With High-risk Exposure and Exposure Risk and Postexposure Monitoring of 16 Contacts to a Mildly Ill, Nonhospitalized Coronavirus Disease 2019 Case

Contact	Exposure Risk	Contact Type	Completed Postexposure Monitoring	Developed Respiratory Symptoms	Nasopharyngeal and Oropharyngeal Specimen Test Result by Day After Last Exposure[a]														
					0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	High	Household	Yes	Yes	Neg	–	–	Neg	–	Neg	–	Neg	–	Neg	–	Neg	–	Neg	–
2	High	Household	Yes	Yes	Neg	–	–	Neg	–	Neg	–	Neg	–	Neg	–	Neg	–	Neg	–
3	High	Intimate	Yes	Yes	–	Neg	–	Neg	–	Neg	–	Neg	–	Neg	–	–	–	–	–
4	High	Healthcare	Yes	No	–	–	–	–	–	–	Neg	–	–	Neg	–	–	Neg	–	Neg
5	High	Healthcare	Yes	No	–	–	–	–	–	–	–	Neg	–	Neg	–	–	Neg	–	Neg
6	High	Healthcare	Yes	No	–	–	–	–	–	–	–	Neg	–	Neg	–	–	Neg	–	Neg
7	High	Rideshare	Yes	No	–	–	–	–	–	–	–	Neg	–	–	–	–	–	–	–
8	High	Rideshare	Yes	No	–	–	–	–	–	–	–	–	–	–	Neg	–	–	–	–
9	High	Rideshare	Yes	No	–	–	–	–	–	–	–	–	–	Neg	–	–	–	–	–
10	High	Rideshare	Yes	No	–	–	–	–	–	–	Neg	–	–	–	–	–	–	–	–
11	High	Rideshare	Yes	No	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
12	Medium	Healthcare	Yes	No	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
13	Medium	Healthcare	Yes	No	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
14	Medium	Healthcare	Yes	No	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
15	Medium	Healthcare	Yes	No	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
16	Medium	Healthcare	Yes	No	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

[a]"Neg" denotes negative for severe acute respiratory syndrome coronavirus 2 in which zero of 3 targets was positive. "–" denotes not tested.

Of 11 contacts with high-risk exposure, 10 (91%) had specimens tested for SARS-CoV-2. The 3 healthcare personnel, 2 housemates, and 1 intimate contact with high-risk exposure had a total of 31 paired nasopharyngeal and oropharyngeal swab specimens tested for SARS-CoV-2 during their 14-day postexposure monitoring periods (Table 2). Four (80%) rideshare drivers with high-risk exposure consented to one-time paired nasopharyngeal and oropharyngeal swab specimen collection for SARS-CoV-2 testing. All 35 paired specimens (100%) collected from contacts with high-risk exposure tested negative for SARS-CoV-2 (Table 2). On 3 February, after the intimate contact's first specimen tested negative for SARS-CoV-2, the intimate contact was placed in voluntary quarantine in separate housing to prevent possible ongoing exposure.

Of 16 contacts, 3 (19%) developed a cough during the 14-day postexposure monitoring period and were considered "persons under investigation" per CDC guidance until clinical specimens tested negative for SARS-CoV-2 [15].

By 5 March, all 16 contacts completed 14-day postexposure symptom monitoring periods.

DISCUSSION

We summarize the public health investigation, contact tracing, and serial SARS-CoV-2 testing results of the first mildly ill, nonhospitalized US case of COVID-19. Among 16 identified contacts, 10 with high-risk contact did not demonstrate viral transmission of SARS-CoV-2 based on serial SARS-CoV-2 testing, and 6 contacts who were not tested for SARS-CoV-2 did not develop any symptom consistent with COVID-19 during postexposure symptom monitoring. Notably, 1 contact had intimate contact with the case for > 36 hours while his clinical specimens tested positive for SARS-CoV-2.

This case investigation suggests that COVID-19 illness severity could correlate with SARS-CoV-2 infectivity. Our patient had a mild nonproductive cough prior to travel to China that persisted unchanged before, during, and after COVID-19 diagnosis. The case had repeated intimate contact with 1 person over > 36 hours while testing positive for SARS-CoV-2. This case differs from cases reported in Chicago, Illinois, and San Benito County, California, where viral transmission occurred between intimate contacts prior to diagnosis and index cases had more severe illnesses, requiring hospitalization [18].

Correlations between illness severity and viral infectivity via viral shedding have been described for other respiratory viruses [19–22]. Viral shedding of some seasonal influenza A and B strains, a proxy for viral infectivity, is lower in asymptomatic and minimally symptomatic patients. Preliminary data suggest that the trend of SARS-CoV-2 viral loads detected in clinical specimens of infected patients during clinical illness is similar to influenza [23]. If true, asymptomatic or mildly ill patients would be less likely to transmit the virus. However, 1 reported asymptomatic patient demonstrated SARS-CoV-2 viral loads as high as those demonstrated by symptomatic patients, but the viability of the virus and whether viral transmission occurred for that case is unknown [23]. This investigation demonstrates that a mildly symptomatic individual can have a relatively high viral load and still not transmit the infection to an intimate contact. We hypothesize this could be because the virus is nonviable, but this cannot be confirmed without viral culture data.

If SARS-CoV-2 infectivity correlates with illness severity, this could have implications for SARS-CoV-2 testing recommendations. At the time of this investigation, testing was only available at CDC and tiered recommendations for testing depended on symptom severity and exposure risk. This patient did not meet "persons under investigation" testing criteria at the time of diagnosis but presented for medical evaluation due to concern over media reports about COVID-19. If COVID-19 cases with asymptomatic or mild illness are less infectious, more stringent criteria for testing are reasonable, but may result in underdiagnosis of COVID-19 and therefore falsely increase estimates of case-fatality rates [20].

To our knowledge, all US COVID-19 cases have remained in isolation until clinical specimens tested negative for SARS-CoV-2 by rRT-PCR. If symptom severity is a proxy for infectivity, cases could be released from isolation based on symptom resolution, rather than 2 consecutive negative tests spaced ≥ 24 hours apart [24]. Prolonged isolation can negatively impact mental health, community and household economies, and strain local public health and healthcare resources [25, 26].

This report is subject to limitations. First, we describe the case investigation, contact tracing, and serial testing of a single COVID-19 case. Data on asymptomatic or mildly ill COVID-19 cases are insufficient, and this case cannot replace larger, systematic studies. Second, while CDC and other experts were consulted to determine a conservative estimate for when the case was most likely to become infectious, we cannot confirm if/when COVID-19 illness onset began. It was challenging to characterize illness onset in this patient, when the only symptom (mild nonproductive cough) began prior to exposure to COVID-19 and remained unchanged during and after diagnosis. Third, although 10 of 11 contacts with high-risk exposure were tested for SARS-CoV-2, 1 contact with high-risk exposure and 5 contacts with medium-risk exposure did not have specimens tested and we cannot rule out that viral transmission occurred in these contacts. Last, no viral culture data exist to evaluate viral viability in this patient.

This report demonstrates that SARS-CoV-2 can cause mild illness with a relatively high viral load, and not transmit the infection to close contacts. Larger studies including contact investigations and viral shedding studies among those with asymptomatic infection or mild illness are needed to determine if symptom severity is related to disease transmission.

These data could help inform and scale the public health response as COVID-19 becomes more widespread in the US and worldwide.

Supplementary Data

Supplementary materials are available at *Clinical Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

Notes

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Disclaimer. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the CDC.

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