

All staff on the unit for  $\geq 2$  hours without wearing a respirator, staff who directly cared for the patient, and all non-COVID-19 patients on the unit were considered potentially exposed. Staff were contacted by occupational health staff and were advised to undergo serial PCR testing every 2–3 days. This study was performed under the auspices of hospital infection control operations but was approved by the Mass General Brigham Institutional Review Board.

## Results

The 7 non-COVID-19 patients (2 of whom were fully vaccinated) were considered exposed; 4 were tested serially for at least  $\geq 10$  days after exposure, 1 was tested through day 8 then expired, and 2 were tested through day 5 then expired. All tested negative. In total, 52 healthcare workers were considered exposed, including 12 who directly cared for the patient. Among them, 32 (62%) were tested at least once  $\geq 3$  days after exposure, including 9 direct-care providers. All tested negative. The vaccination rate among hospital staff was 84%.

## Discussion

The discovery of this patient with undiagnosed COVID-19 in a positive-pressure room triggered high concern for several reasons. First, the patient had a low PCR cycle threshold, indicating a high viral load, a factor strongly associated with transmission.<sup>3,4</sup> Second, the patient was unmasked and required high-flow nasal cannula, which some guidelines and hospitals consider to be an aerosol-generating procedure. Although recent data have demonstrated that high-flow oxygen has very little effect on aerosol generation, it was an indicator of the severity of the patient's respiratory symptoms including tachypnea and cough, two factors associated with increased aerosol generation.<sup>5,6</sup> Third, the unit was circular with adjacent standard-pressure rooms with mostly open doors. Despite these factors, we did not identify any secondary transmission to patients or staff.

Most reports of long-range airborne SARS-CoV-2 transmission have occurred in nonhospital indoor settings with poor ventilation.<sup>7–9</sup> One possible exception is a large cluster our hospital sustained in September 2020, during which our investigation uncovered that the room of the index patient had a positive pressure gradient relative to the nurse station.<sup>10</sup> However, it was difficult to quantify the contribution of positive airflow in that cluster given the large number of staff and patients who had direct close contact with the index patient and other infected individuals.

We speculate that the lack of transmission in this case was due to the high rate of air changes in the patient's room, which would

have rapidly diluted aerosols; the protection afforded by distance from the source patient leading to further aerosol dilution; universal staff masking; and high vaccination rates.

Our analysis was limited by the focus on a single patient in a single unit, albeit one with many concerning circumstances, and incomplete testing of all staff on the unit. Nonetheless, this case study suggests that the risk of long-range SARS-CoV-2 transmission in hospitals may be low, even with highly infectious patients in positive-pressure rooms, in the setting of good ventilation, masking, and high staff vaccination rates.

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# Discontinuation of isolation precautions for coronavirus disease 2019 (COVID-19) patients

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Early in the coronavirus disease-19 (COVID-19) pandemic, research showed that hospital-related transmission may be

contributing to the spread of the virus.<sup>1</sup> Appropriate implementation of transmission-based precautions is critical to preventing severe acute respiratory coronavirus virus 2 (SARS-CoV-2) transmission between patients and healthcare workers. Healthcare workers caring for patients with confirmed or suspected COVID-19 should wear a National Institute for Occupational Safety and Health (NIOSH)-approved N95 (or equivalent or higher-level respirator), gown, gloves, and eye protection. Given uncertainty regarding how long patients with COVID-19 remain infectious, it remains unclear when the discontinuation of transmission-based precautions is appropriate.

The Centers for Disease Control and Prevention (CDC) outlines 3 strategies for discontinuing transmission-based precautions for patients with confirmed COVID-19.<sup>2</sup> The CDC initially recommended a symptom- or test-based strategy for symptomatic patients and a time- or test-based strategy for asymptomatic patients. On July 17, 2020, the CDC updated these strategies.<sup>3</sup> The test-based strategy is no longer recommended because many individuals may have a positive polymerase chain reaction (PCR) test without being infectious. The symptoms-based approach now recommends at least 24-hours since the last fever without use of fever-reducing medications. Finally, the CDC recommends that patients with severe disease or who are immunocompromised continue precautions until 20 days since first symptoms, compared to 10 days for less severe illness.

We undertook a survey to assess variation in and approach to discontinuing transmission-based COVID-19 precautions.

## Methods

The Infectious Disease Society of America (IDSA) Emerging Infections Network (EIN) is a sentinel network of infectious disease physicians that assists the CDC and public health agencies with surveillance of emerging infectious diseases.<sup>4</sup> During July–August 2020, the EIN sent an online 11-question survey (Appendix 1 online) to 696 physicians with infection prevention and/or hospital epidemiology responsibilities or interests to understand practices regarding the discontinuation of transmission-based precautions for COVID-19 patients. Two reminder e-mails were sent ~10 days apart. No incentive for participation was provided. Data were analyzed using descriptive statistics (Excel, Microsoft, Redmond, WA). As an EIN query, this survey was exempt from institutional review board review.

## Results

The timing of the survey coincided with release of CDC updated guidance. Overall, 320 physicians (46%) responded. Of these, 44 respondents (14%) were not aware of precautions used for COVID-19 patients and opted out of the remaining questions. Among 276 responding physicians, 208 (75%) worked in adult infectious diseases and 109 (39%) practiced in a university hospital. Considerable variability was reported for the length of time inpatients remained in COVID-19-level precautions; 14–20 days was the most common response. Respondents most frequently reported using a combination of all 3 strategies (ie, symptom, test, and time-based) to determine when COVID-19-level precautions could be discontinued in inpatients. In the outpatient setting, a combination of symptom and time-based strategies was the most common (44%). In total, 207 respondents (75%) reported that clearance of COVID-19-level precautions in inpatients was authorized by infection control personnel with infectious disease physician input.

Respondents whose facilities used the symptoms-based approach to discontinuing precautions reported that once symptoms improved, discontinuation occurred at 10 days (38%), 11–30 days (20%), >30 days (1%), or “it depends on the population” (21%). The most common applications of the test-based approach were among immunocompromised patients (50%) and patients with a planned discharge to a nursing home (48%). Respondents whose facilities used the time-based strategy discontinued precautions at 10 days (27%), 11–30 days (22%), >30 days (4%), or “it depends on the population” (21%). The most common factors influencing the decision to discontinue COVID-19-level precautions were length of time from initial positive test (80%), improvement in symptoms (74%), and patient characteristics (66%).

## Discussion

Our survey results reveal that most healthcare facilities discontinue COVID-19-level precautions on inpatients with COVID-19 prior to discharge using a combination of the symptom, test, and time-based strategies. Length of time from initial positive test, improvement in symptoms, and patient characteristics influenced respondents' decisions to discontinue precautions. Although the CDC no longer recommends using the test-based strategy in most cases, 68% respondents reported using this strategy (eg, for immunocompromised patients and patients planning discharge to a nursing home). The symptoms-based approach was popular, but there was considerable variability in when precautions were discontinued following symptom improvement.

These findings highlight the need for more specific research and guidance regarding how to discontinue transmission-based precautions for inpatients with COVID-19 who are transferring to congregate living facilities. Because the spread of COVID-19 in these settings has shown devastating consequences, it is understandable that facilities would desire reassurance that patients are no longer infectious. Increasing the availability of personal protection equipment (PPE) and infection prevention resources at these locations could decrease test-based strategy usage. Another issue requiring clarity is how to discontinue isolation precautions for patients who are recovering but remain critically ill or those who require ongoing aerosol-generating procedures. Although evidence regarding the period of infectivity based on RT-PCR testing of the upper airways is available, less is known about whether this accurately represents the lower airways.

This study has several limitations. The CDC updated their guidance around the time of survey deployment. Some respondents commented that their approach has changed in response to CDC guidance or due to seeing patients consistently test positive. The complexity of case-by-case decisions (eg, requiring negative tracheal aspirate specimens for intubated patients) was not captured by our survey questions. The survey did not address healthcare worker return-to-work practices. It is possible to have multiple EIN respondents at 1 center. However, no more than 5 respondents were from the same city, suggesting center and geographic diversity among respondents.

Overall, we found that discontinuation practices vary widely, and decision making is complicated by many factors. Research is needed to understand how long different COVID-19 patient populations remain infectious to determine when to safely discontinue transmission-based precautions.

**Table 1.** Summary Results of Survey on Discontinuation of Transmission-Based Precautions for COVID-19 Patients Among a Network of Infectious Disease Physicians, North America, July–August, 2020<sup>a</sup>

Survey Characteristic	No. (%)
<b>Practice (n=276)</b>	
Adult infectious diseases	208 (75.4)
Pediatric infectious diseases	60 (21.7)
Both adult and pediatric	8 (2.9)
<b>Years' experience since ID fellowship (n=276)</b>	
<5 y	47 (17.0)
5–14 y	73 (26.4)
15–24 y	57 (20.7)
≥25 y	99 (35.9)
<b>Primary hospital type (n=276)</b>	
City/county	16 (5.8)
Community	57 (20.7)
Nonuniversity teaching	78 (28.3)
University	109 (39.5)
VA hospital or DOD	16 (5.8)
<b>No. of inpatients with laboratory-confirmed COVID-19 in past 6 mo (n=276)</b>	
None	0 (0)
1–99	69 (25.0)
100–199	33 (12.0)
200–299	24 (8.7)
≥300	87 (31.5)
Not sure or not answered	63 (22.8)
<b>Duration of precautions for inpatients with COVID-19 (n=276)</b>	
Until discharge in all cases	38 (13.8)
<7 d	4 (1.4)
7–13 d	69 (25.0)
14–20 d	92 (33.3)
≥21 d	43 (15.6)
Not sure or not answered	30 (10.9)
<b>Strategy used to discontinue precautions for inpatients with COVID-19 (n=276)</b>	
Symptom-based	176 (63.8)
Test-based	187 (67.8)
Time-based	167 (60.5)
All 3 strategies	83 (30.1)
Not answered	5 (1.8)
<b>Patient population for which test-based strategy applied (n=276)</b>	
Adult	108 (39.1)
Pediatric /	58 (21.0)
Immunocompromised	138 (50.0)
Planned discharge to nursing home	132 (47.8)
Other	21 (7.6)
Not sure or not answered	71 (25.7)
<b>Factors that influenced decision to discontinue precautions for inpatients with COVID-19 (n=276)</b>	
RNA test availability	73 (26.4)
Illness severity	125 (45.3)

(Continued)

**Table 1.** (Continued)

Survey Characteristic	No. (%)
Improvement in symptoms	205 (74.3)
Asymptomatic vs. symptomatic	140 (50.7)
Length of time from initial positive test	222 (80.4)
Patient characteristics	183 (66.3)
Discharge to home	95 (34.4)
Discharge to congregate living facility (LTCF, jail, shelter)	142 (51.4)
Other	11 (4.0)
Not answered	7 (2.5)

Note. ID, infectious diseases; LTCF, long-term care facility; VA, Veterans' Affairs; DOD, Department of Defense.  
<sup>a</sup>N values indicate number of participants who responded.

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## Appendix 1,

### Survey

#### Inpatient

- Approximately how many inpatients with lab-confirmed COVID-19 has your facility admitted in the past 6 months?
  - None
  - 1–99
  - 100–199
  - 200–299
  - ≥300
- For inpatients with COVID-19, what is the approximate length of time they remain in transmission-based precautions for COVID-19 in your facility?
  - <1 week
  - 1–2 weeks
  - 2–3 weeks
  - >3 weeks
  - Until discharge in all cases

- What strategy does your facility use to determine when inpatients with COVID-19 can discontinue transmission-based precautions? (Check all that apply)
  - Symptom-based
  - Test-based
  - Time-based
- Is clearance of transmission-based precautions in inpatients authorized by (check all that apply):
  - Infection control personnel
  - Infection control personnel with Infectious Diseases physician input
  - Only Command center personnel

#### Outpatient

- Approximately how many outpatients with lab-confirmed COVID-19 has your institution seen in the past 6 months?
  - None
  - 1–99
  - 100–199
  - 200–299
  - ≥300
- What strategy is being used to determine when outpatients with COVID-19 can discontinue transmission-based precautions? (Check all that apply.)
  - Symptom-based
  - Test-based
  - Time-based

#### All Settings

- If you selected your facility uses a test-based approach to discontinue transmission-based precautions, what populations is this done for?
  - Adult
  - Pediatric
  - Immunocompromised patients
  - Planned discharge to nursing home

8. If you selected your facility uses a time-based approach to discontinue transmission-based precautions, what time point is specified?
  - a. 10 days
  - b. 11–30 days
  - c. > 30 days
9. What factors influence the decision to remove patients with COVID-19 from transmission-based precautions?
  - a. RNA test availability
  - b. Illness severity
  - c. Improvement in symptoms
  - d. Asymptomatic vs symptomatic
  - e. Length of time from initial positive test
  - f. Patient characteristics (eg, immunocompromised)
  - g. Discharge to home
  - h. Discharge to congregate living facility (eg, nursing home, jail, shelter)
  - i. Other (specify): (Free text)
10. Additional comments about discontinuation of transmission-based precautions for patients with COVID-19? (Free text)

## Respiratory extracorporeal membrane oxygenation and central-line-associated bloodstream infection: Experience at a tertiary-care center during the coronavirus disease 2019 (COVID-19) pandemic

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Extracorporeal membrane oxygenation (ECMO) is used for respiratory failure or respiratory ECMO. It is usually indicated for patients with reversible, acute respiratory failure who fail to improve with conventional ventilatory support or for those on prolonged mechanical ventilation.<sup>1,2</sup>

One of the most critical ECMO complications is ECMO central-line-associated bloodstream infection (ECMO-CLABSI), which has an incidence density of 3.1–8.0 per 1,000 ECMO days according to previous studies.<sup>3,4</sup> Because ECMO use has increased during the coronavirus disease 2019 (COVID-19) pandemic, we investigated the incidence and changes in the trend of ECMO-CLABSI during the current pandemic.

### Methods

This retrospective study was conducted from December 2013 to the end of February 2021 in 28-bed intensive care units at Tokyo Metropolitan Tama Medical Center, a 790-bed, public, tertiary-care center in Tokyo, Japan. The study center began respiratory ECMO placement in December 2013. The center has been registered with the extracorporeal life support organization (ELSO) since 2015,<sup>5</sup> and 10–20 respiratory ECMO placements are performed there annually.

Patients who received respiratory ECMO during the study period were enrolled for analysis. Their demographic data, indication for ECMO placement, ECMO device days (called ECMO days), duration of ICU hospitalization, in-hospital mortality at the index hospitalization, the number of ECMO-CLABSI events, and causative pathogens were extracted from the electronic

medical records. ECMO-CLABSI patients were required to have a laboratory-confirmed bloodstream infection that was not secondary to an infection at another body site. The definitions of CLABSI, ECMO days, and the ECMO device utilization ratio (DUR) from the National Healthcare Safety Network (NHSN) were used for ECMO-CLABSI.<sup>6</sup> The incidence density of ECMO-CLABSI and the ECMO-DUR were calculated. The Institutional Review Board of the Tokyo Metropolitan Tama Medical Center approved this study.

### Results

In total, 97 patients received respiratory ECMO placement, and the cumulative ECMO-days were 1,138. The in-hospital mortality rate was 38.1% (37 of 97), the median respiratory ECMO-days per patient was 8.0 days (range, 1–55), and the overall ECMO-DUR was 0.023. All the patients with ECMO were concurrently fitted with a central venous catheter and arterial catheter during ECMO use.

In total, ECMO-CLABSI developed in 12 patients, and the cumulative incidence density of ECMO-CLABSI during the entire study period was 10.54 per 1,000 ECMO days. Figure 1 shows the trends in the ECMO-CLABSI incidence and the ECMO-DUR. After February 2020, when the study center began admitting patients with COVID-19, both the ECMO-DUR and ECMO-CLABSI incidence density increased noticeably in comparison with the preceding period. The ECMO-DUR was 0.018–0.061, with a rate ratio of 3.29 (95% confidence interval [CI], 2.89–3.72). The ECMO-CLABSI incidence density was 10.11–11.53 per 1,000 ECMO days, with an incidence ratio of 1.14 (95% CI, 0.16–3.42). The most common causative pathogens in ECMO-CLABSI were *Candida* spp (3 of 12) followed by *Staphylococcus* spp (2 of 12). In-hospital mortality was higher in patients with

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