HCW had no other known COVID-19 exposures but did interact unmasked with coworkers in the 2 weeks before testing positive. Whole-genome sequencing detected the SARS-CoV-2 delta variant (B.1.617.2). Genome alignment to 41 other delta variants isolated at our institution from April through July 2021 confirmed the relatedness of the 2 HCW viruses and their distinctiveness from other SARS-CoV-2 isolates (Fig. 1).

Discussion

Recent CDC guidance says that fully vaccinated individuals may not need to wear masks indoors or practice physical distancing due to vaccine effectiveness and the low likelihood of a fully vaccinated person transmitting the virus to others.[4] The genetic and epidemiological data from our investigation of 2 HCW with breakthrough SARS-CoV-2 infection strongly suggest transmission of the SARS-CoV-2 virus delta variant from one fully vaccinated individual to another in the setting of unmasked close contact. Limitations include the fact that source of the infection for the first HCW is unknown; it remains possible that both HCWs were infected with SARS-CoV-2 from a common source or through separate exposures.

SARS-CoV-2 variants, such as the delta variant, can have higher viral loads, potentially increasing transmissibility and requiring enhanced public health measures.[5] This apparent transmission of SARS-CoV-2 from one fully vaccinated person to another demonstrates that masking and physical distancing remain vital infection prevention measures for fully vaccinated people while the SARS-CoV-2 virus is still evolving and circulating.

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Healthcare personnel frequently have positive severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) antigen tests 5 days or more after diagnosis of coronavirus disease 2019 (COVID-19)

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To the Editor—During the coronavirus disease 2019 (COVID-19) pandemic, healthcare facilities have had to balance the goals of preventing healthcare-associated transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and maintaining adequate staffing.[1] The emergence of the highly transmissible omicron variant has greatly exacerbated staffing shortages due to frequent infections in unvaccinated and vaccinated personnel.[2] In response, the Centers for Disease Control and Prevention (CDC) recently provided modified guidance to mitigate healthcare

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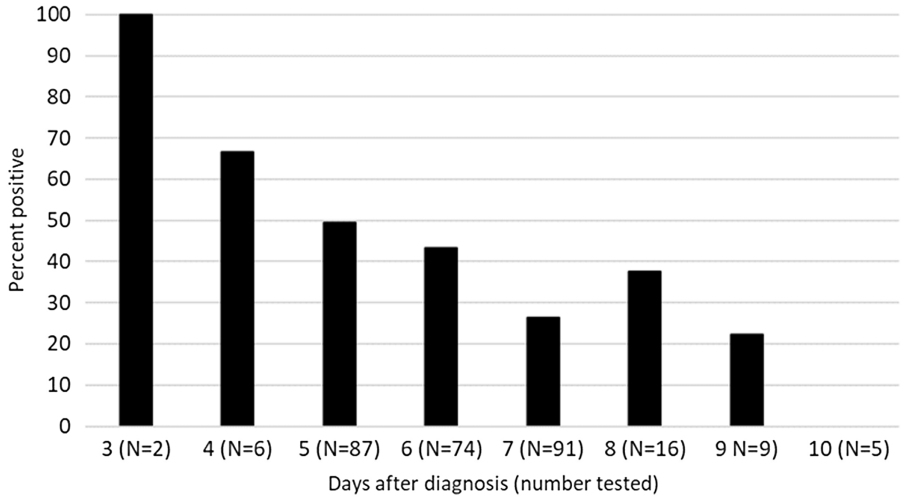

Fig. 1. Percentage of healthcare personnel with positive antigen test results by number of days since diagnosis.

staffing shortages.[2,3] Under contingency strategies, personnel with mild-to-moderate or asymptomatic COVID-19 infection may return to work 5 days after symptom onset if afebrile and improving, either with or without a test to confirm resolution of the infection.[3]

The rationale for allowing healthcare personnel to return to work after 5 days is that the highest risk for transmission is the period 2 days before and 3 days after symptom onset.[3–5] However, the duration of shedding of viable virus particles is unclear for the omicron variant, and the frequency of positive antigen tests 5 or more days after onset of illness is not known. Such information is urgently needed because positive antigen tests have been shown to correlate relatively well with shedding of viable virus and transmission risk.[6–9] Here, we examined the percentage of healthcare personnel with positive antigen tests 5 or more days after diagnosis of COVID-19.

The evaluation was conducted as a quality assurance activity by staff from the Infectious Diseases Section and Personnel Health Department at the Louis Stokes Cleveland VA Medical Center. Beginning January 3, 2022, the facility began performing SARS-CoV-2 antigen testing of personnel with asymptomatic or mild-to-moderate but improving COVID-19 at 5 or more days after diagnosis as a contingency measure to mitigate staffing shortages.[2] The day of diagnosis was day 0. Personnel were asked to report for testing on day 5 or on their next scheduled workday between days 6 and 9; after day 10, personnel could return to work with no testing. Anterior nares swabs were collected under supervision of laboratory personnel. The BinaxNOW COVID-19 Ag Card (Abbott) was used to detect viral nucleocapsid protein directly from the nasal swab samples according to the manufacturer's instructions. The number of days since the positive diagnostic test and the COVID-19 vaccination status of the personnel were recorded. The percentage of healthcare personnel with positive antigen test results was graphed, stratified by the number of days since diagnosis of COVID-19. We used the Fisher exact test to compare the percentages of positive antigen tests at days 5–10 after diagnosis for unvaccinated versus fully vaccinated and/or boosted employees. For a subset of 71 employees, personnel health records were reviewed to determine whether respiratory symptoms were present at the time of diagnosis.

Of 290 total employees tested between days 3 and 10 after COVID-19 diagnosis, 113 (39%) had positive antigen tests. The percentage of employees with positive antigen tests decreased as the number of days after diagnosis increased (Fig. 1). At day 5 after diagnosis, 43 (49%) of 87 antigen tests were positive. For tests collected between days 5 and 10 after diagnosis, there was no difference in the percentage of positive tests for unvaccinated versus fully vaccinated and/or boosted employees: 19 (38.8%) of 49 versus 87 (38.3%) of 227 ($P = 1.0$). For the 71 employees whose records were reviewed, 65 (91.5%) had respiratory symptoms at the time COVID-19 was diagnosed and 6 (8.5%) were asymptomatic. Also, 19 (29.2%) of 65 symptomatic employees and 0 of 6 (0%) asymptomatic employees had positive antigen test results, respectively. There were no suspected transmissions of SARS-CoV-2 to coworkers from employees returning to work after a negative antigen test.

Under CDC-recommended contingency strategies, healthcare personnel with asymptomatic or mild-to-moderate COVID-19 may return to work after at least 5 days have passed since symptom onset with or without testing to confirm resolution of infection.[3] However, many experts recommend that all individuals with COVID-19 have a negative test if isolation is to be discontinued before a full 10 days after a positive test.[9] Our findings provide support for that recommendation because positive antigen tests were common among healthcare personnel tested 5–9 days after diagnosis. If such testing is not completed, the CDC recommends stringent adherence to measures, such as facemasks and social distancing, to minimize the risk of transmission to patients or coworkers.[1,2]

Our study had several limitations. The assessment was conducted in a single hospital using 1 type of antigen test. Additional data are needed for other antigen test kits. Sequencing was not performed to determine the SARS-CoV-2 variant infecting the study personnel. However, the assessment occurred in the context of widespread (>90%) omicron variant transmission in our region. Assessment of symptoms was completed for only a subset of employees. Further studies are needed to determine whether asymptomatic individuals are less likely to have positive antigen results 5 or more days after diagnosis than symptomatic individuals. The day of diagnosis was considered day 0 for our assessment, whereas the CDC has recommended that day 0 should be the day that symptoms first appeared.[3] Because many personnel may have been tested 1 or more days after symptom onset, our results may underestimate the duration of positive antigen tests for facilities that conduct testing based on the timing of symptom onset.

Finally, further studies are needed to determine whether persistent antigen positivity on day 5 or later after diagnosis is associated with culture of viable virus and risk for transmission.

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Virus decay rates should not be used to reduce recommended room air clearance times

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To the Editors—We read with concern the letter by Hurlburt et al[1] proposing revisions to the recommended room air clearance times for infectious aerosols in healthcare facilities. We believe that the calculations performed to justify the changes are based on flawed assumptions and an erroneous calculation. Experimental data on the survival of airborne SARS-CoV-2 virus and the dynamics of room ventilation do not support their conclusions.

Hurlburt et al based their proposed changes on data describing the effects of humidity on the viability of airborne influenza viruses, and on reports that influenza decays more rapidly at mid-range humidities. They then assumed that these decay rates apply to SARS-CoV-2 as well. In fact, this is not the case. Schuit et al[2] studied the decay in viability of airborne SARS-CoV-2 for relative humidities of 20% to 70% at 20°C and found that SARS-CoV-2 was relatively stable in air in the absence of sunlight ($k_{infect} = 0.008$ per minute) and that humidity did not significantly affect the decay rate. Other researchers have also reported either no effect or a small effect of humidity on the decay rate of airborne SARS-CoV-2.[3,4]

Using data for influenza rather than SARS-CoV-2, Hurlburt et al assumed that a relative humidity of 40% to 60% would reduce the viability of SARS-CoV-2 by 30% to 50%. Unfortunately, these researchers miscalculated the effect that this would have on air clearance times. They simply multiplied the equation for the clearance time by their assumed reduction in viability, which has the mathematical effect of assuming that the reduction in viability occurs instantaneously. In fact, experimental data for SARS-CoV-2 and other viruses show that losses in viability are best modeled as an exponential decay. The correct version of the formula is

$$t = \frac{-\ln[1 - (PRE/100)]}{ACH + (k_{infect} \times 60)} \times k_{mix} \times 60$$

where PRE is the desired percent particulate removal (%); ACH is the air exchange rate for the room ventilation (Air changes/hour); k_{infect} is the decay constant for infectivity of the virus (per minute); k_{mix} is the mixing factor (explained below); t is the time to achieve desired percent particle removal (minutes). The error in the authors' formula exaggerates the effect of losses in viability, especially over shorter times. The data from Schuit et al[2] suggest that it would take 45 minutes for airborne SARS-CoV-2 to lose 30% of its viability and 87 minutes to lose 50% of its viability, which is very different from the authors' assumption.

A second problem is that Hurlburt et al failed to include ventilation mixing factors in their calculations. The time required to remove airborne particles from a space can be estimated using the Centers for Disease Control and Prevention (CDC) Guidelines for Environmental Infection Control in Health Care Facilities (Table B.1).[5] Table B.1 matches the values in the "none" column of figure 1 of the Hurlburt et al letter. However, Table B.1 assumes that the air in

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