Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

American Journal of Infection Control 48 (2020) 1279–1285

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Letters to the Editor

Lessons learned – Outbreaks of COVID-19 in nursing homes

To the Editor:

Nursing home (NH) residents comprise a disproportionately high percentage of the deaths from COVID-19 in the United States[1] because close quarters exacerbate asymptomatic and presymptomatic spread among vulnerable populations. As infectious disease doctors and healthcare epidemiologists, our collective practice has been dedicated to preventing the spread of resistant bacteria in NHs, with a focus on implementing and assessing the use of personal protective equipment (PPE).[2–5] Thus, we were well-positioned to provide guidance for preventing the introduction of COVID-19 into the local NHs, and subsequently preventing its spread within these facilities when we had cases. Here are some lessons learned.

Lesson 1: After restricting visitors and volunteers, and screening admissions, staff will be the main source of COVID-19 in NHs. COVID-19 symptoms can be delayed, initially mild, and widely varied.[6] When calling out sick, staff must be supported with adequate sick leave and coverage to prevent presenteeism. Occupational and Employee Health play a critical role in preventing COVID-19 in NHs. Rapid testing of staff is mandatory so that a contact investigation can be initiated quickly.

Lesson 2: NH residents generally present with nonspecific symptoms prior to developing typical COVID-19 symptoms. Decreased appetite and energy, confusion, and low-grade fever often precede respiratory complaints. Any patient with these vague symptoms should be moved to a private room and tested. Time is your enemy; a single infected resident likely represents multiple asymptomatic or presymptomatic infections.

Lesson 3: Be able to test residents and staff quickly. While the CDC has advocated for weekly universal testing, we have focused on broad contact investigations.[7] As soon as you identify a resident with COVID-19, test all residents and staff regardless of the PPE being used. This is analogous to cancer staging; you need to assess the extent of your outbreak. If you find subsequent cases, continue testing with broad contact investigations until you stop finding positives. Be particularly focused on break room contact among staff where PPE adherence is low. Then hold your breath for 14 days and hope no more symptomatic residents or staff test positive.

Lesson 4: Assume everyone has COVID-19 in an outbreak until they test negative. Residents exposed to infected staff should be in private rooms until their tests return negative. Exposed staff should not return to work until they test negative and remain asymptomatic.

Lesson 5: After controlling your outbreak, focus on measures to prevent spread in the event that an asymptomatic carrier of COVID-19 comes to work, such as:

- Daily surveillance of both staff and residents for COVID-19 symptoms and exposures, followed by rapid isolation and testing. For residents, temperature trends seem more important than absolute values.[8] As testing becomes more available, expand testing to include at-risk asymptomatic staff or residents (eg, those who live in high-prevalence zip codes or work at other institutions with an active outbreak).
- Universal PPE, focused on protecting the faces of staff and residents in the moments when they are closest together. In addition to universal masking, eye protection (ie, face shield or googles) is required while providing direct resident care or when in a resident's room, and gowns and gloves are required for high-contact care (eg, bathing, wound care).[9] Residents wear masks while receiving care, and when leaving the unit.
- Limiting traffic through NHs. We have restricted visitors and prohibited volunteers and geographically assigned clinical staff and housekeeping to specific units. Most outpatient visits have been converted to telemedicine. For specialty care, we have asked a single provider to come to the NH rather than sending the residents to outpatient clinics. NHs should invest in treatment rooms which can accommodate in-facility procedures. Private rooms may be needed for family communication (eg, videoconferencing) and isolation to prevent resident-to-resident transmission.
- Physical distancing for NH staff. NHs need to re-envision their work and break areas. Computers on wheels allow staff to spread out. Plexiglas shields could be used for change of shift reporting. Outdoor and large dining rooms should be used as break areas.

We need to re-imagine how care is delivered in NHs and invest in infrastructure that keeps residents and staff healthy. It is difficult to control the introduction and spread of COVID-19 in NHs and requires resources that most NHs do not currently have. NHs need to invest in Infection Preventionists and Occupational and Employee Health. Testing needs to be readily available and free of charge. COVID-19 will not be the last respiratory infection to threaten NH residents; it is time to invest in prevention for the future.

References

1. Abrams HR, Loomer L, Gandhi A, Grabowski DC. Characteristics of U.S. nursing homes with COVID-19 cases. *J Am Geriatr Soc*. 2020;68:1653–1656.
2. Roghmann M-C, Johnson JK, Sorkin JD, et al. Transmission of Methicillin-Resistant Staphylococcus aureus (MRSA) to healthcare worker gowns and gloves during care of nursing home residents. *Infect Control Hosp Epidemiol*. 2015;36:1050–1057.
3. Pineles L, Morgan DJ, Lydecker A, et al. Transmission of MRSA to healthcare worker gowns and gloves during care of nursing home residents in VA community living centers. *Am J Infect Control*. 2017;45:947–953.

0196-6553/Published by Elsevier Inc. on behalf of Association for Professionals in Infection Control and Epidemiology, Inc.

4. Blanco N, Pineles L, Lydecker AD, et al. Transmission of resistant gram-negative bacteria to health care worker gowns and gloves during care of nursing home residents in veterans affairs community living centers. *Antimicrob Agents Chemother*. 2017;61:e00790–17.
5. Morgan DJ, Zhan M, Goto M, et al. The effectiveness of contact precautions on methicillin-resistant Staphylococcus aureus (MRSA) in long-term care across the United States [e-pub ahead of print]. *Clin Infect Dis*. https://doi.org/10.1093/cid/ciz1045. Accessed August 13, 2020.
6. *Coronavirus Disease 2019 (COVID-19) – Symptoms*. Centers for Disease Control and Prevention; 2020. Available at: https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html. Accessed July 1, 2020.
7. *Coronavirus Disease 2019 (COVID-19) - Testing Guidelines for Nursing Homes*. Centers for Disease Control and Prevention; 2020. Available at: https://www.cdc.gov/coronavirus/2019-ncov/hcp/nursing-homes-testing.html. Accessed July 6, 2020.
8. High KP, Bradley SF, Gravenstein S, et al. Clinical practice guideline for the evaluation of fever and infection in older adult residents of long-term care facilities: 2008 update by the Infectious Diseases Society of America. *Clin Infect Dis*. 2009;48:149–171.
9. *Implementation of Personal Protective Equipment (PPE) in Nursing Homes to Prevent Spread of Novel or Targeted Multidrug-resistant Organisms (MDROs)*. Centers for Disease Control and Prevention; 2019. Available at: https://www.cdc.gov/hai/containment/PPE-Nursing-Homes.html. Accessed June 22, 2020.

Conflicts of interest: None to report.

Justin J. Kim, MD*
KC Coffey, MD, MPH
Daniel J. Morgan, MD, MS
Mary-Claire Roghmann, MD, MS
[a] *VA Maryland Health Care System, Baltimore, MD*
[b] *Department of Epidemiology and Public Health, University of Maryland School of Medicine, Baltimore, MD*

* Address correspondence to Justin J. Kim, MD, Baltimore Geriatrics Research Education and Clinical Center, VA Maryland Health Care System, 10 North Greene St, Baltimore, MD 21201.
E-mail address: justin.kim@som.umaryland.edu (J.J. Kim).

https://doi.org/10.1016/j.ajic.2020.07.028

Monitoring environmental contamination caused by SARS-CoV-2 in a healthcare facility by using adenosine triphosphate testing

We read with great interest the recent article by Wu et al[1] describing a study of environmental contamination by SARS-CoV-2. The authors reported that the touchable surfaces were heavily contaminated in the designated hospital for 2019 novel coronavirus diseases (COVID-19). Environmental management in healthcare facilities is essential for preventing hospital outbreaks of SARS-CoV-2 during the 2019 novel coronavirus disease (COVID-19) pandemic.[2] Assessment of environmental contamination with Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by real-time reverse transcriptase-polymerase chain reaction (RT-PCR) or culture-based method is not cost effective and time consuming. Adenosine triphosphate (ATP) monitoring is utilized as a surrogate marker for hygiene in hospitals.[3] The detection of ATP indicates a biologic reaction that produces light such as organic matter, including microbes, feces, dirt.[4] ATP is required during viral lifecycles, especially during viral replication.[5] However, the correlation between viral concentration and ATP measurement has not been well documented. The objective of this study was to determine the contamination degree of an isolation room of a patient with COVID-19 using additional ATP monitoring, before and after cleaning, to determine the proper approach to prevent the hospital spread of SARS-CoV-2.

An adult patient with COVID-19 was treated in a negative-pressure isolation room in March 2020 at our tertiary care hospital in South Korea. Surface samples in the isolation room and bathroom inside the isolation room were collected using an eNAT sampling kit (Copan, Brescia, Italy) at 25 sites for real-time RT-PCR analysis for SARS-CoV-2. The sampling sites were divided into routine disinfection sites and sites that were not disinfected. The samples at routine disinfection sites were collected before and after daily cleaning measures. Samples from nondisinfected sites were collected once before the routine cleaning measures. The routine cleaning of the room was done once daily with 0.2% sodium hypochlorite (Clorox). The samples were taken on the fifth hospital day. ATP monitoring was performed immediately before sampling for RT-PCR of SARS-CoV-2. The real-time RT-PCR was performed using a STANDARD M nCOV Real-Time Detection Kit (SD biosensor, Osong, Korea) following the manufacturer's instructions with an ABI 7,500 fast instrument (Applied Biosystems, CA). The target genes were *RdRp* and *E* genes.[6] The amplification curve of each gene was checked and the Ct values were recorded regardless of cutoff value (Ct ≤36), as suggested by the manufacturer. ATP bioluminescence was measured in relative light units (RLUs) using a 3 M Clean-Trace Surface ATP meter (3 M, St. Paul, MN) following the manufacturer's protocol. The results were represented as RLUs. The threshold value for the ATP measurement was 100 RLU/100 cm^2.

A 25-year-old male patient was admitted to the isolation room for COVID-19 on the second day of symptom onset, and the samples were collected on the seventh day of symptom onset. The patient had a slight dry cough without fever on the date of sampling. The patient did not wear any type of mask. The severity of COVID-19 was mild. The patient had high viral shedding of SARS-CoV-2 on the sampling day, with cycle threshold values of 29.94, 29.19, and 21.88 in the oropharynx, nasopharynx, and sputum, respectively. The RT-PCR of all environmental samples showed negative results. The results of ATP monitoring before and after cleaning are shown in Table 1. The isolation room floor, mattress, bathroom sink, and pillow showed high ATP measurements, whereas the toilet seat cover, shower handle, and ventilator hole in the isolation room revealed negative results for ATP monitoring. The median ATP measurement decreased by 47% after cleaning [before cleaning: 328 (131-794) RLU vs. after cleaning: 157 (113-179) RLU]. The difference between the ATP measurement results before and after cleaning was significant by the paired *t* test analysis ($P = .03$).

Even though previous studied have reported extensive environmental contamination of the healthcare facilities housing COVID-19 patients, by SARS-CoV-2,[7] SARS-CoV-2 was not detected in any surface sample in our study. In line with our results, Wang et al. also failed to detect SARS-CoV-2 RNA among various environmental surface samples.[8] These results suggested that environmental contamination may not always happen at the level that can be detected by RT-PCR when the patient has only a mild cough.

In our study, post cleaning ATP value was significantly decreased. These results indicate that routine cleaning may be enough to manage the hospital environment for preventing the outbreak of COVID-19. There were limited studies regarding association between viral contamination and ATP measurement. Laura et al. reported that ATP measurement does not represent the viral load on surfaces.[9] These results suggest that the ATP assay merely has a role in the assessment of surface contamination.

In conclusion, routine cleaning effectively controls environmental contamination in a COVID-19 isolation room, according to ATP monitoring. The ATP system could be used to monitor environmental cleanliness, and its usefulness as a SARS-CoV-2 contamination screening tool should be evaluated in future studies.