JAMDA 21 (2020) 893–894

JAMDA

journal homepage: www.jamda.com

Special Article

Practical Steps to Improve Air Flow in Long-Term Care Resident Rooms to Reduce COVID-19 Infection Risk

Richard M. Lynch PhD [a,*], Reginald Goring BS [b,c]

[a] Environmental Safety Management Corporation, Riverside, NJ
[b] California Association of Health Facilities, Sacramento, CA
[c] American Healthcare Association, Washington, DC

Keywords:
COVID
Corona
skilled nursing facilities
airborne infection isolation
respiratory droplets
long-term care
hotel
industrial hygienist

A B S T R A C T

The potential for spread of COVID-19 infections in skilled nursing facilities and other long-term care sites poses new challenges for nursing home administrators to protect patients and staff. It is anticipated that as acute care hospitals reach capacity, nursing homes may retain COVID-19 infected residents longer prior to transferring to an acute care hospital. This article outlines 5 pragmatic steps that long-term care facilities can take to manage airflow within resident rooms to reduce the potential for spread of infectious airborne droplets into surrounding areas, including hallways and adjacent rooms, using strategies adapted from negative-pressure isolation rooms in acute care facilities.

Pathways for COVID-19 Spread in Long-Term Care

With the Pandemic spread of COVID-19 infections, and understanding that the virus is spread via droplet nuclei, as well as fomite transmission from surfaces,[1] patients and staff in skilled nursing facilities, assisted living, or other long-term care facilities face special challenges, as older populations with pre-existing conditions are at higher infection risk.[2]

According to the California Department of Public Health,[3]

> Most SNFs do not have airborne infection isolation rooms (AIIR) for placement of residents with COVID-19 infection… Place residents with suspected or confirmed COVID-19 infection in single-occupancy rooms (or cohorted in multi-occupancy rooms with other residents with confirmed COVID-19 infection) with the door closed. Symptomatic residents and exposed roommates must limit movement outside their room; if they need to leave the room, they should wear a facemask.

Atkinson et al[4] reported that respiratory droplets from humans (which may include bacteria, fungi, and viruses) typically range from 0.5 to 12 μm in diameter, and droplet nuclei <5 μm can remain airborne for significant periods of time. van Doremalen et al[5] recently reported that COVID-19 remains stable in airborne aerosols for at least 3 hours, and can persist on inanimate surfaces for 48 to 72 hours. Kampf et al[6] reported that Corona viruses can live on surfaces up to 9 days.

Based on the above, it can be seen that techniques for prevention of infection including social distancing, interception of droplet discharge during coughs and sneezes, regular cleaning and disinfection of surfaces, hand hygiene, and the use of personal protective equipment (PPE) are all essential to controlling spread. However, those steps alone are unlikely to provide adequate protection for residents and care providers in long-term care facilities, with several long-term care facilities reporting COVID-19 outbreaks.

Control of Airflow Essential to Reducing Infection Spread

In acute care facilities, airborne infection isolation (AII) rooms are designed to be under a slight negative pressure with respect to adjacent rooms and hallways. This reduces the potential for airborne respiratory droplets to be carried on air currents from the patient into the hallways, where they can then be further transported into surrounding areas. General design parameters typically include an exhaust fan discharging above the rooftop drawing air from the AII room at a rate sufficient to place the room under approximately −0.03″ water column vacuum relative to the hallway. According to the American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE 170), AII rooms provide 12 air changes per hour (ACH), with 2 ACH from outdoor air.[7] ASHRAE 170 recommends that resident rooms within skilled nursing facilities provide only 2 ACH outdoor with no pressure differential.

The authors declare no conflicts of interest.

* Address correspondence to Richard M. Lynch, PhD, CIH, Environmental Safety Management Corporation, 21 E. Scott Street, Riverside, NJ 08075.
E-mail address: rlynch@esmcorp.com (R.M. Lynch).

https://doi.org/10.1016/j.jamda.2020.04.001
1525-8610/

Five Steps to Modify Patient Rooms to Negative Pressure

Administrators or facility managers for long-term care facilities should consider the following to reduce risk of community infection within the facility. Inform your state Department of Health representative to ensure that these do not result in noncompliance with Life Safety Code or state regulations.

Step 1: Estimate Total Room Volume, Ventilation, and Differential Pressure

As an example, in a 15′ × 20′ room with 8′ ceilings, the total room volume is 2400 cubic feet. Assuming the ASHRAE 170 guideline of 2 ACH, the room is receiving approximately 80 cubic feet per minute (cfm) of outdoor air from the rooftop air handler along with some recirculated air. Estimate room pressure at the hallway door using a manometer, and use a tissue or plastic to determine air current direction.

Step 2: Install Supplemental Exhaust Ventilation Through Dedicated Exhaust Portals

Inspect the room for sources of dedicated exhaust ports leading to the outside. This may include bathroom or kitchenette exhaust fans or possibly portable terminal air conditioning units, but *does not include* return registers associated with the general heating, ventilation, and air conditioning (HVAC) system. Contact an industrial hygienist and HVAC contractor to discuss options for supplemental exhaust ventilation through these portals. This may include an in-line fan to increase exhaust discharge from bathroom vents, or increasing the size of exhaust fans. In a 2400-cubic-feet resident room, an additional 100 cfm of exhaust discharging from the room to the outdoors would increase the ACH from 2 to approximately 4.5. A 250-cfm booster fan would increase the air exchange rate by approximately 6.5 ACH beyond the 2 ACH already provided by the rooftop air handler. This would remove airborne respiratory droplets approximately 3 times faster than the standard resident room. If there are no apparent exhaust portals, contact the industrial hygienist to design appropriate safe retrofit options. Anticipate higher energy costs and increased noise as conditioned make-up air is drawn from hallways into rooms and discharged outdoors.

Step 3: Increase Efficiency of Filtration

All rooms are typically equipped with MERV (minimum efficiency reporting value) 7 prefilters and MERV 14 final filters, which remove up to 98% of airborne particles as small as 0.3 to 1.0 μm in diameter (typical diameter of respiratory droplets). Place lower-efficiency filters on HVAC return registers to reduce airborne droplets entering the return air stream. Discuss these options for increasing filter efficiency with your HVAC contractor to ensure compatibility with your HVAC system.

Step 4: Keep Doors to Hallways Closed

Keep doorways between hallways and resident rooms closed to maintain a negative pressure differential. If the bathroom is where the exhaust is being discharged, keep bathroom doors open to the resident room.

Step 5: Follow Infectious Disease Prevention Guidelines for Health Care Workers

Continue to follow Centers for Disease Control and Prevention (CDC) guidelines for prevention of infections including hand hygiene, personal protective equipment and eye protection, respiratory hygiene/cough etiquette, patient placement, cleaning of patient care equipment devices, and environmental cleaning as described in the 2007 CDC “Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings.”[8] Adhere to recommendations for triaging of patients, adherence to standard and transmission-based precautions, patient placement, aerosol-generating procedure precautions, management of ill health care workers, environmental infection control, and reporting as described in the recently released “Interim Infection Prevention and Control Recommendations for Patients with Suspected or Confirmed Coronavirus Disease 2019 (COVID-19) in Healthcare Settings.”[9]

A Certified Industrial Hygienist can work with your HVAC contractor and facility manager to design these upgrades. Although these approaches may not reach the levels of protection in acute care All rooms, they can reduce risk for COVID-19 spread and transmission. These guidelines should also be considered for hotel rooms and other facilities being converted for use as emergency COVID-19 sites.

References

1. Centers for Disease Control and Prevention. How COVD-19 spreads. Available at: https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-covid-spreads.html. Accessed April 2, 2020.
2. Centers for Disease Control and Prevention. Centers for Disease Control, people who are at higher risk for severe illness. Available at: https://www.cdc.gov/coronavirus/2019-ncov/specific-groups/high-risk-complications.html. Accessed April 2, 2020.
3. California Department of Public Health. March 20, 2020, letter to facility managers. Available at: https://www.cdph.ca.gov/Programs/CHCQ/LCP/Pages/AFL-20-25-1.aspx. Accessed April 2, 2020.
4. Atkinson J, Chartier Y, Pessoa-Silva CL, et al. Natural ventilation for infection control in health-care settings. World Health Organization. Available at: https://www.ncbi.nlm.nih.gov/books/NBK143281/. 2009. Accessed April 2, 2020.
5. van Doremalen N, Bushmaker T, Morris DH, et al. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. N Engl J Med 2020;382:1564–1567.
6. Kampf G, Pfaender S, Steinmann E. Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. J Hosp Infect 2020;104:246–251.
7. American Society of Heating. Refrigeration and Air Conditioning Engineers. Ventilation of health care facilities, Standard 170. Atlanta, GA: ASHRAE; 2008.
8. Centers for Disease Control and Prevention. Guideline for isolation precautions: Preventing transmission of infectious agents in healthcare settings. Available at: https://www.cdc.gov/infectioncontrol/guidelines/isolation/. 2007. Accessed April 2, 2020.
9. Centers for Disease Control and Prevention. Interim infection prevention and control recommendations for patients with suspected or confirmed coronavirus disease 2019 (COVID-19) in healthcare settings. Available at: https://www.cdc.gov/coronavirus/2019-ncov/infection-control/control-recommendations.html. 2020. Accessed April 2, 2020.