

# A Practical Decontamination Framework for COVID-19 Front-line Workers Returning Home

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The question, “*how can I keep the people in my household safe?*” points to a fundamental fear among health care workers and other essential employees. For those on the front lines of the COVID-19 pandemic, anxiety regarding virus transmission does not stop at shifts’ end. Instead, providers are grappling with how to ensure they do not bring infectious materials home. Few, if any, guidelines exist to advise personnel on how to best limit viral spread to their families, and most focus on how to limit transmission after individuals become infected. In this context, we have endeavored to synthesize scientific evidence, agency guidelines, and best practices from workers in the field, to create a framework for staff returning from work.

## PRINCIPLES OF VIRAL TRANSMISSION

Decontamination recommendations are based largely on our understanding of how the virus spreads, and how long it persists on various surfaces. This information is extrapolated from several sources including studies on endemic coronavirus 229e (the common cold), Middle East respiratory syndromerelated coronavirus, and recent examination of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (COVID-19) infected-cruise ships. Risk mitigation strategies, such as social distancing and the use of personal protective equipment, are based on transmission data, demonstrating spread primarily through inhaling droplets. However, persons may also become infected by transferring virus from contaminated surfaces to mucous membranes.<sup>1</sup> The precise contact time necessary to transmit SARS-CoV-2 is unknown; however, Flu A data suggests that 5 second is enough to transfer approximately 1/3 of virus inoculum.<sup>2</sup>

## VIRAL SURVIVAL

Transmission risk also seems to be highly dependent on the material in question, which has direct implications for workers worried about bringing virus home.

### Hard Surfaces

Experimental evidence indicates that SARS-CoV-2 survives better on hard surfaces, such as glass, metal, or plastic.<sup>3</sup> In some studies, coronavirus could remain infectious up to 9 days, with higher

inocula (eg, greater amount of virus) remaining infectious longer.<sup>4</sup> However, the Centers for Disease Control and Prevention (CDC) reports that swabs taken from the Diamond Princess cruise ship had viral traces a full 17 days after passengers disembarked (though it remains unclear whether these traces were sufficient to be infective).<sup>5</sup>

### Porous Materials

Soft, porous materials such as cardboard or fabric seem to be more resistant, as particles get trapped between fibers making it difficult for the virus to transfer again. In fact, 1 study found no viable SARS-CoV-2 remained on cardboard beyond 24 hours.<sup>3</sup>

### Environmental Variation

Viral survival also depends on environmental conditions. Higher humidity (eg, environments with 50% humidity relative to 30%) favored HCoV-229E survival, whereas temperatures above 86–1004°F were more hostile for Middle East respiratory syndromerelated coronavirus.<sup>4</sup> Exposure to UV-C light also seems to degrade viral RNA<sup>6</sup> but may damage the charge on protective equipment like N95 masks.<sup>7</sup>

## WHAT ARE THE BEST SOLUTIONS FOR CLEANING VARIOUS SURFACES?

Although data suggest SARS-CoV-2 may persist on surfaces for days, there are many household that effectively kill the virus in around a minute. The World Health Organization endorses cleaning products that are >62% ethanol (with other sources preferring those >75%), 0.5% hydrogen peroxide (commercially available topical solutions are usually around 3%), and 0.1% sodium hypochlorite (bleach).<sup>8</sup> In addition, products with a US Environmental Protection Agency-approved emerging viral pathogens icon are expected to be effective against SARS-CoV-2, but consumers should adhere to the manufacturer’s guidelines. A full list from the can be found here: (<https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2>)

If bleach is selected, bleach dilution guidelines should be followed (Table 1). A new batch should be made daily, especially if the solution is kept in a translucent container. Care should be taken when using bleach solution to avoid injury (wear gloves) or permanent damage to items.

**TABLE 1.** Sodium hypochlorite dilution ratios to create a 1% solution

Original Strength (% Sodium Hypochlorite)	Bleach (mL)	Water (mL)	Total (mL)
1%	100	9000	1000
2%	50	950	1000
3%	33	967	1000
4%	25	975	1000
5%	20	980	1000

To make using US cup measurements you need a 1:9 ratio.  
Add 1/4c bleach to 2 1/2 c water if using a 1% solution.

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## WHAT DO I DO WHEN I GO HOME?

Perfect guidelines for front-line workers do not exist. Much remains to be uncovered regarding how the virus behaves outside the hospital setting. Individuals will need to tailor their approach to the risk profiles of their family (eg, immunocompromised children, elderly parents, 2-physician homes) and the realities of their living spaces or finances. As has been widely touted, the most effective strategy is likely isolation. High-risk workers may aim to totally quarantine themselves from their families by either living in separate dwellings or partitioning their homes. However, this set-up is both emotionally challenging, and in many cases, impossible. Thus, our strategies attempt to balance the aforementioned science, and practical constraints.<sup>9,10</sup> Additional information can be found at the CDC (<https://www.cdc.gov/coronavirus/2019-ncov/index.html>) and the World Health Organization ([https://www.who.int/health-topics/coronavirus#tab=tab\\_1](https://www.who.int/health-topics/coronavirus#tab=tab_1)) websites.

## HOME TO WORK TRANSITION CHECKLIST

Preparing for A High-risk Environment (Supplemental Fig. 1, <http://links.lww.com/SLA/C185>):

- Avoid wearing any accessories
- Minimize the items you bring (excess tech, multiple bags)
- Bring food in disposable bags, avoid reusable coffee mugs
- Consider placing cellular phone in disposable plastic bag, or in pocket of clothing
- Practice meticulous hand hygiene

During Working Hours (Supplemental Fig. 2, <http://links.lww.com/SLA/C186>):

- Wear a hair covering (eg, cloth scrub cap all day)
- For persons with longer hair, hair should be braided or pulled up into a bun.
- Change into scrubs upon entering, and roll pants or stuff into socks to avoid contact with shoes. Best to change in the locker room.
- Change into a pair of hospital-only shoes, preferably those that withstand decontamination solutions and do not require hands for donning/doffing.
- Do not wear white coats/overwear when seeing patients
- Use speakerphone as possible to avoid bringing phone to face
- Regularly disinfect phone, pager, badge, eyewear, stethoscope, and surfaces with environmental protection agency-approved decontamination
- Adhere to PPE donning and doffing protocols, using the buddy system to ensure compliance if no dedicated “dofficer” is available

Preparing for Departure (Supplemental Fig. 3, <http://links.lww.com/SLA/C187>):

- Remove hospital shoes (+/- with gloves) and store in locker
- Remove scrub tops by lifting from the collar, without turning inside out to avoid contact with outside; pull pants from the ankle cuffs if rolled up, or peel off from the waist if wearing socks over pant legs to avoid outside contact with skin
- Place cloth scrub cap and socks in plastic bag for home laundering
- If you have operated or performed aerosolizing procedures on person under investigation (PUI) or COVID-19+ patients, consider showering before leaving
- Wash hands
- Some personnel may choose to don surgical masks

Transit (Supplemental Fig. 4, <http://links.lww.com/SLA/C188>):

- Open trunk and place any items on top of plastic sheeting, close trunk

- Sanitize hand on car entry and exit
- Clean steering wheel, dashboard, and other high-touch surfaces (seatbelt, gearshift, turn signal, radio, door handles, touch screen) and wipe with a dedicated towel.
  - Avoid using bleach in closed areas
- Re-wipe phone

Home Arrival (Supplemental Fig. 5, <http://links.lww.com/SLA/C189>):

- Create a decontamination zone (ideally in a garage, but if not possible, immediately inside your home to avoid tracking infected material). Post a checklist and physically demarcate to keep others from touching anything in this zone. Stock area with:
  - laundry bag
  - shoe rack or tray
  - hand sanitizer
  - decontamination wipes/spray bottle with paper towels
- Try to bring the fewest potentially contaminated inside
- Remove shoes (handsfree if possible) leave in decontamination area
- Remove clothing, and place directly in cloth laundry bag (do not shake), leave in decon area for now
  - Proceed directly to shower, if possible, designating 1 shower in home for high-risk workers
  - Detergent should be sufficient to disinfect clothing, water temperature >160°F is also effective
- Wipe phone, badge, credit cards, and keys
- Wipe down any surfaces encountered
- CDC guidance regarding universal mask use is evolving. Individuals may choose to wear a surgical mask to decrease transmission in high-risk conditions

### Maintenance

- Ensure that shared spaces have good airflow (eg, air conditioner or an opened window)
- Perform hand hygiene frequently. Especially before and after preparing food, before eating, after using the toilet, and whenever hands look dirty.
  - Flush toilets should be flushed with lid closed.
- Clean all “high-touch” surfaces: counters, tabletops, doorknobs, bathroom fixtures, toilets, phones, keyboards, tablets, and bedside tables
- Consider using dedicated linen and eating utensils for workers; cleaned with soap and water after use and may be re-used instead of being discarded.

Self-Isolation for Individuals who are COVID-19+ or PUI (Supplemental Fig. 6, <http://links.lww.com/SLA/C190>)

Anticipate the need for an area to isolate yourself away from other members of your household. The time to create an isolation zone is not after you have become exposed or sick.

- If you share your home, the most important thing is to keep your home very clean and mandate handwashing before and after any communal task
- If possible, designate a separate entrance for PUI
- Isolate sleeping, person hygiene/toileting, and eating from the rest of the household
- If symptomatic, wear a surgical mask at all times, and limit time outside of the room. 6' social distancing is not enough, as you need to limit ongoing exposure.
- Avoid touching your face (masks may help cue this behavior)
- Do not handle food others will eat
- If laundry is not directly accessible to quarantined individual, pass laundry in cloth laundry bag, throw entire bag in wash, wash hands
- Use video conferencing to communicate

## REFERENCES

1. Wang W, Xu Y, Gao R, et al. Detection of SARS-CoV-2 in different types of clinical specimens. *JAMA*. 2020. doi: 10.1001/jama.2020.3786.
2. Bean B, Moore B, Sterner B, et al. Survival of influenza viruses on environmental surfaces. *J Infect Dis*. 1982;146:47–51.
3. 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.
4. Kampf G. Potential role of inanimate surfaces for the spread of coronaviruses and their inactivation with disinfectant agents. *Infect Prevent Pract*. 2020;2:100044.
5. Moriarty LF, Plucinski MM, Marston BJ, et al. Public health responses to COVID-19 outbreaks on cruise ships — worldwide, February–March 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69:347–352.
6. Darnell MER, Taylor DR. Evaluation of inactivation methods for severe acute respiratory syndrome coronavirus in noncellular blood products. *Transfusion*. 2006;46:1770–1777.
7. Haung V. N95 Re-Use Instructions 2020. 2020. Available at: <https://www.sages.org/n-95-re-use-instructions/>. Accessed March 31, 2020
8. WHO. Infection Prevention and Control of Epidemic- and Pandemic-Prone Acute Respiratory Infections in Health Care. Geneva: World Health Organization; 2014. Annex G, Use of disinfectants: alcohol and bleach. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK214356/>
9. Zummallen R. Still Have to Drive? How to Disinfect Your Car to Cut Coronavirus Risk. *The Seattle Times Nation & World*. 2020. Available from: <https://www.seattletimes.com/nation-world/how-to-keep-your-car-clean-to-reduce-coronavirus-risk>.
10. Brat GA, H SP, Chhabra K, et al. Protecting surgical teams during the COVID-19 outbreak: a narrative review and clinical considerations. *Ann Surg*. 2020. Available from: [https://journals.lww.com/annalsofsurgery/Documents/COVID%20Surgery\\_VF.pdf](https://journals.lww.com/annalsofsurgery/Documents/COVID%20Surgery_VF.pdf).