



# CITADEL EHS

assess • resolve • strengthen



SCAN ME

Presented by  
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and  
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Practice Leader, Industrial Hygiene & Safety

## Clean and Clear: Which Cleaning and Testing Methods Should You Be Using

# INTRODUCTIONS

Please meet our discussion leaders for today:



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Please submit any questions  
that arise during the  
presentation to us  
via online chat or by email to  
**[mtorres@citadelehs.com](mailto:mtorres@citadelehs.com)**

# OBJECTIVES

**Review the science and application of methods for surface cleaning, disinfecting and testing and how to improve your indoor air quality to minimize the risk from COVID-19.**

This includes:

- **Effective ventilation system operation** and the use of auxiliary equipment
- Pros and cons and the application of common **cleaning and disinfecting** methods
- Methods to evaluate the **effectiveness of cleaning and disinfecting**
- How to **select the best method(s)** to apply at your facility



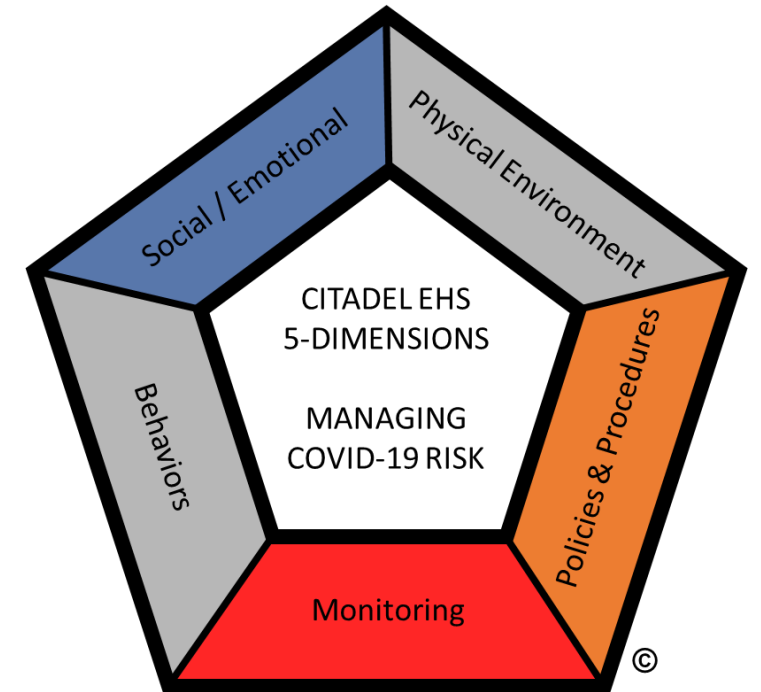
# MANAGING EXPECTATIONS

- Unfortunately there is **no “silver bullet”** solution
- Nearly all methods have their place
- We will not be able to cover every method today
- We will provide information to help you select the best method(s) for your application but . . .
- We will not promote or endorse any particular product or company nor discuss costs – focusing only on the science and application of various methods
- Technologies are evolving rapidly – so stay tuned



# CITADEL EHS 5-DIMENSIONS

During the previous webinar, we outlined Citadel's 5-Dimensions Assessment Framework to evaluate risk and design fit-for-purpose controls to manage COVID-19 risks in your workplace.



Our discussion today will focus on:

- **Policies & Procedures** for cleaning and disinfecting
- **Monitoring** and managing the indoor environment
- **Social/Emotional** benefits

# CLEANING VS DISINFECTING

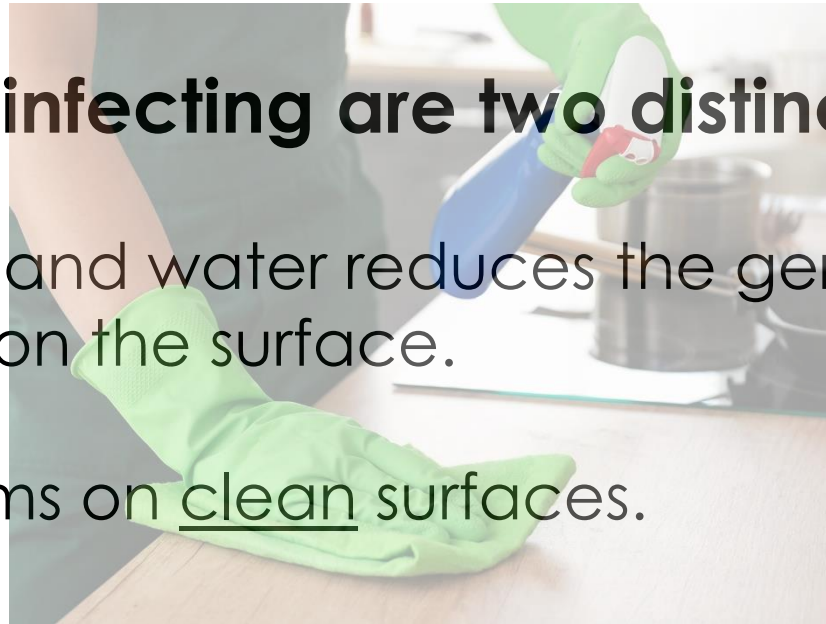
CLEANING  $\neq$  DISINFECTING

**Cleaning and disinfecting are two distinct processes**

***Cleaning*** with soap and water reduces the germs, dirt, and impurities on the surface.

***Disinfecting*** kills germs on clean surfaces.

**Disinfecting may be ineffective if the cleaning step is not performed properly.**



# METHODS OF CLEANING AND DISINFECTING

## **Airborne cleaning and disinfection**

- Ventilation
- Filtration
- Ultraviolet radiation (UV)

## **Surface cleaning and disinfecting**

- Ultraviolet radiation (UV)
- Manual cleaning
- Electrostatic sprayers
- Hydrogen Peroxide
- Ultra-Low Volume (ULV) Foggers
- Sprayers



# AIRBORNE TRANSMISSION OF COVID-19

**Harvard Medical School** estimates that  
“Aerosolized coronavirus can remain in the air for up to three hours.”

**CDC notes:** “The contribution of small respirable particles, sometimes called aerosols or droplet nuclei, to close proximity transmission is currently uncertain. However, airborne transmission from person-to-person over long distances is unlikely. “



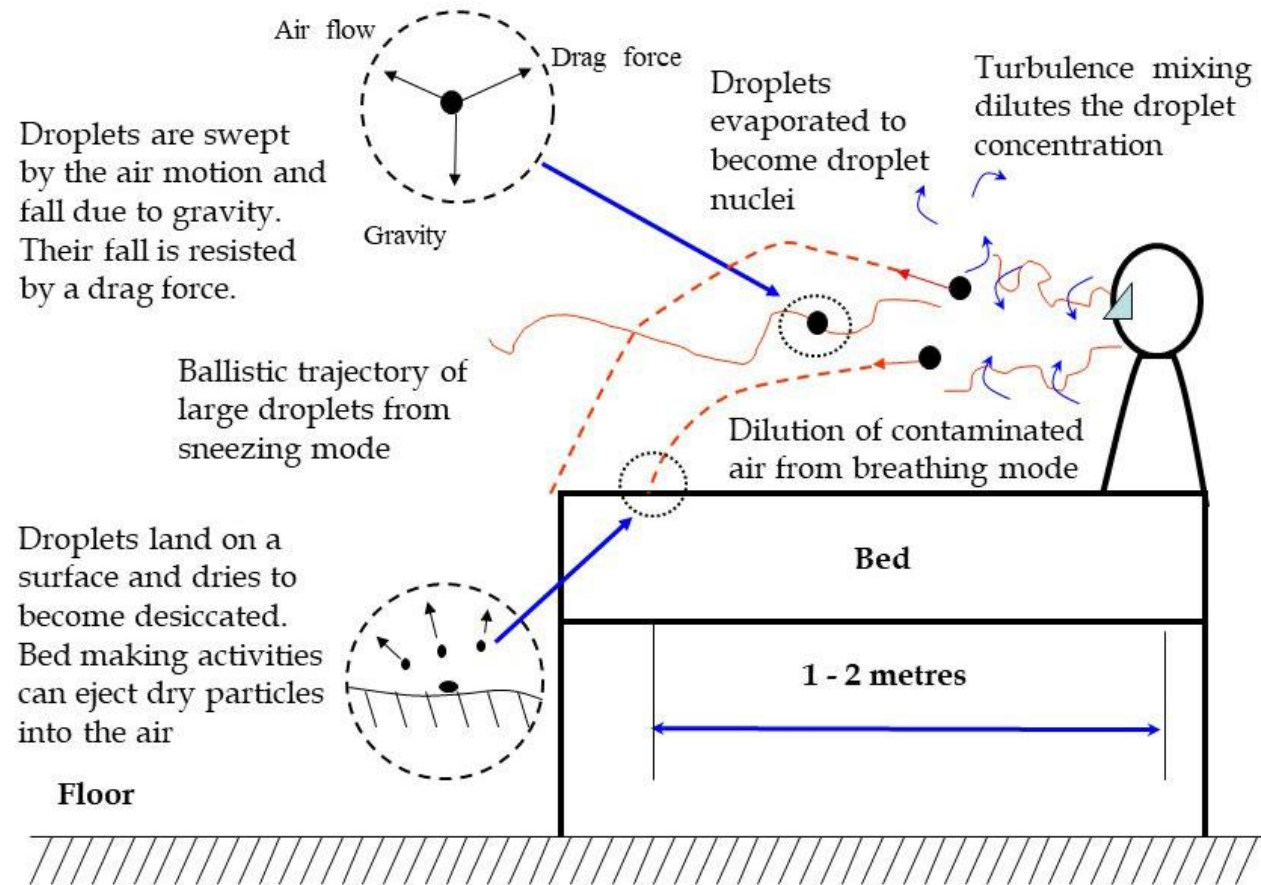
“It is unknown how long the air inside a room occupied by someone with confirmed COVID-19 remains potentially infectious. Facilities will need to consider factors such as the size of the room and the ventilation system design (including flowrate [air changes per hour] and location of supply and exhaust vents) when deciding how long to close off rooms or areas used by ill persons before beginning disinfection.”

## **ASHRAE Statement on airborne transmission of SARS-CoV-2**

“Transmission of SARS-CoV-2 through the air is sufficiently likely that airborne exposure to the virus should be controlled. Changes to building operations, including the operation of heating, ventilating, and air-conditioning systems, can reduce airborne exposures.”



# VENTILATION



# VENTILATION

- Natural ventilation can be quite effective, depending on local air quality
- The design and operation of HVAC systems can affect transmission, but is only one part of a COVID-19 control plan
- Dilution - At least 4-6 air changes per hour (ACH)
- Minimize air recirculation (100% exhaust)
- Target a Relative Humidity (RH) between 40% - 60%
- Disable demand-controlled ventilation
- Run systems longer (24/7 if possible)
- Pressure differentials – e.g. negative pressure

# FILTRATION

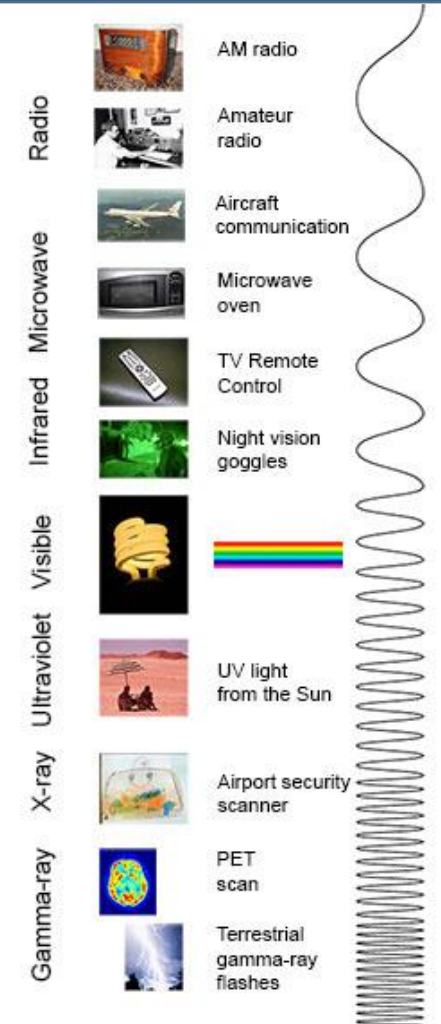
- Certain filters can remove particles that contain COVID-19 but they do not disinfect.
- High Efficiency Particulate Air (HEPA) filters at least 99.97% efficiency in removing particles as small as 0.3 microns.
- MERV (Minimum Efficiency Reporting Value) filters ratings of 17 or better required to filtering microbes and viruses.
- A HEPA filter is ranked between 17-20 the highest group in MERV ratings.
- Add portable room air cleaners with HEPA/MERV filters. May be difficult to move large volumes of air though.

*Caution: unfiltered vacuum cleaners can aerosolize a significant amount of respirable dust, which may carry infectious pathogens*



# ULTRAVIOLET (UV) RADIATION

- UV radiant energy was first used for disinfecting surfaces in 1877, for water in 1910 and for air in 1935.
- Germicidal UV (GUV) or Ultraviolet Germicidal Irradiation (UVGI) refers to using ultraviolet radiant energy to inactivate bacteria, mold spores, fungi or viruses.
- Three categories of UV radiation:
  - **UV-A light** (320-400nm) is UV light with the longest wavelength, and the least harmful and generally do not effectively inactivate viruses
  - **UV-B light** (290-320nm) causes sunburns with prolonged exposure along with increasing the risk of skin cancer and other cellular damage.
  - **UV-C light** (200-290nm) is extremely harmful and is commonly used to kill bacteria and inactivate viruses.
- Few accepted standards for equipment designed for the UV disinfection of air and/or surfaces.
- Effectiveness depends on wavelength, exposure time and ability of UV light to “see” the virus in air or on surfaces.

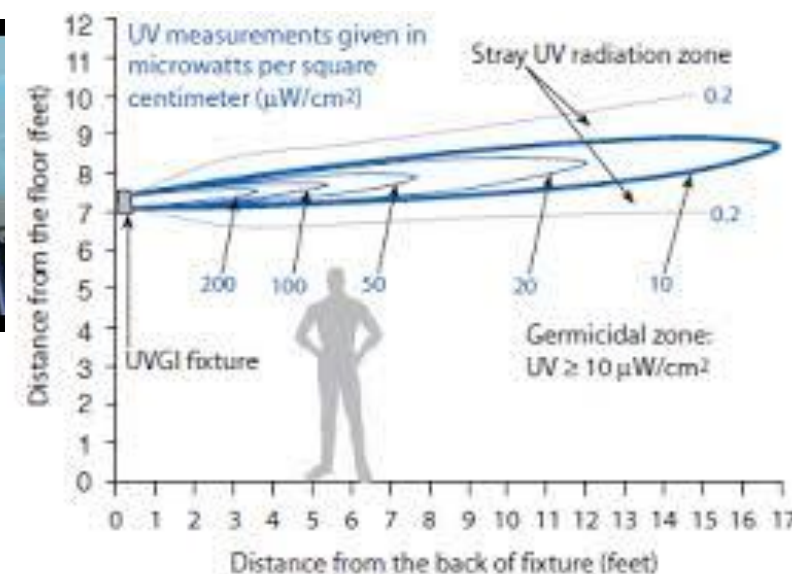




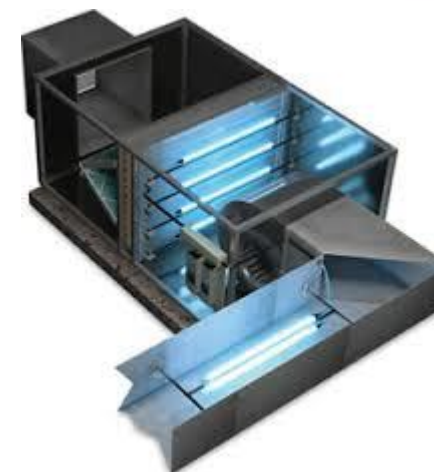
# UV APPLICATIONS

UV is typically used in three ways:

1. upper-room UVGI fixtures with air mixing, to disinfect air in the upper room where ceiling height permits;
2. mobile UVGI units, to disinfect high-touch surfaces (lamps, robots);



3. UVGI lamps in ventilation exhaust or supply ducts (mercury lamps).



# UV CONSIDERATIONS

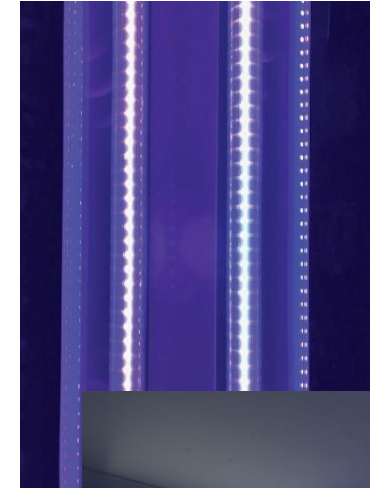
- UVGI is an excellent surface disinfectant, but it does not penetrate surface debris and cannot disinfect “dirty” surfaces.
- UV radiant energy may not reach shadowed recesses of surfaces.
- Hand-held, compact UVGI are useful for disinfecting small objects but require longer exposure times.
- UV useful to treat air in ducts, but does not help prevent person-to-person transmission in a room, therefore is a secondary approach to treating any recirculated air.
- UV rays in general will degrade paint, yellow plastics, and destroy most air filter materials.
- UV-C may damage plants.
- UV-C can damage the retina of your eye.
- Potential occupational exposure depending on the design (e.g. ozone, mercury, burns)



*Consult with specialist to select the right UV system for your application*

# LED (UV-A)

- Light emitting diodes (LEDs) and krypton-chlorine excimer lamps, in the germicidal range (UV-C), are emerging technologies.
- LED blue light excites certain molecules in harmful microorganisms through photo-activation. Reactive Oxygen Species (ROS) are then produced that damage and kill the harmful cells.
- Some studies found that exposure to UV-A light had no effect on viruses after 15 minutes.
- The advantage of UV-A or visible-light LEDs would be that they can easily be incorporated into LED-based lighting, and there might be no need for protective gear.



# SURFACE DISINFECTANTS

- Enveloped viruses, like COVID-19, are relatively easy to deactivate by disinfection.
- Not all disinfectants are created equal:
  - Stick to using those on EPA List N →
  - Be sure to use the product as directed for effectiveness and safety reasons
  - Don't rush – adhere to the prescribed dwell times



**Don't waste good disinfecting efforts by  
poor cleaning practices**



# MANUAL CLEANING

**Water** – helps remove and dislodge dirt and microbes, but does not dissolve fats and oils.

## **Soaps and Detergents**

- remove fats and oils from surfaces and reduce the surface tension of water
- help dissolve, disrupt and destroy COVID-19 lipid envelope

*Note: Antibacterial agents are generally ineffective against viruses*

## **Method**

- Quarter fold clean cloth/wipe and turn to new surface after each stroke
- Use parallel, linear, overlapping strokes working cleanest to dirtiest – never in circular motion
- Air dry or wipe dry with clean disposable paper towels or a clean towel or cloth.

# ELECTROSTATIC SPRAYERS

- Sprays an electrostatically charged mist (“dry fog”) onto surfaces and objects using a disinfecting solution combined with air and atomized by an electrode inside the sprayer.
- Envelopes objects and coats surfaces evenly even if the mist is only sprayed from one side
- Positively charged particles adhere to surfaces and objects



## Cautions

- Disinfecting product used must list fogging, fumigation, or electrostatic spraying as an application method
- Areas should be vacant during application and some period afterward (~1-2 hours)
- Safe for sensitive surfaces, such as wood, upholstery and electronics, but *avoid* paperwork, articles of clothing, food, dishware, wall decorations.
- Only works on surface that can be electrostatically charged



# VAPOR HYDROGEN PEROXIDE

Vapor Hydrogen Peroxide (VHP) or Hydrogen peroxide vapor (HPV) is a vapor form of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) with applications as a low-temperature antimicrobial vapor used to disinfect air and surfaces

- VHP is produced from a solution of liquid  $\text{H}_2\text{O}_2$  and water
- Special equipment generates VHP by passing aqueous hydrogen peroxide over a vaporizer, and circulates the vapor
- After the VHP has circulated in the enclosed space it is circulated back through the generator, where it is broken down into water and oxygen until concentrations of VHP fall to safe levels (typically  $<1$  ppm) or vented to the outside air
- Considered a "dry process" that doesn't leave toxic residue on surfaces
- Requires skilled application and monitoring as  $\text{H}_2\text{O}_2$  concentrations could exceed occupational exposure limits



# IONIZED HYDROGEN PEROXIDE

- A two-step decontamination process that activates and ionizes 7.8% Hydrogen Peroxide ( $\text{H}_2\text{O}_2$ ) solution into a fine mist/fog that produces Reactive Oxygen Species (ROS) that inactivates viral cells
- Electrostatically charged mist improves dispersion and surface coverage as droplets repel each other attraction to oppositely charged items in the area
- After decontamination, the solution decomposes into oxygen and water

## Cautions

- Requires skilled application and monitoring as  $\text{H}_2\text{O}_2$  concentrations could exceed occupational exposure limits
- The fine mist may activate smoke detectors





# ULTRA-LOW VOLUME FOGGERS

- Can produce a range of droplet sizes to create a mist using pressure to vaporize and deliver disinfectants
- Droplets as small as <10 microns can remain airborne for hours increasing chance of bonding with aerosols and particulates
- Can be applied to hard surfaces after effective cleaning



# SPRAYERS

## Airless sprayer

- Create large droplets and deliver best surface wetting
- Relatively easy to use, portable and can cover large areas with longer wet contact time



## Foaming sprayer

- Disinfectant “sticks” to surface providing even longer contact time
- User can see what is covered
- Relatively easy to use, portable
- Somewhat slower application than airless sprayer



# TIME AND EXPOSURE

**Use time to your advantage**

**You won't need to clean and  
disinfect areas that are  
not exposed**

# ATP TESTING

A photograph of several glowing green mushrooms against a dark background. The mushrooms have a bright green, almost neon, luminescence. They are of various sizes and are scattered across the frame. The text is overlaid on a white rectangular box in the center of the image.

**Currently, there is no analytical test available to determine if a surface is contaminated by active COVID-19 virus**



# ATP TESTING

- Adenosine Triphosphate (ATP) is present in all living material and is the universal unit of energy used in all living cells. Viruses do not exhibit the characteristics of life while outside cells, and are generally NOT considered to have ATP.
- ATP bioluminescence assay cell detection was first developed in the 1950s by NASA scientists who were interested in finding life (living cells) on other planets.
- ATP bioluminescence assay is probably the most widely used technique in the food industry for hygiene monitoring and cleaning validation. It was created mainly to validate the cleaning on a production surface before the use of the sanitizer.
- In simple terms, it measures the dirt or filth on a surface indicating the need for cleaning and disinfecting.

# ATP TESTING

- Test swabs are used in the field to test for the presence of ATP.
- ATP test kits only test for a specific molecule, and cannot differentiate between organisms that have been killed with a disinfectant or sanitizing agent, or are still alive.
- Test results given in Relative Light Units (RLU) available in as little as 10 seconds.

## **Considerations:**

Need to establish RLU limits for locations in your facility based on the following factors:

- easy to clean surfaces, such as stainless steel or new equipment may have lower limits.
- hard to clean equipment such as rough or porous surfaces may have higher limits.
- Follow the ATP test equipment manufacturer recommendations for establishing RLU limits.



# RNA TESTING

- Uses a lab analysis called polymerase-chain-reaction (PCR) to detect even very small amounts of the RNA (genetic material) that is very specific to a virus or other organism.
- PCR testing methods for COVID-19 are still evolving. Common variations include PCR, RT-PCR, qPCR, RT-qPCR.
- PCR is a highly sensitive yet, relatively simple and widely used molecular biology technique to amplify and detect DNA and RNA sequences.
- PCR testing cannot differentiate between viable and non-viable virus particles.
- May give false positive results from surfaces that have been cleaned with an antimicrobial and not thoroughly wiped-down.

# FLUORESCENT MARKER

- Used to improve cleaning and disinfection of high-touch surfaces
- Liquid sprayed on surface before cleaning that leaves an invisible marker when dry
- Fluorescent light used to see if the marker was removed by the cleaning

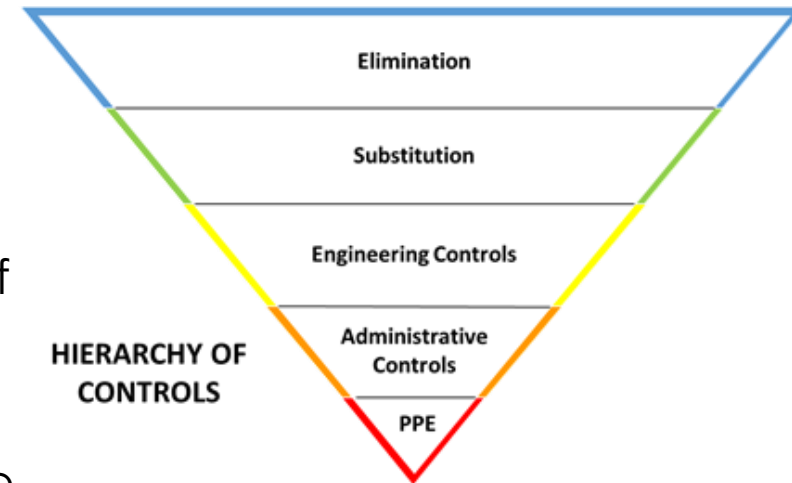


# SELECTING CONTROLS

- No one-size-fits-all – combination of methods may work best.
- Most technologies have yet to be directly tested on COVID-19.
- Be wary of false claims – research and gather information.
- Consider health and safety hazards associated with application of each method.
- Keep up with technology advances, but don't necessarily abandon the tried and true methods that are effective.
- Consider the social / emotional benefit to the worker when selecting a method too.

**Cleaning and disinfecting, efficiency testing and improved indoor air quality are not substitutes for social distancing, face coverings, hand hygiene, health monitoring and physical changes in the workplace.**

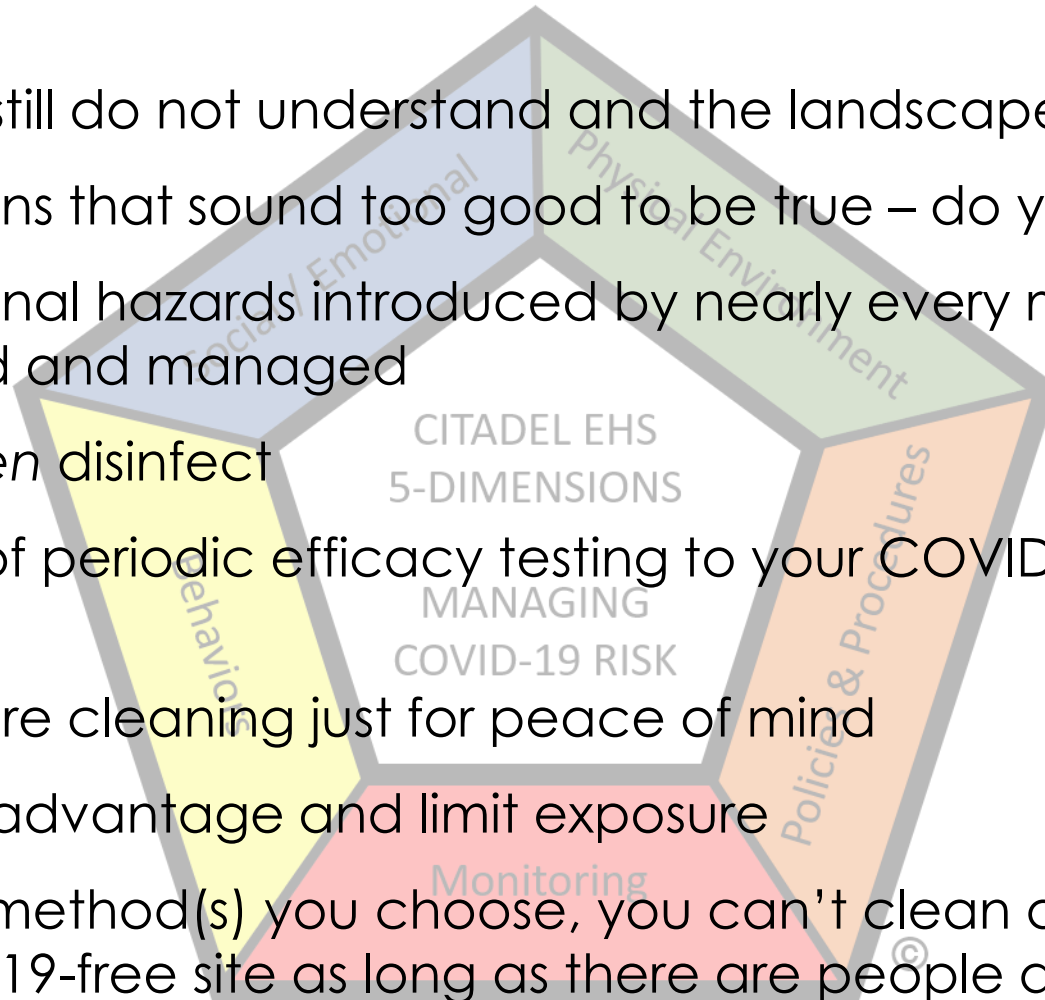
**They all work together to minimize the risk from COVID-19**





# REVIEW

- There is a lot we still do not understand and the landscape is changing rapidly
- Beware of solutions that sound too good to be true – do your due diligence
- There are additional hazards introduced by nearly every method that need to be understood and managed
- **CLEAN FIRST** – *then* disinfect
- Add some form of periodic efficacy testing to your COVID-19 management plan
- Sometimes you are cleaning just for peace of mind
- Use time to your advantage and limit exposure
- No matter what method(s) you choose, you can't clean and disinfect your way to a COVID-19-free site as long as there are people around.



# REFERENCES

- American Biological Safety Association (ABSA) <https://absa.org/wp-content/uploads/2020/05/ABSA-200515-What-do-we-know-about-Environmental-Testing.pdf>
- American Cleaning Institute <https://www.cleaninginstitute.org/cleaning-tips/cleaning-hard-surfaces>
- American Industrial Hygiene Association [https://aiha-assets.sfo2.digitaloceanspaces.com/AIHA/resources/Public-Resources/RecoveringFromCOVID-19BuildingClosures\\_GuidanceDocument.FINAL.pdf](https://aiha-assets.sfo2.digitaloceanspaces.com/AIHA/resources/Public-Resources/RecoveringFromCOVID-19BuildingClosures_GuidanceDocument.FINAL.pdf)
- ASHRAE <https://www.ashrae.org/technical-resources/resources>
- Centers for Disease Control (CDC) [www.cdc.gov/coronavirus](http://www.cdc.gov/coronavirus)
- Environmental Protection Agency <https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2>
- Illuminating Engineering Society <https://www.ies.org/standards/committee-reports/International>
- Ultraviolet Association (IUVA) <http://www.iuva.org/>
- National Environment Agency <https://www.nea.gov.sg/our-services/public-cleanliness/environmental-cleaning-guidelines/guidelines/guidelines-for-environmental-cleaning-and-disinfection>
- National Institute for Occupational Safety and Health (NIOSH) <https://www.cdc.gov/niosh/topics/indoorenv/default.html>
- Occupational Safety & Health Administration [www.osha.gov/coronavirus](http://www.osha.gov/coronavirus)
- World Health Organization (WHO) [www.who.int/coronavirus](http://www.who.int/coronavirus)

A blurred background image showing a crowd of people with their hands raised, suggesting a public event or a Q&A session. The image is out of focus, with the hands in the foreground being more prominent than the faces.

# QUESTIONS?

*Please submit now via*

*online chat*

*or*

*by email to*

*[mtorres@citadelehs.com](mailto:mtorres@citadelehs.com)*

# THANK YOU

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**From all of us at Citadel EHS, we wish you all the best.**

**Stay Safe and Stay Healthy**



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