COVID-19 & Engineering Guidance

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THINK. LISTEN. CREATE.®

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COVID-19 Guidance

The following guidance is developed as healthcare facilities prepare for COVID patients, and is based on input from ASHE, ASHRAE Technical Committee for Healthcare and ASHRAE/ASHE Standard 170 Committee.

This guidance includes personal opinions. ASHRAE and ASHE are not responsible for the use or application of this information.

Please contact Michael.sheerin@tlc-eng.com (Chair ASHRAE Standard 170) with questions.


STANDARD

ANSI/ASHRAE/ASHE Standard 170-2017
(Supersedes ANSI/ASHRAE/ASHE Standard 170-2013)
Includes ANSI/ASHRAE/ASHE addenda listed in Appendix C

Ventilation of Health Care Facilities

See Appendix C for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, the ASHE Board of Directors, and the American National Standards Institute.

This Standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the Standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE website (www.ashrae.org) or in paper form from the Senior Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

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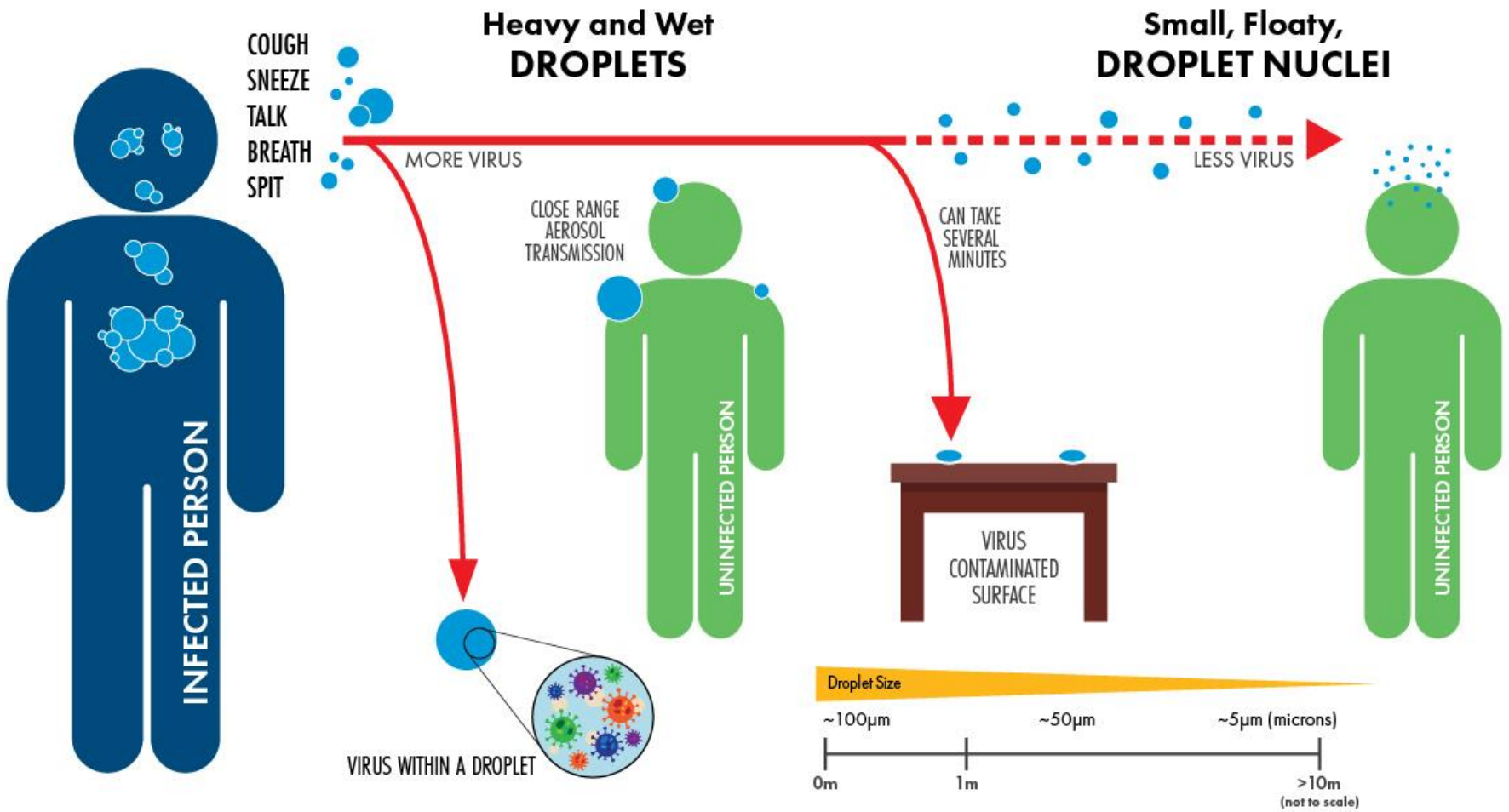
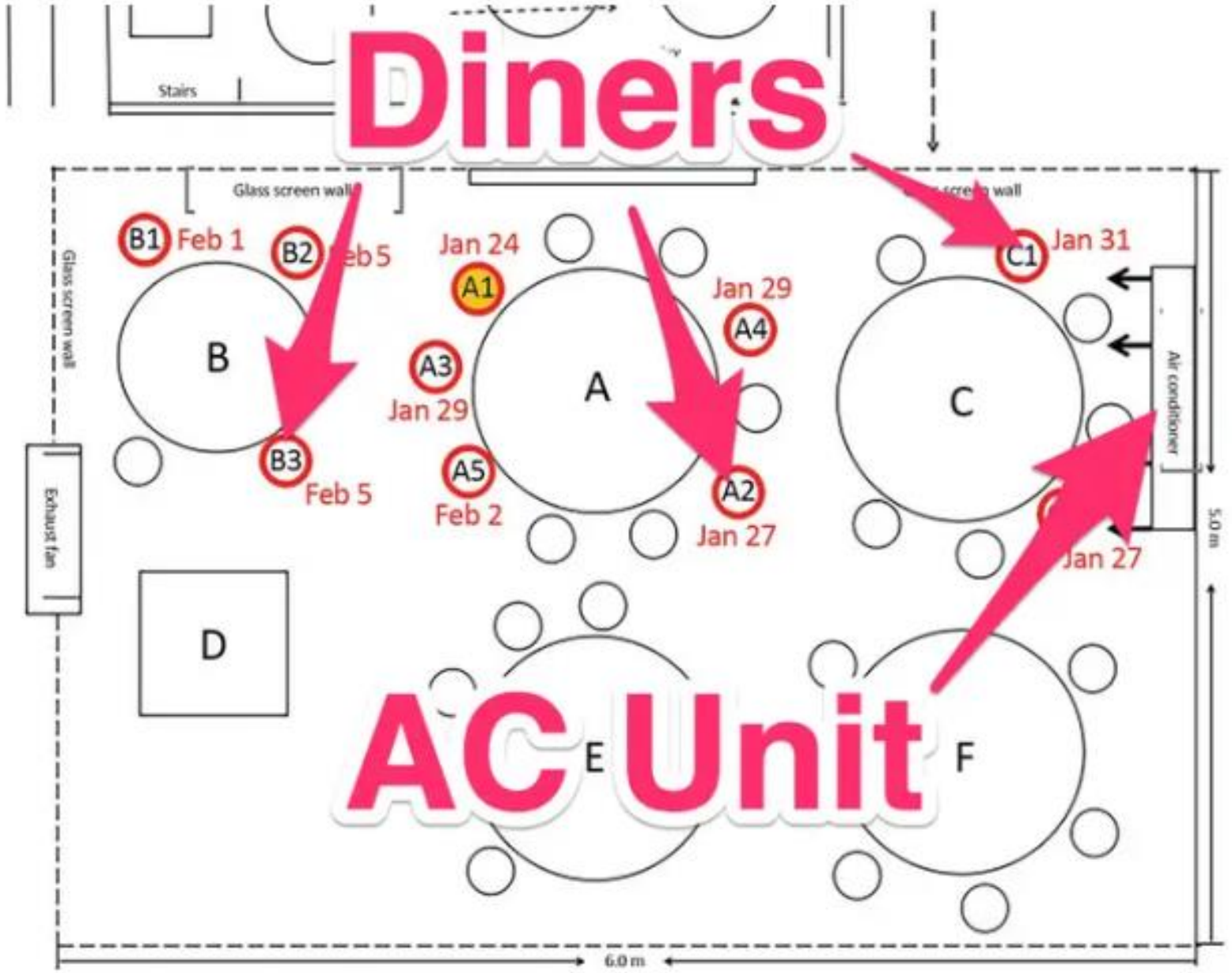
ASHRAE
ASHE
American Society for Healthcare Engineering
A personal membership group of the American Hospital Association
Approved American National Standard
ANSI
www.ansi.org

1. COVID in Perspective



COVID-19 Spreads Rapidly

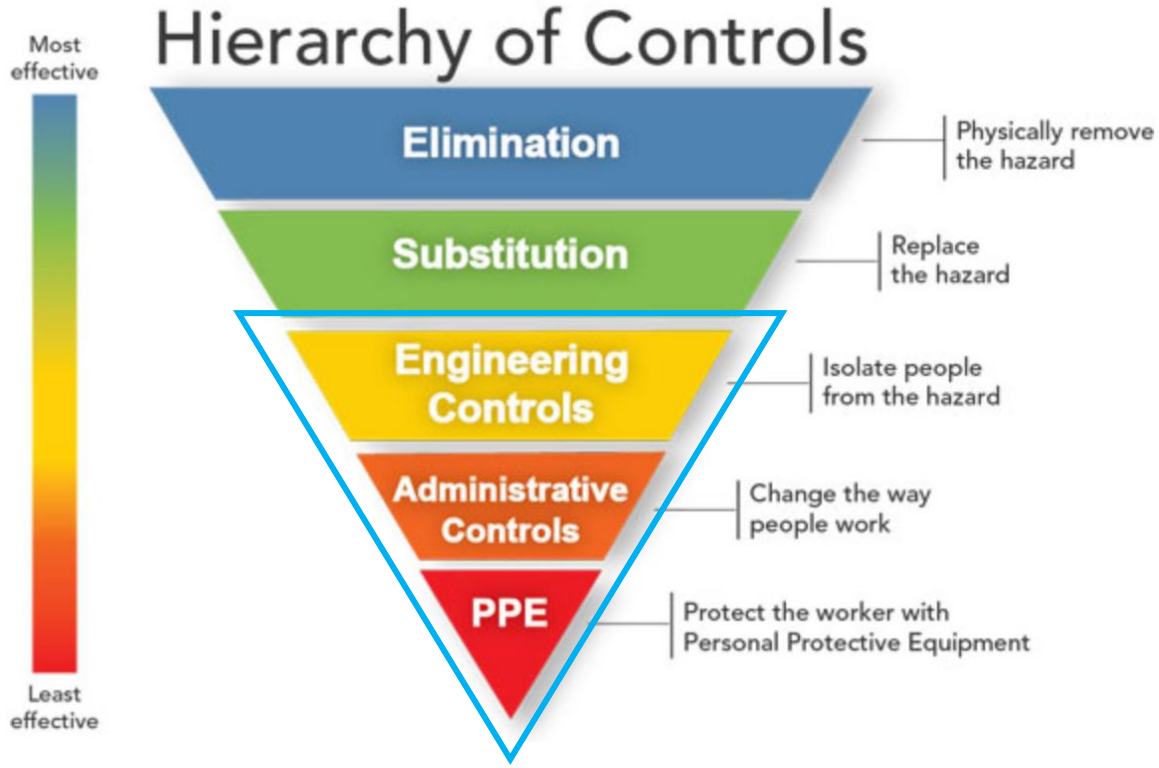


An annotated diagram showing the location of the AC in the restaurant in Guangzhou, China. CDC EID Journal

2. Basic Measures

Health Facility Operators Took Action

- Based on What Was Known
  and
- What Was Still Unknown
  About COVID 19



Prioritization of Controls
as Defined by CDC NIOSH

1. Engineering Controls
2. Administrative Measures - Management, Flow and Restrictions of Patients and Staff
3. Personal Protective Equipment

Ventilation Basics

Increase Outside Air Quantity – Supplemental Conditioned or Via Economizer Mode As Possible

Increase Air Changes in Spaces – Use Control Strategies with Existing Systems

OR

- Add Portable HEPA Fan/Filter Machine

Increase Filtration Levels – Beneficial AND Necessary with Increased Outside Air Quantities

AND

- Increases Air Cleaning of Recirculated Air

Exhaust Sources of Contaminants – Reduces/Removes Contaminants from Space

Passive Isolation

As prescribed in CDC Guidance*

Most Basic Approach

- One patient per room
- Close the door
- Implement related CDC Safety Protocols

Work with Clinicians, anticipate patient load and establish layered approach as needed

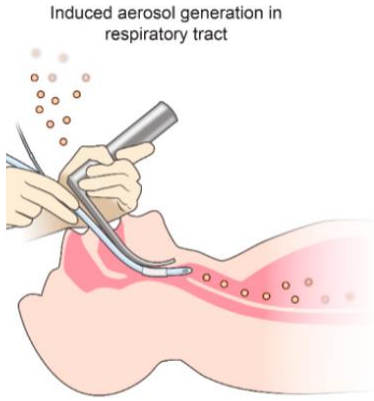
These rooms do not justify negative pressure or 100% exhaust, and are not meant for aerosol generating procedures

* https://www.cdc.gov/coronavirus/2019-ncov/infection-control/control-recommendations.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fhcp%2Finfection-control.html

Basics

Airborne Infectious Isolation Room

- Air changes dilute contaminant level
- Exhaust removes contaminants
- Filtration removes contaminants
- Anteroom preserves pressure relationship



Further Considerations

Ventilate the room and terminal clean before re-use

Follow CDC air change **clearance rates**

Dilution is the Solution to Pollution!

Table B.1. Air changes/hour (ACH) and time required for airborne-contaminant removal by efficiency *		
ACH § ¶	Time (mins.) required for removal 99% efficiency	Time (mins.) required for removal 99.9% efficiency
2	138	207
4	69	104
6+	46	69
8	35	52
10+	28	41
12+	23	35
15+	18	28
20	14	21
50	6	8

FILTRATION 16

For HVAC Systems serving patient and medical procedure spaces, evaluate improving Central Air and other HVAC filtration from MERV 14 to MERV 16 (ASHRAE 2017b) or the highest level achievable.

MERV-16 Filters

- Strongly consider MERV-A, non-degrading, non-electro-static filter for consistent performance.
- MERV 16 is effective in capturing the SARS-CoV-2 virus.
- Dealing with particles in the range of 0.3 to 1.0 micron.
- Certified to filter at least 95% of airborne particles.

MERV RATING CHART

Standard 52.5 Minimum Efficiency Reporting Value	Dust Spot Efficiency	Arrestance	Typical Controlled Contaminant	Typical Applications and Limitations	Typical Air Filter/Cleaner Type
20	n/a	n/a	< 0.30 pm particle size	Cleanrooms	≥99.999% eff. On .10-.20 pm Particles
19	n/a	n/a	Virus (unattached)	Radioactive Materials	Particles
18	n/a	n/a	Carbon Dust	Pharmaceutical Man.	Particulates
17	n/a	n/a	All Combustion smoke	Carcinogenetic Materials	≥99.97% eff. On .30 pm Particles
16	n/a	n/a	.30-1.0 pm Particle Size	General Surgery	**Bag Filter**- Nonsupported
15	>95%	n/a	All Bacteria	Hospital Inpatient Care	microfine fiberglass or synthetic media, 12-36 in. deep, 6-12 pockets
14	90-(	Droplet Nuclei (Sneeze)	Most Tobacco Smoke	Smoking Lounges	**Box Filter**- Rigid Style Cartridge Filters 6 to 12" deep m ay use
13	89-90%	>98%	Proplet Nuceli (Sneeze)	Superior Commercial Buildings	lofted or paper media.

Patient Room

HEPA to Outside

Single patient room with dedicated bathroom

Seal off return air grill in patient room

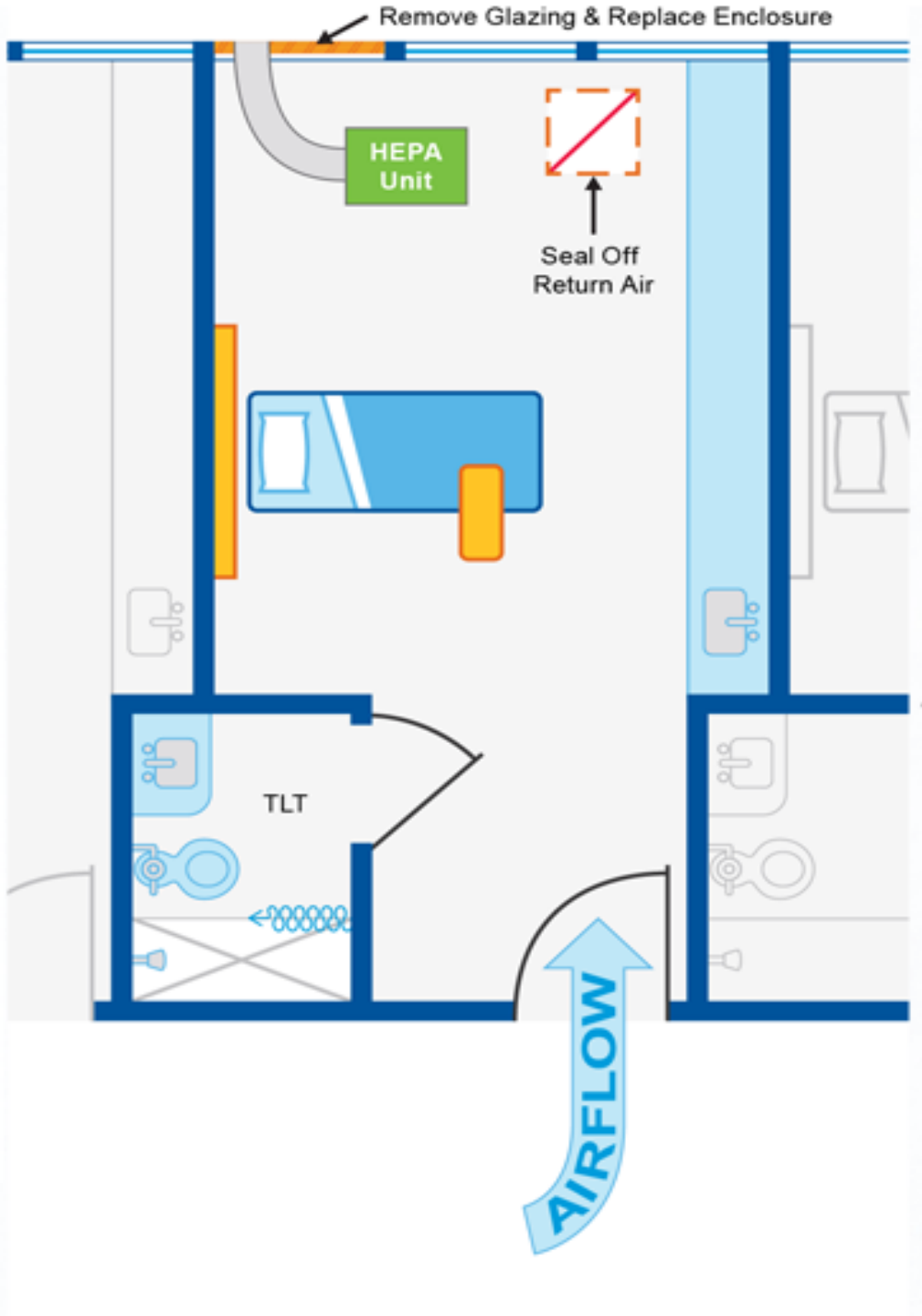
Place HEPA filtered negative air machine in patient room

Duct through exterior to outside

- Remove window and enclose opening

Keep door to patient room closed

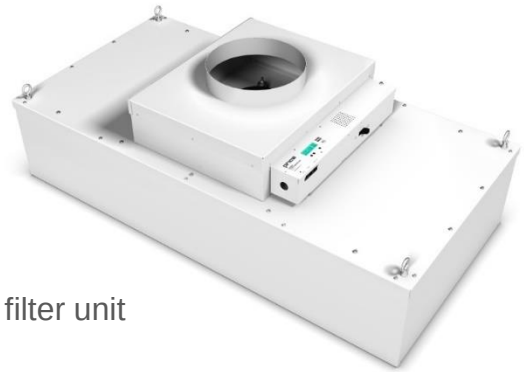
Verify negative pressure prior to placing room in service and monitor negative pressure while in service



HEPA UNIT

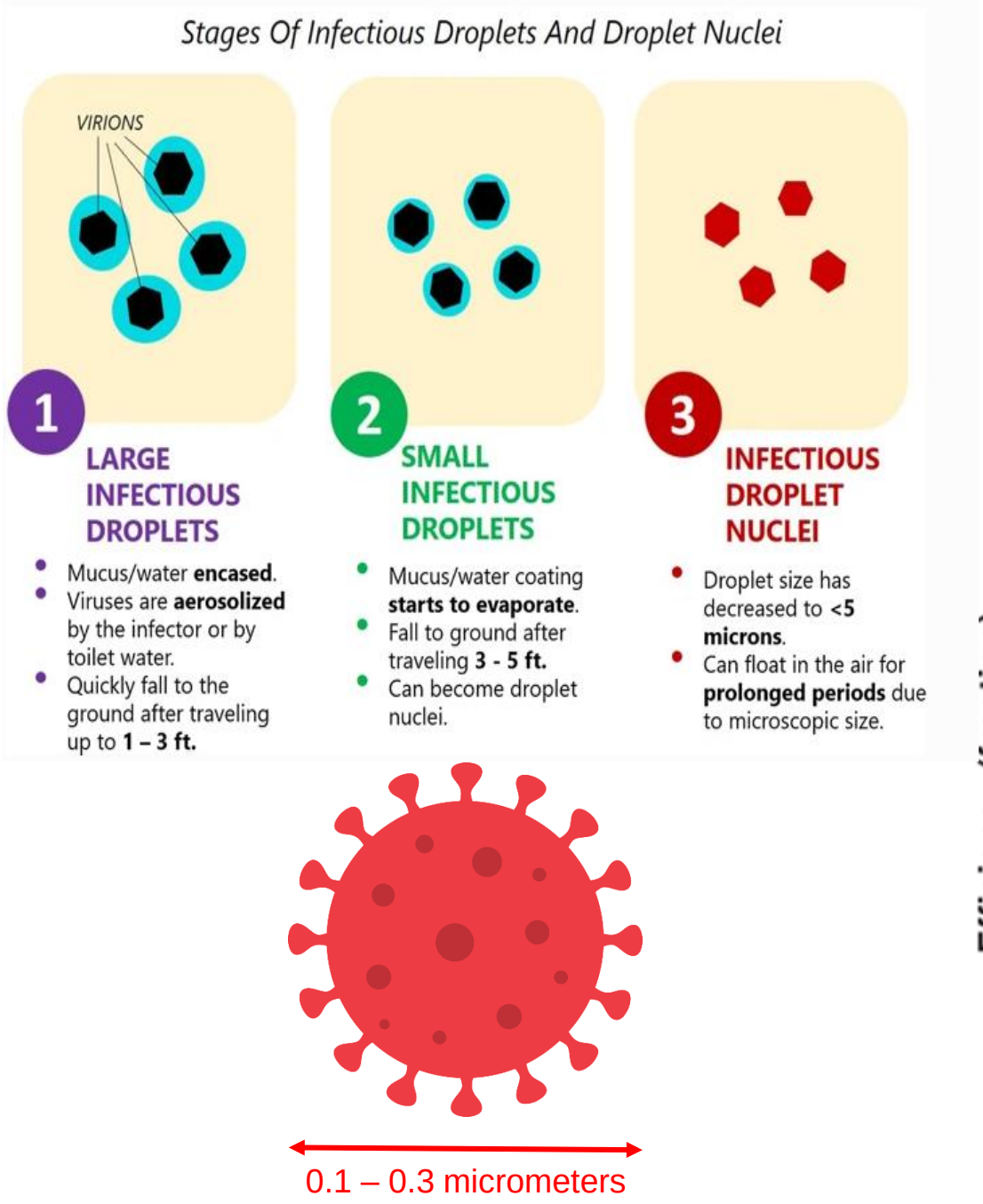
Portable HEPA Machines

Pre-Assembled System

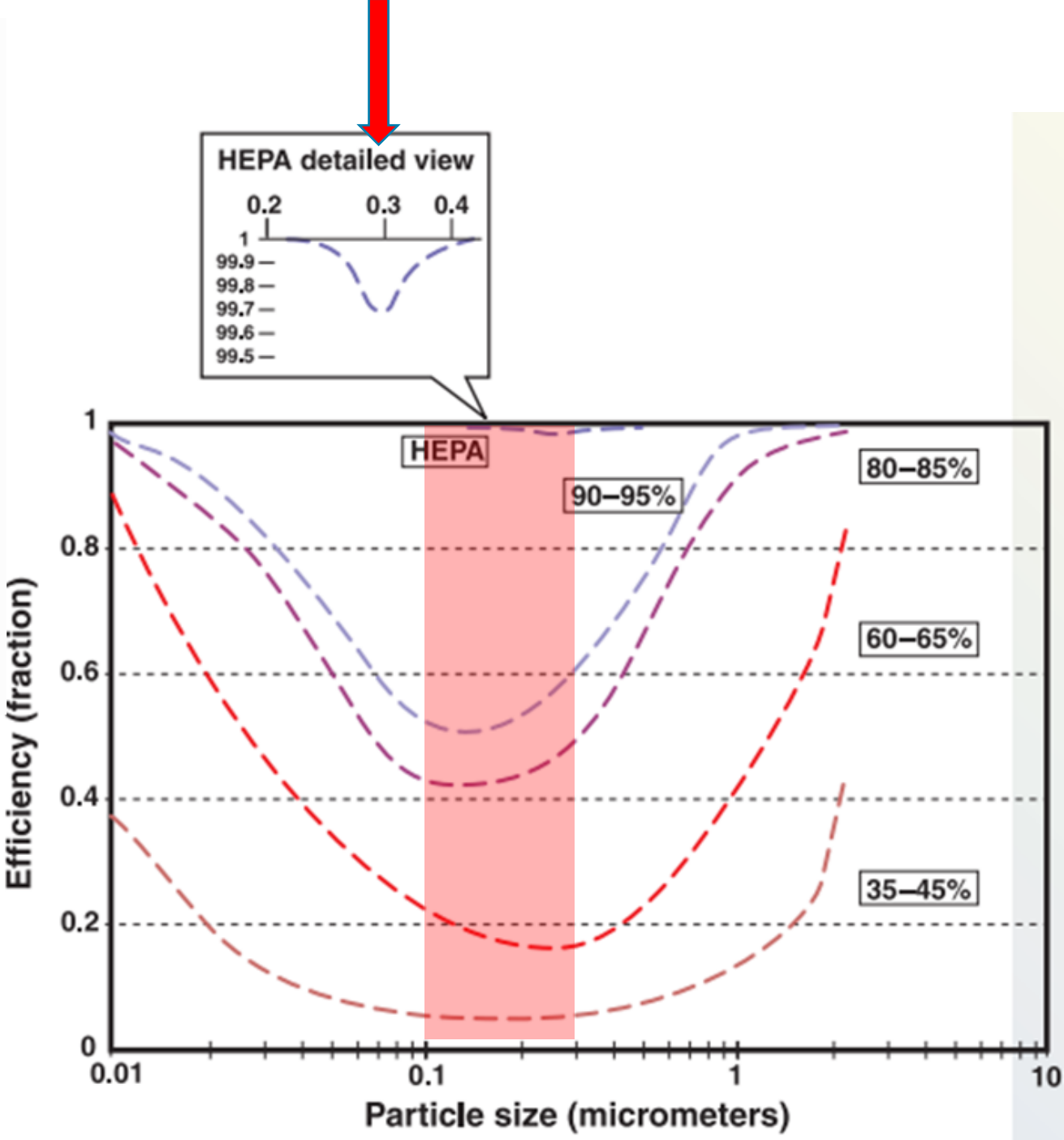


Ceiling fan filter unit

Anteroom assemblies


Stages Of Infectious Droplets And Droplet Nuclei
VIRIONS
1
LARGE INFECTIOUS DROPLETS
Mucus/water encased.
Viruses are aerosolized by the infector or by toilet water.
Quickly fall to the ground after traveling up to 1 – 3 ft.
2
SMALL INFECTIOUS DROPLETS
Mucus/water coating starts to evaporate.
Fall to ground after traveling 3 - 5 ft.
Can become droplet nuclei.
3
INFECTIOUS DROPLET NUCLEI
Droplet size has decreased to <5 microns.
Can float in the air for prolonged periods due to microscopic size.

0.1 – 0.3 micrometers


HEPA detailed view
0.2
0.3
0.4
1
99.9
99.8
99.7
99.6
99.5
HEPA
90–95%
80–85%
60–65%
35–45%
Efficiency (fraction)
1
0.8
0.6
0.4
0.2
0
0.01
0.1
1
10
Particle size (micrometers)

Healthcare Facilities - TODAY

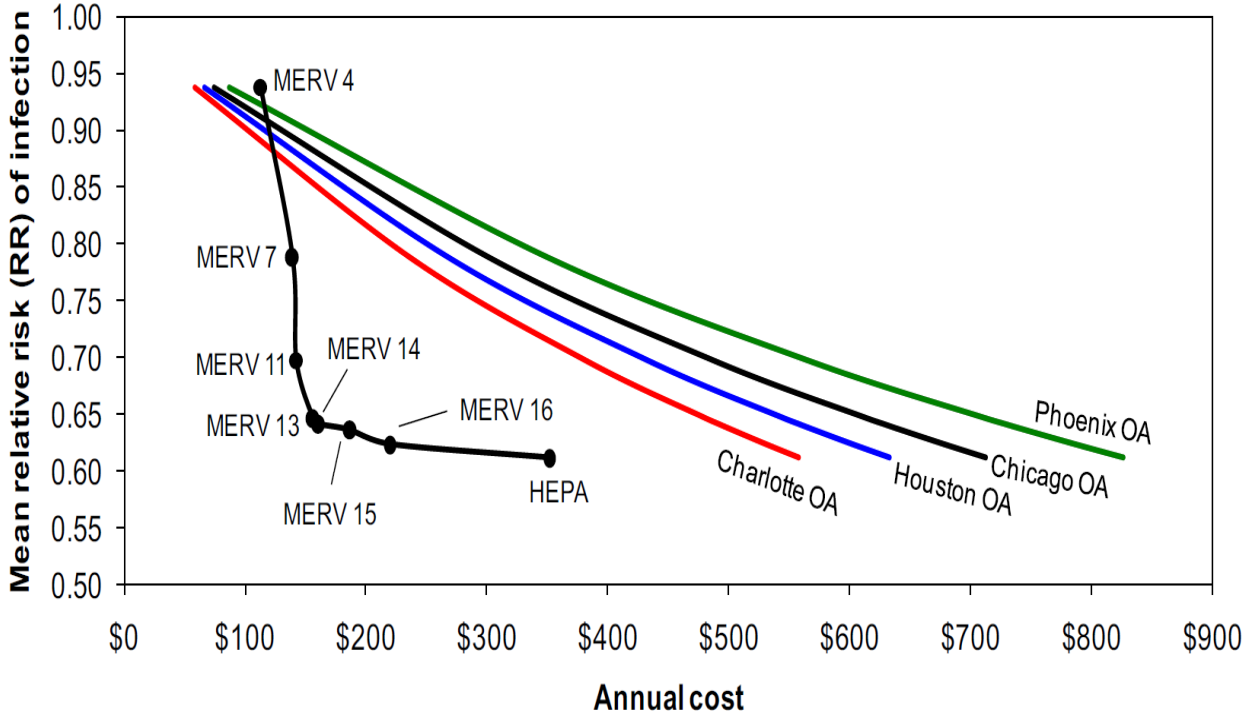
- Understand COVID 19 Virus Mechanics
- Low Transmission Rate from Surface Fomites
- Confirmation that Most COVID Transmission is Close Contact Droplet/Aerosol
- Proximity and Time Duration with Infected Persons Matters
- Low COVID Viability Beyond Space of Origin
- No Documented Case of Viable Virus at Air Handler
- Airborne Infectious Isolation Rooms used for Aerosol Generating Procedures
- Lower Relative Humidity (<40%) Increases Susceptibility
- Resurgence at Any Time is Possible

Temporary Measures NOW

Patients with COVID-19 do <u>not</u> need to be in single-pass, 100% outside air environments.

Greater outside air fractions do provide some dilution but are no more effective at mitigating infection than providing highly filtered (MERV 16 or greater) supply air.

“Negative” (clean-to-dirty) airflow patterns will inhibit the migration of air in spaces that contain COVID-19 patients to adjacent spaces.



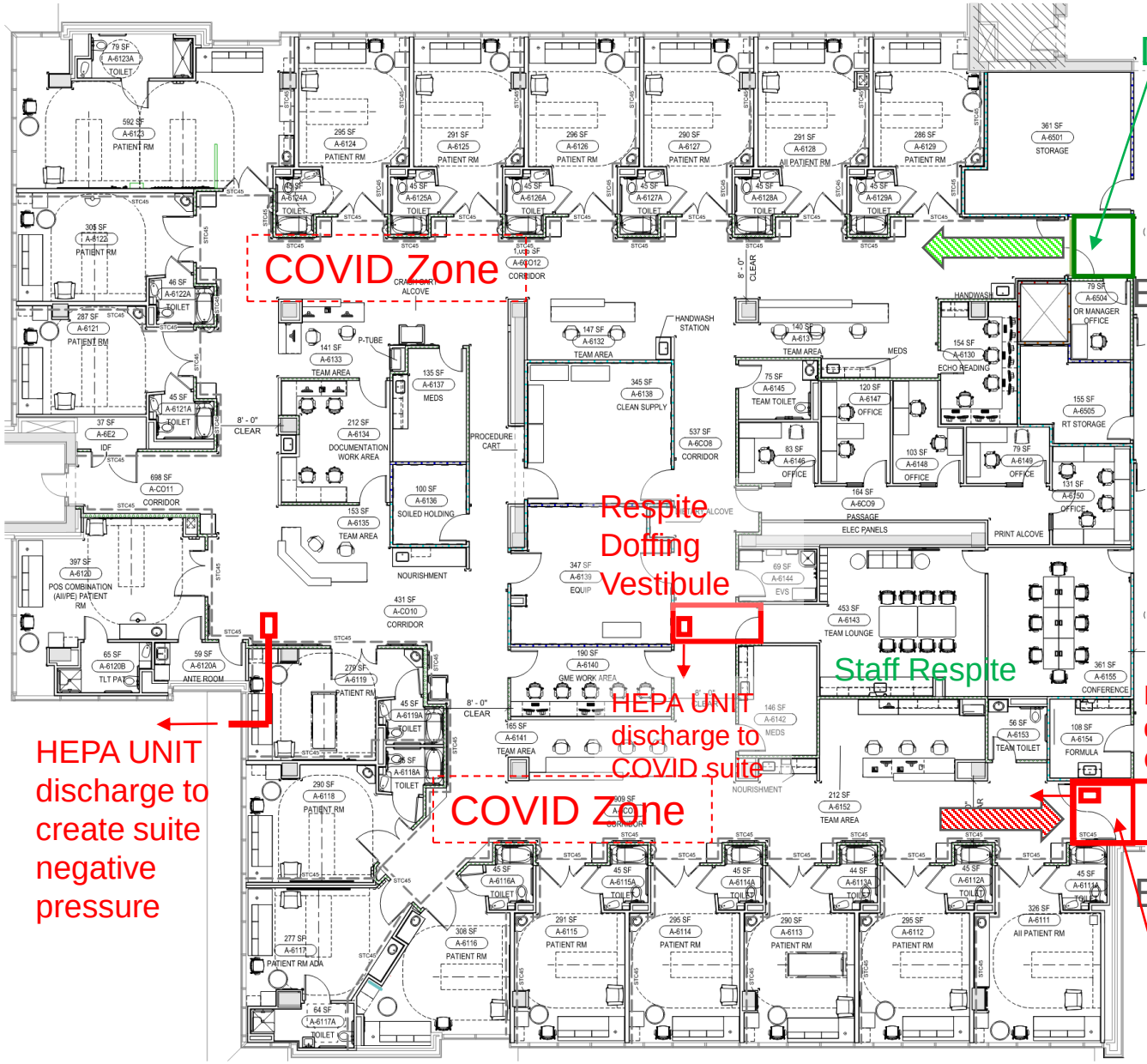
- When patient census grows beyond small scale surge capacity, consider
  - Convert units, wings or floors where all patients in “hot” zone are considered pandemic infected
  - Use anterooms/vestibules to segregate “hot” from “cold” zones
  - Rather than convert individual rooms one-at-a-time, use HEPA machines to create pressure difference at unit hot/cold boundary
  - Create one-way flow if possible, with PPE donning in one anteroom and doffing in another
    - Large enough to accommodate two caregivers, working in “buddy system”
    - Handwash in the anteroom or adjacent
  - If necessary, create positive pressure zones for staff respite inside hot zone, using HEPA machines to establish pressure differences, using anterooms/vestibules if practical
  - This approach conserves PPE
  - 100% exhaust not required – no known case of infection via ducted/filtered return

Hot / Cold Zones

The benefits of designating COVID patient suites includes the ability to establish the suite as a negative relative pressure zone to adjoining suites.

Use a HEPA fan filter machine to establish negative relative pressure in the suite. Consider using at least two machines for redundancy purposes.

This arrangement avoids the need for HEPA units in each patient room and the necessary HVAC air re-balance and correspondent make-up air issues.

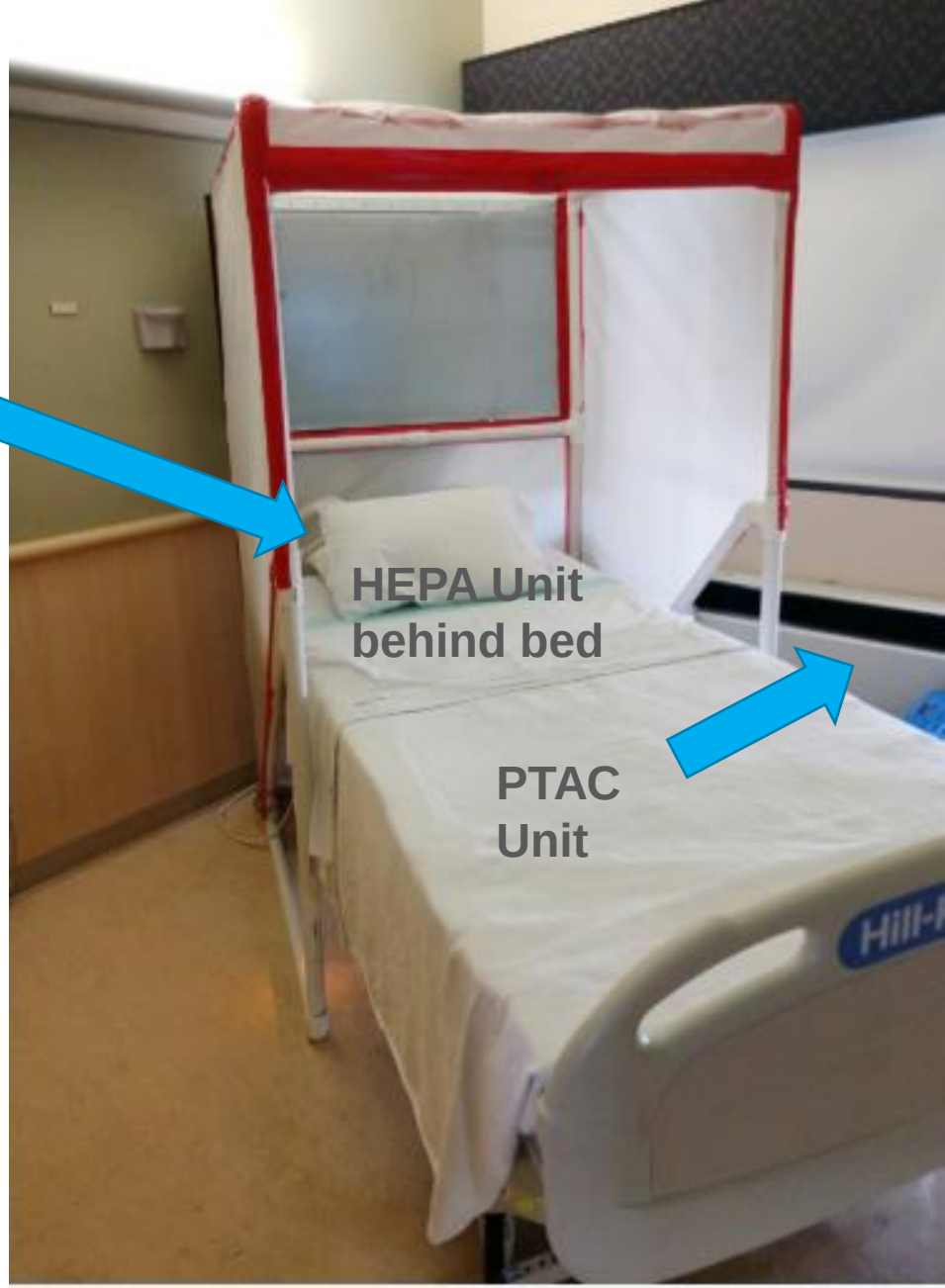


Alternate Strategy – Source Control

Consider Local Exhaust Source Control at Patient Head for Patients on CPAP, Nebulizer or other AGP

Ventilated Headboard (photo, page 68)
https://www.cdc.gov/niosh/surveyreports/pdfs/301-05f.pdf

Can Be Custom Built On Site



Courtesy. Amid the COVID-19 pandemic, B&I Contractors is working with Lee Health on a concept that could help reduce the spread of the disease in hospitals.

Alternate Strategy – Source Control

- Consider Local Exhaust Source Control at Patient Head for Patients on CPAP, Nebulizer, or other AGP
- Patient Tent w HEPA Headboard (i.e., Demistifier) https://www.peacemedical.com/2000A%202014.pdf
- Portable Snorkel Exhaust (i.e., SentryAir used for soldering) https://www.sentryair.com/portable-floor-sentry.htm

McCormick Center, Chicago

COVID care

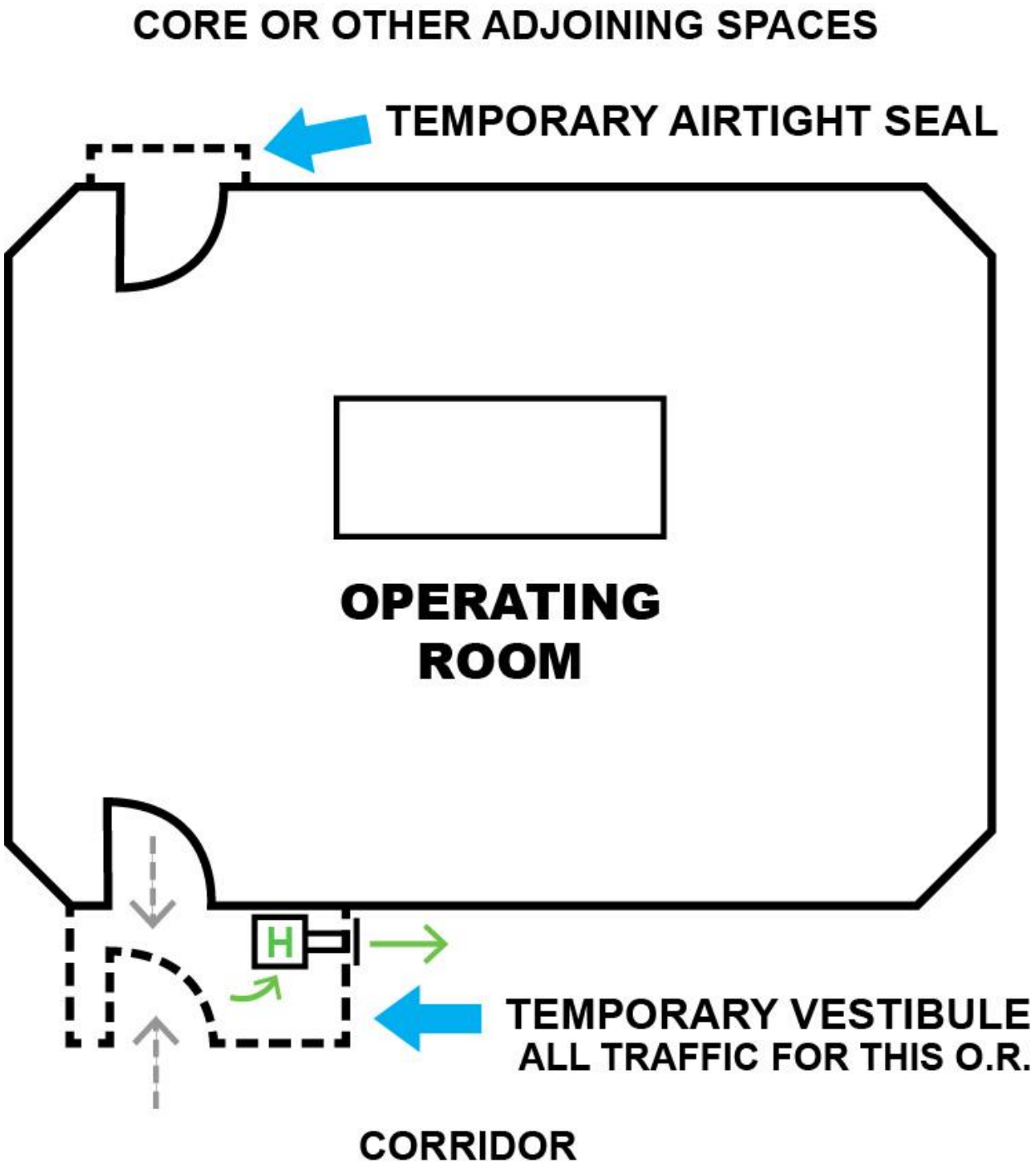
Treatment Bay

Limited Resources

Pressurized / Airflow past patient

Operating Room – COVID Patient

- Temporary vestibule
- HEPA unit in vestibule to create negative zone
- Seal other entries



NEED INFO - START HERE:

See the ASHRAE COVID page https://www.ashrae.org/technical-resources/resources

Have questions? Need help?

Contact: Michael.Sheerin@tlc-eng.com

Questions?