AIA Orange County

Impact of COVID-19

in

Building Design and Management

Building and Energy Codes and Building Management in a Pandemic

4:30-6:00 PM 12/8/2020 Part 1

4:30-6:00 PM 12/10/2020 Part 2

"Dr. Saum K. Nour, Ph.D." PE 32 States

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PE Civil, PE Electrical, PE Mechanical, CPD,

Fellow ASPE, CFPE, **LEED AP**

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Greenerade.com

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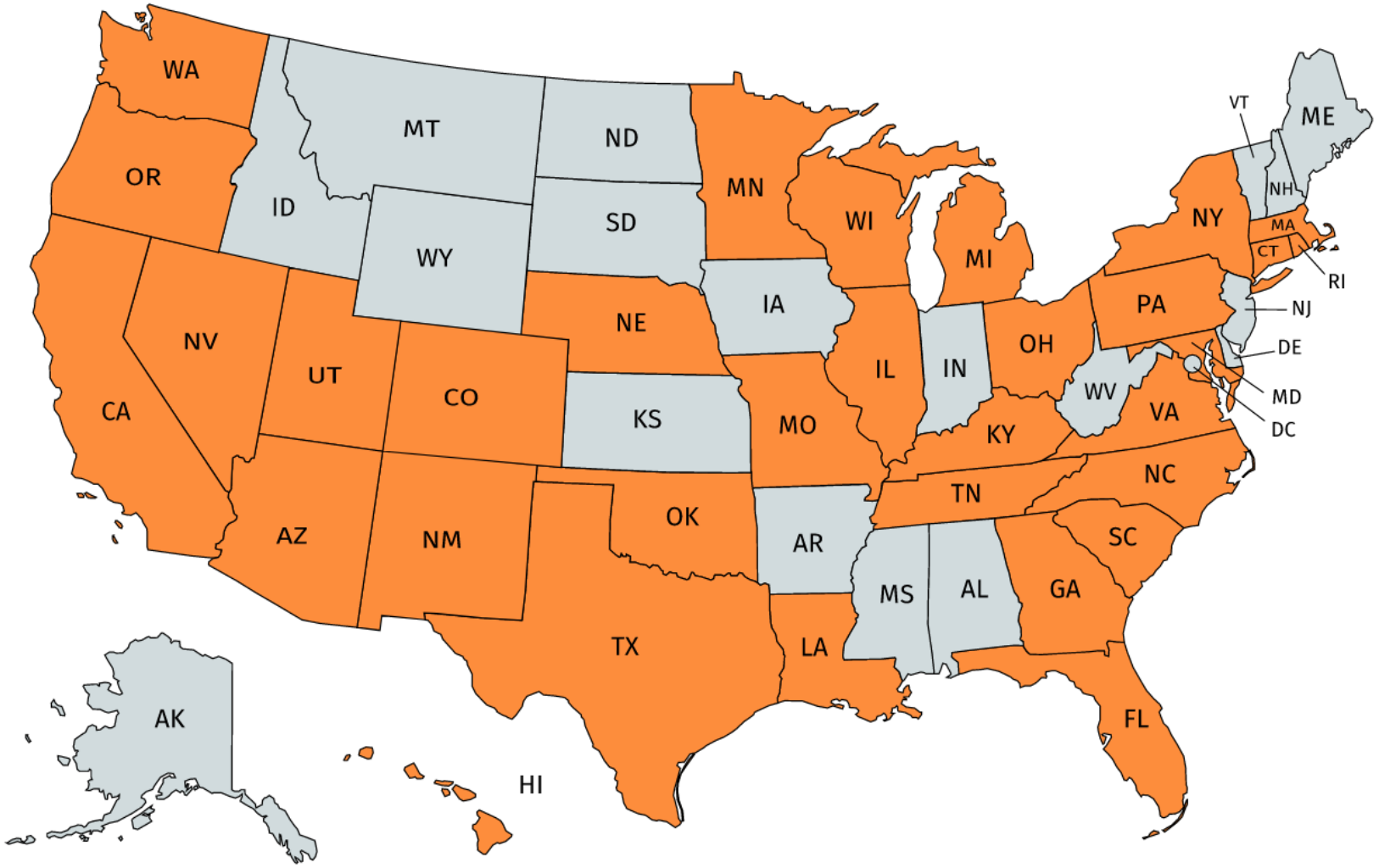
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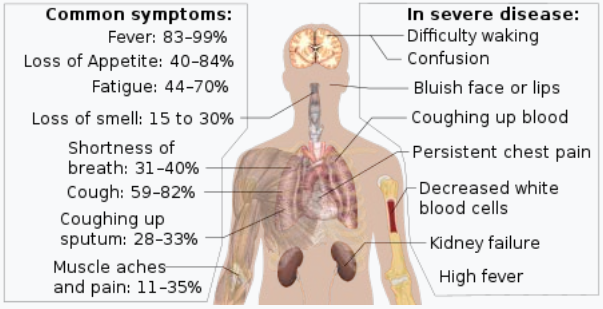
Back to Basics

- Novel coronavirus (nCoV) is a provisional name given to coronaviruses of medical significance before a permanent name is decided upon. Although coronaviruses are endemic in humans and infections normally mild, such as the common cold (caused by human coronaviruses in ~15% of cases), cross-species transmission has produced some unusually virulent strains which can cause viral pneumonia and in serious cases even acute respiratory distress syndrome and death
- The word "novel" indicates a "new pathogen of a previously known type" (i.e. known family) of virus. Use of the word conforms to best practices for naming new infectious diseases published by the World Health Organization (WHO) in 2015. Historically, pathogens have sometimes been named after locations, individuals, or specific species. However, this practice is now explicitly discouraged by the WHO. A study published in 2020 suggested that referring to the novel coronavirus (COVID-19) as the "Chinese virus" was stigmatizing and could hinder public health efforts.
- The official permanent names for viruses and for diseases are determined by the ICTV and the WHO's ICD, respectively.

Coronavirus disease 2019 (COVID-19)

Other names	• Coronavirus, Corona, COVID, 2019-nCoV acute respiratory disease • Novel coronavirus pneumonia[1][2] • Severe pneumonia with novel pathogens[3]



Symptoms of COVID-19

Specialty	Infectious disease
Symptoms	Fever, cough, fatigue, shortness of breath, loss of smell; sometimes no symptoms at all[5][6]
Complications	Pneumonia, viral sepsis, acute respiratory distress syndrome, kidney failure, cytokine release syndrome
Usual onset	2–14 days (typically 5) from infection
Causes	Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)
Risk factors	Travel, viral exposure
Diagnostic method	rRT-PCR testing, CT scan
Prevention	Hand washing, face coverings, quarantine, social distancing[7]

Last updated on June 15, 2020

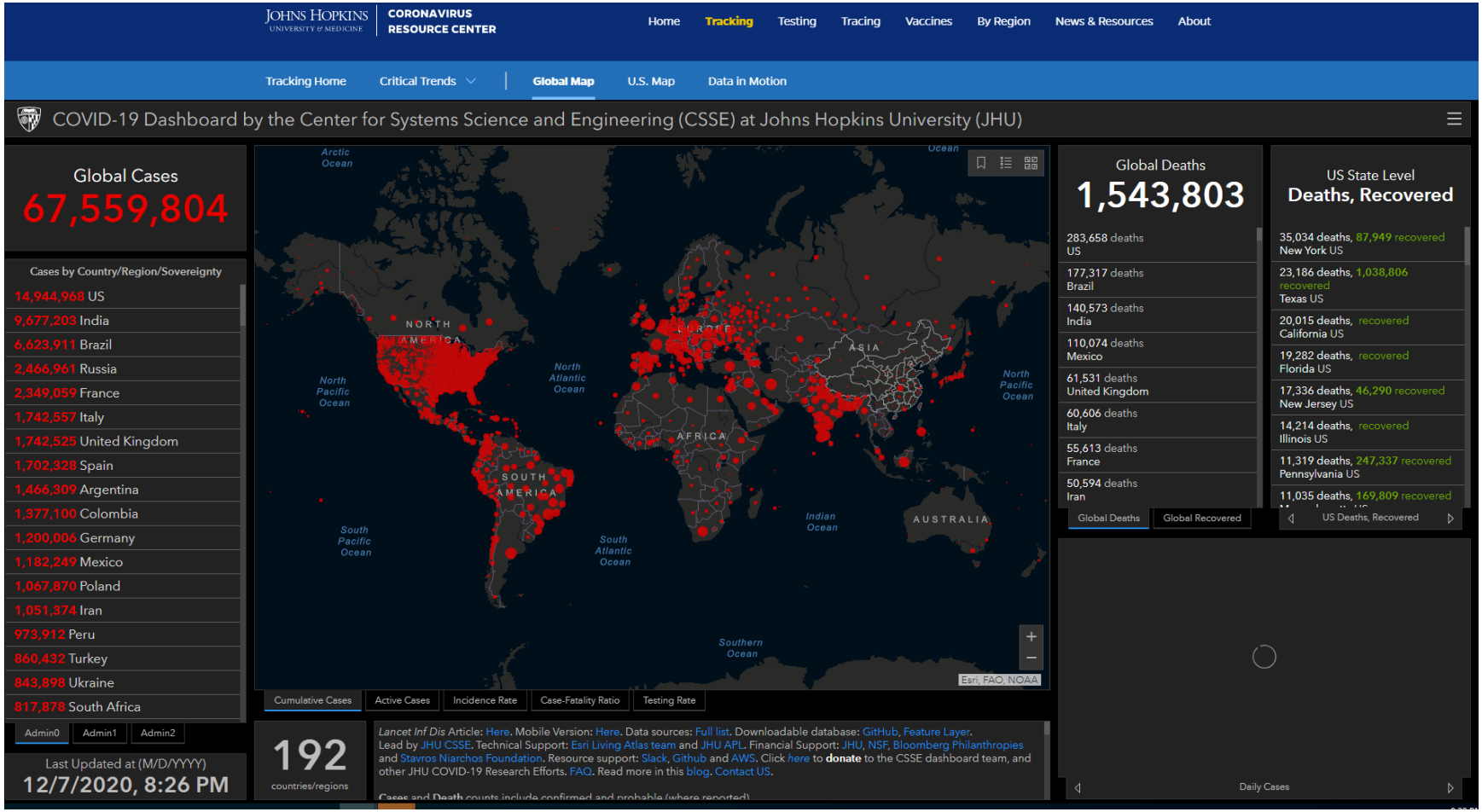
TOTAL CASES 2,085,769 21,957 New Cases*

TOTAL DEATHS 115,644 373 New Deaths*

As of 12/7/2020

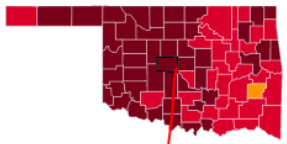
TOTAL CASES 14,944,968

TOTAL DEATHS 283,658


JOHNS HOPKINS UNIVERSITY & MEDICINE
CORONAVIRUS RESOURCE CENTER
Home
Tracking
Testing
Tracing
Vaccines
By Region
News & Resources
About
Tracking Home
Critical Trends
Global Map
U.S. Map
Data in Motion
COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU)
Global Cases
67,559,804
Cases by Country/Region/Sovereignty
14,944,968 US
9,677,203 India
6,623,911 Brazil
2,466,961 Russia
2,349,059 France
1,742,557 Italy
1,742,525 United Kingdom
1,702,328 Spain
1,466,309 Argentina
1,377,100 Colombia
1,200,006 Germany
1,182,249 Mexico
1,067,870 Poland
1,051,374 Iran
973,912 Peru
860,432 Turkey
843,898 Ukraine
817,878 South Africa
Admin0
Admin1
Admin2
Last Updated at (M/D/YYYY)
12/7/2020, 8:26 PM
Arctic Ocean
North Pacific Ocean
North Atlantic Ocean
North Pacific Ocean
NORTH AMERICA
EUROPE
ASIA
AFRICA
SOUTH AMERICA
AUSTRALIA
Indian Ocean
South Pacific Ocean
South Atlantic Ocean
Southern Ocean
Esri, FAO, NOAA
Cumulative Cases
Active Cases
Incidence Rate
Case-Fatality Ratio
Testing Rate
192
countries/regions
Lancet Inf Dis Article: Here. Mobile Version: Here. Data sources: Full list. Downloadable database: GitHub, Feature Layer.
Lead by JHU CSSE. Technical Support: Esri Living Atlas team and JHU APL. Financial Support: JHU, NSF, Bloomberg Philanthropies
and Stavros Niarchos Foundation. Resource support: Slack, Github and AWS. Click here to donate to the CSSE dashboard team, and
other JHU COVID-19 Research Efforts. FAQ. Read more in this blog. Contact US.
Cases and Death counts include confirmed and probable (where reported)
Global Deaths
1,543,803
283,658 deaths US
177,317 deaths Brazil
140,573 deaths India
110,074 deaths Mexico
61,531 deaths United Kingdom
60,606 deaths Italy
55,613 deaths France
50,594 deaths Iran
Global Deaths
Global Recovered
US State Level
Deaths, Recovered
35,034 deaths, 87,949 recovered New York US
23,186 deaths, 1,038,806 recovered Texas US
20,015 deaths, recovered California US
19,282 deaths, recovered Florida US
17,336 deaths, 46,290 recovered New Jersey US
14,214 deaths, recovered Illinois US
11,319 deaths, 247,337 recovered Pennsylvania US
11,035 deaths, 169,809 recovered
US Deaths, Recovered
Daily Cases

Search for your state, county, or zip

OKLAHOMA USA



Canadian County, OK

SHARE RECEIVE ALERTS

COVID RISK LEVEL

Severe outbreak

Canadian County is currently experiencing a severe outbreak. Take all possible precautions to avoid exposure.

ALERT

The U.S. is in a third COVID wave. Exercise extra caution in order to reduce your risk of infection, to avoid infecting others, and to avoid overwhelming our healthcare system. Learn more.

DAILY NEW CASES	INFECTION RATE	POSITIVE TEST RATE	ICU HEADROOM USED	TRACERS HIRED
82.6 PER 100K	1.06	18.5%	100%	Unknown
Very dangerous number of new cases	COVID is still spreading, but slowly	Indicates insufficient testing	High risk of hospital overload	Insufficient data to assess
			Beta	Beta

Updated December 7, 2020 · County data is currently in beta. Because counties don't report hospitalizations, our forecasts may not be as accurate. See something wrong? Email us.

Compare Save Share

This map shows COVID-19 cases and deaths reported by U.S. states, the District of Columbia, New York City, and other U.S.-affiliated jurisdictions. Hover over the map to see the number of cases and deaths reported in each jurisdiction. To go to a jurisdiction's health department website, click on the jurisdiction on the map.

Add U.S. Map to Your Website

Cases & Deaths by County

Select a state to view the number of cases and deaths by county. This data is courtesy of USAFacts.org

Select a State View County Data

New Cases by Day

The following chart shows the number of new COVID-19 cases reported each day in the U.S. since the beginning of the outbreak. Hover over the bars to see the number of new cases by day.

In the very past seven days, number of my client have either requested to campus wide modification of their HVAC units to isolate and reduce the Covid 19 like virus in their buildings. In addition, the short article in the Linkedin has created a number of phone conversations and request for a more broader article. Unfortunately, some have used this unfortunate incident for products portraying themselves as a Covid 19 solutions are now spreading on the engineering product advertising. The author requests for all readers to utilize this article as an inception, and expand, critique, modify, and elaborate further for their circumstances and their buildings. And in this collaborative environment, we can safe many future lives and create a safe working/living environments for our greater communities. As we know, at least for now, all of 7.783 billion persons use this the address to reside, namely, Earth. Let us help residence of this address.

Prior to initiate the theme of the topic, one must fully understand, the virus, its transmission, and prevention. The following data will not make us a biologist, yet enough for us to understand selection of the devices or materials in our endeavor. CDC has quite number of articles and under category of Reduce Facility Risk or Implement Engineering Control, many of the topics here are discussed at length.

CDC under Implement Engineering Controls mandates:

Design and install engineering controls to reduce or eliminate exposures by shielding HCP and other patients from infected individuals. Examples of engineering controls include:

- physical barriers or partitions to guide patients through triage areas
- curtains between patients in shared areas
- air-handling systems (with appropriate directionality, filtration, exchange rate, etc.) that are properly installed and maintained

Historically, there are examples of similar pandemic but nothing of this magnitude since 1918. AIDS, SARS, H2N2 (influenza A Virus), Hong Kong Flu, third cholera pandemic, or similar incidences did not have the speed of spread, contagiousness, level of hospitalization, effect on economy, or similar factors of Covid 19 Virus. American Society of Heating Refrigeration Engineers has a position paper on Covid 19 and describes the ASHRAE mandates of HVAC guidelines for prevention and transmission of viruses.

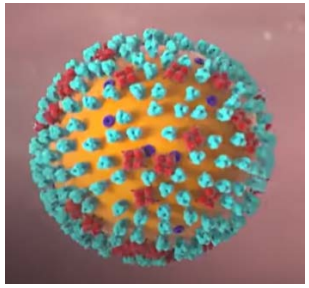
At this time based on, there are 7.7832 billion people on earth, 67,564,565 million Covid 19 cases in the world with ~~284,335~~ 14,944,968 WITH 283,658 dead individuals. Right now, the United States, with 330,731,676 population (4.25% of the world) has 22% of world infected of Covid 19 and 18.37% of the world death. Daily addition of death count is equivalent to 911, near 2800 persons, or in other words, United States has one 911 occurring every day.
This disproportionate rate of cases near 22% of the world yet only having 4.25% of world population is alarming. Till the "herd infection" of the entire world and say 1.5% of the world death (over 11 million person), or an effective vaccine, the current mood the of the social behavior is to stay. Fastest vaccine introduced was a four year process. Vaccine is to be 90% effective, remaining 33 million persons vulnerable.

Therefore, a force major process may be taken into place, otherwise, last economic depression will seem to be a mild recession in the upcoming future. One may wear a mask and fully geared Personal Protection Equipment to go for an accounting or telemarketing job. Once in the building, the building may not be a hospital setting with infectious disease ward, but it must have all the environment to protect the regular full time essential employees. Most likely, transients, patrons to office will be modified to online services, and non-essential workers (sales force or similar) will never report to office. Our phones will have more capabilities and fiber optics services will carry the highest 5G capabilities to insure an smooth operations.

Before identifying the new design of the work environment, one must understand the Covid 19 virus (0.12 micron), its behavior, transmission, or biological impacts. Note 19 was for the year 2019, the year of discovery or introduction to humans. Without being a biologist, please see this video, and to our amazement how this virus travels, survives and populates.

https://www.youtube.com/watch?v=7sQCmgCmN7U

Vaccines…. MRNA



Historical Impacts of Health Disease on City Planning

Paris: Haussmann's renovation of Paris was a vast public works program commissioned by Emperor Napoléon III and directed by his prefect of Seine, Georges-Eugène Haussmann, between 1853 and 1870. It included the demolition of medieval neighborhoods that were deemed overcrowded and unhealthy by officials at the time; the building of wide avenues; new parks and squares; the annexation of the suburbs surrounding Paris; and the construction of new sewers, fountains and aqueducts. Haussmann's work was met with fierce opposition, and he was finally dismissed by Napoleon III in 1870; but work on his projects continued until 1927. The street plan and distinctive appearance of the center of Paris today are largely the result of Haussmann's renovation.

London: The **Broad Street cholera outbreak** (or **Golden Square outbreak**) was a Severe outbreak of cholera that occurred in 1854 near Broad Street (now Broadwick Street) in the Soho district of the City of Westminster, London, England, and occurred during the 1846–1860 cholera pandemic happening worldwide. This outbreak, which killed 616 people, is best known for the physician John Snow's study of its causes and his hypothesis that germ-contaminated water was the source of cholera, rather than particles in the air (referred to as "miasma").[1][2] This discovery came to influence public health and the construction of improved sanitation facilities beginning in the mid-19th century. Later, the term "focus of infection" started to be used to describe sites, such as the Broad Street

pump, in which conditions are good for transmission of an infection. Snow's endeavor to find the cause of the transmission of cholera caused him to unknowingly create a double-blind experiment.

New York City in the late 1800s faced grim, cramped living conditions in tenement housing that once dominated the Lower East Side. During the 19th century, immigration steadily increased, causing New York City's population to double every decade from 1800 to 1880.

Walls were erected to create extra rooms, floors were added, and housing spread into backyard areas. To keep up with the population increase, construction was done hastily and corners were cut. Tenement buildings were constructed with cheap materials, had little or no indoor plumbing and lacked proper ventilation. These cramped and often unsafe quarters left many vulnerable to rapidly spreading illnesses and disasters like fires.

By 1900, more than 80,000 tenements had been built and housed 2.3 million people, two-thirds of the total city population

Diseases or outbreaks

HIV infections, SARS, Lyme disease, Escherichia coli O157:H7 (E. coli), hantavirus, dengue fever, West Nile virus, and the Zika virus.

Re-emerging diseases:

malaria, tuberculosis, cholera, pertussis, influenza, pneumococcal disease, and gonorrhea.

CDC Guidelines October 29th 2020

COMMUNITY, WORK & SCHOOL

COVID-19 Employer Information for Office Buildings

Updated Oct. 29, 2020

During the COVID-19 pandemic, office building employers, owners and managers, and operations specialists can take the following steps to create a safe and healthy workplace for workers and clients.
How You Can Protect Your Staff and Others and Slow the Spread
Create a COVID-19 workplace health and safety plan.

- Start by reviewing the CDC Interim Guidance for Businesses and Employers.

Before resuming business operations, check the building to see if it's ready for occupancy.

- Evaluate the building and its mechanical and life safety systems to determine if the building is ready for occupancy. Check for hazards associated with prolonged facility shutdown such as mold growth, rodents or pests, or issues with stagnant water systems, and take appropriate remedial actions.
- Ensure that ventilation systems in your facility operate properly. For building heating, ventilation, and air conditioning (HVAC) systems that have been shut down or on setback, review new construction startup guidance provided in ASHRAE Standard 180-2018, Standard Practice for the Inspection and Maintenance of Commercial Building HVAC Systems.

- Increase circulation of outdoor air as much as possible by opening windows and doors if possible, and using fans. Do not open windows and doors if doing so poses a safety or health risk for occupants, including children (e.g., a risk of falling or of breathing outdoor environmental contaminants such as carbon monoxide, molds, or pollens).
- To minimize the risk of Legionnaires' disease and other diseases associated with water, take steps to ensure that all water systems and features (e.g., sink faucets, drinking fountains, decorative fountains) and water-using devices (e.g., ice machines, cooling towers) are safe to use after a prolonged facility shutdown.

Identify where and how workers might be exposed to COVID-19 at work.

Employers are responsible for providing a safe and healthy workplace.

- Conduct a thorough hazard assessment of the workplace to identify potential workplace hazards that could increase risks for COVID-19 transmission.
- Identify work and common areas where employees could have close contact (within 6 feet) with others — for example, meeting rooms, break rooms, the cafeteria, locker rooms, check-in areas, waiting areas, and routes of entry and exit.
- Include all employees in communication plans — for example, management, staff, utility employees, relief employees, janitorial staff, and maintenance staff.
- If contractors are employed in the workplace, develop plans to communicate with the contracting company about changes to work processes and requirements for the contractors to prevent transmission of COVID-19.

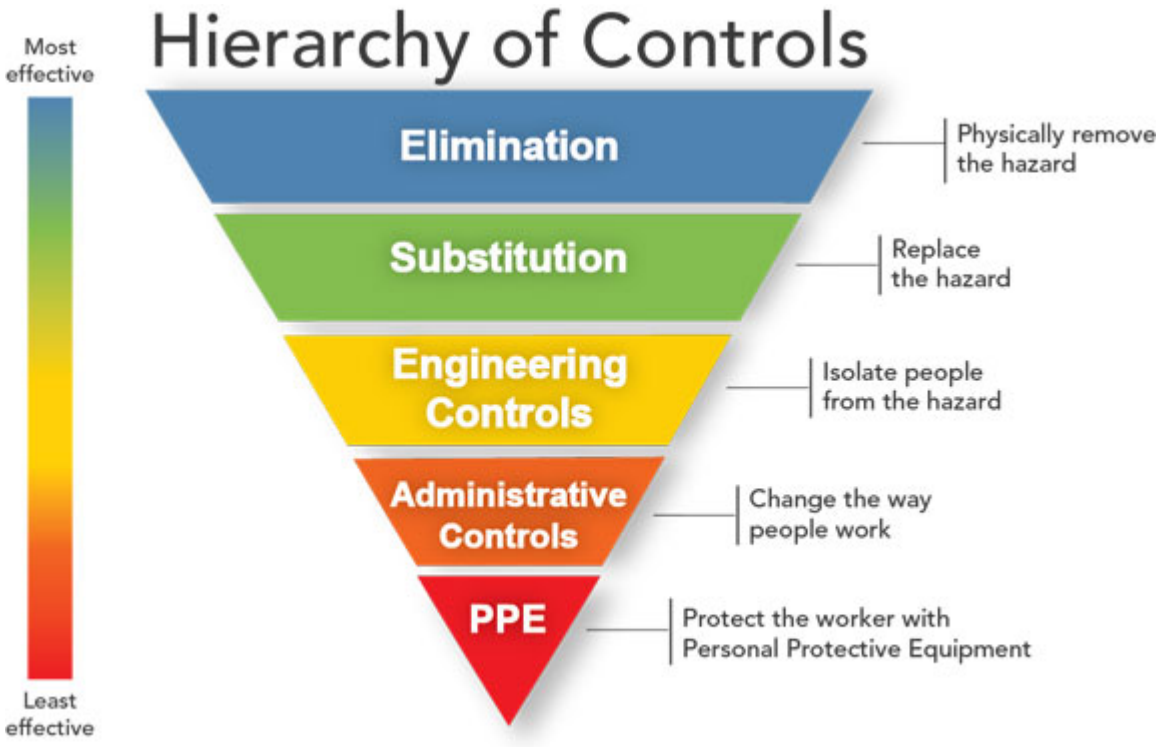
Develop hazard controls using the hierarchy of controls to reduce transmission among workers. Use a combination of controls noted below.

HIERARCHY OF CONTROLS

Overview

Controlling exposures to occupational hazards is the fundamental method of protecting workers. Traditionally, a hierarchy of controls has been used as a means of determining how to implement feasible and effective control solutions.

One representation of this hierarchy is as follows:



The idea behind this hierarchy is that the control methods at the top of graphic are potentially more effective and protective than those at the bottom. Following this hierarchy normally leads to the implementation of inherently safer systems, where the risk of illness or injury has been substantially reduced.

NIOSH leads a national initiative called **Prevention through Design** (PtD) to prevent or reduce occupational injuries, illnesses, and fatalities through the inclusion of prevention considerations in all designs that impact workers. Hierarchy of controls is a PtD strategy. To learn more, visit the PtD website.

Elimination and Substitution

Elimination and substitution, while most effective at reducing hazards, also tend to be the most difficult to implement in an existing process. If the process is still at the design or development stage, elimination and substitution of hazards may be inexpensive and simple to implement. For an existing process, major changes in equipment and procedures may be required to eliminate or substitute for a hazard.

Engineering Controls

Engineering controls are favored over administrative and personal protective equipment (PPE) for controlling existing worker exposures in the workplace because they are designed to remove the hazard at the source, before it comes in contact with the worker. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection. The initial cost of engineering controls can be higher than the cost of administrative controls or PPE, but over the longer term, operating costs are frequently lower, and in some instances, can provide a cost savings in other areas of the process.

For descriptions of engineering control technologies researched by NIOSH, and information on the control details and their effectiveness, visit our Engineering Controls Database. The engineering controls contained in the database are beneficial for users who need control solutions to reduce or eliminate worker exposures.

Administrative Controls and PPE

Administrative controls and PPE are frequently used with existing processes where hazards are not particularly well controlled. Administrative controls and PPE programs may be relatively inexpensive to establish but, over the long term, can be very costly to sustain. These methods for protecting workers have also proven to be less effective than other measures, requiring significant effort by the affected workers.

Engineering controls: Isolate workers from the hazard

- Modify or adjust seats, furniture, and workstations to maintain social distancing of 6 feet between employees, where possible.
    - Install transparent shields or other physical barriers where possible to separate employees and visitors where social distancing is not an option.
    - Arrange chairs in reception or other communal seating areas by turning, draping (covering chair with tape or fabric so seats cannot be used), spacing, or removing chairs to maintain social distancing.
- Use methods to physically separate employees in all areas of the building, including work areas and other areas such as meeting rooms, break rooms, parking lots, entrance and exit areas, and locker rooms.
    - Use signs, tape marks, or other visual cues such as decals or colored tape on the floor, placed 6 feet apart, to show where to stand when physical barriers are not possible.
    - Replace high-touch communal items, such as coffee pots and bulk snacks, with alternatives such as pre-packaged, single-serving items. Encourage staff to bring their own water to minimize use and touching of water fountains or consider installing no-touch activation methods for water fountains.
- Consider taking steps to improve ventilation in the building, in consultation with an HVAC professional, based on local environmental conditions (temperature/humidity) and ongoing community transmission in the area:
    - Increase the percentage of outdoor air, (e.g., using economizer modes of HVAC operations) potentially as high as 100% (first verify compatibility with HVAC system capabilities for both temperature and humidity control as well as compatibility with outdoor/indoor air quality considerations).

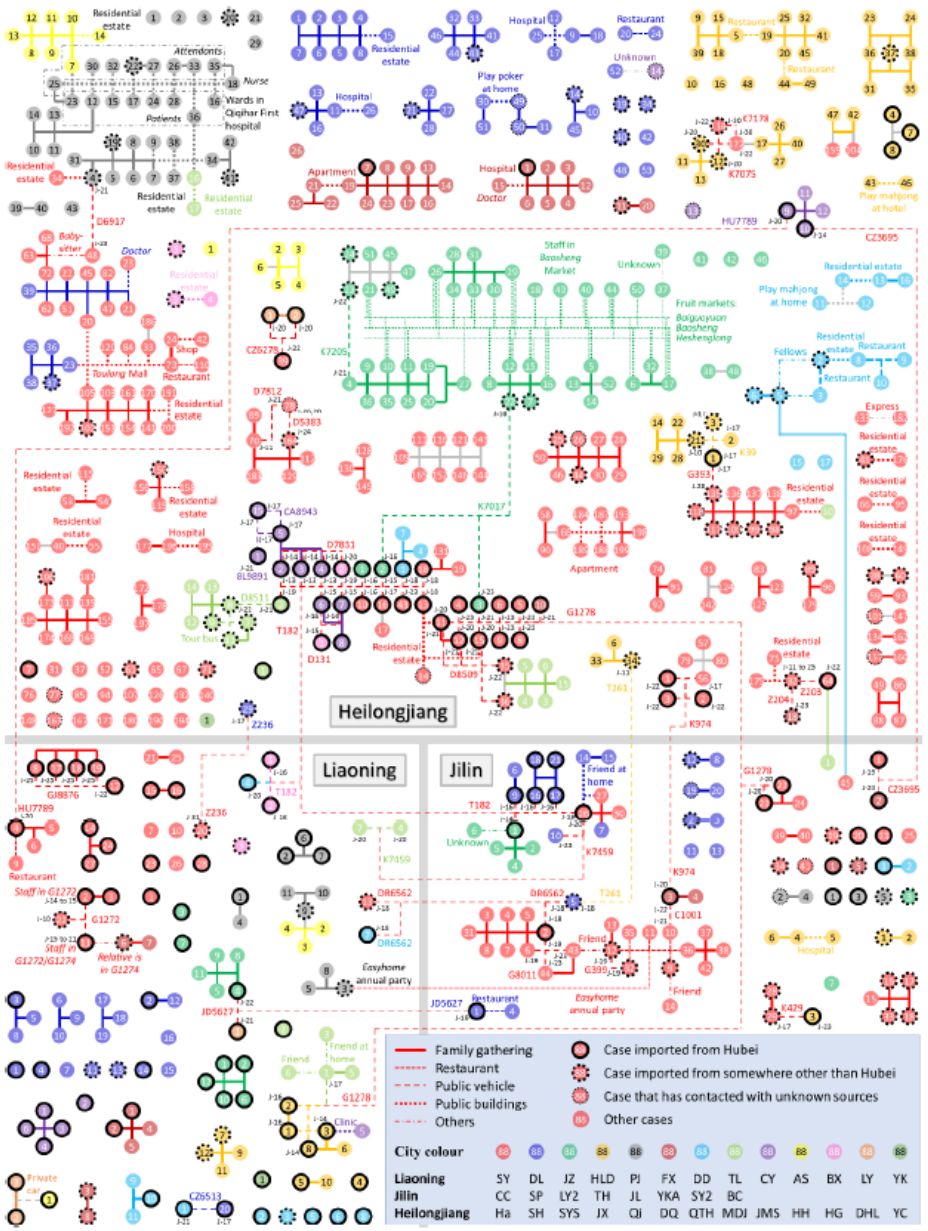
- Increase total airflow supply to occupied spaces, if possible.
- Disable demand-control ventilation (DCV) controls that reduce air supply based on temperature or occupancy.
- Consider using natural ventilation (i.e., opening windows if possible and safe to do so) to increase outdoor air dilution of indoor air when environmental conditions and building requirements allow.
- Improve central air filtration:
  - **Increase air filtration to as high as possible without significantly diminishing design airflow.**
  - **Inspect filter housing and racks to ensure appropriate filter fit and check for ways to minimize filter bypass.**
- Consider running the HVAC system at maximum outside airflow for 2 hours before and after occupied times, in accordance with industry standards.
- Generate clean-to-less-clean air movements by re-evaluating the positioning of supply and exhaust air diffusers and/or dampers and adjusting zone supply and exhaust flow rates to establish measurable pressure differentials. Have staff work in "clean" ventilation zones that do not include higher-risk areas such as visitor reception or exercise facilities (if open).

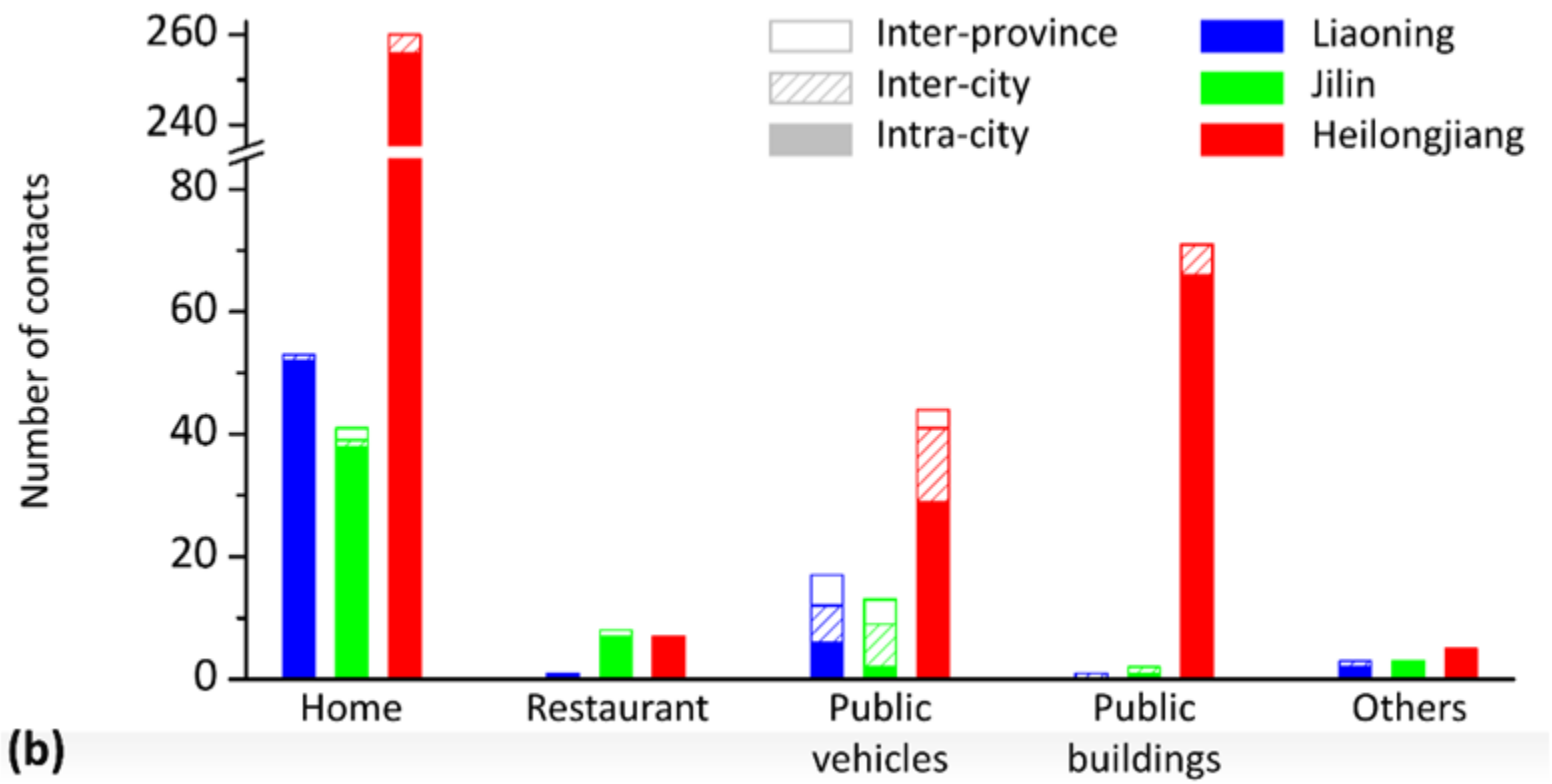
- Consider using portable high-efficiency particulate air **(HEPA) fan/filtration systems to help enhance air cleaning (especially in higher-risk areas).**
- Ensure exhaust fans in restroom facilities are functional and operating at full capacity when the building is occupied.
- Consider using ultraviolet germicidal irradiation (UVGI) as a supplemental technique to inactivate potential airborne virus in the upper-room air of common occupied spaces, in accordance with industry guidelines.

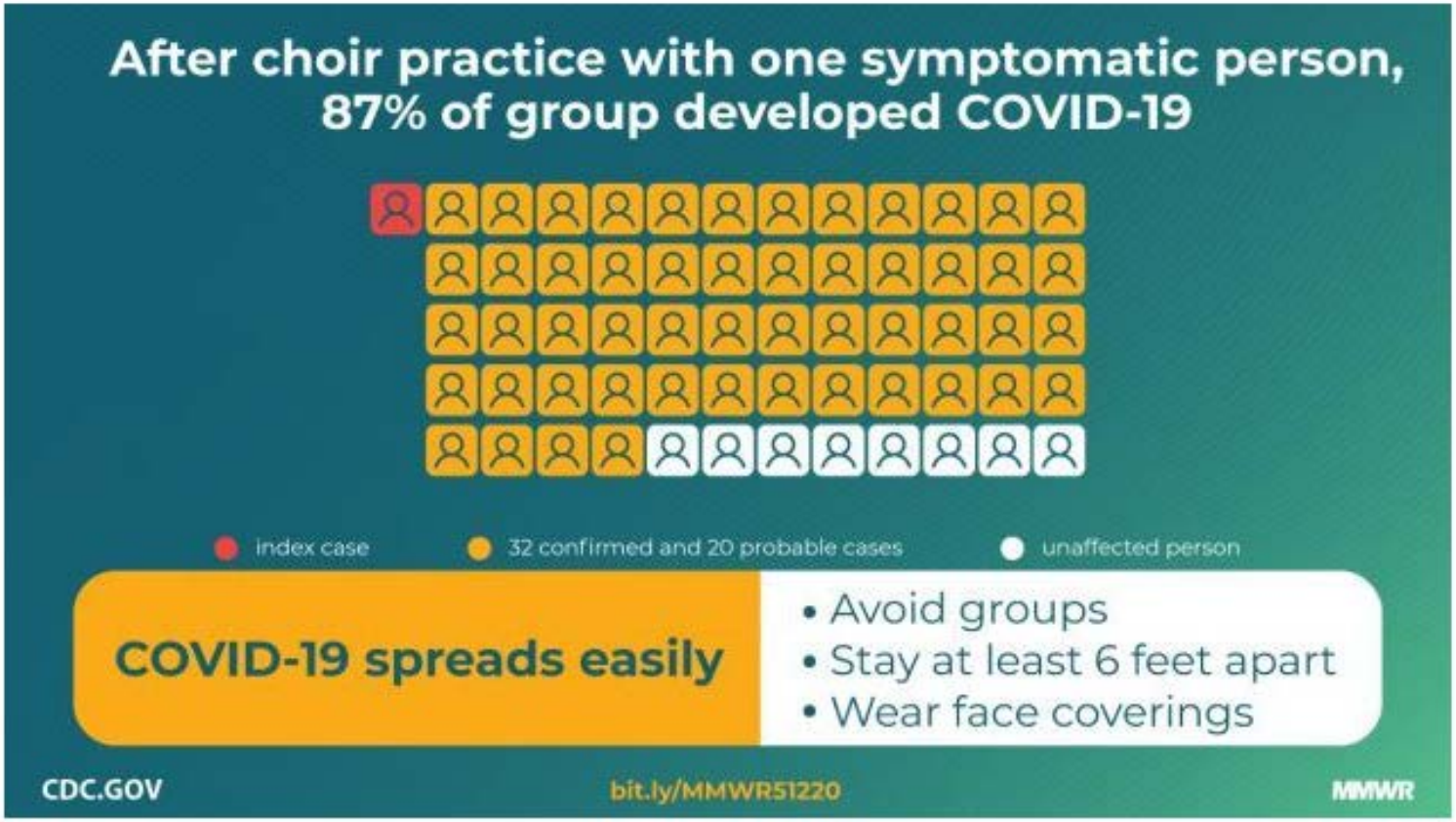
Three Publications:

A. British Journal: very detailed
B. Chinese: elaborate contact tracing
C. Generic ASHRAE article

- CDC
- BOMA
- Legal Firms
- AIA


Heilongjiang
Liaoning
Jilin
Family gathering
Restaurant
Public vehicle
Public buildings
Others
Case imported from Hubei
Case imported from somewhere other than Hubei
Case that has contacted with unknown sources
Other cases
City colour
Liaoning SY DL JZ HLD PJ FX DD TL CY AS BX LY YK
Jilin CC SP LY2 TH JL YKA SY2 BC
Heilongjiang Ha SH SYS JX QI DQ QTH MDJ JMS HH HG DHL YC


Inter-province
Inter-city
Intra-city
Liaoning
Jilin
Heilongjiang
Number of contacts
260
240
80
60
40
20
0
Home
Restaurant
Public vehicles
Public buildings
Others
(b)


After choir practice with one symptomatic person, 87% of group developed COVID-19
index case
32 confirmed and 20 probable cases
unaffected person
COVID-19 spreads easily
• Avoid groups
• Stay at least 6 feet apart
• Wear face coverings
CDC.GOV
bit.ly/MMWR51220
MMWR

Transfer of the Virus

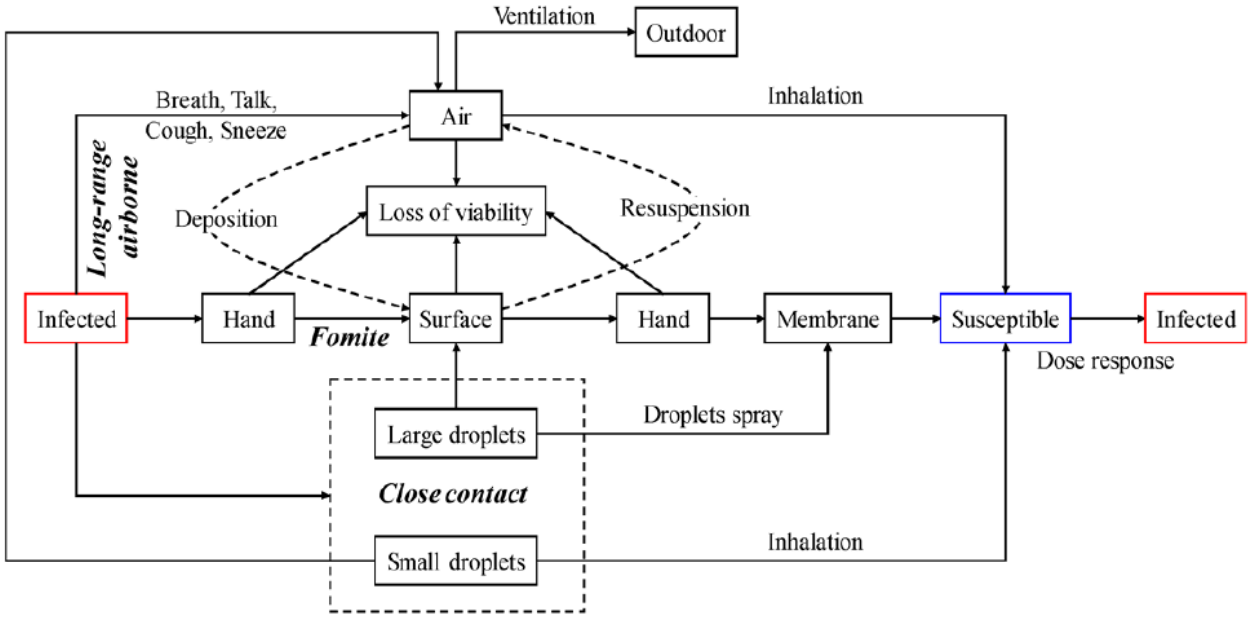


Figure 4: Three potential transmission pathways for respiratory viruses. [obtained from Zhang *et al.* (2018)]

Surface Contamination.

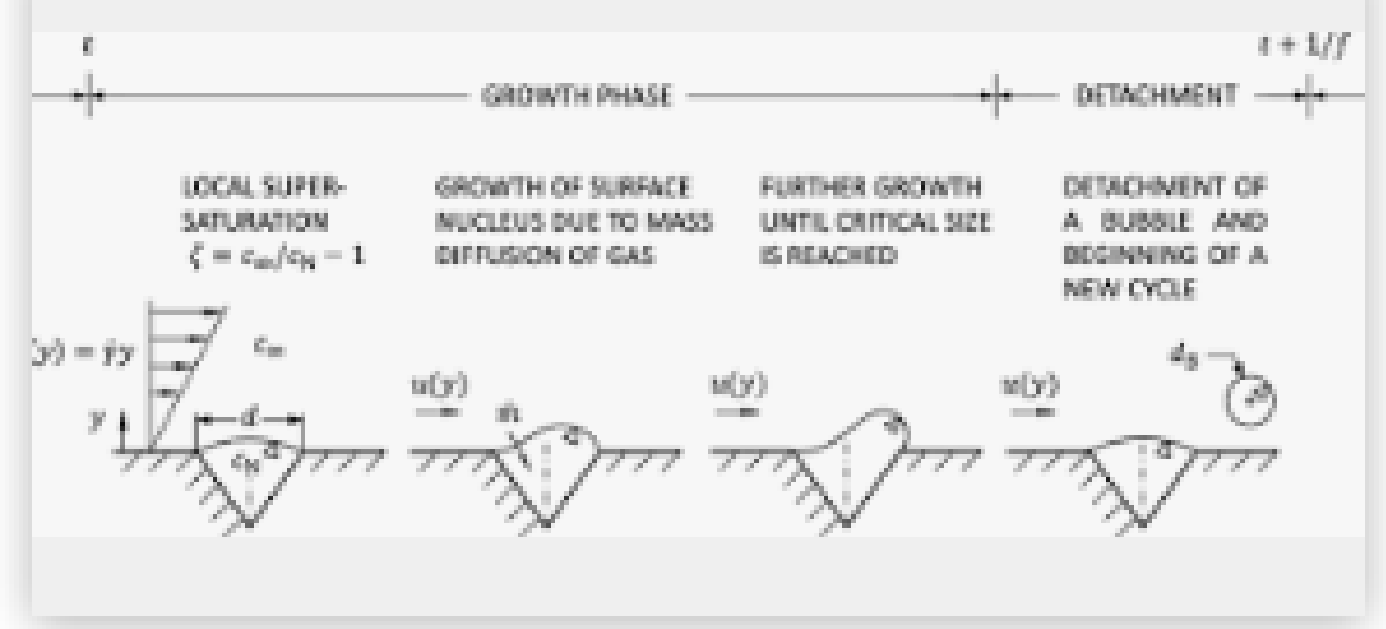
In a hospital setting where infectious diseases are rampant, all surfaces are subject to question in designing a facility. Given the life expectancy of the Virus on different surfaces, they can survive up to 3 says. In a research by this Author for the Doctoral thesis, multiple papers were published on particle deposition in turbulent flow over rough surfaces (Khosrow Nourmohammadi, Ph.D. Thesis, Nuclear Engineering, U. of Illinois- Urbana-Champaign, 1982). Based on this study for Uranium mines, the rougher surface caused higher deposition of radioactive materials of surfaces of mine. Therefore, all areas, surfaces, furniture, obstructions must be redesigned for least accumulation of virus.

Saum's Theory:

Nuclear Engineering and Design
Volume 60, Issue 3, October 1980, Pages 401-411

A study of forced convective subcooled boiling in heated annular channels

P.K.Jain, K.Nourmohammadi, R.P.Roy



ASME DIGITAL COLLECTION
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Journal of Fluids Engineering

Turbulent Air Flow Over Rough Surfaces: II. Turbulent Flow Parameters

Khosrow Nourmohammadi,

P. K. Hopke,

J. J. Stukel

J. Fluids Eng. Mar 1985, 107(1): 55-60 (6 pages)

Uranium and radiation particles were less absorbed on smooth surfaces

Saum's theory: If you have smooth surface, you can clean the contaminant easier, no deposits and with time you will not have a collection of contaminant source for dispersing.

Bowden and Tabor (1950) Theory - British Journal

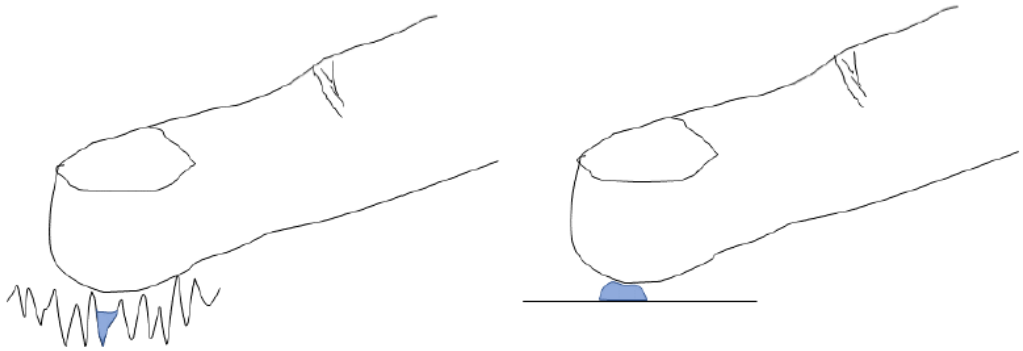


Figure 7: Illustration of how a droplet in a surface roughness groove (left) can be inaccessible to finger touch compared with a droplet on a smooth surface (right).

In Costco, when they wipe the surfaces, Only smooth surfaces will be wiped.

Survival rate of Covid 19 is assumed to be same as SARS-CoV-2

Survival Environment	Hours
Median half-life as aerosolized particles	1
Surfaces	
Plastic and stainless steel	72
Cardboard	24
Copper	4

Person to Person: Distance Travel as moist	ft
Normal Condition	6
Active, running, gasping	8 to 12
Coughing/Sneezing- Laboratory Studies	26

Material Filtration against 0.02 Micron Particle	% Captured
Covid 19 is 0.12 micron	
Surgical Mask	89
Vacuum Cleaner Bag	86
Dish Towel	73
Cotton Blend	70
Antimicrobial Pillowcase	68
Linen	62
Pillowcase	57
Silk	54
100% Cotton T shirt	51
Scarf	49

Typical air exhaled from human has the following composition:

- 5.0–6.3% water vapor
- 74.4% nitrogen
- 13.6–16.0% oxygen
- 4.0–5.3% carbon dioxide
- 1% argon

Exhaled particles from a person range in diameter from 0.01 and 1000 μm depending on generation mechanism and site of origin

The water vapor content becomes the carrier of the virus to travel. The myth about the cold or warm weather affecting the virus transmission is as follows. Although temperature and humidity reduce the transmission rate, yet we have any outbreaks in Florida or Arizona. One of the main reason for the reduction is the fact that in warmer air, people spend more outdoor versus indoor (confined space), hence rate of transmission is reduced.

N95 masks are the reference standard acceptable device for transmission reduction.

N95 Filtration (0.1-0.3 microns)	Effectiveness
NaCl Particles	95%
0.75 Microns	99.50%
Bacteria Size	99.50%

As noted, we must understand the Covid 19 prior to finding resolutions in tackling this in our building design. We will use the above data in our findings at length.

Subjects of Interest

There are number of subjects in building design that one must concentrate on. In earthquake design, structural elements become parameters of interest. In building fire design, egress path, building material or type of construction, and compartmentalization are of values. What about Covid 19 impact? It seems, that the adaptation and lessons from **design of the hospital biocontainment will be our primary reference.**

Compartmentalization. NFPA 101

Life Safety Code®

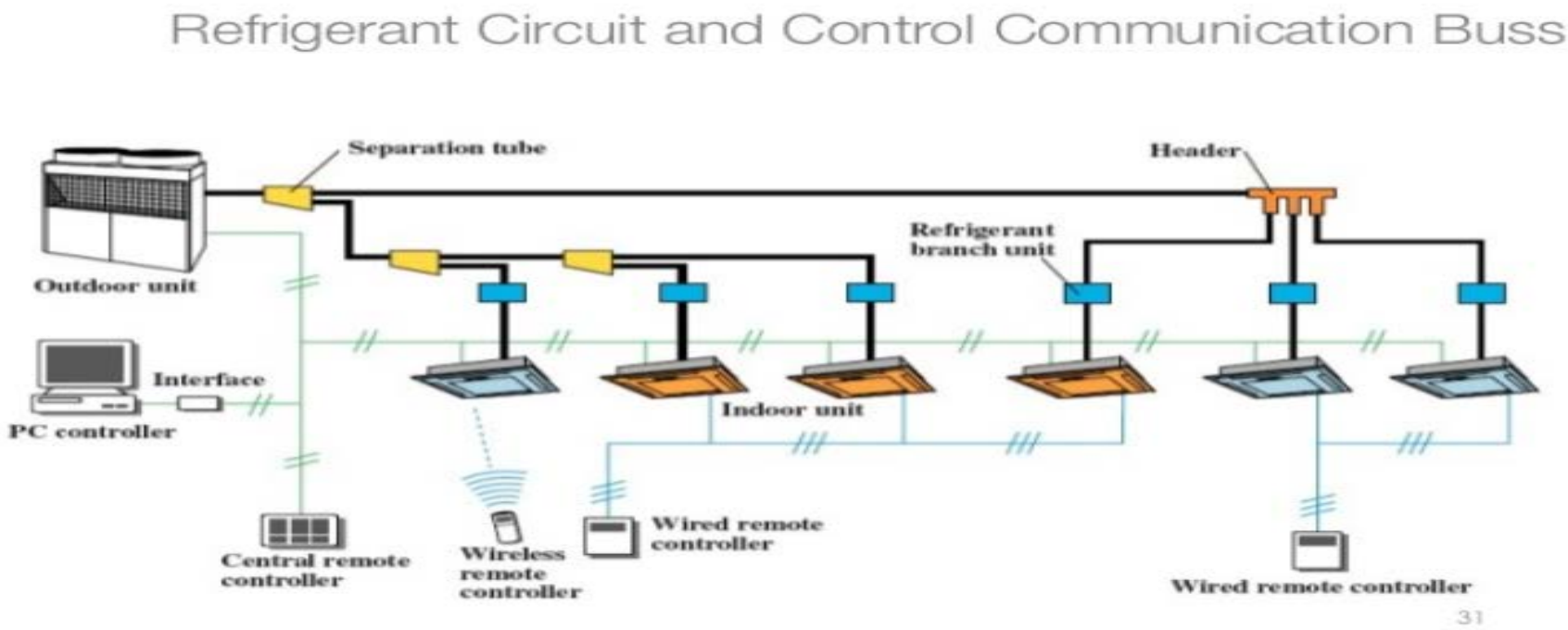
The Life Safety Code is the most widely used source for strategies to protect people based on building construction, protection, and occupancy features that minimize the effects of fire and related hazards. Unique in the field, it is the only document that covers life safety in both new and existing structures.

In building design, either for security in a bank or a software company, infectious disease control in a hospital, for containment of fire based on occupancy/population/type of building, the architect lays out the building to satisfy the building owners or local plan examiners.

In the Covid 19 environment, Compartmentalization has caused places such as Walmart to create a one way path in the isles to minimize the impact of two passing shoppers. In Building and Safety departments, patrons are only permitted one area by appointment or only email conversations and plan transmissions. In addition, besides isolation of movement of people, compartmentalization requires, dedicated air condition system for that compartment. In a school, individual classrooms must have dedicated self contained HVAC units with no cross contamination. As you may have encountered, when one pupil attends **school**, the classroom or entire section of building becomes ill.

In a new **high rise building**, the choices in HVAC design varies with number of floors. However, one can select, one air handing unit per floor, or use of water source heat pumps, or a four pipe system, or similar to achieve increased compartmentalization.

In a non-high rise building, the choices increase. The smaller the HVAC zones, ideally one per room, will be the best solution. With the advent of **Variable Refrigerant Flow by Samsung provides an easy solution** where a Heat Pump system is applicable. Our intention is not to advertise a product, only to show simple solutions exist and are designed currently.



One of my lessons, in 1992, IEEE Conference, when I chaired a session in **International conference in Anaheim on Biological Effect of Electromagnetic Field** was the word "Prudent Avoidance".

> ***Prudent avoidance*** *is a precautionary* ***principle*** *in risk management. It states that reasonable efforts to minimize potential risks should be taken when the actual magnitude of the risks is unknown. (Wikipedia)*

Filtration of the HVAC system falls under this category. California Green Code 2019 upgraded the Filtration (fibrous media air filter) to Merv 13. Merv, Minimum Efficiency Reporting Value (MERV), ranging from MERV 1 to MERV 16 based on the average removal efficiency across three particle size ranges: 0.3–1 μm, 1–3 μm, and 3–10 μm. Other commercially common proprietary test metrics for in-duct air filters are:

MPR	Microparticle Performance Rating
FPR	Filter Performance Rating

Average Particle Size Efficiency in Microns	MERV Rating
3.0 - 10.0 less than 20%	1 to 4
3.0 - 10.0 49.9%	6
3.0 - 10.0 84.9%	8
1.0 - 3.0 50% - 64.9%, 3.0 - 10.0 85% or greater	10
1.0 - 3.0 80% - 89.9%, 3.0 - 10.0 90% or greater	12
0.3 - 1.0 75% - 84%, 1.0 - 3.0 90% or greater	14
0.3 - 1.0 75% or greater	16
99.97% of dust, pollen, mold, bacteria, and any airborne particles with a size of 0.3 microns (µm)	HEPA, high efficiency particulate air [filter]

Use of HEPA filters is not practical and can be used for hospitals or labs. Best option based on "Prudent Avoidance" principle is to selected MERV 16. Thinnest MERV 16 is 4", this has to be further research by manufacturers for least depth. Other key parameters are:

- **Higher static pressure maybe offset by RPM modifications of the motors,**
- **the air velocity through filters to be reduced to near 300 ft/min for highest effectiveness of particulates,**
- **placement of pressure differential device to announce when filters must be replaced, and**
- **good maintenance practice though the system to insure no leaks or cross contamination will ever exist.**

In existing systems, one can add recirculating fan system with MERV 16 filters to insure the higher probability of particulates. In past, I was required to design tobacco/smoke particulate within Casino environments. A basic supply and return within one zone with filtration can be added to a zone without altering the main system. However, the author recommends both.

Heating, ventilation, and air conditioning (HVAC) systems in health-care facilities are designed to

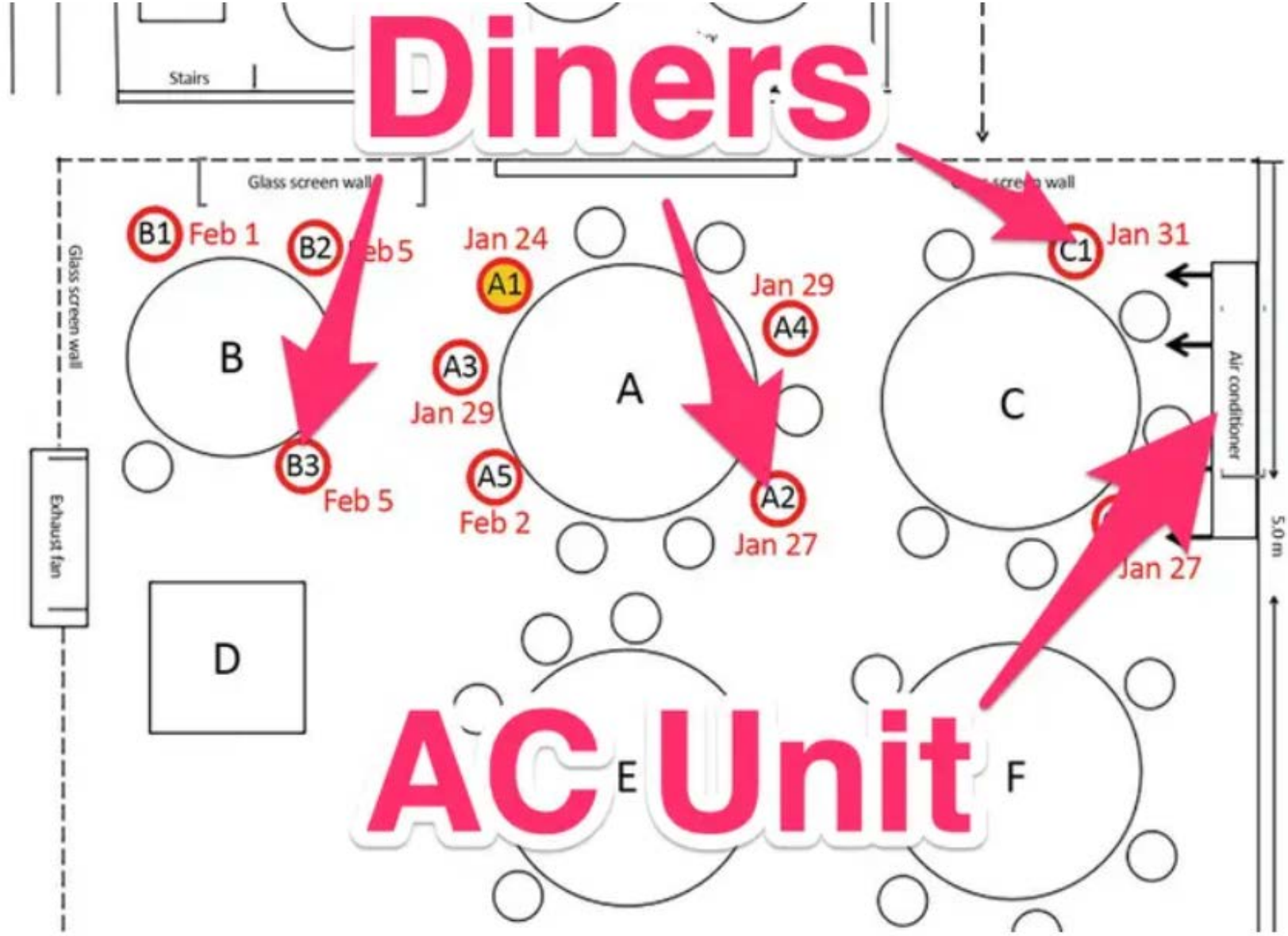
- maintain the indoor air temperature and humidity at comfortable levels for staff, and visitors
- control odors;
- remove contaminated air;
- facilitate air-handling requirements to protect susceptible staff and patrons from airborne pathogens; and
- minimize the risk for transmission of airborne pathogens

Decreased performance of healthcare facility HVAC systems, filter inefficiencies, improper installation, and poor maintenance can contribute to the spread of health-care associated airborne infections.

Air Distribution

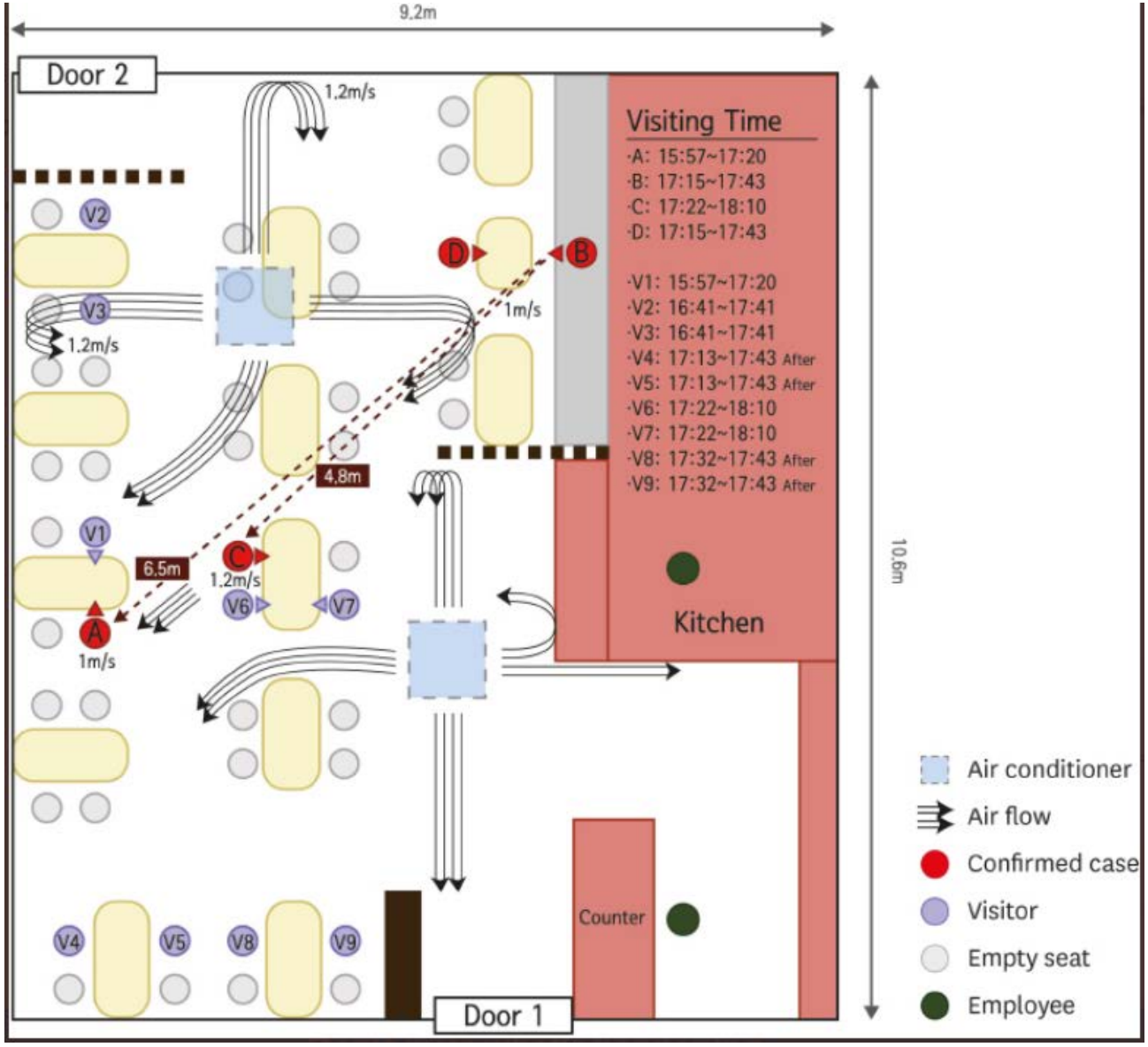
Based on the South Korean restaurant article with 31 seats (Tables A,B,C,D, and E) nine persons were infected by one person, although they were 6 ft apart and tables E and D had no infection, since the two tables were not in the air conditioning path. See

Linkedin "Saum Nour" (Linkedin Article).



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

Air distribution will be in conjunction with other segment of this article, if the zones become smaller, then the level of contamination reduces. In addition, one can introduce UV and inline filtration, independent of the air handling unit or even central HVAC unit.


9.2m
Door 2
1.2m/s
Visiting Time
·A: 15:57~17:20
·B: 17:15~17:43
·C: 17:22~18:10
·D: 17:15~17:43
·V1: 15:57~17:20
·V2: 16:41~17:41
·V3: 16:41~17:41
·V4: 17:13~17:43 After
·V5: 17:13~17:43 After
·V6: 17:22~18:10
·V7: 17:22~18:10
·V8: 17:32~17:43 After
·V9: 17:32~17:43 After
V2
D
B
1m/s
V3
1.2m/s
4.8m
V1
6.5m
C
1.2m/s
V6
V7
A
1m/s
Kitchen
10.6m
Air conditioner
Air flow
Confirmed case
Visitor
Empty seat
Employee
Counter
V4
V5
V8
V9
Door 1

Case B infected case A from 6.5m (~21 feet!) away in *just five minutes*, and case C from 4.8m (15 feet!). Footage shows no interaction—and only those in line of air flow got infected.


2 에어컨 바람에 의한 비말 확산
천장형 에어컨 6개
1 환기 어려운 통유리창
3 마스크 미착용
4 접촉에 의한 오염
8일 오후 7시30분 방문한
첫 확진자 자리(추정)
STARBUCKS
파주 스타벅스 야당역점
스타벅스 파주 야당역점 집단감염의 원인
1 환기 어려운 통유리창
1층 전체 3m 통유리.
2층은 아래쪽
4분의 1에만 작은 창문
2 에어컨 바람에 의한 비말 확산
2층에 천장형 에어컨 6개.
첫 확진자가 에어컨 아래에서
2시간 30분 머뭄. 2층 전체가
바람의 영향권
3 마스크 미착용
손님 대부분 마스크 제대로
쓰고 있지 않았던 상태.
직원들은 전원 마스크와 위생 장갑
착용해 모두 음성 판정
4 접촉에 의한 오염
확진자가 머물면서
만진 화장실 문 등을
다른 손님들이 만져
감염됐을 가능성
그래픽=박상훈

56 coronavirus cases were linked to a Starbucks in South Korea. But employees who were wearing masks didn't get infected.

A person sitting under an air conditioner infected 27 others with coronavirus at a Starbucks cafe in South Korea, but none of employees, who were wearing masks, got the virus

Researchers studying the case think that the restaurant's air-conditioner blew the viral droplets of one person who was asymptomatic farther than they might have normally gone. Nine other people across the three families later got sick.

But in a potentially hopeful finding for the locked-down restaurant industry, none of the 73 other diners and eight employees in the restaurant at the time got sick.

Ultraviolet Germicidal Irradiation (UVGI)

National Academy of Sciences, Engineering and Medicine provided basic data on UV Lights. UV Light produced by the sun and by three special lamps (UVA, UVB, and most Energy UVC). UV energy destroys genetic materials inside viruses and other microbes. Therefore, UVC light is used for **disinfection**. UVC lamps and robots are commonly used to sanitize water, objects such as laboratory equipment, and spaces such as buses and airplanes.

UVC light has been found to destroy **viruses** and **other microbes** on surfaces in hospitals. But it is not widely used in hospitals or other health care settings. The U.S. government and the UV technology **industry** are working to **define standards** for UV disinfection technologies in healthcare settings.

Most UV sanitizers have not been tested against the novel coronavirus, SARS-CoV-2. But UVC light been shown to destroy related coronaviruses, including the one that causes the disease **MERS**.

Use of UV lights in the HVAC system, especially in the condensate pan of the air handler has been very effective. In another incident, UV light wall sconces were installed in a hospital corridor, although very inefficient. After September 11th, on September 2002, EPA commissioned RTI International from North Carolina to provide a Technology Evaluation Report on Biological Inactivation Efficiency by HVAC In-Duct Ultraviolet Light Systems -American Ultraviolet Corporation ACP-24/HO-4. EPA announced the formation of the National Homeland Security Research Center (NHSRC)- part of the Office of Research and Development. Their mission was to report on research and technical assistance design efforts to provide:

- appropriate,
- affordable,
- effective, and
- validated technologies and methods for addressing risks posed by:
    - chemical,
    - biological, and
    - radiological terrorist attacks.

Ironically, this report applied to presence of Covid 19. EPA, Test/QA Plan for Biological Inactivation Efficiency by HVAC In-Duct Ultraviolet Light Air Cleaners were conducted using three organisms:

- two bacteria (Bacillus atrophaeus and Serratia marcescens) and
- one bacterial virus (MS2). These organisms were selected because their sizes, shapes and susceptibility to UV inactivation make them reasonable surrogates for biological warfare agents (BWAs).

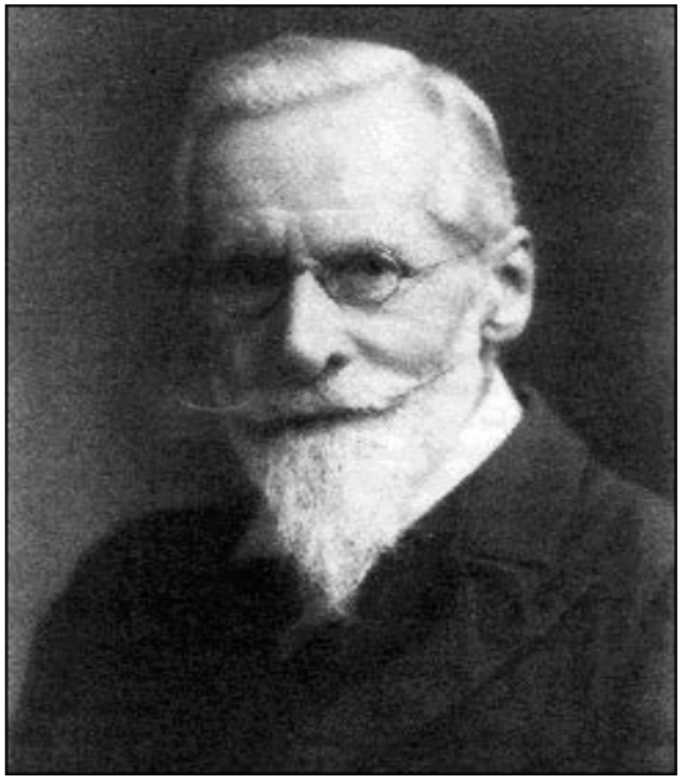
Generally, vegetative bacteria are readily killed and bacterial spores are more difficult. To model use in an HVAC system, RTI used a test duct designed for testing filtration and inactivation efficiencies of aerosol, bioaerosol, and chemical challenges.

Most critical design criteria for the UVGI is the UV Dosage for 90% reduction of the virus. Attached is the 611 micro Joules in every cm square cross sections area. Therefore the cross sectional area of the air handling in cm square must be measured and proper light intensity applied. UV lamps have life expectancy of 9000 hours and then significantly reduce the UV intensity, hence effectiveness. In addition, the other factors is the contact time of virus and the air stream. This mandates careful analysis of placement of UV lamp in the air stream. It is recommended that the air handler area to be stainless or reflective material to amplify the light bouncing the chamber for more effective routing.

Airstream Disinfection			
Microbe	Type	Diameter	UV Dose for 90% Reduction
		µm	µJ/cm2
Coronavirus (incl. SARS)	ssRNA	0.11	611
Influenza A virus	ssRNA	0.098	1935
Ref: Walker, Chris & Ko, Gwangpyo. (2007). Effect of Ultraviolet Germicidal Irradiation on Viral Aerosols. Environmental science & technology. 41. 5460-5			

History of Air Ionization

Plasma was first identified in a Crooks tube, and so described by Sir William Crookes in **1879** (he called it "radiant matter"). The nature of the Crookes tube "cathode ray" matter was subsequently identified by British physicist Sir J.J. Thomson in **1897**. The term "plasma" was coined by Irving Langmuir in **1928,** perhaps because the glowing discharge molds itself to the shape of the Crooks tube (a thing moulded or formed).

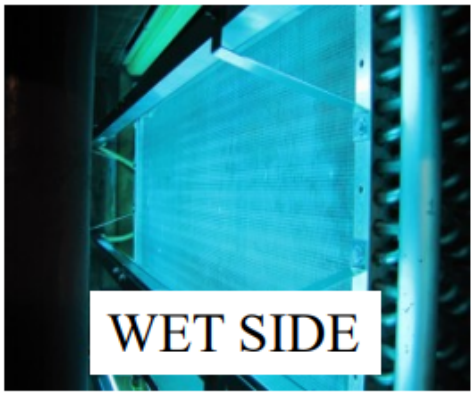


Sir William Crookes, OM, FRS was a British chemist and physicist who attended the Royal College of Chemistry, London, and worked on spectroscopy.

Needlepoint Bi-Polar Ionization v/s UVC

CHEMICAL	Bi-polar Ionization	UVC Light
Replacement Interval?	None	Annually
Produces Detectable Ozone?	No	No
Kill Mold, Bacteria and Virus?	Yes	Yes
Kills Pathogens in the Space?	Yes	No
Controls Odors?	Yes	No
Reduces Particulates?	Yes	No
Contains Mercury?	No	Yes
Electrodes Fragile?	No	Yes
Shock Resistant	Yes	No
Hazardous Disposal Req'd	No	Yes

Note: Cleans entire coil depth, not just "line of sight".



ASHRAE does not currently have a Society position on bipolar ionization. However, the ASHRAE ETF did reach out to CDC for their position on the technology. The following is the response from CDC in its entirety:

While bi-polar ionization has been around for decades, the technology has matured and many of the earlier potential safety concerns are reportedly now resolved. If you are considering the acquisition of bi-polar ionization equipment, you will want to be sure that the equipment meets UL 2998 standard certification (Environmental Claim Validation Procedure (ECVP) for Zero Ozone Emissions from Air Cleaners) which is intended to validate that no harmful levels of ozone are produced. Relative to many other air cleaning or disinfection technologies, needlepoint bi-polar ionization has a less-documented track record in regards to cleaning/disinfecting large and fast volumes of moving air within heating, ventilation, and air conditioning (HVAC) systems. This is not to imply that the technology doesn't work as advertised, only that in the absence of an established body of evidence reflecting proven efficacy under as-used conditions, the technology is still considered by many to be an "emerging technology". As with all emerging technologies, consumers are encouraged to exercise caution and to do their homework. Consumers should research the technology, attempting to match any specific claims against the consumer's intended use. Consumers should request efficacy performance data that quantitively demonstrates a clear protective benefit under conditions consistent with those for which the consumer is intending to apply the technology. Preferably, the documented performance data under as-used conditions should be available from multiple sources, some of which should be independent, third party sources.

Ozone

- Ozone (O3) is a reactive gas that can disinfect air and surfaces by killing viruses, bacteria, and fungi.
- Ozone is harmful for health and exposure to ozone creates risk for a variety of symptoms and diseases associated with the respiratory tract.
- ASHRAE's Environmental Health Committee issued an emerging issue brief suggesting "safe ozone levels would be lower than 10 ppb" and that "the introduction of ozone to indoor spaces should be reduced to as low as reasonably achievable (ALARA) levels."
- Should only be considered for disinfection on unoccupied spaces; it should never be used in occupied spaces.
    - Available scientific evidence shows that, at concentrations that do not exceed public health standards, ozone is generally ineffective in controlling indoor air pollution.
    - Reputable cleaning and restoration companies should be used for effective, safe disinfection of unoccupied spaces.

In-Room or Portable Air Cleaners

- Device is located in the room where air cleaning is desired. Place air cleaner where air intake and discharge are not impeded (e.g., not near furniture or behind curtains).
- Air is pulled into the device, and cleaned air is returned to the room. Flexible ductwork can be attached to some devices to allow strategic positioning of intake and/or discharge locations, including discharge outside the room to create pressure differences and/or create clean to less-clean directional airflow.
- Devices may include any or combinations of air cleaning technologies (filters, sorbents, UV, etc.). Users are advised to carefully determine that the application of the technology is appropriate for their need.
- Devices are rated by the Association of Home Appliance Manufacturers.
  - The rate of particle removal from air is termed the Clean Air Delivery Rate (CADR), typically in units of cubic feet per minute (CFM).
  - CADR ≈ airflow rate × removal efficiency
- To reach a desired air exchange rate in air changes per hour (ACH):
  - ACH = CADR (cfm) × 60 (min/hr) ÷ room volume (ft^3)

Chemical Disinfectants

- EPA reviews and registers antimicrobial pesticides, which include disinfectants for use on pathogens like SARS-CoV-2
- Carefully read product labels and use as directed.
- Most products have a required contact or dwell time, which is the amount of time a surface must remain wet to kill a certain pathogen.
- Applying a product in a way that does not align with its intended use may render the product less effective.
- Products on EPA List N have not been tested specifically against SARS-CoV-2, however the EPA expects them to kill the virus because they:
  - Demonstrate effectiveness against a harder-to-kill virus; or
  - Demonstrate efficacy against another type of human coronavirus similar to SARS-CoV-2.
- All surface disinfectants on List N can be used to kill viruses on surfaces such as counters and doorknobs.
- Because SARS-CoV-2 is a new virus, this pathogen is not yet readily available for use in commercial laboratory testing of disinfectant product effectiveness at killing that specific virus.

Vaporized Hydrogen Peroxide (VHP)

- Liquid hydrogen peroxide (H2O2) is vaporized and the vapor fills the space to disinfect all exposed surfaces.
- Space MUST be unoccupied during VHP treatment.
- Requires spaces to be sealed, including all doorways, plumbing/electrical penetrations and HVAC supply and return vents, to prevent vapor from escaping.
- After prescribed exposure times, remaining H2O2 vapor is scrubbed from space and converted ack to oxygen and water before space can be safely reoccupied.
- The effectiveness and safety of VHP when generated inside active HVAC ducts and occupied spaces has not been rigorously studied.
- VHP is hazardous at high concentrations, and lengthy exposure is often necessary to inactivate bacteria and viruses in sealed spaces.

Pulsed Xenon (Pulsed UV)

- High-powered UV lamps (generally containing xenon gas) used in rapid pulses of intense energy.
- Emits a broad brand of visible and ultraviolet wavelengths, with a significant fraction in the UV-C band.
  - Uses significantly higher power outputs that usual UV-C techniques.
  - Inactivates viruses, bacteria and fungi using the same mechanisms as standard UV-C systems.
- Typically used for healthcare surface disinfection, but can be used in HVAC systems for air and surface disinfection.

For more information, see the FAQ on Germicidal Ultraviolet (GUV) published by the Illuminating Engineering Society (IES) Photobiology Committee.

405 nm Visible Light

- Sometimes referred to a "Near UV," although not in the UV spectrum.
- Generally integrated into standard room lighting systems.
- Kills bacteria and fungi via different mechanism than UV-C.
  - Targets and excites naturally-occurring porphyrin molecules inside organisms, creating reactive oxygen species.
  - Reactive oxygen species kill by a mechanism similar to bleach.
- Effectiveness at killing viruses, including SARS-CoV-2, is not as well documented.
- Provides continuous disinfection of air and exposed surfaces in occupied spaces.
- In the FAQs on Germicidal Ultraviolet (GUV), the Illuminating Engineering Society (IES) Photobiology Committee notes that **effectiveness is approximately 1000 times less than UV-C and** the effective doses are not practical in an occupied environment.

Far Ultraviolet

- Far UV spectrum is 205 to 230 nm.
- Some deactivation of bacteria and viruses at the 207 nm and 222 nm range.
- 222 nm said to effectively penetrate microorganisms 1µm in size and smaller.
- Unable to fully penetrate larger microorganisms.
- UV Dose required to inactivate microorganisms is significantly higher at these wavelengths than in the UV-C range.
- While safety concerns are reduced, can still cause damage to eyes and skin.

For more information, see the FAQs on Germicidal Ultraviolet (GUV) published by the Illuminating Engineering Society (IES) Photobiology Committee.

Special Precautions

- Exposure to UV-C energy can cause eye and skin damage.
  - Photokeratitis (inflammation of the cornea)
  - Keratoconjunctivitis (inflammation of the ocular lining of the eye)
- Symptoms may not be evident until several hours after exposure and may include an abrupt sensation of sand in the eyes, tearing, and eye pain, possibly severe.
  - Symptoms usually appear 6 to 12 hours after UV exposure.
  - Symptoms are fully reversible and resolve within 24 to 48 hours.
- Maintenance workers should receive special training before working on UV-C systems.
- If exposures are likely to exceed safe levels, special personal protective equipment (PPE) is required for exposed eyes and skin.
  - Eyewear that blocks UV-C energy
  - Clothing, suits, or gowns known to be nontransparent to UV-C

Summary

- It is likely, but not yet shown, that COVID19 could be spread through the air.
- Air cleaning can help mitigate disease transmission.
- Options for air cleaning include:
  - HVAC systems
  - In-Room devices
- Technologies that can be effective include:
  - Mechanical Air Filters
  - Electronic Air Filters/Air Cleaners
  - UV-C Systems
  - Other Emerging Technologies
- Care and professional judgement should be taken to understand choices for filtration and air disinfection, pros and cons of each and impact(s) on existing buildings systems.

Best Management Practice.

It is evident that all theories and articles and guidelines are only as good as they are implemented, applied, and maintained, even though mas casualty pandemics occur once in a century. A rigid protocol with weekly assessment is mandatory and essential for safe keeping of the occupants.

Summary

This article was more detailed than previous articles and the intent was not use to bore the reader. The intention was simply open up the dialogue. Compartmentalization, filtration, UV systems, ionization, surface contamination, air distribution, system selection, and quite number of other untold parameters become step stones of designing and creating a building while living through this pandemic.

Please Stay Safe.

And May God Bless all who have lost their lives due to Covid 19.

AIA Orange County

Impact of COVID-19

in

Building Design and Management

Building and Energy Codes and Building Management in a Pandemic

- **4:30-6:00 PM 12/8/2020 Part 1**
- **4:30-6:00 PM 12/10/2020 Part 2**

"Dr. Saum K. Nour, Ph.D." PE 32 States

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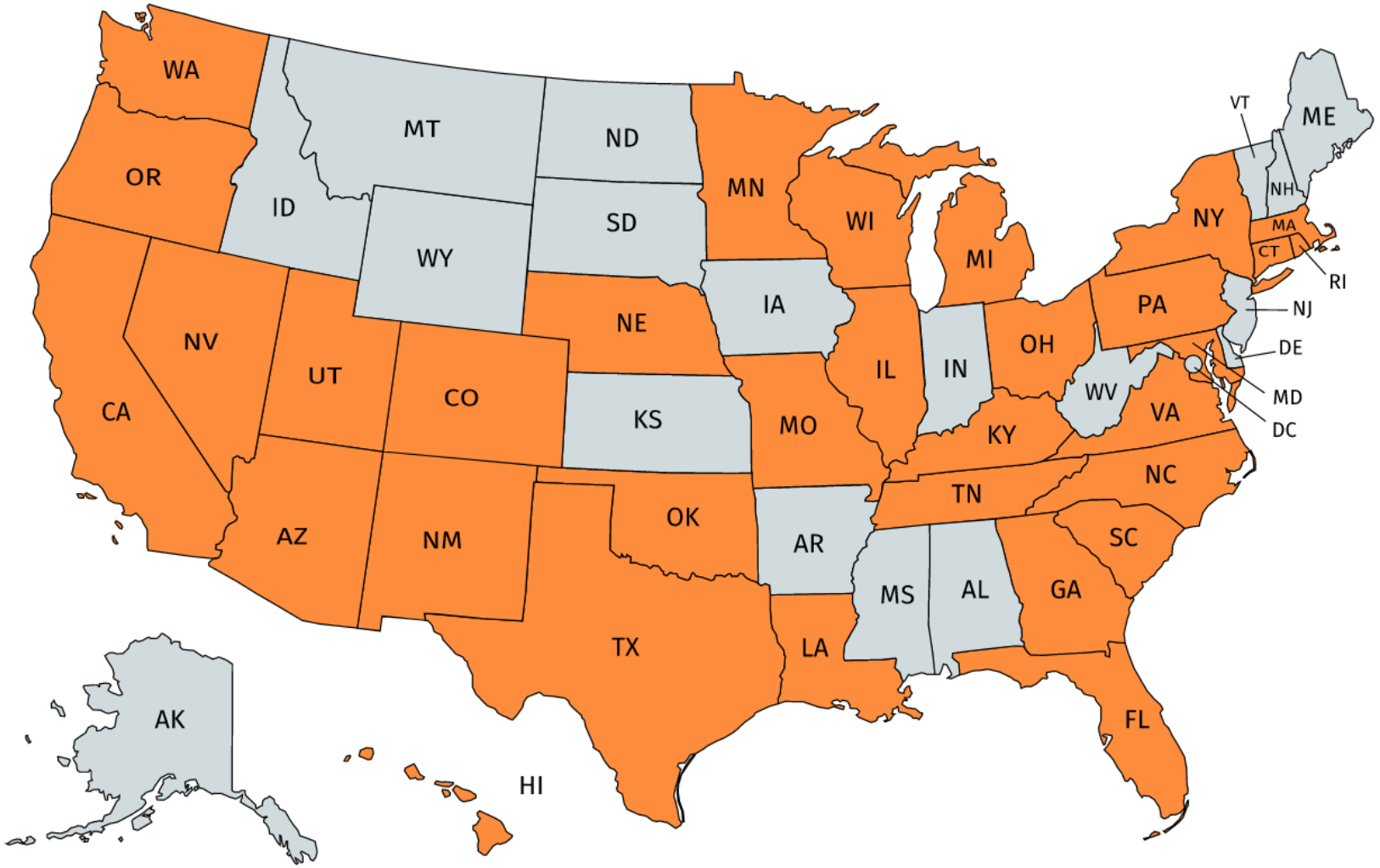
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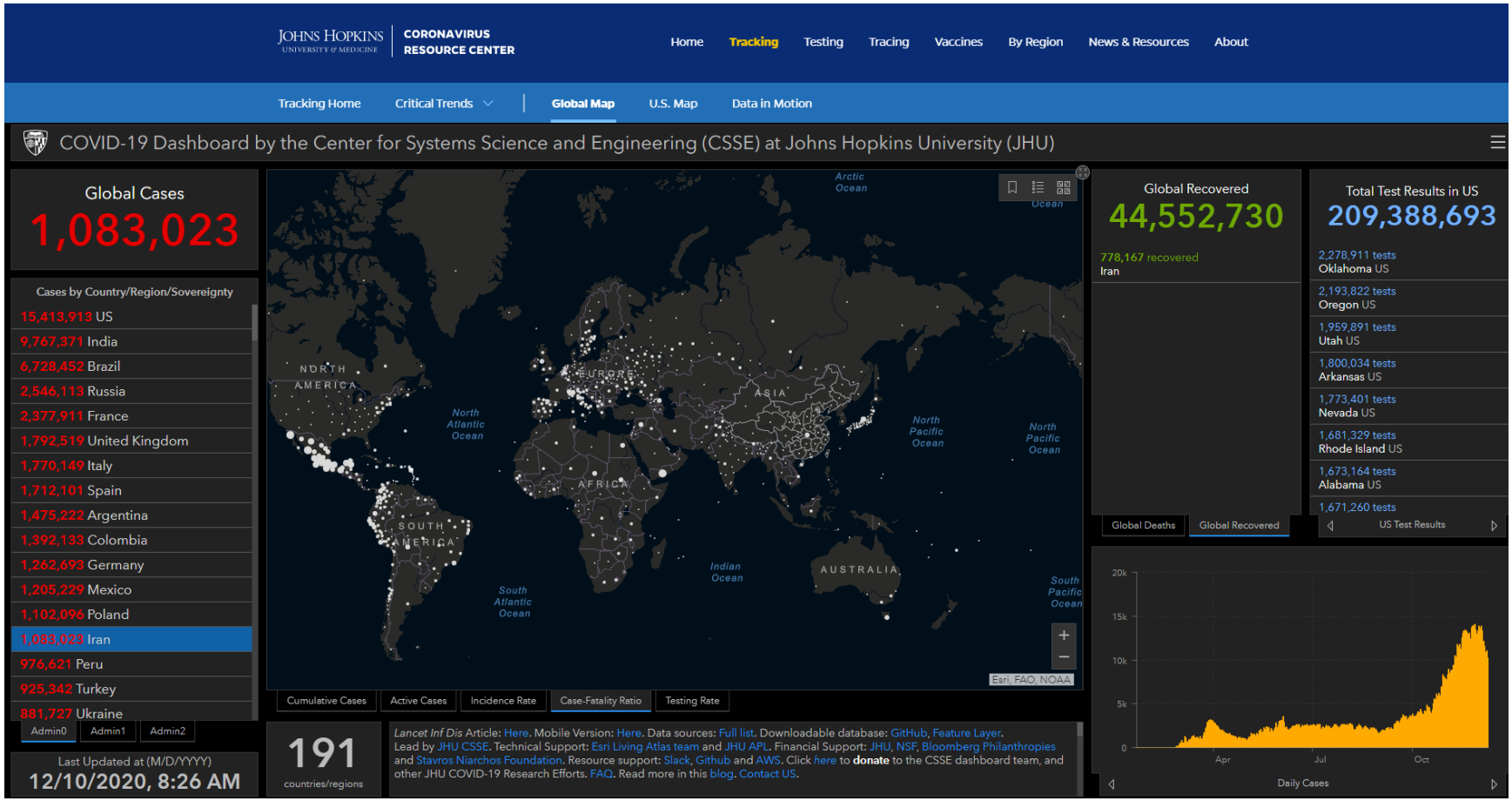
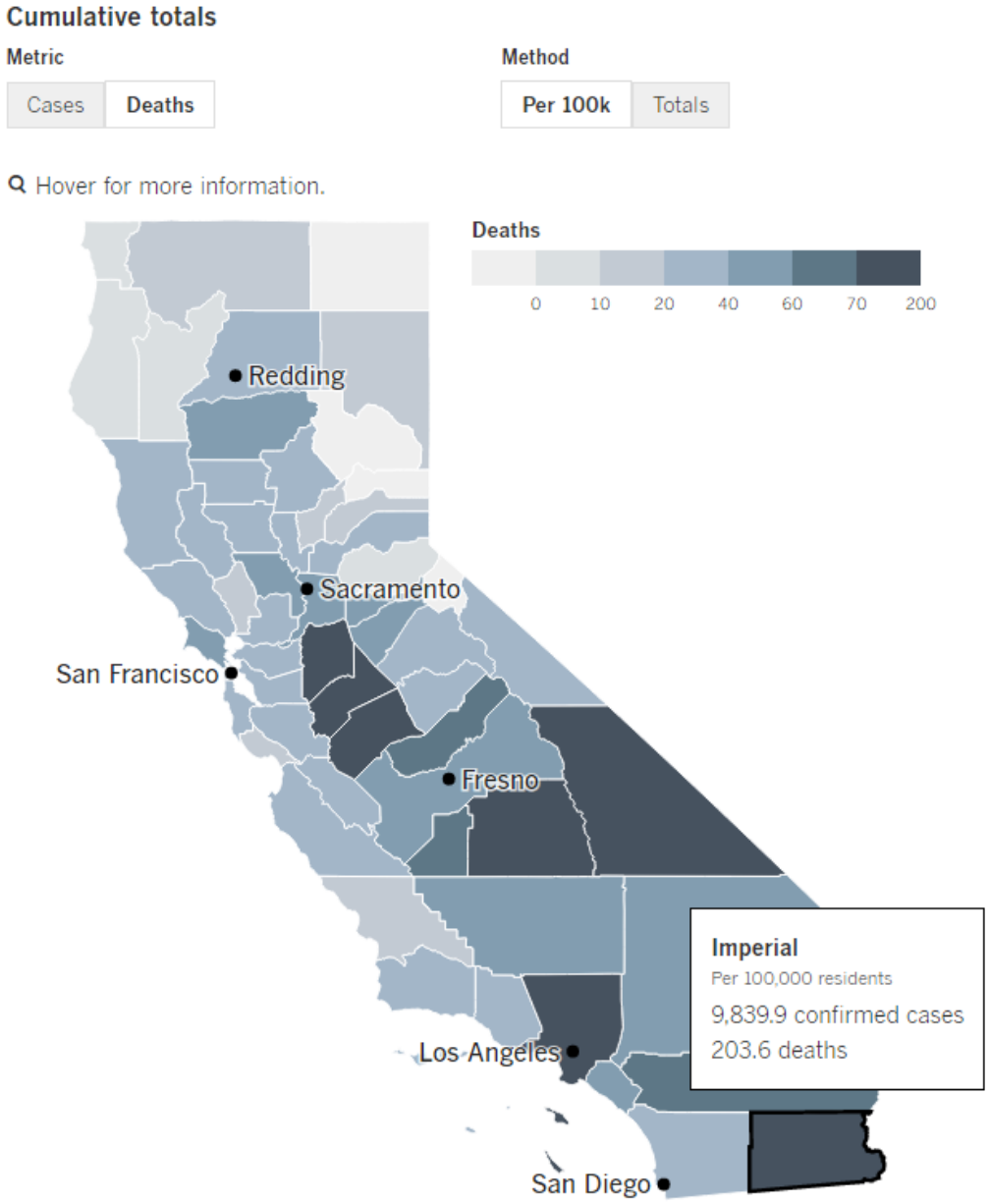
Before We begin




Cumulative totals
Metric
Cases
Deaths
Method
Per 100k
Totals
Hover for more information.
Deaths
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10
20
40
60
70
200
Redding
Sacramento
San Francisco
Fresno
Los Angeles
San Diego
Imperial
Per 100,000 residents
9,839.9 confirmed cases
203.6 deaths

Ashrae Work on Epidemic Task Force

General Information
- Building Readiness Intent
- Building Readiness Team
- Building Readiness Plan

Epidemic Conditions in Place (ECiP)
- Systems Evaluation
- Building Automation Systems (BAS)
- Increased Ventilation
- Increased Ventilation Control
- Building and Space Pressure
- Pre- or Post-Occupancy Flushing Strategy
- Upgrading and Improving Filtration
- Energy Savings Considerations
- Exhaust Air Re-entrainment
- Energy Recovery Ventilation Systems Operation Considerations
- UVGI Systems
- Domestic Water & Plumbing Systems
- Maintenance Checks
- Shutdown a Building Temporarily-FAQ
- System Manual
- Reopening During Epidemic Conditions in Place

Post-Epidemic Conditions in Place (P-ECiP)
- P-ECiP: Prior to Occupying
- P-ECiP: Operational Considerations once Occupied
- P-ECiP: Ventilation
- P-ECiP: Filtration
- P-ECiP: Building Maintenance Program
- P-ECiP: Systems Manual

Additional Information
- Acknowledgements
- References
- Disclaimer

Legal Question: Architect- Main Technical

All guidelines by all groups are stating please

- have a Risk Assessment Manager and
- Talk to your Legal Council

Saum's Thoughts:

A basic legal English that you will provide a design basis with best of abilities to confront the Covid- 19

Please practice: Utilize AIA Contracts as basis…

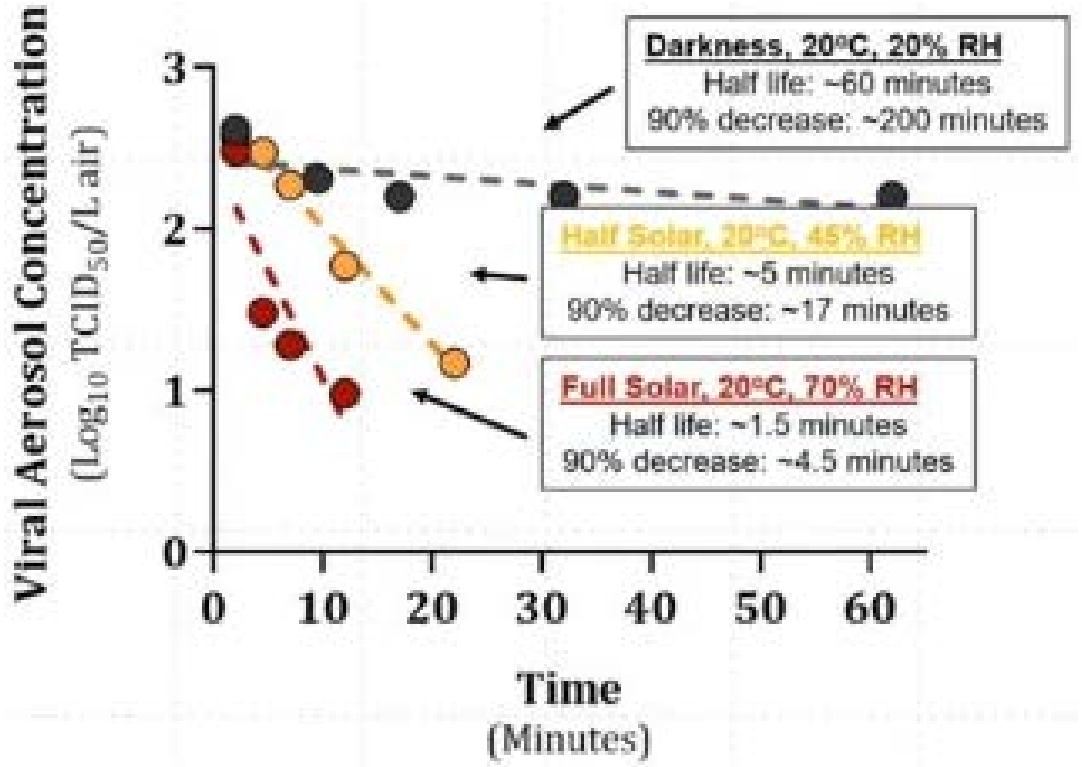
Use "Prudent Avoidance" as your BMP

Temperature Question

Sun on Surfaces with SARS-Covid2:

Air

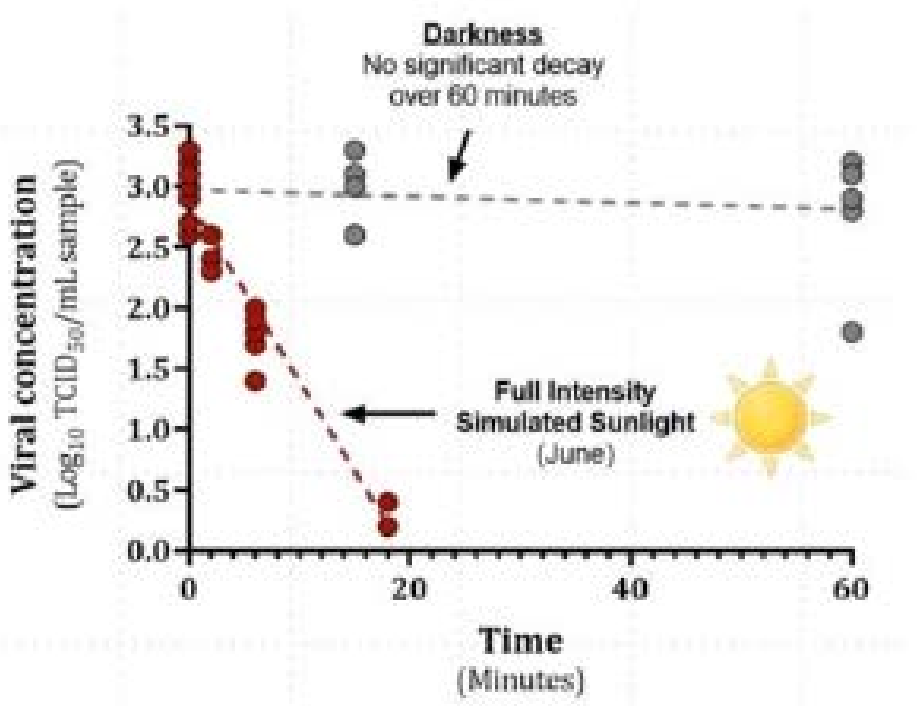
90% reduction from 200 minutes to 4.5 minutes



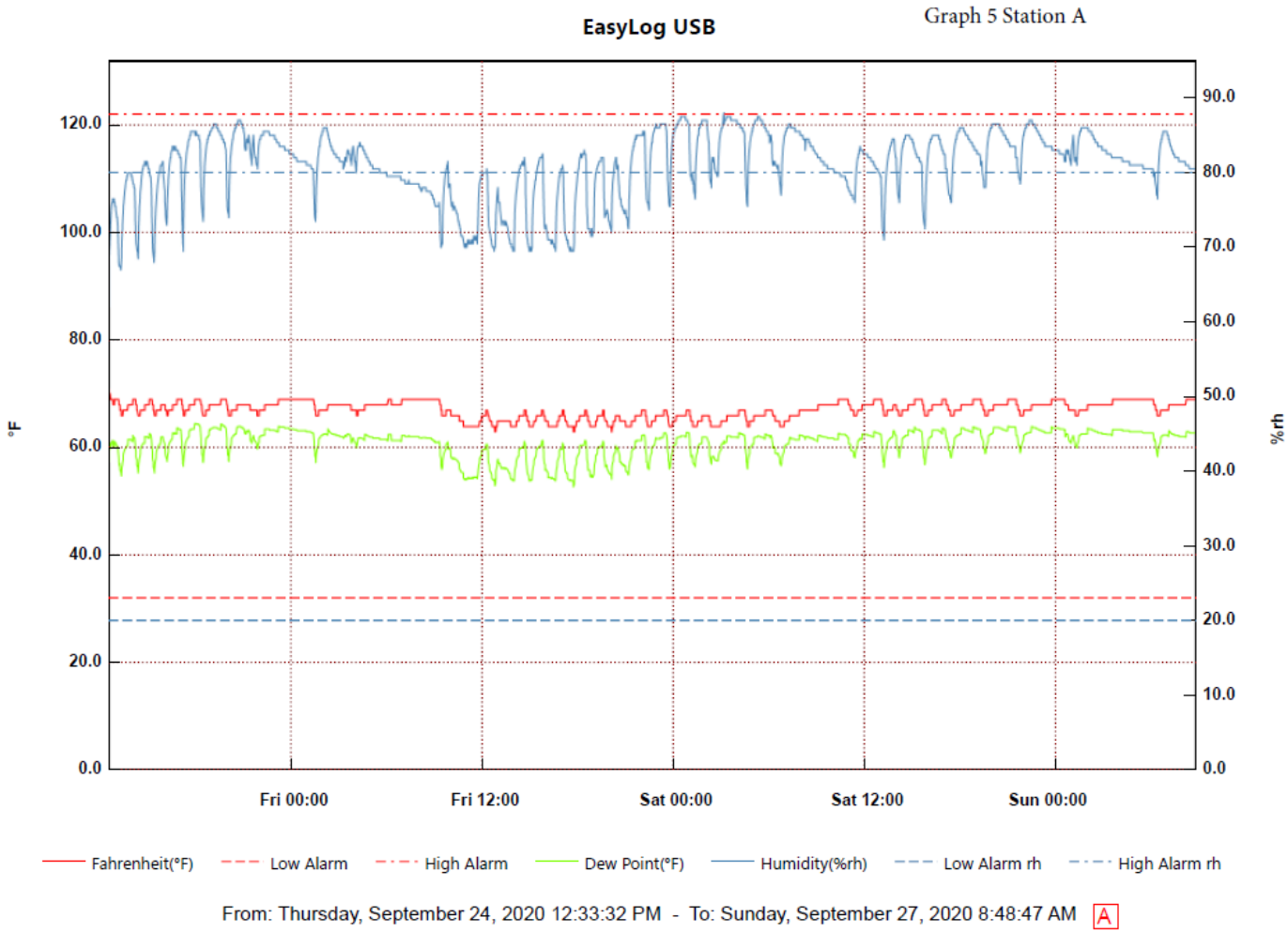
Sun on Surfaces with SARS-Covid2:

Steel

90% in 7 minutes



Humidity Factor



Humidity Control.

RH 40%-60% Least Life Expectancy of coronaviruses

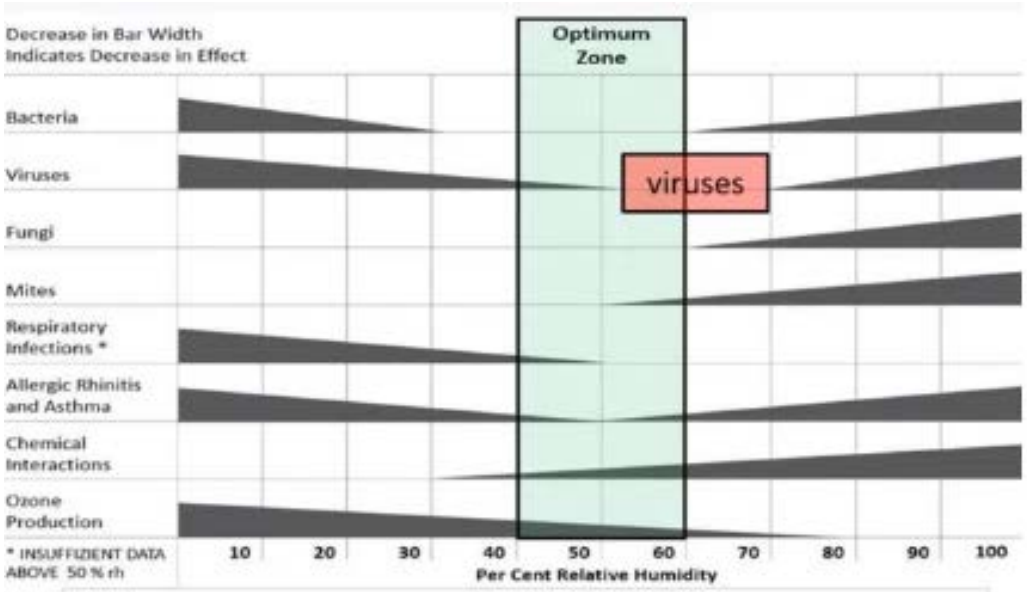
RH < 40%

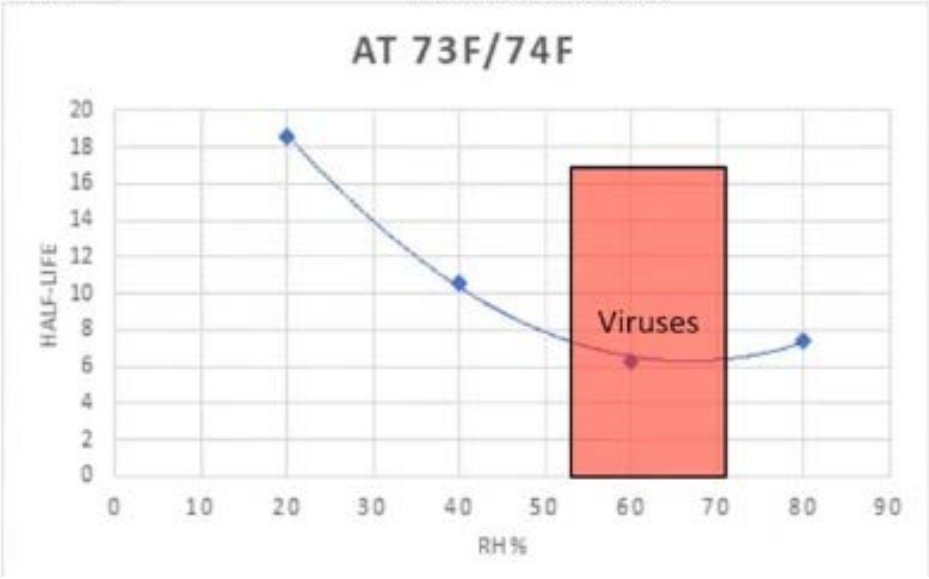
And

RH >60% Life expectancy is longer.

However, it is not yet defined the surge of virus in summer was other elements vs longer life expectancy.

Transmission rate not been mofide


Decrease in Bar Width
Indicates Decrease in Effect
Optimum Zone
Bacteria
Viruses
Fungi
Mites
Respiratory Infections *
Allergic Rhinitis and Asthma
Chemical Interactions
Ozone Production
viruses
* INSUFFIZIENT DATA ABOVE 50 % rh
10 20 30 40 50 60 70 80 90 100
Per Cent Relative Humidity


AT 73F/74F
HALF-LIFE
0 2 4 6 8 10 12 14 16 18 20
0 10 20 30 40 50 60 70 80 90
RH %
Viruses

Story of UVGI and LED

- **UV Disinfection.** Although UV light has the potential to reduce virus exposure in some situations, there are insufficient data to support widespread application.

Do LED light bulbs emit UV?

How viable are LED black lights? Are there LED tanning bed lights? With the rise in popularity of LED bulbs, many questions are asked as to how the cutting-edge technology will fare in certain applications.

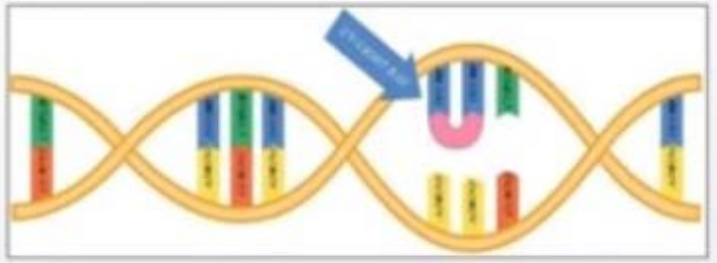
Black light technology is a cinch for LED. LED's can be designed to produce light of any wavelength. Most black light LED sources are in the 385-400nm range, though a little lower is considered the sweet spot for creating the optimal black light effect. A fixture or bulb peaking at around 365nm will cover the entire black light spectrum.

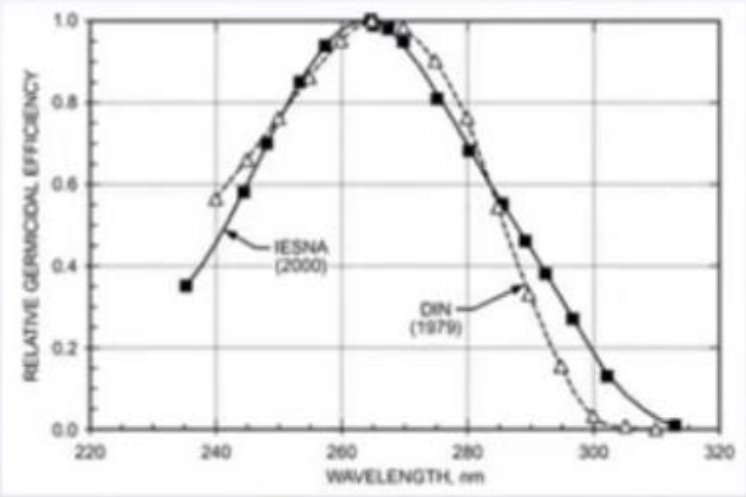
Some in the lighting business have stated that LEDs do not produce UV radiation. However studies have shown that standard LEDs do create a small amount of UV. That said, the amount of UV they actually emit is even less. This is due to the phosphors within an LED

With such limited UV output from LED, it is no wonder you cannot find LED tanning lights stateside. It is not so much that it cannot be done, but rather the challenge is making them efficient, long life, and low cost. Will LED tanning beds be commercialized one day? A quick search on Alibaba will reveal various LED tanning beds, though the cost (and likely the quality) of these leave a bit to be desired. But never say never with LED – a few years back it would have been hard to imagine some of the things LED can do now.

Air disinfection – germicidal UV light

- Ultraviolet light in UVC band
- 265 nm ideal, 254 nm produced by low pressure Hg vapor lamps is standard
- Disrupts microbial DNA/RNA, prevents reproduction
- Exponential dose response
- Coronavirus susceptibility is good
- Long record of application, CDC approved for tuberculosis control as adjunct to filtration
- Emerging technology – LEDs, far UV (222 nm) from Kr-Cl excimer lamps

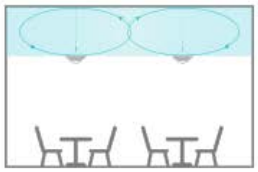




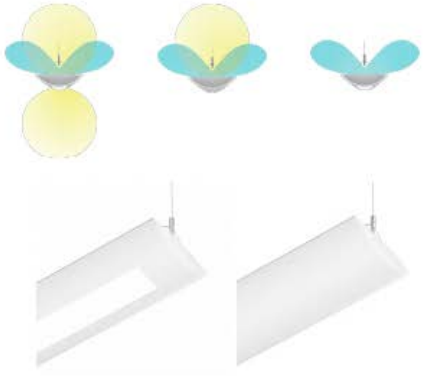
Lighting with Upper Air Disinfection

Litecontrol's upper air disinfection luminaires create a germicidal zone in an upper portion of the room away from occupants and sensitive materials. Standard building climate control systems move airborne pathogens from the lower part of a room into this germicidal zone. Pathogen inactivation occurs through the cumulative exposure to UVC over time. Each exposure cycle inactivates pathogens until the concentration in room is effectively diluted.

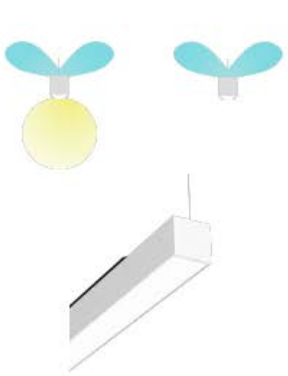
When combined with Direct, Indirect, or Indirect/Direct LED ambient lighting, rooms and open areas benefit from the combination of exceptional illumination, which offers effective disinfection in a stylized luminaire that seamlessly integrates into most commercial lighting applications.



Arcos™ by Litecontrol



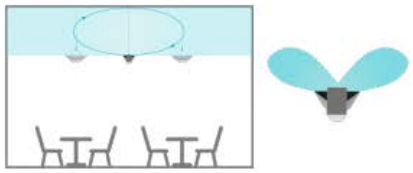
MOD™ 4L by Litecontrol



Upper Air Disinfection

Columbia Lighting's SpectraClean 254 UVC only product solutions can be an effective tool for disinfecting specific areas within a room. UVC only systems operate independent of the lighting system and do not provide ambient lighting. These products are available as upper air disinfection systems, in pendant or wall mount forms.

SCU Pendant by Columbia Lighting



SCU Wall by Columbia Lighting

Litecontrol Luminaires

Open Ceiling

MOD™ 4L-P-D | by Litecontrol
LED Pendant Direct
Applications: Education, Medical, Offices

- Safe and effective architecturally styled LED lighting with UVC upper air disinfection
- MOD 4L, a 4" rectilinear form-factor available in 4' and 8' lengths (individual or continuous row)
- Direct visible light distribution with upper UVC coverage
- Specially designed "stacked V" UVC lamp baffle system to ensure UVC rays are targeting the required upper air zone
- Cable pendant mounting
- Minimum 7' mounting above finished floor to ensure proper safety for occupants per ANSI guidelines
- UL1598 annex L upper air UVC design guidelines
- Simple time based "on/off" scheduling to control using onboard Hubbell NX Distributed Intelligence™ controls or customer provided control system

Arcos® 59L | by Litecontrol
Pendant
Applications: Education, Medical, Offices

- Safe and effective architecturally styled LED lighting with UVC upper air disinfection
- Arcos, an arcuate form-factor available in 4' and 8' lengths (individual or continuous row)
- Choice of visible light distributions, Indirect/Direct or Indirect, both with upper UVC air disinfection option
- Cable pendant mounting
- UVC lamp is recessed within the luminaire, shielded to ensure UVC rays are targeting the required upper air zone
- Minimum 7' mounting above finished floor to ensure proper safety for occupants per ANSI guidelines
- UL1598 annex L upper air UVC design guidelines
- Simple time based "on/off" scheduling to control using onboard Hubbell NX Distributed Intelligence™ controls or customer provided control system

I Indirect Lighting
D Direct Lighting
ID Indirect/Direct Lighting

Installers and occupants should avoid exposure to UVC lamps as well as looking directly at the lamp source as UVC can be harmful to skin and eyes. UVC lamps contain mercury, please recycle accordingly.

Columbia Lighting Luminaires

Upper Air

SCU Pendant | by Columbia Lighting
Upper Air Disinfection
Applications: Classrooms, Offices, Corridors, Warehouses, Manufacturing Environments

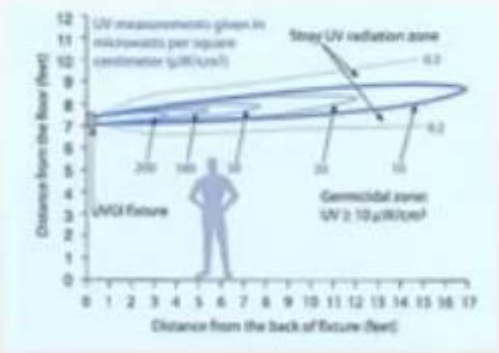
- SpectraClean 254 disinfection only
- Stainless steel construction with low reflectance, UVC stable black optics
- Aircraft cable mounting with top entry power cord or side entry cord/plug option
- UVC lamp is recessed in the luminaire, shielded to ensure UVC rays are targeting to required upper air zone
- Designed to UL1598 annex L upper air UVC design guidelines
- Simple time based "on/off" scheduling to control using onboard Hubbell NX Distributed Intelligence™ controls or customer provided control system

SCU Wall | by Columbia Lighting
Upper Air Disinfection
Applications: Classrooms, Offices, Corridors, Warehouses, Manufacturing Environments

- SpectraClean 254 disinfection only
- Stainless steel construction with low reflectance, UVC stable black optics
- Wall mounting with optional junction box cover plate or side entry cord/plug option
- UVC lamp is recessed in the luminaire, shielded to ensure UVC rays are targeting to required upper air zone
- Designed to UL1598 annex L upper air UVC design guidelines
- Simple time based "on/off" scheduling to control using onboard Hubbell NX Distributed Intelligence™ controls or customer provided control system

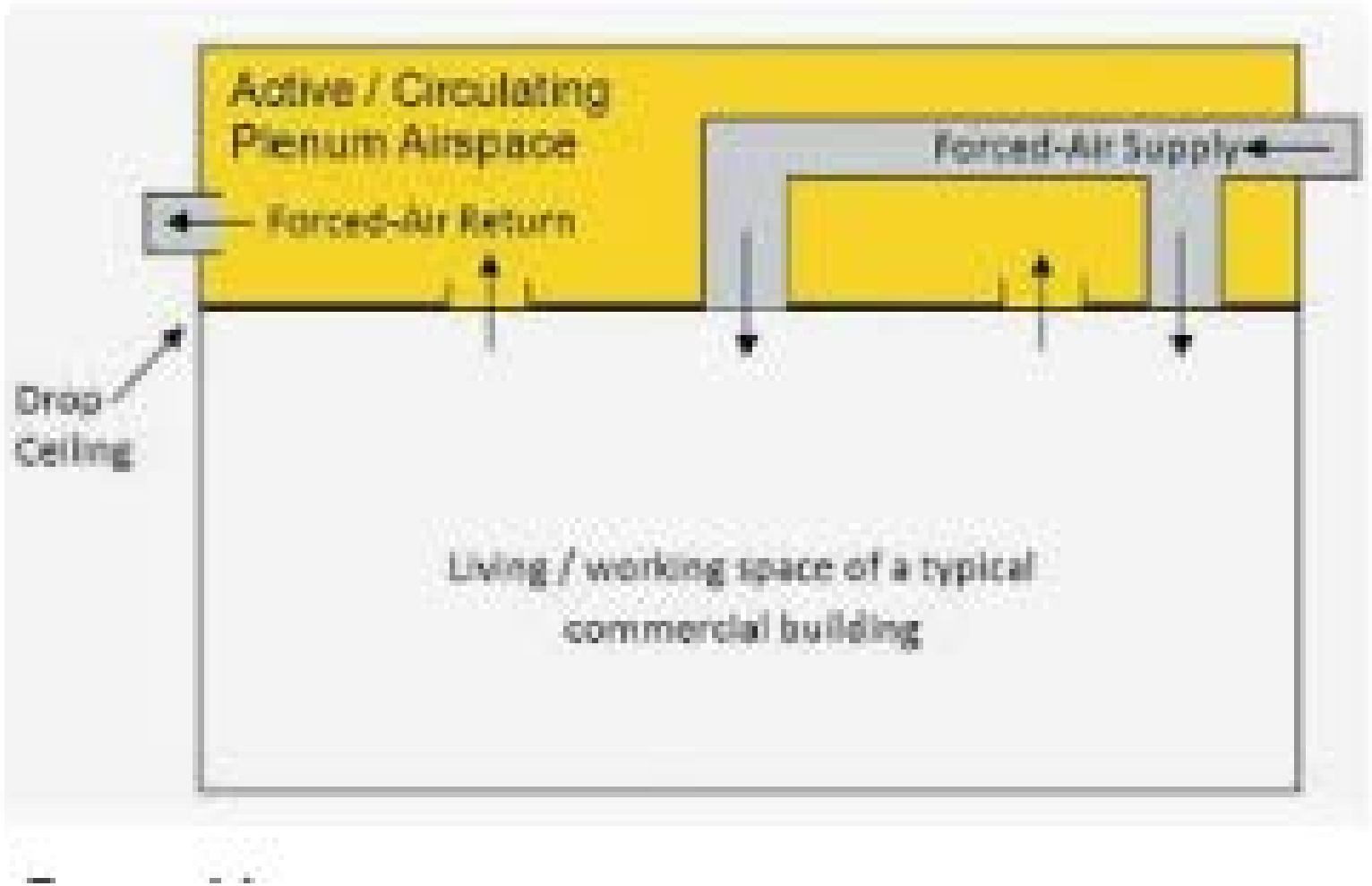
Germicidal UV applications

Upper Air UVGI



In-Duct/Coil UVGI

Portable Surface Treatment UVGI



Plenum UV in each floor

Samples Taken at filters in Michigan

Air Distribution:

OSA:

Quality (Dust/smog outside)

50% of HVAC (w/ economizer)

Distribute air effectively

VXRTU DOAS Series Dedicated Outdoor Air System

FREE SHIPPING in continental US **WE SHIP TO CANADA!** Contact us

SHORT LEAD TIMES! SHIPS IN 3 WEEKS OR LESS!

Note: Please contact our technical sales center for a custom quote to meet your specific needs.

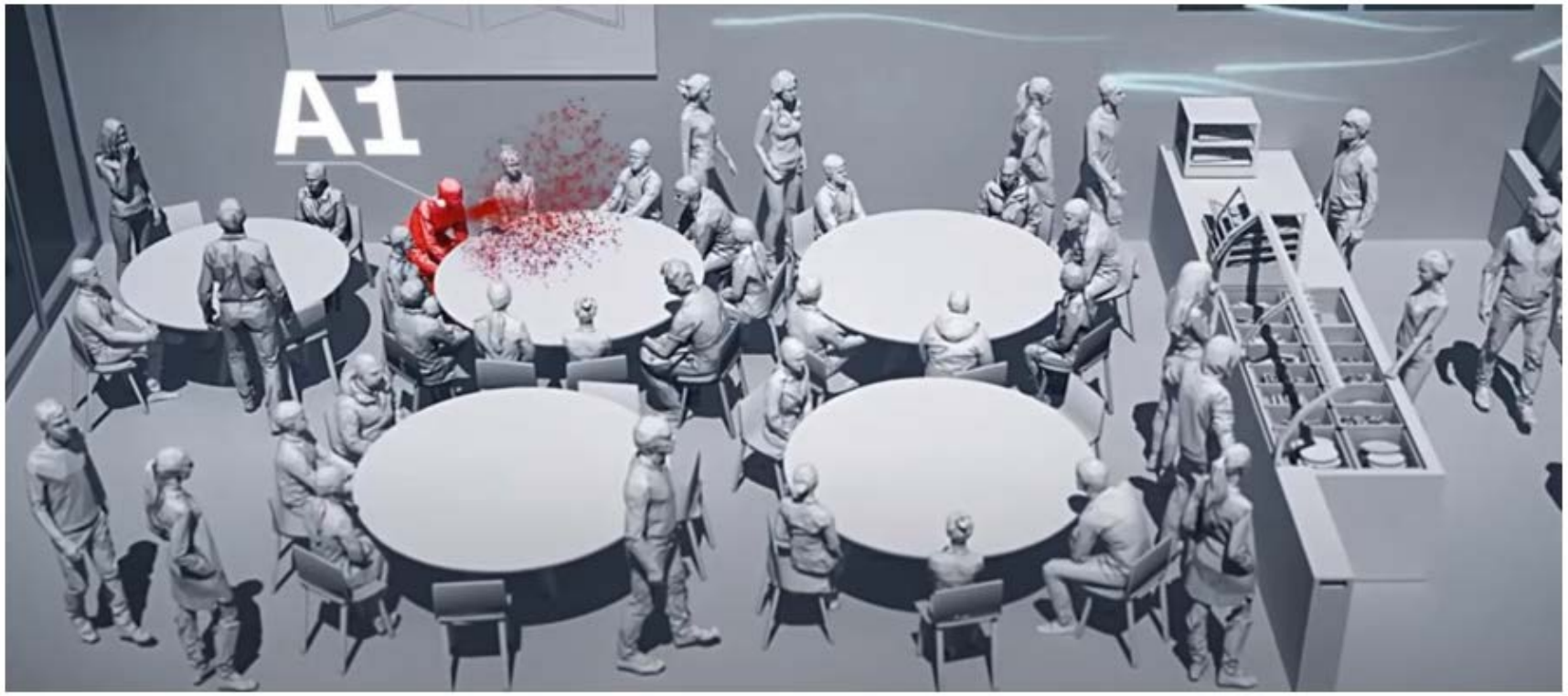
Ventilation Direct's Dedicated Outdoor Air System (DOAS) is the ideal HVAC solution offering exceptional energy savings and unprecedented comfort and humidity control.

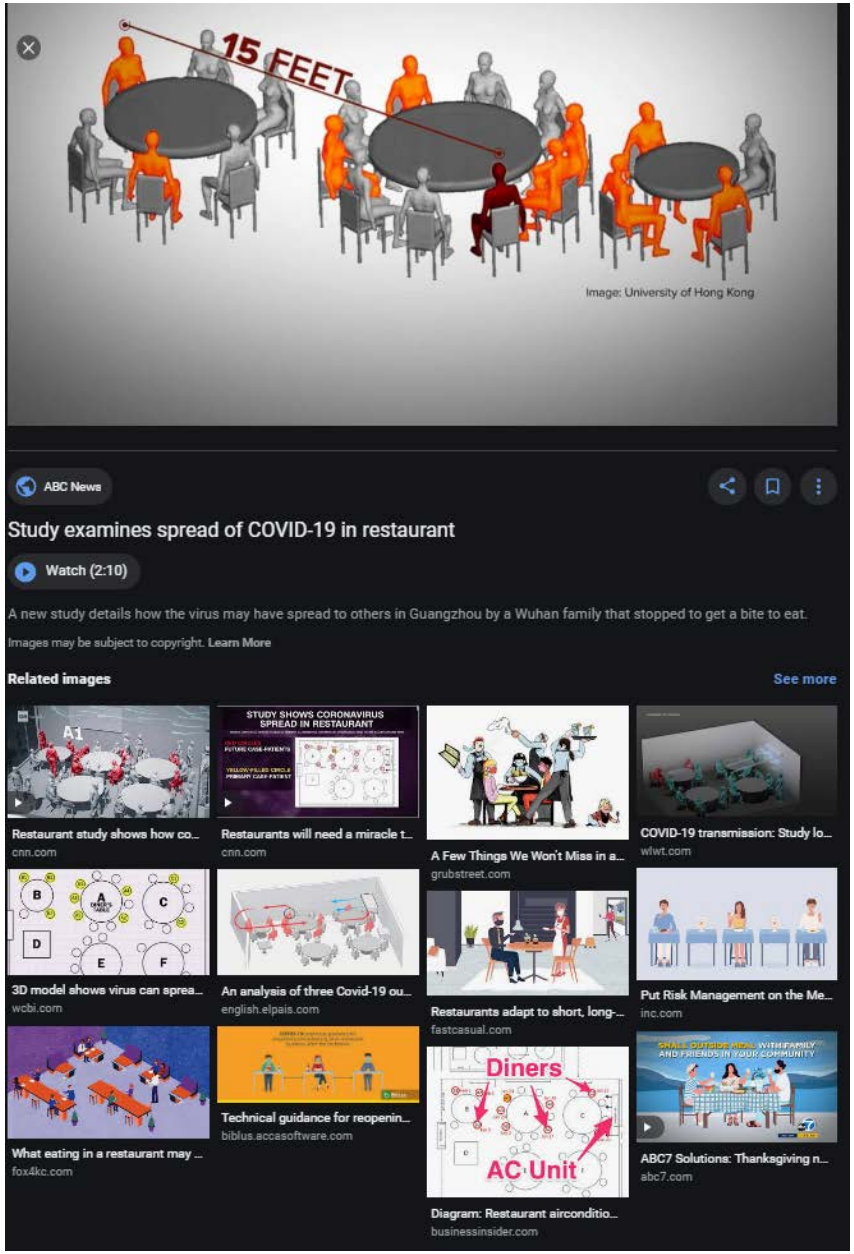
The DOAS is designed from its core to conserve energy and save on operating costs. Its rare earth magnet inverter scroll compressor eliminates excessive cycling, premature unit aging, inefficient hard starts, and unnecessary energy consumption. Modulating technologies allow it to deliver the highest efficiencies at part-load conditions.

The DOAS contains fully modulating refrigeration and optional hot gas reheat components that deliver the exact amount of air requested at the desired temperature and humidity. Variable speed components allow the unit to adjust its heating and cooling capacity to match the required load. This provides a consistent temperature throughout the space and avoids large temperature swings often associated with single stage equipment.

The DOAS achieves an impressive 20.2 IEER rating (Integrated Energy Efficiency Ratio) which is over 1.5x the ASHRAE 90.1-2016 IEER standard. Designed with the future in mind, it is poised to exceed rising IEER standards for years to come.

Restaurant in China




15 FEET
Image: University of Hong Kong
ABC News
Study examines spread of COVID-19 in restaurant
Watch (2:10)
A new study details how the virus may have spread to others in Guangzhou by a Wuhan family that stopped to get a bite to eat.
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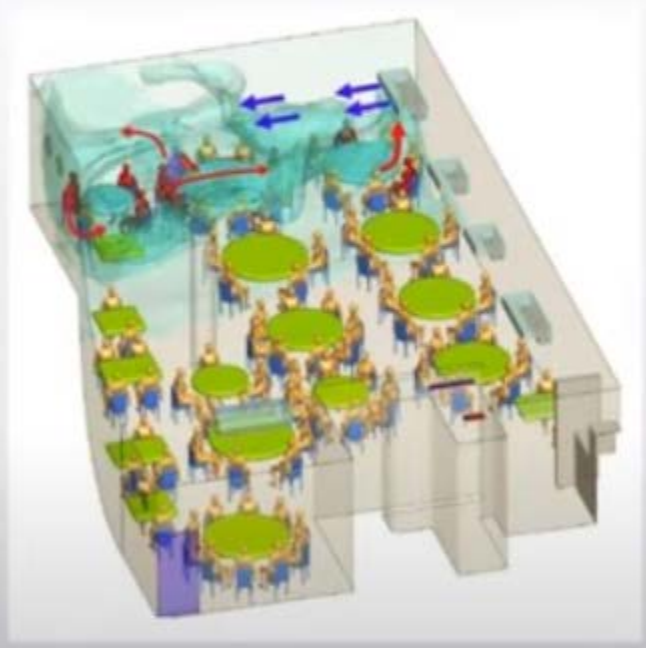
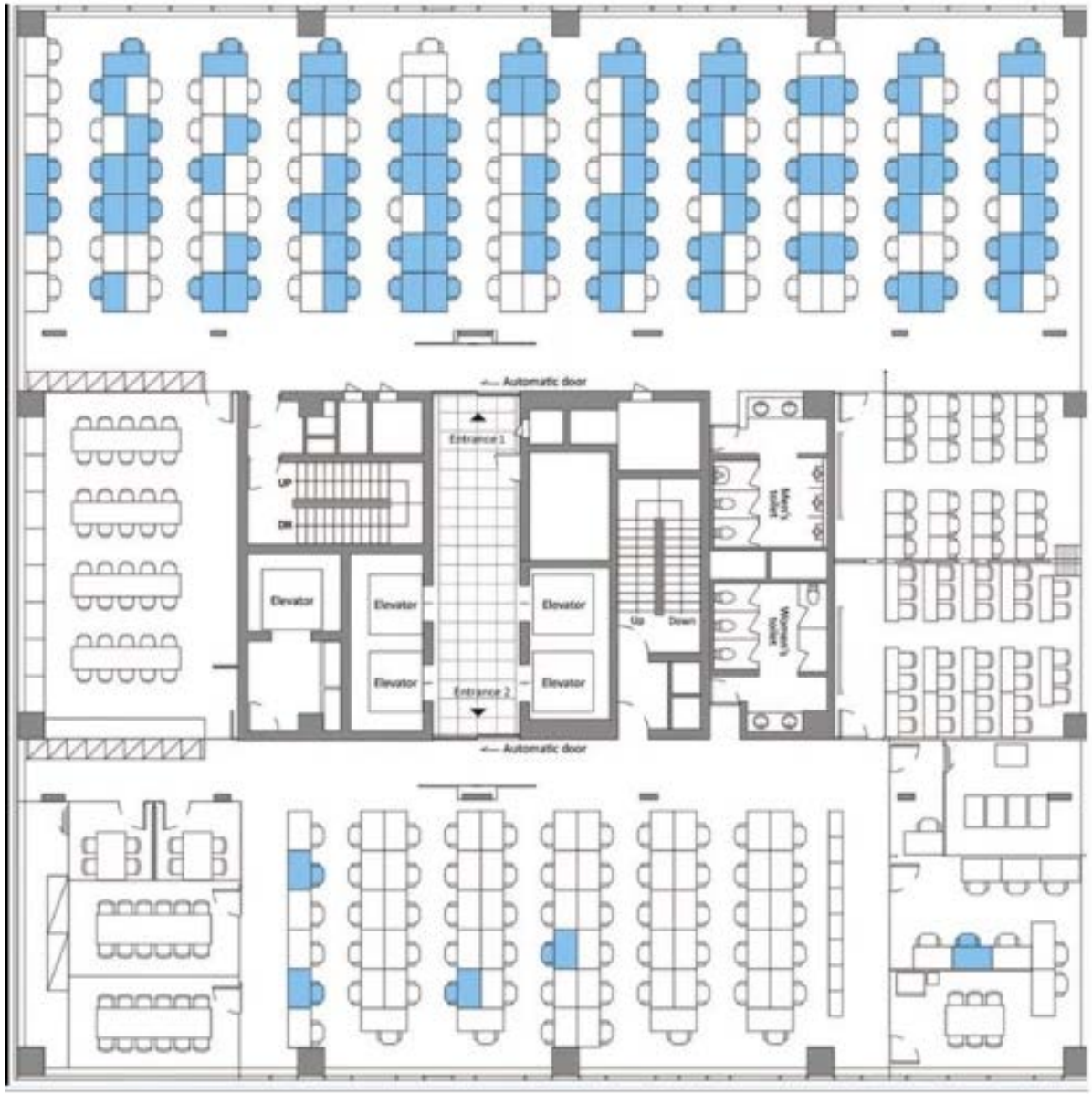
Restaurant study shows how co...
cnn.com
STUDY SHOWS CORONAVIRUS SPREAD IN RESTAURANT
Restaurants will need a miracle t...
cnn.com
A Few Things We Won't Miss in a...
grubstreet.com
COVID-19 transmission: Study lo...
wlwt.com
3D model shows virus can sprea...
wcbi.com
An analysis of three Covid-19 ou...
english.elpais.com
Restaurants adapt to short, long-...
fastcasual.com
Put Risk Management on the Me...
inc.com
What eating in a restaurant may ...
fox4kc.com
Technical guidance for reopenin...
biblus.accasoftware.com
Diners
AC Unit
Diagram: Restaurant airconditio...
businessinsider.com
ABC7 Solutions: Thanksgiving n...
abc7.com

ASHRAE Assumes Possibility of Airborne/Aerosol Transmission

- 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.



Li, et al. (2020) https://doi.org/10.1101/2020.04.16.20067728


Automatic door
Entrance 1
Elevator
Elevator
Elevator
Elevator
Elevator
Entrance 2
Automatic door
Men's toilet
Women's toilet
Up
Down

Data Center in China:

97 of 811 employees tested positive

94 on same floor

Floor surfaces/carpet/restroom/HVAC

Korean Call Center.

All 1,145 occupants of an office/apartment building were tested for COVID-19, and a cluster of cases was found on one floor, a densely occupied call center. There, 44% of the employees tested positive, and 94% of those were located on one side of the building. Only five cases were found on the rest of the floor, where the majority of employees worked. Any contact between occupants of the affected side of the floor with the other employees was very brief. Uniform spread throughout the affected area suggests there was airborne transmission beyond direct contact. No information was provided to determine the relationship between case location and HVAC zoning.8

Other COVID-19 studies sampled SARS-CoV-2 in air and on surfaces but did not correlate this with infection patterns. While measured contaminant concentrations established airborne exposure away from the infected individual, it was not determined if this exposure transmitted the infection to others.

Dilution with Outside Air

Ventilation and Pressurization

- Ventilation dilutes contaminants, increases exposure time required for exposure to an infectious dose
- Effective, but energy intensive, even with energy recovery
- Works in conjunction with exhaust and pressurization to isolate or contain

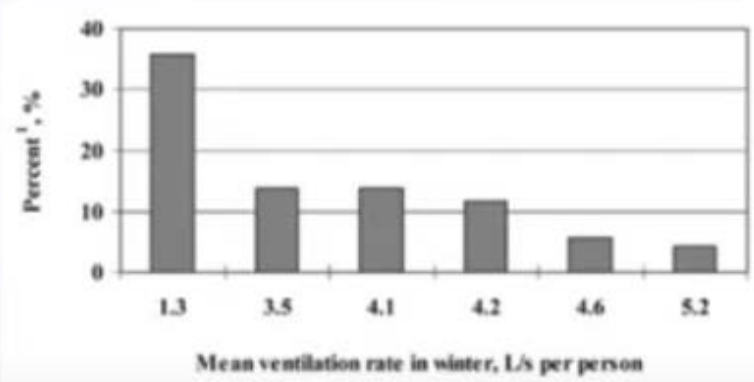
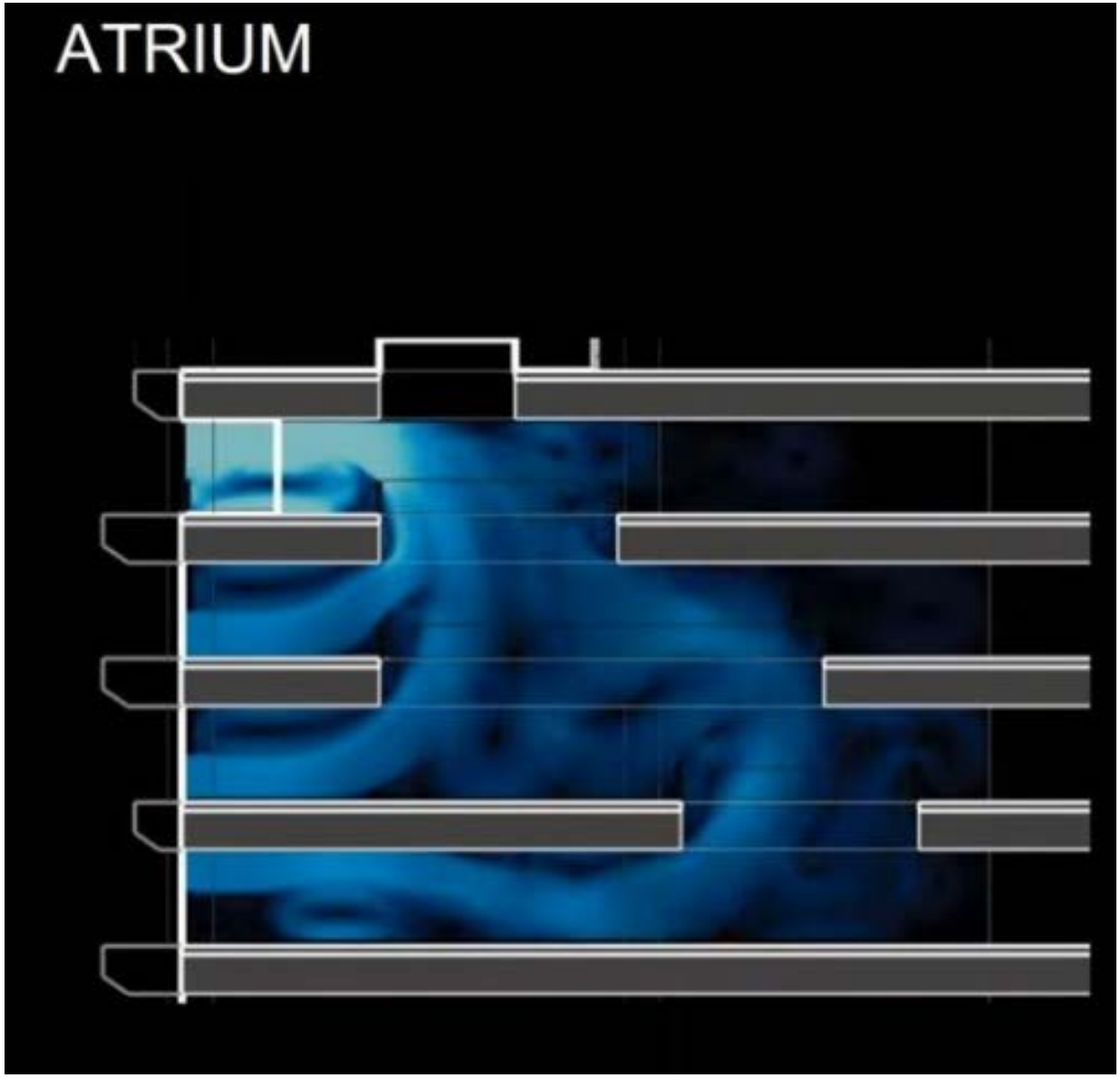


Figure 4. Associations between common cold infection rates and mean ventilation rate in winter in buildings constructed after year 1993. [1] Proportion of occupants with ≥6 common colds in the previous 12 months.

Sun, et al. (2011)
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3217956/

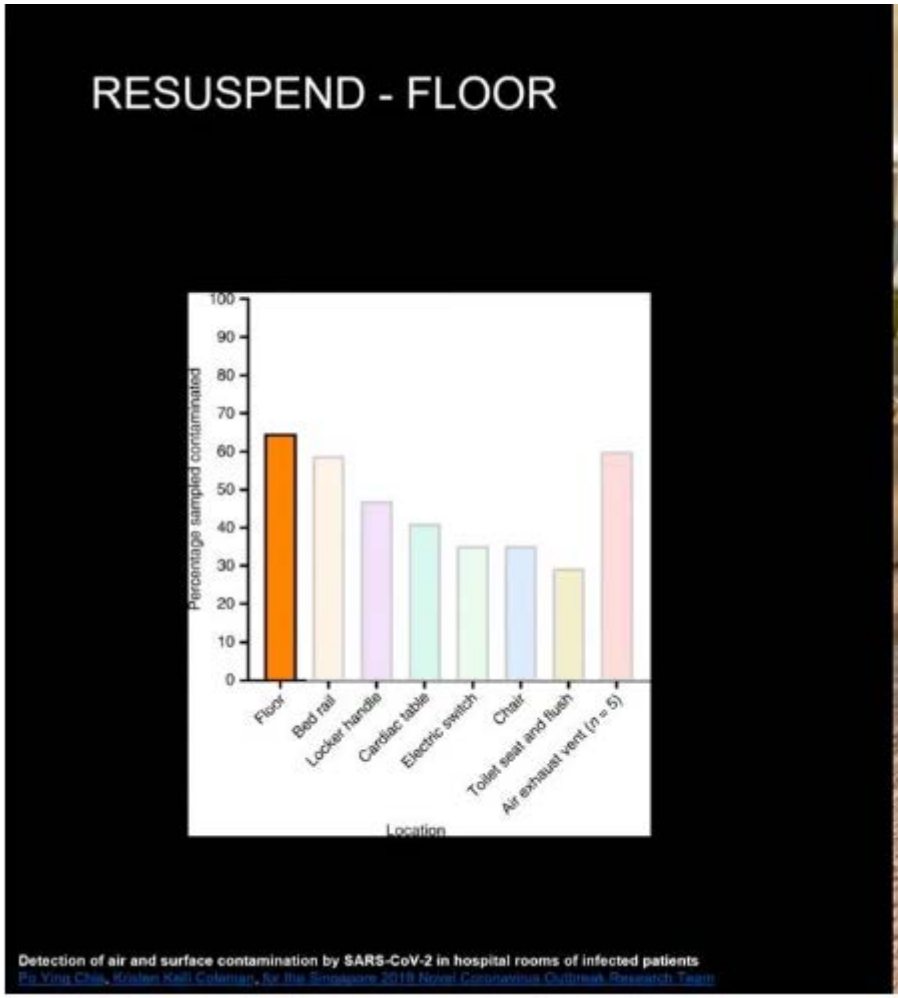

ATRIUM

Surface dust loading values (mg m^{-2})

	D_p<500 µm	D_p<45 µm	D_p<10 µm	D_p<2.5 µm
Carpet				
Geometric mean	7800	310	41	16
95th Percentile	38000	1500	200	76
Hard floor				
Geometric mean	420	17	2.2	0.8
95th Percentile	2400	96	12	4.8

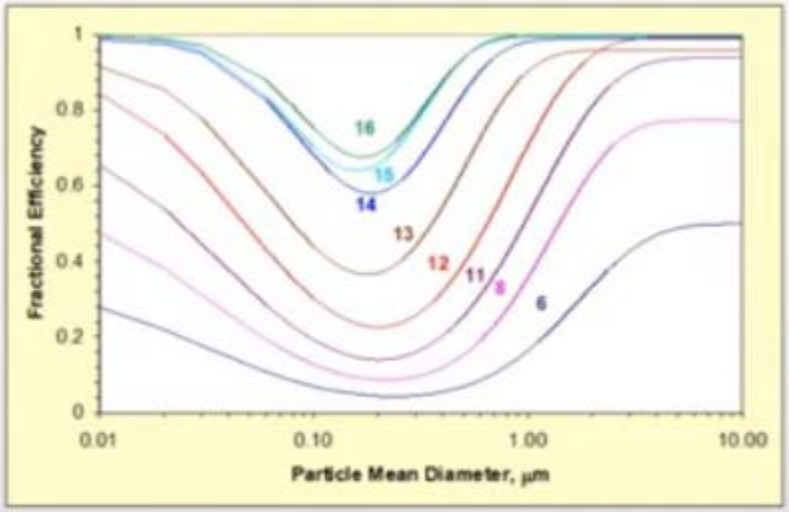
Almost 20 Times More Material

Remember Saum's Theory



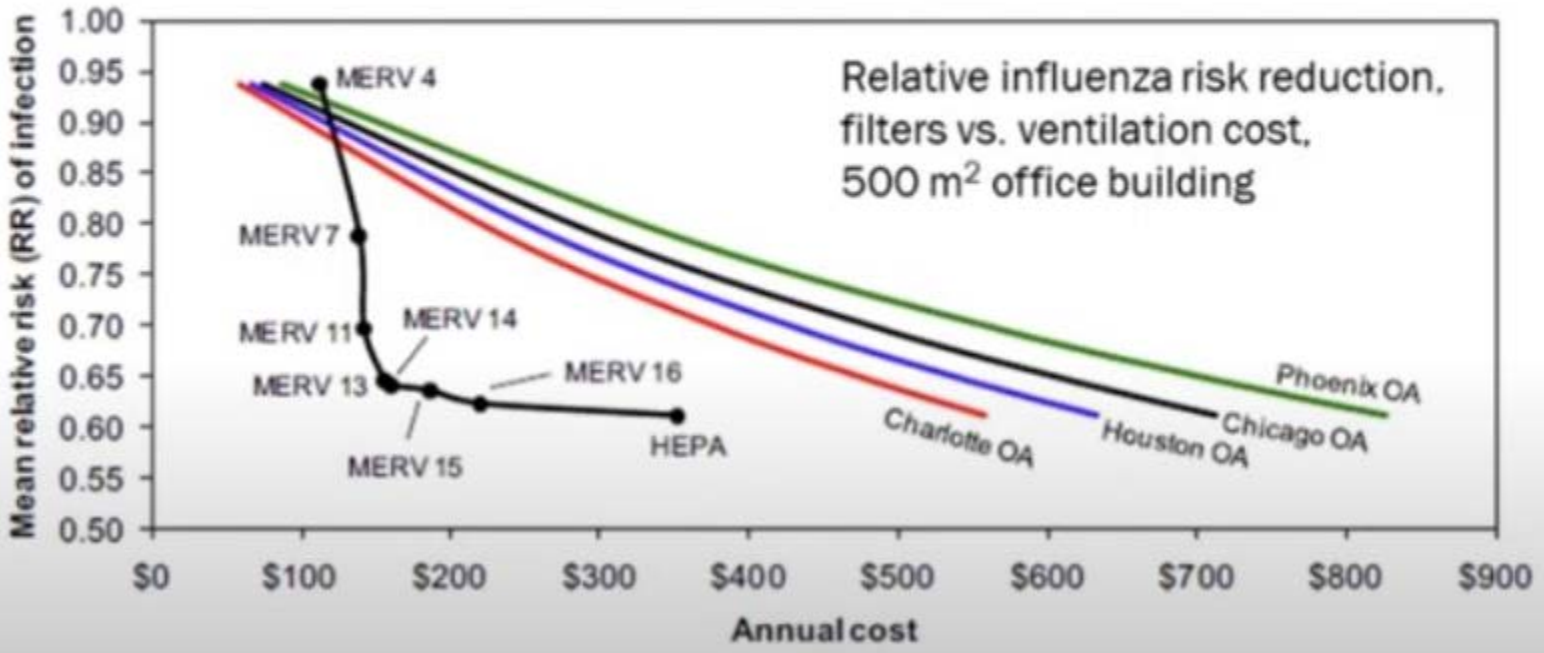
Filtration

- Can remove any aerosol contaminant (but not with 100% certainty)
- For indoor sources, requires recirculation in space or system
- Effective if
  - Contaminants of concern are airborne
  - Clean air delivery (efficiency + recirculation) is high enough

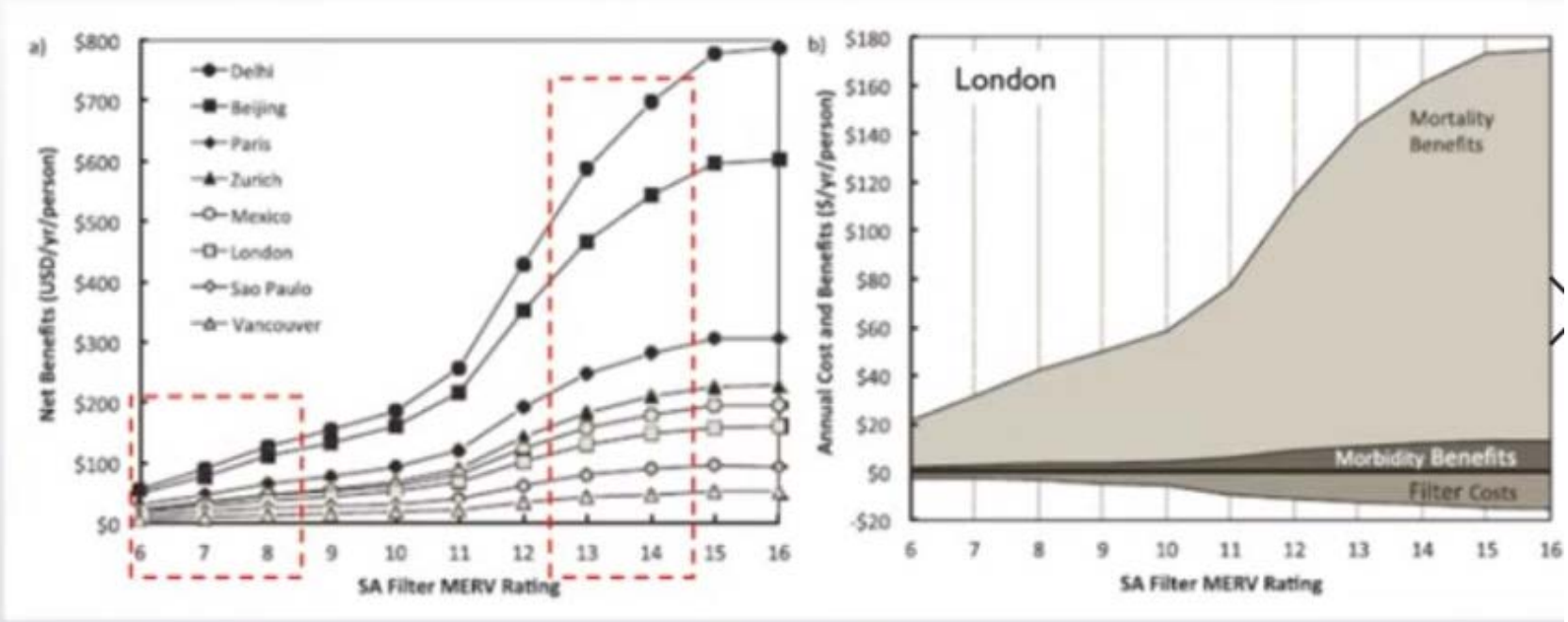


Representative MERV rated filter performance (Kowalski and Bahnfleth 2002)

Filtration can be a lower energy way to reduce aerosol/airborne infection risk



Filtration has benefits other than infection control



(Montgomery, J., C. Reynolds, S. Rogak, S. Green. 2015. Financial Implications of Modifications to Building Filtration Systems. Building and Environment 85:17-28.)

More discussion

Let's get back to work!?

Leishenshan Hospital was constructed on a parking lot from prefabricated modules in two weeks in Wuhan, China. (Sam McNeil / Associated Press)

Back to Work Indoors?

Change in Architectural Design in Buildings

Components like folding glass doors offer seamless transitions between the inside and outside; image via Carlos Delgado Architect

CANNONDESIGN → COVID-19 Updates

pandemic future.

CannonDesign Unveils COVID Shield

COVID Shield is a modular, scalable, customizable testing solution that

At Oro Bistrot by Natale Giunta, the rooftop restaurant at the NH Collection Fori Imperiali in Rome, guests are seated at bare tables with QR codes that allow them to load the menus directly on their smartphones. Photo: Courtesy of NH Hotels

Making the Most of Outdoor Space

Melba's, in Harlem, received a new, safer outdoor-seating design by the Rockwell Group as part of the firm's pro bono DineOut NYC project. Photo: Emily Andrews for Rockwell Group

Imàgo restaurant in Rome's Hassler Hotel has relocated from its indoor space to the terrace of a seventh-floor suite. Photo: Laura Itzkowitz

Mediamatic Amsterdam installed a series of mini greenhouses to keep diners safely distanced from other visitors and servers. Photo: Willem Velthoven for Mediamatic Amsterdam

How COVID-19 Will Impact Restaurant Design

The main driver will be short-term pivots focused on safety and sanitation.

OUTSIDE INSIGHTS | JULY 2020 | RICHARD LAYUGAN

THINKSTOCK

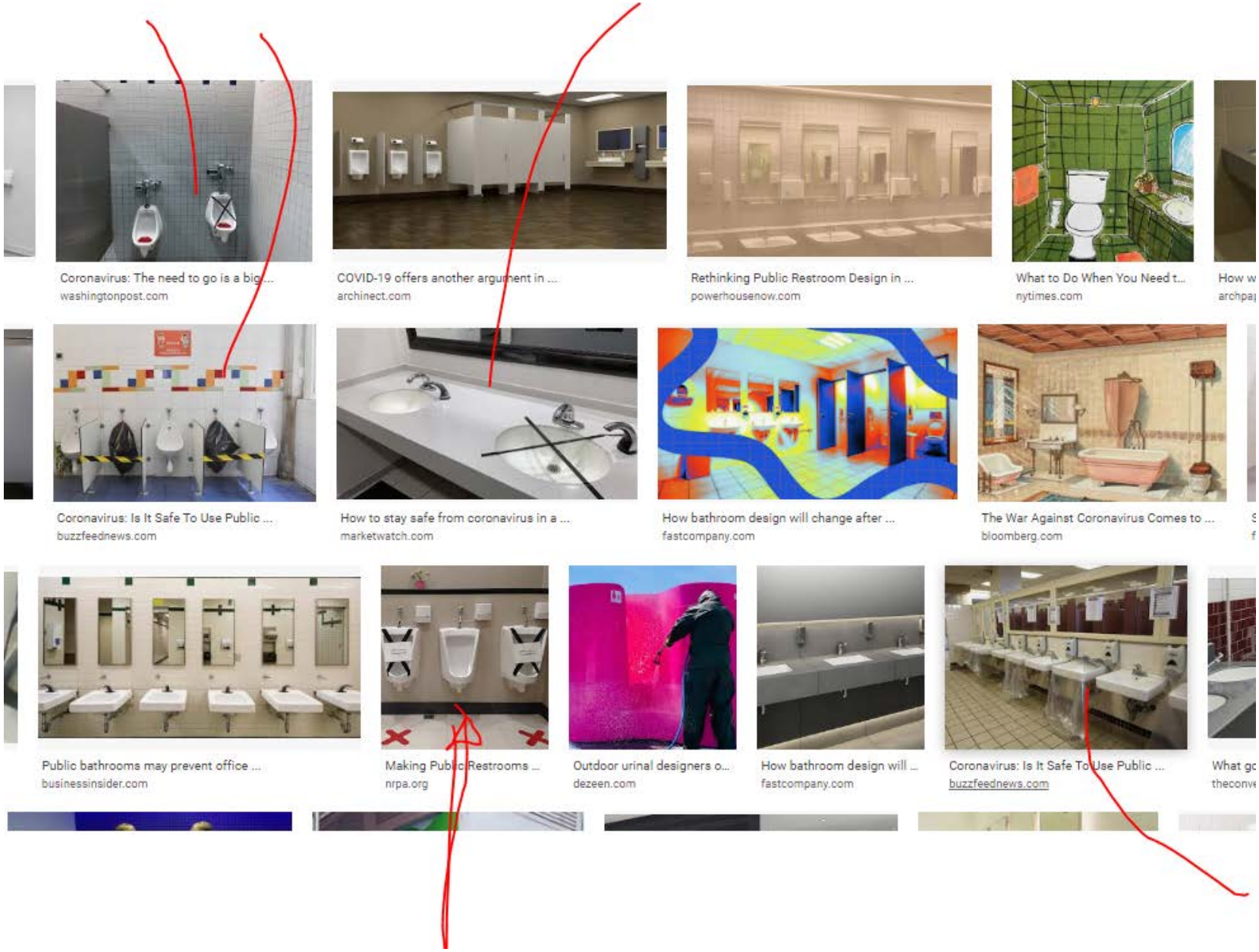
Restaurants must provide adequate space for customers to socially distance.

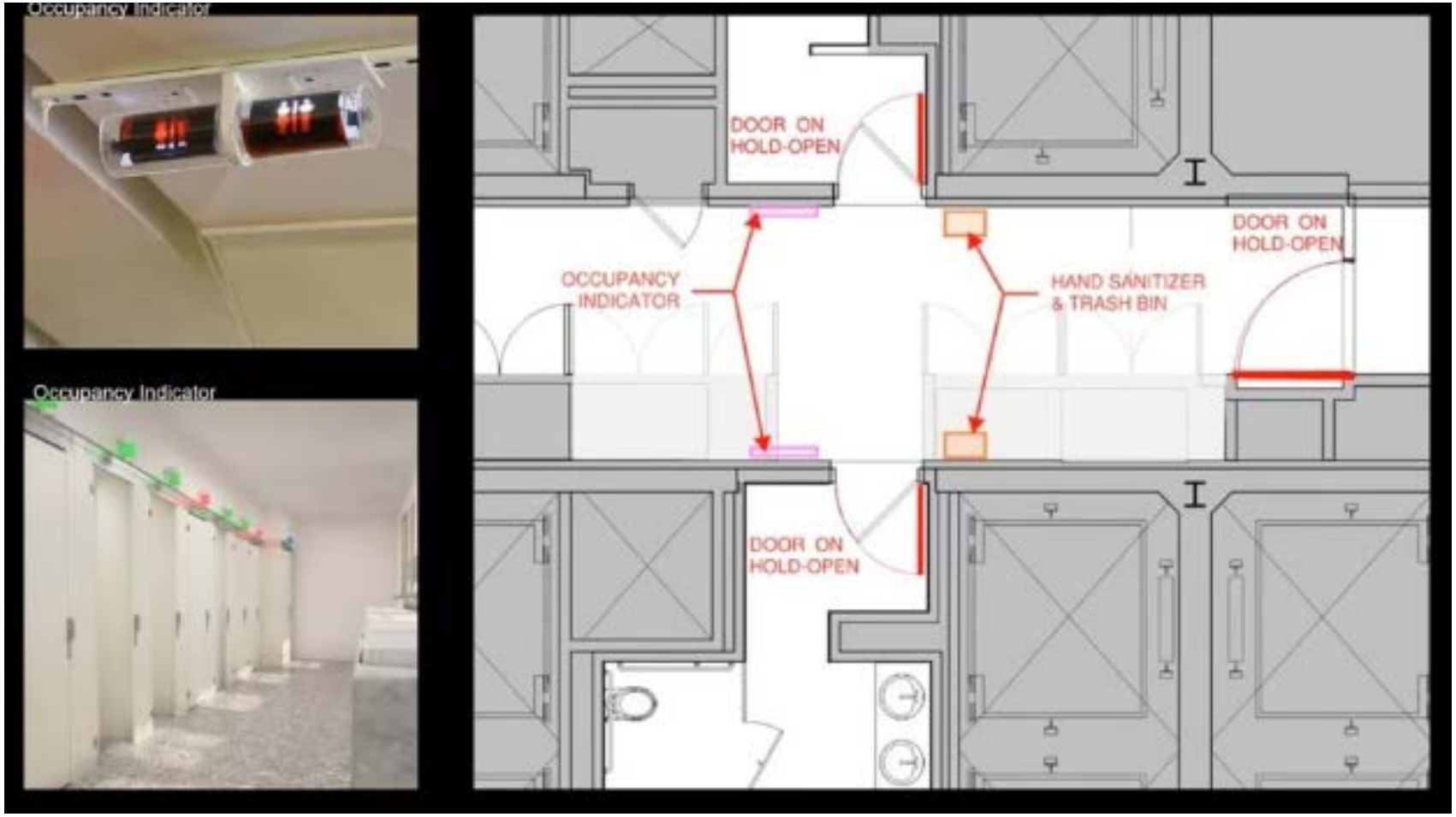
Photo Credit: courtesy of KFC SOPAC


Drive-In

Restrooms

▲ The coronavirus crisis has prompted calls for a greater focus on infection control in the design of public toilets, including much greater use of sensor taps. Photograph: Garry Weaser/The Guardian


Coronavirus: The need to go is a big ...
washingtonpost.com
COVID-19 offers another argument in ...
archinect.com
Rethinking Public Restroom Design in ...
powerhousenow.com
What to Do When You Need t...
nytimes.com
Coronavirus: Is It Safe To Use Public ...
buzzfeednews.com
How to stay safe from coronavirus in a ...
marketwatch.com
How bathroom design will change after ...
fastcompany.com
The War Against Coronavirus Comes to ...
bloomberg.com
Public bathrooms may prevent office ...
businessinsider.com
Making Public Restrooms ...
nrpa.org
Outdoor urinal designers o...
dezeen.com
How bathroom design will ...
fastcompany.com
Coronavirus: Is It Safe To Use Public ...
buzzfeednews.com


Occupancy Indicator
Occupancy Indicator
DOOR ON HOLD-OPEN
DOOR ON HOLD-OPEN
OCCUPANCY INDICATOR
HAND SANITIZER & TRASH BIN
DOOR ON HOLD-OPEN

- **High rate of Exhaust- with full distribution**
- **Door hold open… no touch**
- **Occupant indicators- Costco gas stations**
- **Complete touchless- include doors, etc.**

1. No-touch fixtures. "Voice command and IoT are other up-and-coming hands-free technologies for restrooms," said Kempen. "Automatic door openers typically seen to support accessible design are now also being implemented in locations to prevent hand-surface contact."

2. Improved ventilation. "We are seeing clients consider using more robust HVAC systems throughout their facilities but especially in shared spaces such as in restrooms," Kempen said. "Ventilating with outdoor air is vital to diluting airborne contaminants."

3. Modified layouts. The European model of gender-neutral restrooms were becoming more popular pre-COVID-19, and there are pluses to that design post-COVID-19. "The European model of stalls forming a perimeter around communal washing stations with open circulation may be a layout we see more of in the U.S.," Kempen said. "This design can help facilitate one-way traffic and minimize cross-traffic."

4. Avoiding wet floors. "I see a big opportunity for sleek all-in-one hand washing fixtures that have the soap, faucet and dryer all in one unit to contain water," Kempen said.

5. **Antimicrobial finishes and materials.** "Before COVID-19, the design community was seeing a lot of antimicrobial layers and coatings on products," Kempen said. "We are now seeing a rise from

facility managers and building owners requesting this option as an enhanced safety precaution for their customers. Clients are also considering products that are inherently antimicrobial such as copper."

6. Sink materials and designs. Smooth, nonporous materials with seamless construction make sinks less prone to hold bacteria or mold. "For multi-user restrooms, new washbasin designs with increased space between the hand washing areas allow for social distancing while washing hands," Dommisse said.

Extreme High finishes on China--------- remember Saum's Theory

4:30-6:00 PM 12/10/2020 Part 2

COMMUNITY, WORK & SCHOOL

COVID-19 Employer Information for Office Buildings

Updated Oct. 29, 2020

Part II

Administrative controls: Change the way people work

- Encourage employees who have symptoms of COVID-19 or who have a sick family member at home with COVID-19 to notify their supervisor and stay home.

  -
  - Employees who appear to have symptoms when they arrive at work or who become sick during the day should immediately be separated from others, provided a face mask if they are not using one, and sent home with instructions and guidance on how to follow-up with their healthcare provider.
  - Sick employees should follow CDC-recommended steps. Employees should not return to work until they meet the criteria to discontinue home isolation, in consultation with their healthcare provider.
  - Perform enhanced cleaning and disinfection after anyone suspected or confirmed to have COVID-19 has been in the workplace.

- Consider conducting daily in-person or virtual health checks (e.g., symptoms and/or temperature screening) of employees before they enter the work site.
    -
    - See CDC's COVID-19 General Business FAQs for guidance on how to safely conduct employee screening.
    - Develop and implement a policy to prevent employees from gathering in groups while waiting for screening, and maintain a 6-foot separation between employees.
    - Alternatively, consider having employees perform self-checks at home before heading to the office.
- Stagger shifts, start times, and break times as feasible to reduce the number of employees in common areas such as screening areas, break rooms, and locker rooms.
- Consider posting signs in parking areas and entrances that ask guests and visitors to phone from their cars to inform the administration or security when they reach the facility.
    - Provide directions for visitors to enter the building at staggered times.
- Consider posting signs in parking areas and entrances that ask guests and visitors to wear cloth face coverings if possible, to not enter the building if they are sick, and to stay 6 feet away from employees, if possible.
- Clean and disinfect high-touch surfaces.
    -
    - Follow the Guidance for Cleaning and Disinfecting to develop, follow, and maintain a plan to perform regular cleanings of surfaces to reduce the risk of people's exposure to the virus that causes COVID-19.

- At least daily, clean and disinfect all surfaces that are frequently touched by multiple people, such as door handles, desks, light switches, faucets, toilets, workstations, keyboards, telephones, handrails, printer/copiers, and drinking fountains. More frequent cleaning and disinfection may be required based on level of use.
  -
    - If hard surfaces are dirty, clean them using a detergent or soap and water before you disinfect them.
    - Disinfect using products that are EPA-approved for use against the virus that causes COVID-19. Follow the manufacturer's instructions for all cleaning and disinfection products (e.g., concentration, application method, and contact time).
    - When EPA-approved disinfectants are not available, alternative disinfectants can be used (for example, 1/3 cup of 5.25-8.25% bleach added to 1 gallon of room temperature water, or 70% alcohol solutions).
      - Prepare fresh bleach solutions daily.
      - Do not mix bleach with ammonia or any other cleanser. This can cause fumes that may be very dangerous to breathe in.
    - Read EPA's infographic on how to use these disinfectant products safely and effectively.
    - Keep all disinfectants out of the reach of children.

-
  - Give employees enough time to wash and dry their hands and provide accessible sinks, soap, water, and a way to dry their hands (e.g., paper towels, hand dryer).
    - Remind employees to wash their hands often with soap and water for at least 20 seconds. If soap and water are not available, they should use hand sanitizer with at least 60% alcohol.

- Establish policies and practices for social distancing:
  - Remind employees that people may be able to spread COVID-19 even if they do not show symptoms. Consider all close interactions (within 6 feet) with employees, clients, and others as a potential source of exposure.
  - Discourage handshaking, hugs, and fist bumps.
  - Encourage the use of outdoor seating areas and social distancing for any small-group activities such as lunches, breaks, and meetings.
- For employees who commute to work using public transportation or ride sharing, consider offering the following support:
  - If feasible, offer employees incentives to use forms of transportation that minimize close contact with others (e.g., biking, walking, driving or riding by car either alone or with household members).
  - Ask employees to follow the CDC guidance on how to protect yourself when using transportation.
  - Allow employees to shift their hours so they can commute during less busy times.
  - Ask employees to wash their hands as soon as possible after their trip.
- Post instructions and reminders at entrances and in strategic places on hand hygiene, COVID-19 symptoms, wearing cloth face coverings, and cough and sneeze etiquette. This should include signs for non-English speakers, as needed.
- Use no-touch trash cans when possible.
- Remind employees to avoid touching their eyes, nose, and mouth.

Educate Employees and Supervisors about Steps They Can Take to Protect Themselves at Work

- Communication and training should be easy to understand, be in preferred languages spoken or read by the employees, and include accurate and timely information. Topics should include signs and symptoms of infection, staying home when ill, social distancing, cloth face coverings, hand hygiene practices, and identifying and minimizing potential routes of transmission at work, at home, and in the community.
- CDC has free, simple posters available to download and print, some of which are translated into different languages.
- Provide information and training on what actions employees should take when they are not feeling well (e.g., workplace leave policies, local and state health department information).
- CDC recommends wearing a cloth face covering as a measure to contain the wearer's respiratory droplets and help protect others. Employees should not wear a cloth face covering if they have trouble breathing, cannot tolerate wearing it, or can't remove it without help.
    - Cloth face coverings are not considered personal protective equipment and may not protect the wearers from exposure to the virus that causes COVID-19. However, cloth face coverings may prevent workers, including those who don't know they have the virus, from spreading it to others.
    - **Remind employees and clients that CDC recommends wearing cloth face coverings in public settings where other social distancing measures are hard to maintain, especially in areas of significant community-based transmission. Wearing a cloth face covering, however, does not replace the need to practice social distancing.**

Develop Special Considerations for Elevators and Escalators

- Encourage occupants to take stairs when possible, especially when elevator lobbies are crowded or when only going a few flights.

- Where feasible, designate certain stairwells or sides of stairwells as "up" and "down" to better promote social distancing.
- Use floor markings in elevator lobbies and near the entrance to escalators to reinforce social distancing. Place decals inside the elevator to identify where passengers should stand, if needed.
- Use stanchions (for lobbies only; not inside elevators) or other ways to mark pathways to help people travel in one direction and stay 6 feet apart.
- Encourage the use of cloth face coverings by all elevator and escalator occupants. Ask elevator occupants to avoid speaking, when possible.
- Consider limiting the number of people in an elevator and leaving steps empty between passengers on escalators, where possible, to maintain social distancing.
- Post signs reminding occupants to minimize surface touching. They should use an object (such as a pen cap) or their knuckle to push elevator buttons.
- Encourage elevator and escalator passengers to wash their hands and avoid touching their face after holding on to handrails or touching buttons.
- Consider adding supplemental air ventilation or local air treatment devices in frequently used elevator cars.

Take Actions to Maintain a Healthy Work Environment for Your Employees and Clients

- Read the CDC Interim Guidance for Businesses and Employers to learn about more recommendations for creating new sick leave policies, cleaning, and employee communication policies to help protect your workers and clients.

box tissue light icon

Protect Your Health This Flu Season

Essential workers: protect yourself from flu this fall and winter with a flu vaccine. While getting a flu vaccine will not protect against COVID-19, it can protect you from becoming sick with flu and needing medical care. Flu is another serious respiratory illness that can cause missed work, hospitalizations, and, in some cases, even death. The combination of flu and COVID-19 could overwhelm healthcare settings.

-
  - Protect yourself, your family, and your community by getting a flu vaccine.

Where can I get more information?

You, as the employer, are responsible for responding to COVID-19 concerns and informing employees of the hazards in your workplace. You can use these additional sources for more information on reducing the risk of exposures to COVID-19 at work:

- CDC Interim Guidance for Businesses and Employers (COVID-19)
- CDC General Business Frequently Asked Questions
- NIOSH COVID-19 Workplace Safety and Health Topic
- CDC COVID-19
- OSHA COVID-19
- OSHA Guidelines on Preparing Workplaces for COVID
- OSHA Guidance on Returning to Work
- AIHA Reopening: Guidance for General Office Settings
- ASHRAE Recommendations for commercial buildings under epidemic conditions external
- Building Owners & Managers Association International (BOMA): Getting Back to Work: Preparing Buildings for Re-Entry Amid COVID-19

BOMA International: Guidance #4 May 1st 2020 Updated

Getting Back to Work: Preparing Buildings for Re-Entry Amid COVID-19

- The COVID-19 pandemic spread quickly across the United States in February and March, forcing cities to impose stay-at home and shelter-in-place orders. Building operations had to adjust as non-essential personnel worked from home. We are now preparing for a phased re-entry of office buildings over the coming months. To provide guidance on building operations and workforce issues, BOMA International assembled a task group from across North America to help owners and managers plan for what is coming. This document provides guidance for preparing commercial buildings for the safe return of office tenants, building personnel, visitors, vendors, contractors, and others, and identifies other operational and safety procedures and protocols that should be implemented, updated, or enhanced as we prepare to live and work in a post-COVID-19 world. This is a framework for developing your individual property or portfolio plans. Information presented represents suggested best practices and procedures and identifies questions and issues you should consider.

Plans and Purpose

- **Start Now.** Develop a plan for building re-entry well before stay-at-home orders and other restrictions are lifted. Update your plan regularly as situations change and new information becomes available.
- **Assemble Your Team**. Your planning team should include representatives from owners/asset management, property management, engineering, and key vendors and service providers. Consider involving tenant councils if you have them at any of your properties.
- **Communicate with Tenants, Vendors and Contractors.** Share your re-entry plan with tenants, vendors, and contractors, and ask them to share their plans, questions, and concerns with you. Discuss potential changes to leases and contracts.

- **Assess New Risks.** Meet with your **owner's risk manager** and insurance broker to update coverage and assess new liability risks as a result of COVID-19.
- **Consult with Legal Counsel**. Review all planned new procedures and protocols, leases and contracts, staffing and operational changes, and other potential legal exposures. Be sure you understand guidance from the Occupational Safety and Health Administration (OSHA), Equal Employment Opportunity Commission (EEOC), National Labor Relations Act (NLRA), Families First Coronavirus Response Act (FFCRA), Family and Medical Leave Act (FMLA), and other employment-related laws and orders.
    - ***Legionnaires' disease***
- **Stay Informed!** Stay abreast of federal, state, and local mandates and recommendations, as well as guidelines from the Centers for Disease Control (CDC), Environmental Protection Agency (EPA), American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), and other regulatory and public health agencies.

- **Health and Safety for Building Personnel, Tenants & Visitors**
- **Social Distancing and Personal Protective Equipment**
- Follow CDC guidelines to maintain social distancing and follow federal, state and local mandates or recommendations for wearing face masks or coverings. Face masks/coverings may be helpful where social distancing is a challenge.
- Instruct building personnel, vendors, and contractors to wear face masks/coverings provided by their employers. Amend existing service agreements, if necessary, to include these new requirements.
- Advise tenants to follow state and local guidelines and recommendations regarding social distancing and face masks/coverings. Clearly communicate any building requirements and recommendations that may be in place for tenants to wear face masks/coverings in common areas.

- Maintain proper hygiene by frequently washing hands (with hot water and soap for 20 seconds, as recommended).
- Hand sanitizers should be readily available in public spaces and common areas.
- Recommend tenants limit the number of guests/visitors as the building adjusts to re-entry.
- Work with tenants on possible staggered work hours and/or workdays to limit building occupancy initially and for some period of time after re-entry (some cities are mandating that occupancy be maintained at less than 50 percent initially).
- Follow state and local guidelines regarding limits on meetings and gatherings; CDC currently recommends meeting limitations of 10 people or less. Encourage virtual meetings whenever possible.
- Schedule virtual rather than in-person property tours whenever possible, or schedule tours before or after normal business hours.

- **Safety Use and Occupancy of Elevators**
- Consider elevator cab sizes, number of building floors, and daily number of tenants and visitors when establishing social distancing guidelines for elevator riders. If an elevator cab is not large enough to accommodate 6-foot spacing between occupants, consider limiting riders to 4–one in each corner–for example.
- Place queuing marks in elevator lobbies to reinforce social distancing; consider using stanchions, floor decals, mats, etc. to control elevator traffic.
- Designate elevators for "up" and "down" use to avoid longer ride times. Consider programming elevators to return to the ground floor for faster loading.
- To ease elevator traffic and wait times, consider opening stairwells and designate "up" and "down" stairwells. Plan for more frequent and more thorough cleaning and disinfecting of stairwells and handrails in response to increased stair traffic.

- **Common Areas and Amenity Spaces**

- Increase space between lobby furniture and/or reduce seating to promote and support social distancing.
- In cooperation with third-party contractors where applicable, consider closing amenity spaces, such as fitness areas, conference rooms, retail, and restaurants for at least 30 days following re-entry, as recommended by BOMA, or follow state and local guidelines and mandates.
- After fitness centers have re-opened, increase space between or restrict use of some equipment (e.g. every other stationary bike or treadmill) to maintain distance between guests, and implement social distancing protocols for fitness classes and personal training. Review existing waivers, revise as needed, and reissue for user's signature.
- Provide hand sanitizer stations in lobbies, elevator lobbies, mailrooms, parking facilities and other common areas, and near restrooms, fitness facilities, retail, and restaurants. Supply hand wipes in fitness facilities for guests before and after equipment use.
- Provide covered trash containers for face masks near entrances/exits, elevators, and other common areas; empty and disinfect containers at least daily and more often if warranted.
- Allow bike rooms to remain open and prepare for an increase in bike riders as commuters seek alternatives to mass transit. Identify additional bike parking areas to support increased volume.

Restrict Use of Shared Equipment, Supplies and Space

- Following CDC guidance, discourage workers from sharing office equipment, such as phones and computers. In the event equipment is shared, provide cleaning and disinfection between uses and advise staff on the use of masks, gloves, and other protection while using equipment.
- Instruct building engineers and contractors to maintain their own toolboxes and to clean or disinfect their tools and other materials between uses.
- Consider installing physical setups, such as sneeze and cough guards, to protect your staff, and partitioned workstations if possible.
- Ensure cleaning supplies and materials utilized by vendors are not shared among buildings and clients and that Utilize or phase-in touch-free technology wherever possible. Equip restrooms with

touch-free toilets, sinks, fixtures and dispensers; utilize touch-free hand sanitizing stations; and provide touch-free trash cans where possible.

Security and Building Access

- Limit access points to the building–one entrance and one exit if possible. Create visitor areas at lobby desk with separate paths for "in" and "out."
- If possible, position security personnel at entry points and clearly define their duties and roles. For example, if building policy requires tenants and visitors to wear face masks/coverings in lobbies and other common areas, security personnel may be asked to monitor or manage these requirements.
- Implement social distancing protocols at security and lobby desks to protect personnel.
- Use clear, subscribed and consistent floor markings and signage. If possible, require tenants to meet and escort visitors or report them in advance to security personnel. Use a visitor management system through pre-registration and check-in to minimize interaction with the security team.
- Develop delivery protocols in cooperation with tenants to accommodate different delivery security preferences. For buildings not open to the public, encourage employees receiving packages to retrieve them from the lobby.

Signage

- Provide signage in parking facilities, building entrances and exits, lobbies, common areas, and outside tenant and occupant spaces outlining new rules and procedures. Display posters about social distancing, handwashing, steps to take if ill, etc.
- Provide signs near elevators explaining any new procedures for queuing, occupancy limitations in elevator cabs, etc. Don't forget signage near freight elevators with requirements for face masks/coverings and other personal protective equipment for contractors and building personnel.

- Signage near fitness centers and restaurants should include information on new or limited operating hours, guidance for social distancing, and information about regular cleaning and disinfecting routines.
- Be sure to provide multilingual signs where appropriate, and use pictures and graphics.

Health and Safety Building Operations, Systems, and Management Practices

- Building Personnel and Contractors

Building Personnel

- Follow CDC guidelines and provide your staff with the equipment and training necessary to perform their jobs safely, including the use of personal protective equipment (PPEs).
- Conduct employee awareness training to help prevent initial or further exposure to the virus and keep detailed records of when trainings were provided. Training should include how to interact with tenants and visitors in this new environment, such as when to get on an elevator, engaging tenants in their space, social distancing, face mask/covering usage, proper hygiene, etc.
- Absenteeism may have an impact on staffing. Discuss with your staff the policies regarding flex hours and leave as employees may feel uncomfortable returning to work and risk becoming ill. Best practices include cross training all staff to fill in when other staff members are out sick or caring for another individual who is sick.
- If a staff member tests positive for COVID-19, practice non-discriminatory and CDC-based criteria to determine when it is safe for the staff member to return to work.
- Consider additional staffing that may be necessary for traffic direction in lobbies and elevator lobbies and manage
- Consider CDC and OSHA recommendations for offering flex hours and staggering staff shifts. As you adjust work schedules, make sure to modify or eliminate any overlapping shifts.
- Reduce face-to-face interactions between building staff, tenants, and vendors. Are there any services you can provide remotely to reduce face-to-face interactions? Consider performing certain

maintenance and other services before or after normal business hours when the building is relatively empty.

Vendors and Contractors

- Ask your vendors to share their health and safety plans and new protocols with you in advance of opening, and proactively work with your vendors to have a plan in place before stay-at-home orders are lifted.
- Establish procedures to protect the safety of your vendors and contractors, such as check in/check out, use of PPEs and other protective gear, limiting access to assigned work areas, and managing no-touch key drop-off.
- Amend building rules and regulations for construction contractors to incorporate specific COVID-19 requirements, including questionnaires, use of appropriate PPE, etc. Do not permit vendors to send staff to your property who may be showing signs of illness or have been in contact with a confirmed case of COVID-19.
- Identify back-up vendors where possible in case of personnel shortages or supply chain interruptions.
- Re-negotiate or re-bid service contracts to include new requirements for staffing or services; be sure to consider union requirements and restrictions.

Janitorial---------- *All elements will be tainted with Covid*

- Prior to building re-entry, consult with your janitorial contractor about the level of cleaning that may be needed in your building and review site inventory to ensure adequate cleaning supplies and products. If the building has been empty, normal cleaning and sanitizing may be all that is needed. If the building has been occupied or partially occupied, more thorough cleaning and disinfection may be desirable.
- Depending on building class and occupancy, consider using hand-held UVC wands or electrostatic sprayers for quick, high-volume disinfecting; flash restrooms with UVC or electrostatic spray disinfection when empty.

- Increase frequency of cleaning and disinfection in high density and high-touch areas, such as building and elevator lobbies; elevator interiors, buttons and surfaces; restrooms; furniture; fixtures; door knobs; switch plates; shared conference spaces; building and suite entrances; mats; handrails; turnstiles; counters; trash containers; and other frequently touched surfaces.
- Fitness facilities, cafes, restaurants, and retail located in the building may require more frequent and deeper cleaning and disinfecting.
- Cloth wipes and other reusable cleaning materials should be laundered daily and used with an EPA-approved disinfectant. Follow EPA and CDC recommendations for disposing or hot-water laundering of cleaning supplies. As an alternate, disposable disinfecting cleaning wipes may be used. A protocol should be established for the number or area sizes of surfaces or number of discrete items that should be cleaned with any one disposable wipe.
- If a building employee, tenant, or visitor becomes ill or tests positive for COVID-19, schedule deep cleaning and disinfection in the affected and all building common areas. Follow a defined COVID-19 cleaning program provided by a qualified service provider.
- Cleaning staff may benefit from new and refresher training on cleaning protocols and proper use of disinfectants.
- Follow EPA, CDC and other government-approved guidelines, recommendations, and directions for cleaning products, procedures, dwell times, and protocols; confirm with your service provider or consult a third party if practical.

Mechanical Systems (HVAC, Plumbing, Water, Elevator)- *All filters will be considered tainted.*

- During low- or no-occupancy and prior to building re-entry, run HVAC equipment in building and tenant spaces on at least a reduced–if not regular–schedule.
- Continue normal and regular HVAC maintenance, including filter changes. Check with your building engineers and HVAC contractor for any other recommended maintenance, changes in maintenance schedules, or filter or system upgrades or changes.

- If possible, consider increasing exhaust and infusion of outside air for re-entry and perhaps for several weeks following re-entry.
- Consult ASHRAE guidelines for operating heating, ventilating, and air conditioning systems to reduce COVID-19 transmission and follow CDC guidance where applicable.
- During low- or no-occupancy and prior to building re-entry, operate water systems, toilets, faucets, etc. on a regular HVAC Plumbing and Water Consider flushing and cleaning systems before opening. Refer to ICC's 2018 ~~International~~ (California) Plumbing Code for flushing and disinfecting guidelines and/or consult with a third party if necessary and practical.
- Check P-traps to confirm water seals have not dried out due to lack of water flow.
- basis to avoid the accumulation of biofilm and other bacteria which can accumulate in as little as 3-5 days.

Filter banks are contaminated now!?

Elevator and Other

- Continue to monitor and service all water systems, including hot water heaters, ice machines, filtration systems, etc. Continue normal and regular elevator maintenance and implement new cleaning protocols as described above under "Janitorial."
- Conduct an overall maintenance and systems check with your engineer before re-opening. Ensure elevator emergency phones are operational.

Emergency Preparedness, Evacuation, and Response

- Have a plan in place should there be a resurgence of the virus later in the year. Medical experts expect the

- Utilize your existing emergency preparedness team (or separate pandemic team, if warranted) to communicate with tenants and document how the building will respond to pandemic emergencies. Be aware that tenant expectations are likely to change and increase. Also monitor federal, state and local changes or mandates and adjust your pandemic plan where necessary.
- Work with your local fire department to determine best practices for holding fire drills while social distancing measures are in place. Social distancing may not be practical when moving people rapidly to safety, and new relocation protocols and after-drill cleaning may be needed.
- Monitor federal, state, and local changes or mandates and adjust your pandemic plan where necessary. Regularly check with CDC and World Health Organization (WHO) for the most up to date COVID-19 guidelines.
- COVID-19 situation to continue to evolve throughout the year, and you may need to adjust your emergency preparedness plan to incorporate the appropriate pandemic response.
-
- **Communication with Tenants (Legalities)**
- Provide frequent and timely communications with your tenants and ensure their senior leadership's buy-in to reduce confusion, help prevent further spread of the infection, and provide a safe building environment.
- Be prepared for re-entry well before an official date is set. Ensure you are constantly communicating with tenants about building updates and changes and tenants are communicating with you about their plans prior to re-entry.
- Hold a virtual pre-opening meeting with tenants. Convey any new policies or procedures the building will be implementing, how you will communicate with tenants about any changes in building procedures, and proper protocol for reporting a positive COVID-19 case. Communicate any new policies for entry/exit, common areas, elevator usage, amenity spaces, parking, and deliveries. Ask tenants to share their re-entry plans so that building staff may help make the process as smooth and safe as possible.

- Clearly communicate tenants' responsibilities and obligations within their suites/workspaces for decisions about social distancing, use of PPEs, work hours, illness monitoring/temperature taking, and other health and safety procedures in the workplace. Employers are responsible for their employees.
- Communicate what notification and cleaning procedures and steps will be taken if a positive COVID-19 case is detected. Talk with tenants about their financial responsibility for cleaning and disinfecting procedures in their space that may be outside normal or typical cleaning requirements.
- Ask tenants about any challenges they may be facing. Do their employees have any concerns? What are their priorities as they return to work? How can property management continue to be an effective partner?
- Refer to BOMA International's COVID-19 Tenant FAQ for sample responses to tough tenant questions. elevator usage, amenity spaces, parking, and deliveries. Ask tenants to share their re-entry plans so that building staff may help make the process as smooth and safe as possible.

- **Risk Management and Insurance**
- **Meet with your owner's risk manager and insurance broker to review policies and coverage and assess new liability risks as a result of COVID-19. Review all preventative steps you have taken and plan to take to keep your staff, tenants, and buildings safe**.
- Verify all procedures for making and filing claims, including required forms, deadlines, and backup materials.
- Keep an accurate record of any potential income losses that may be covered and any expenses related to mitigating potential claims for an insured loss.

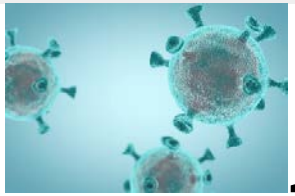
- Identify the appropriate contact in the insurance broker's or carrier's office who handles any claims against the building made by contractors or tenants on losses resulting from force majeure or business interruption.
- Talk to your risk manager and insurance broker about liability exposure in the event a tenant does not follow safety protocols; understand tenant vs. landlord responsibilities.

- **Legal Considerations: Liability, Responsibilities, Contracts, Leases and Staff**
- If the building manager or property owner becomes aware an individual who tested positive for COVID-19 was at the premises (whether its own employees, tenants, or visitors), there may be a duty to warn other tenants and employees and/or prevent access to certain areas in the building. However, be sure to protect the identity of the infected person and his/her employer; we suggest you announce only the floor or area of the building where that person worked or visited.
- Identify all contracts for construction or other services that were in effect or in final negotiations prior to stay-at home mandates. Determine which contracts should be amended, canceled or delayed and discuss force majeure and other legal exposures and remedies with legal counsel.
- Review and consider revising leases to include new and additional tenant insurance requirements, protection of landlord from rent abatement and loss-of-use claims, and hold harmless protection.
- Owners, managers, and legal counsel should work together to develop criteria for responding to tenant requests for rent or lease term adjustments. The same team should advise regarding the owner's obligations to its lenders and their requirements for late payments or adjustments.
- Ensure you understand and follow employment-related laws and regulations before implementing new staffing related rules, procedures, work requirements, hours/shifts, and other new requirements and protocols. These include: OSHA; EEOC; NLRA; state and local orders about essential businesses; return-to-work; mask/face coverings/PPE; ADA and state and local anti-discrimination laws; state and local sick leave and COVID-specific leave and protection laws; obligations under CARES Act/PPE; national origin discrimination laws; and federal and state laws regarding potential harassment or discrimination of employees with Asian ancestry.

Resources

Federal Emergency Management Agency
www.fema.gov/coronavirus
International Codes Council
Occupational Safety & Health Administration
www.osha.gov/coronavirus
White House
World Health Organization
www.iccsafe.org
www.whitehouse.gov/openingamerica
www.who.int/coronavirus
American Society of Heating, Refrigerating, and Air Conditioning Engineers
BOMA International
Centers for Disease Control
www.cdc.gov/coronavirus
Coronavirus (COVID-19) Resource Center
Equal Employment Opportunity Commission
www.ashrae.org/technical-resources/resources
www.boma.org/coronavirus
www.coronavirus.gov
www.eeoc.gov
For more information about BOMA International's emergency prep

- CDCINFO: 1-800-CDC-INFO (1-800-232-4636) | TTY: 1-888-232-6348 | website: cdc.gov/info

- COVID-19 resources for architects
-  **AIA Web Site**
- *Last updated: November 11, 2020*
- As we navigate this unprecedented crisis in our global community, AIA is committed to equipping our members with the information they need to help navigate these uncertain times. This page is intended to provide guidelines, policies, and tools for our members and will be updated frequently as new resources become available.
- Business
- Design
- Economy
- Career
- HR
- Legal
- Relief
- Free
- Business planning
- **COVID-19 Business resources to thrive**
- The AIA COVID-19 Business Task Force has gathered key talking points and resources architects can use when speaking with clients to reinforce the many ways their services are of great importance and value, now and in the future. This work is focused on three key areas: why architects and design matter, business and financial strategies, and construction and shovel-ready project strategies.
- COVID-19 Business resources to thrive >

- **Five Steps to Thrive**
- This five step guide can help you demonstrate your value to clients and potential clients as they review their future budgets and plans.
- Five Steps to Thrive >
- **Ten Thoughts on the Future of Practice**
- Phil Bernstein, FAIA, associate dean and senior lecturer at the Yale School of Architecture, shares ten thoughts on how the architecture profession may be impacted, and potentially transformed, by the economic downturn.
- Ten Thoughts on the Future of Practice >
- **Professional Service Firms Should Have Health and Safety Plans**
- Many professional service firms seem to think that health and safety rules are requirements for contractors and others performing construction work. Firms often are surprised or confused when a potential client requires that they submit their health and safety plans as a contractual requirement.
- Professional Service Firms Should Have Health and Safety Plans >
- **Covid-19: What About My Insurance?**
- The Covid-19 pandemic has changed nearly everything in our lives and in architectural practice. This AIA Trust article reviews some resulting insurance issues that are important to consider and address.
- Covid-19: What About My Insurance? >
- **Ensure That Your Customer Relationships Outlast Coronavirus**
- *Harvard Business Review* has tips for making sure your customer relationships outlast the COVID-19 crisis.
- Ensure That Your Customer Relationships Outlast Coronavirus >
- **Architecture Firm Best Practices, Resources & Templates for Communications and Temp Policies in Response to COVID-19**

- Review or contribute to a living document of resources that compiles guidelines and examples of how architecture firms are adapting to keep their practices open during the pandemic. (Created by the team at Practice of Architecture)
- Architecture Firm Best Practices, Resources & Templates for Communications and Temp Policies in Response to COVID-19 >
- **How Architecture Firms Are Responding to COVID-19**
- Wanda Lau at *ARCHITECT Magazine* interviews several design firms about their reactions to the impact of COVID-19 on their staff, clients, office operations, and projects. Lau profiles firms of various sizes and diverse locations, focusing on how they are adjusting to remote work and how they are maintaining connections to their clients.
- How Architecture Firms Are Responding to COVID-19 >
- **A Guide to Managing Your (Newly) Remote Workers**
- *Harvard Business Review* provides detailed examples of how to overcome the challenges of working remotely and how managers can help support remote employees.
- A Guide to Managing Your (Newly) Remote Workers >
- **Straightforward Advice on Preserving Cash Flow**
- Learn how to preserve cash flow through appropriate contract terms and collection procedures to help your firm navigate difficult times.
- Straightforward Advice on Preserving Cash Flow >
- **An Architect's Guide to Virtual Practice**
- Today, a new reality in architectural practice is that most architects are no longer interacting across their workstations. Nearly every practicing architect engages in some form of virtual practice. This guide outlines the important considerations that should be made when running a virtual practice.
- An Architect's Guide to Virtual Practice >
- How to Navigate the AXP During the Coronavirus Outbreak >
- **Business Plan Template for Small Architecture Firms**

- Modified specifically for small architecture firms, the Small Firm Exchange developed a business plan template and a business model dashboard to assist firms in creating and evaluating sustainable business practices.
- Business Plan Template for Small Architecture Firms >

The National Law Review

Commercial Property Management Considerations in the New COVID-19 Reality

Jenifer M. Bologna

Wednesday, September 30, 2020

Commercial property management companies face unique operational challenges during the ongoing COVID-19 pandemic and a COVID-19 health and safety plan is becoming more important every day.

Not only do commercial property management companies have **to address the COVID-19 health and safety needs of their own employees, but they also need to address the reimagined workplace needs of their tenants.** This often means creating COVID-19 operational plans for their own employees and their tenants' employees, visitors, and customers.

Given the magnitude of federal, state and local laws and guidance (that seemingly change daily) keeping COVID-19 operational plans fully compliant is **no easy task**. Further, as more employers are encouraging, and in many cases requiring, their employees to return to the office, building managers face additional challenges to create COVID-19 operational plans that meet their tenants' increased needs.

Creating a **COVID-19 health and safety plan** that is continuously reviewed and updated as new laws and guidance are issued is a critical component in mitigating operational risk in the new COVID-19 reality. The constantly evolving COVID-19 situation means these plans also will need to be revised as conditions change and the number of employees working on-site increases. In states that have enacted limited liability laws, compliance with current health and safety directives often is required to take advantage of the liability protections offered.

Following are some of the obligations that property managers of commercial buildings will need to address as part of their COVID-19 operational plans:

- Social distancing protocols in common areas and amenity spaces: As the number of individuals entering the building daily continues to increase, be sure protocols are sufficient to maintain appropriate social

distancing. Plans should address COVID-19 capacity requirements in common areas such as elevators, cafeteria spaces, and meetings rooms. In addition, if amenity spaces such as a building gym will be opened, compliance with health and safety obligations for gyms will need to be followed.

- **Building ventilation:** Many state and local orders have specific ventilation systems requirements, including ensuring outdoor air circulation is increased to the extent possible, and tenants may be vocal on this issue. In many states, employers have **an affirmative obligation** to discuss ventilation systems improvements with building management.
- **Signage requirements:** Be sure to comply with state and local requirements regarding posting of specific notices. While some required postings are obvious, such as reminders to wear a mask in common areas and not to enter if experiencing COVID-19 symptoms, others are less so. For example, Georgia mandates posting of a sign with specific language to be covered by the limited liability law. New York requires posting of the safety plan in a conspicuous area.
- Screening processes including temperature monitoring for use by tenant employees, visitors, and customers: In many states, employers have a legal obligation to conduct daily health screening and temperature monitoring of their employees. Many of these rules allow employers to work in conjunction with building owners to satisfy the screening obligations. As the number of people entering the building continues to increase, consider more efficient ways to address this obligation both in terms of employees and on behalf of tenants. For example, many property owners and managers are installing temperature monitoring kiosks that employees and tenants can use to monitor temperatures. In creating any screening plan, it is important to ensure compliance with privacy requirements, as well as have a plan to address requests for reasonable accommodations.
- Create a plan to respond to COVID-19 positive situations in the building: In preparing a COVID-19 response plan, consider whether there is a legal obligation to notify employees, other tenants or visitors, or local health authorities of any positive cases. Notifications should protect the confidentiality of the positive individual. Like many COVID-19 obligations, response obligations to positive situations evolve continuously. In California, a new law will require all employers to issue a written notice containing specific information within one day of learning about a positive COVID-19 situation.

While the shift back to on-site work brings additional compliance related challenges, it is likely a welcome trade-off to see tenants returning to the office. To keep tenants' employees returning to the office, compliance with COVID-19 health and safety rules is critical. Many employers face an uphill battle in encouraging their employees to physically return to the office. Even absent a legal entitlement to remote work, employers are in a difficult position trying to enforce return-to-work plans when many of their workforce feel safer working at home. Having building space that is fully compliant with COVID-19 health and safety rules is the first step to a successful return-to-office process.

Covid Cases:

One choir practice, 53 cases, two deaths

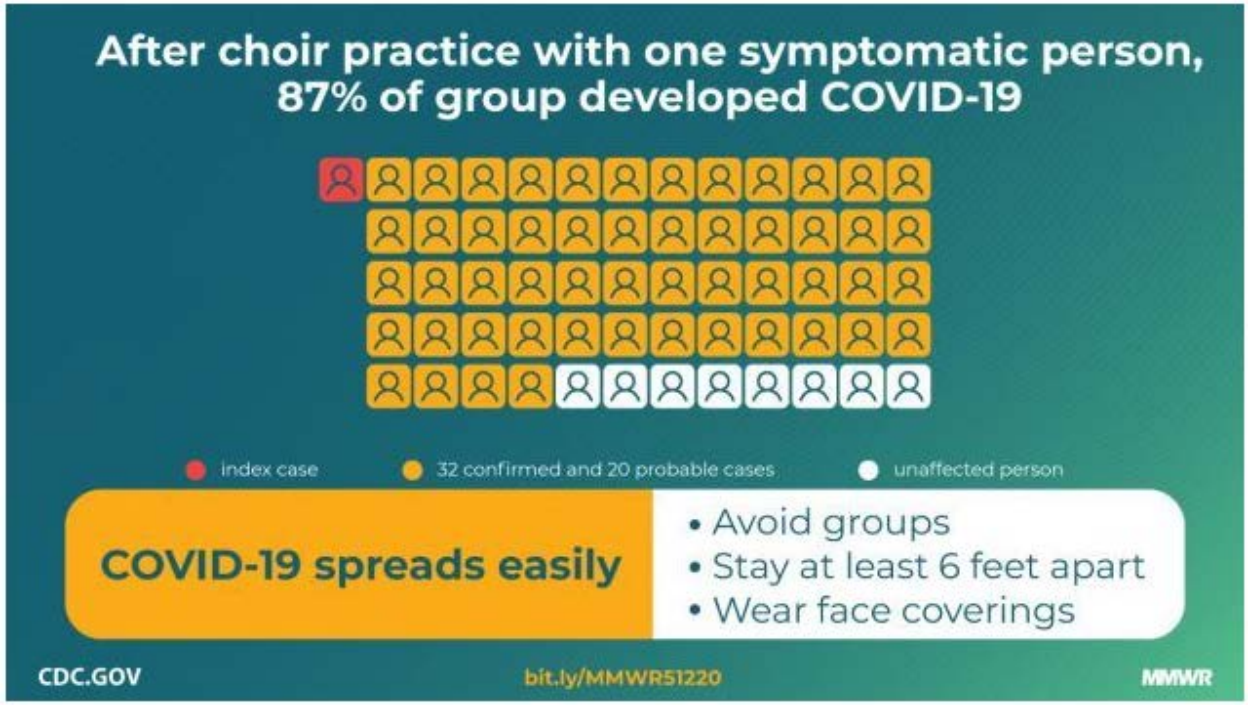
On Tuesday March the 10th, in Skagit County, Washington, a group of choir members met for their weekly rehearsal. At that point in time news of the novel coronavirus had already been spreading, and after some consideration, it was decided the rehearsal would continue as scheduled, albeit with some cursory protections.

From around 6 pm members of the choir began to arrive. They were offered hand sanitizer on entry, and physical contact was limited, with no handshakes or hugs reportedly taking place across the two-and-a-half-hour event. All up, 61 singers took part in the rehearsal.

Over 120 chairs were set up in a large multipurpose space, and since only half of the choir was present, there were many empty spaces between singers. In between two 40-minute group rehearsals, the singers split into two smaller groups for a 50-minute practice.

A 15-minute break took place before the final session. Cookies and oranges were freely available from a table at the back of the main space, but many members refrained from eating the snacks.

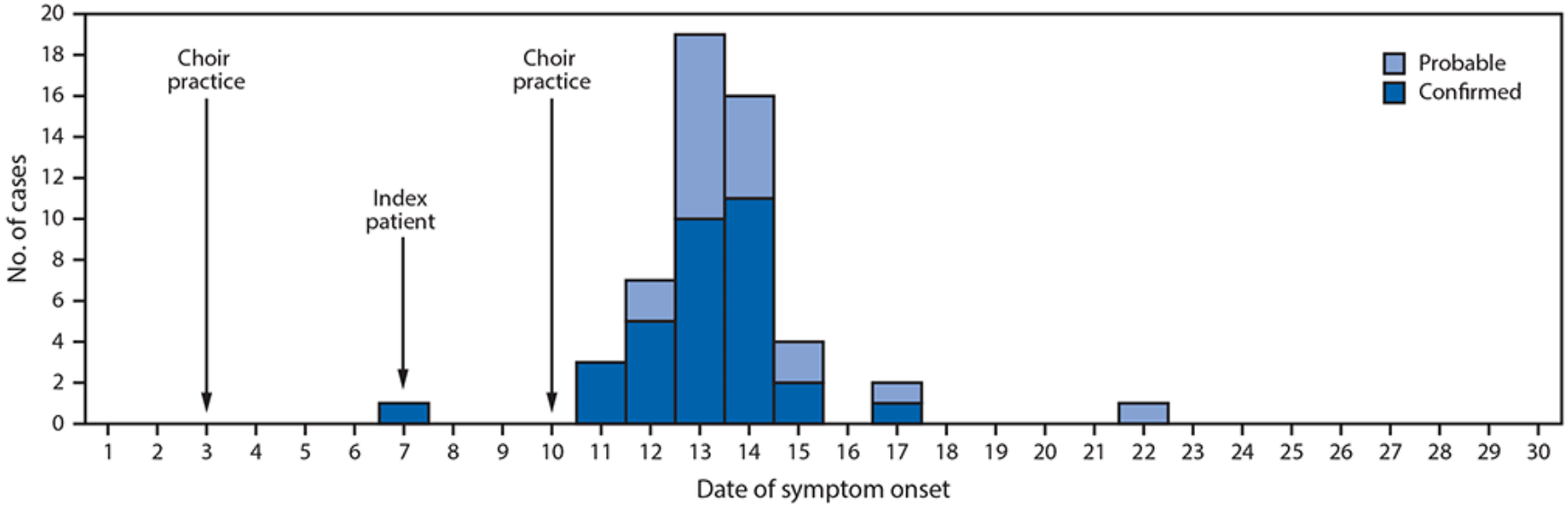
"Most attendees left the practice immediately after it concluded. No one reported physical contact between attendees," the CDC report states.



Within two weeks, 87 percent of those at the March 10 rehearsal were confirmed to have contracted COVID-19. Two of the 53 infected subjects died.

Although a small number of attendees began displaying COVID-19 symptoms within two days of the March 10 practice, suggesting they may have been infected earlier, the CDC investigators suspect the vast majority of cases could be tracked back to this single super-spreading event.

Alongside the potential of several subjects infecting others during their pre-symptomatic period, the report found one individual did attend the rehearsal with active cold-like symptoms. They had been exhibiting symptoms for three days, and subsequent testing confirmed COVID-19.



Confirmed and probable COVID-19 cases linked to choir practice by date of symptom onset. While the onset of some cases suggest infection prior to March 10, the majority of cases can be linked to the single practice.
CDC

Exactly how each individual contracted the virus over the course of this two-and-half-hour choir rehearsal is still unknown. While the virus is still primarily thought to be transmitted by direct touch, not all cases in this particular event can be explained that way. The CDC report does recognize actions such as stacking chairs and sharing snacks may account for some of the infections, but the big mystery in this scenario surrounds the act of singing, and how that may have potentiated the super-spreading event.

The extended family gatherings

In late February a Chicago man experiencing mild respiratory symptoms was linked to **16 confirmed COVID-19 cases, resulting in three deaths**. The infections were thought to have occurred over a three-day period spanning several family gatherings, including a funeral and a birthday party.

The cluster began when the man shared a takeout meal with two family members of the deceased, the night before the funeral. Over the course of three hours the trio talked and ate out of shared serving dishes.

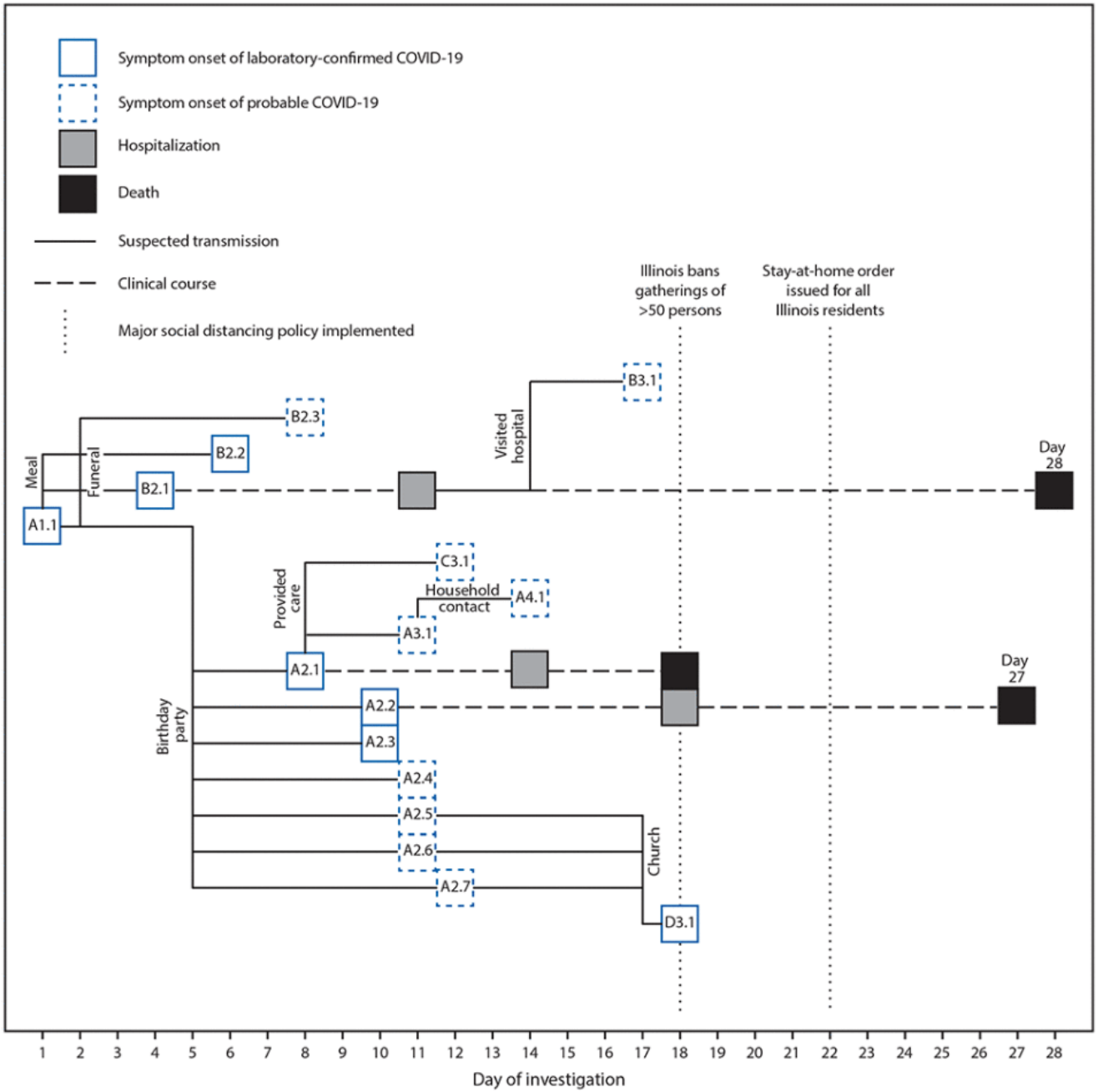
The next day at the funeral the infected man shared a communal "potluck-style" meal and hugged a number of family members. Three days later the man, still mildly symptomatic, attended a family birthday party. The event took place in a family member's home and was attended by 10 people, including the primary COVID-19 subject.

For the next three hours the group celebrated in the house, sharing food and occasionally embracing. A week later seven of the party attendees had developed COVID-19.

"Within three weeks after mild respiratory symptoms were noted in the index patient, 15 other persons were likely infected with SARS-CoV-2, including three who died," the CDC report states. "Patient A1.1, the index patient, was apparently able to transmit infection to 10 other persons, despite having no household contacts and experiencing only mild symptoms for which medical care was not sought."

The CDC report suggests this particular cluster strikingly highlights the important of social distancing within family units. Although extended family gatherings may feel somewhat safer than broader non-

family encounters in public spaces, this case report illustrates how swiftly the virus can spread from small gatherings of people from multiple households.



The CDC investigation's chain of transmission, illustrating how a single case can trigger a cluster of cases

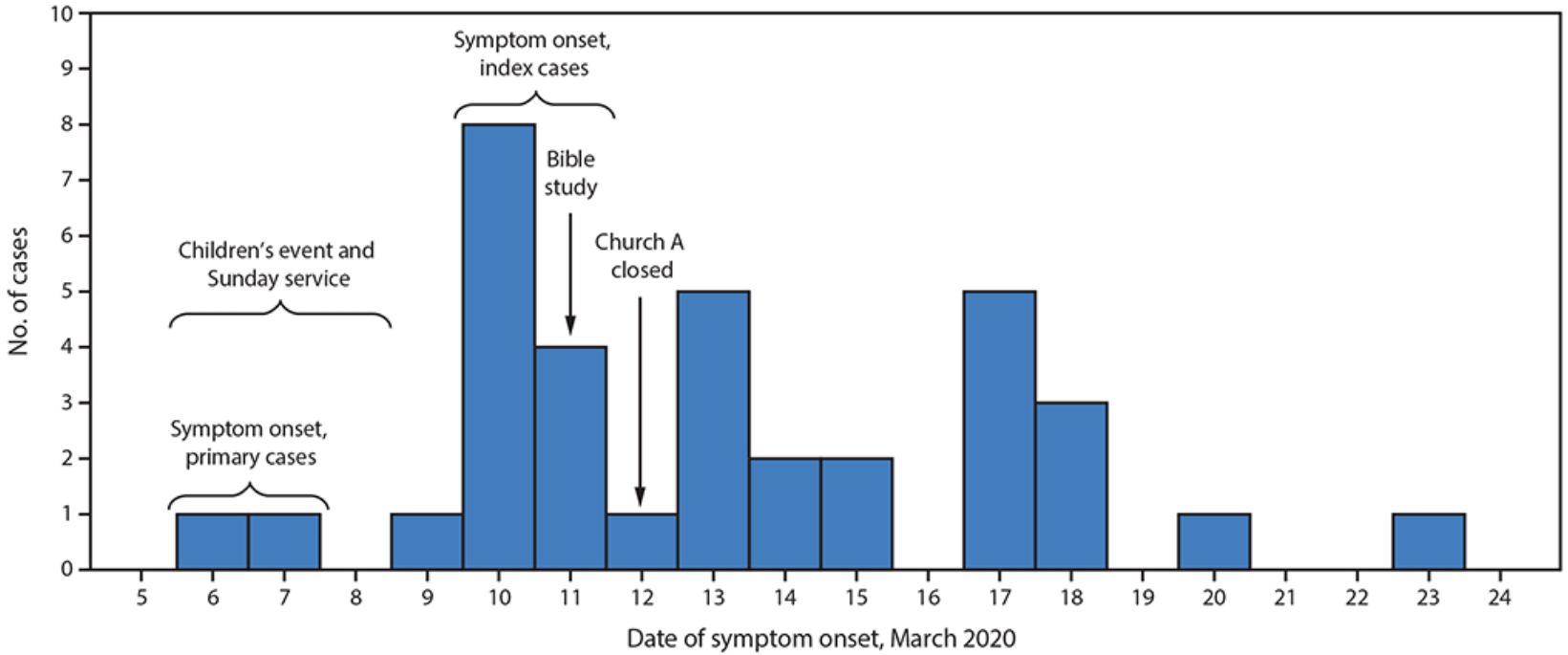
The church chain

Between March 6 and March 8 a church in rural Arkansas hosted a multi-day children's event. Over the course of the **three days adults and children participated in games involving close contact, and a buffet-style shared meal.**

On March 11 the church's pastor and his wife began to develop a mild cough and fever. The next day, upon hearing about similar respiratory symptoms appearing in the congregation, the pastor immediately closed his church. Testing revealed the pair had indeed contracted COVID-19, and investigations tracked the exposure back to the church events a few days prior.

The investigation homed in on the source as two subjects who attended the church events between March 6 and 8 while they were mildly symptomatic. From the multi-day children's event, to an additional bible study class at the church on March 11, there

were 35 subsequent COVID-19 cases directly linked to the gatherings.



Spread of the virus from the first two primary cases, symptomatic at the early church events
CDC

Out of the 92 attendees linked to church events over that five-day period, 38 percent were confirmed with COVID-19 and three ultimately died. The CDC report suggests an additional 26 cases of community transmission could be linked back to this chain, all stemming from two symptomatic individuals attending a few church events.

"Despite canceling in-person church activities and closing the church as soon as it was recognized that several members of the congregation had become ill, widespread transmission within church A and within the surrounding community occurred," the CDC report states. "The primary patients had no known COVID-19 exposures in the 14 days preceding their symptom onset dates, suggesting that local transmission was occurring before case detection."

Irwin Redlener, director of Columbia University's National Center for Disaster Preparedness, says this case study illustrates the concerning way the virus can spread so easily via religious gathering spaces. Speaking to the The Daily Beast, Redlener suggests this particular case may be less an example of a more contagious "super-spreader" and more an indication of how church gatherings in particularly can trigger clusters of infection.

"People can go to church and become infected and then spread it into their larger communities, and with an infection like SARS-CoV-2, this could really promote a major secondary or tertiary wave of infection in the larger community," said Redlener. "It's not just limited to the people who attend these services."

These three case studies offer clues as to what kinds of social interactions may need the most vigilance moving forward. There are volumes of similar case studies appearing, offering insights into how clusters can stem from nightclubs, bars, schools, and cinemas.

Mike Ryan, executive director of the World Health Organization's emergency health program, recently said it is unlikely this virus is going away anytime soon. Ryan noted, even with a vaccine, it is possible this virus could become endemic. So, the sooner we can adapt our social environments to limit its transmission, the sooner we can get back to some kind of normalcy.

COVID-19 Case Study 1

This is based on real events and real people but names were changed to protect privacy.

Department of Public Health CITY OF PHILADELPHIA

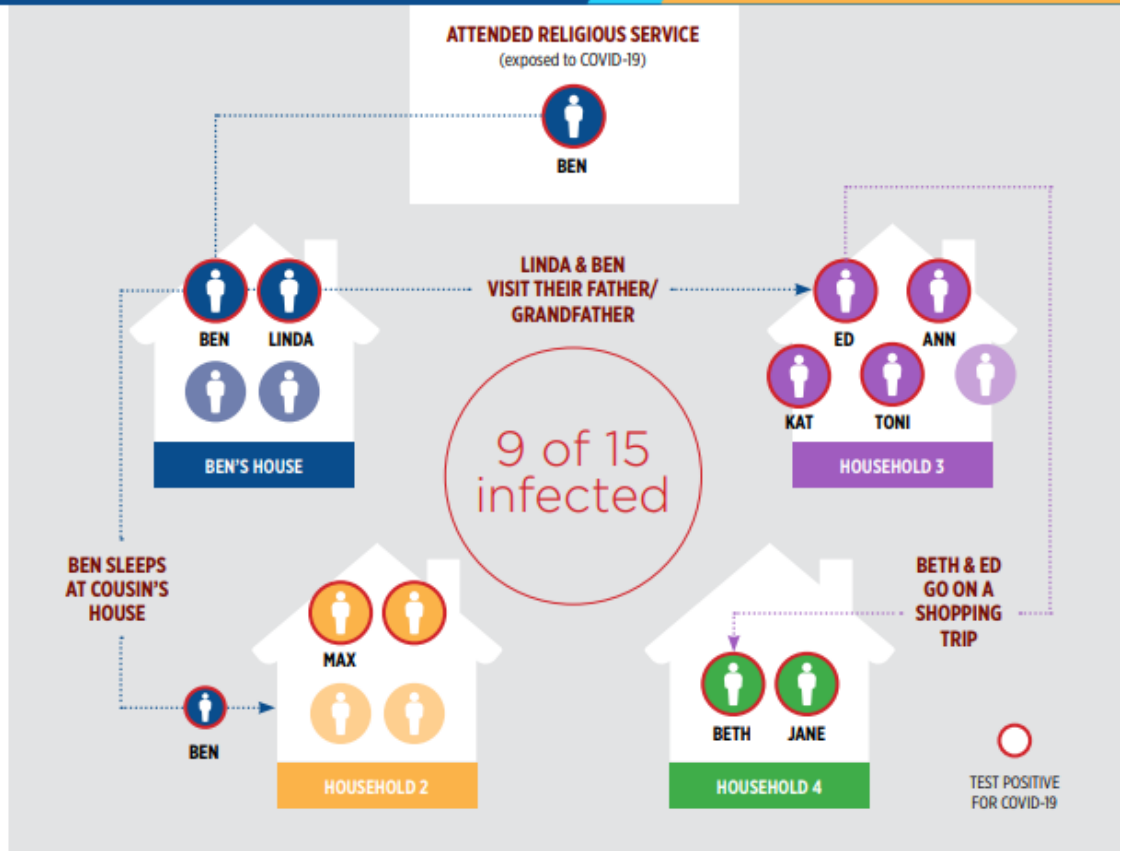
Ben, a teenager, attends an in-person church service and was unknowingly exposed to COVID-19. Days later, he goes to a sleepover at his cousin Max's house. His mother, Linda, picks him up the next morning to visit his grandfather, Ed. The next day, Ben begins to feel sick, and later finds out that his cousin Max is also not feeling well. Soon, Linda and Ed start experiencing symptoms. All four test positive.

When Ed begins to feel sick, his daughter, Ann, starts taking care of him. Ann and her daughter, Kat, both live with Ed and his wife, Toni. Just as Ed's test comes back positive, Ann, Kat, and Toni feel sick and are tested. Two days later, they learn they are also positive.

Beth, Ed's granddaughter, hears that many of her family members are sick. She and her mother, Jane, who live together, quarantine in their home because Beth had gone on a shopping trip with Ed a week earlier. When Beth begins experiencing symptoms, she and Jane, who isn't feeling sick, go to get tested. Both of their test results come back positive.

TOTAL INFECTED: 9 OF 15

Department of Public Health City of Philadelphia



COVID-19 Case Study 2

This is based on real events and real people but names were changed to protect privacy.

Department of Public Health CITY OF PHILADELPHIA

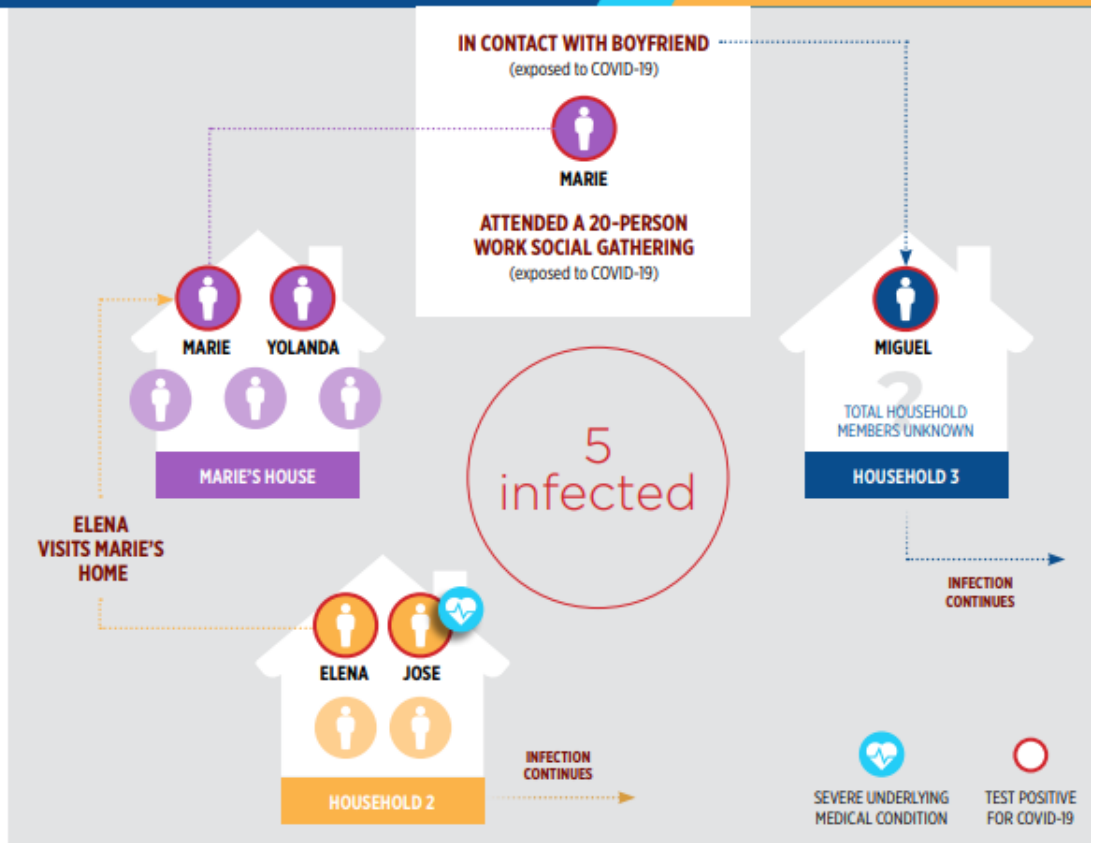
Marie developed symptoms and tested positive for COVID-19. She reported being in contact with her boyfriend Miguel who had previously tested positive and being exposed at a small social gathering of around 20 coworkers. The participants at the social gathering worked at a food factory outside the city where many workers had tested positive for COVID.

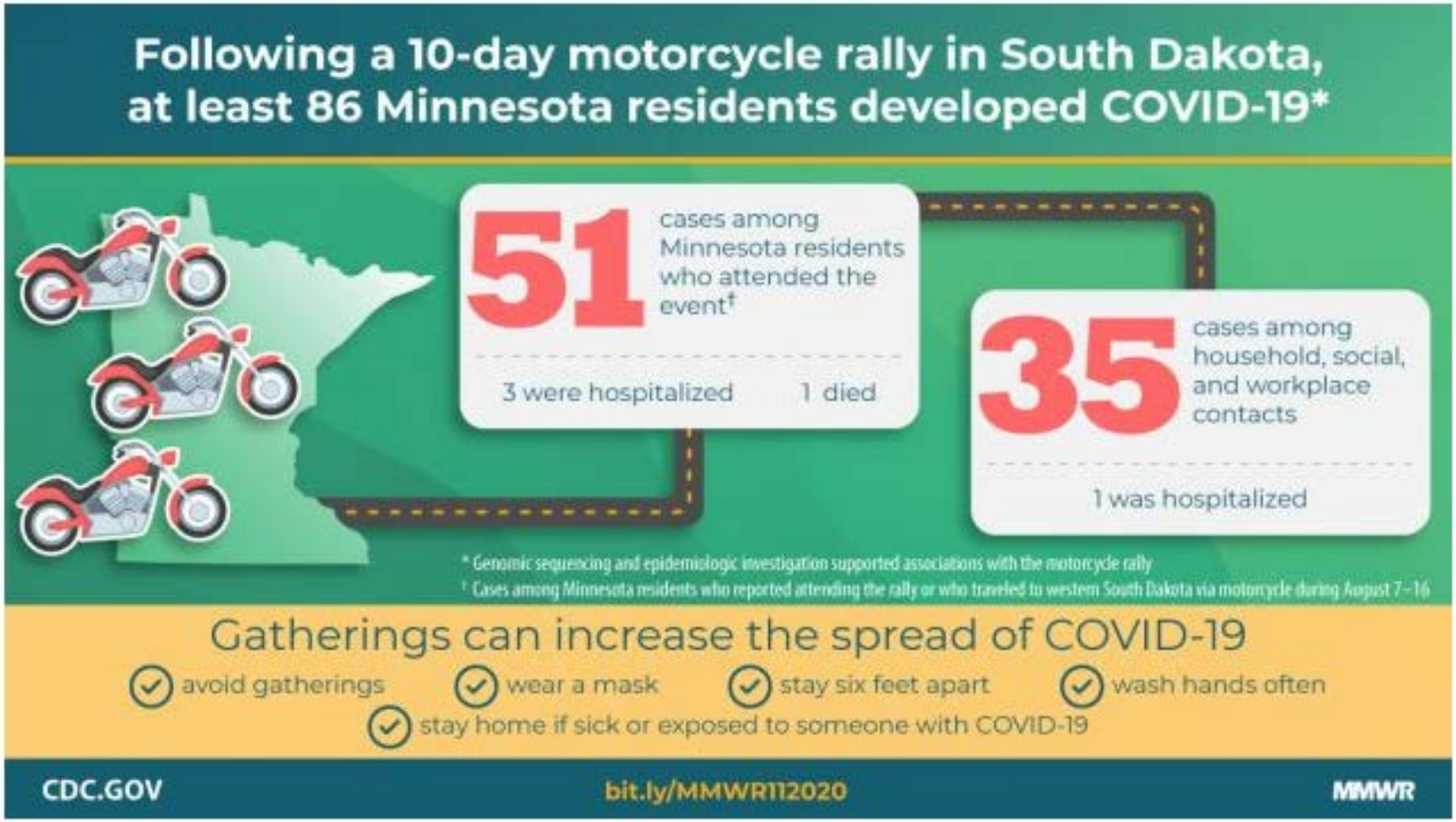
Marie's boyfriend had not participated in contact tracing due to fear of interaction with the government. While Marie was sick, her mother Elena visited the home to help care for Marie's 3 children.

Days later, Elena's husband Jose—who had a serious underlying medical condition—also fell ill and tested positive. Although it would be kept confidential and unable to be accessed by others in the government, Jose did not want to provide the information for 2 other members of his household who were exposed. Then Marie's cousin Yolanda who also lived in Marie's household developed symptoms.

TOTAL INFECTED: 5

Department of Public Health City of Philadelphia




Following a 10-day motorcycle rally in South Dakota, at least 86 Minnesota residents developed COVID-19*
51
cases among Minnesota residents who attended the event†
3 were hospitalized
1 died
35
cases among household, social, and workplace contacts
1 was hospitalized
* Genomic sequencing and epidemiologic investigation supported associations with the motorcycle rally
† Cases among Minnesota residents who reported attending the rally or who traveled to western South Dakota via motorcycle during August 7–16
Gatherings can increase the spread of COVID-19
avoid gatherings
wear a mask
stay six feet apart
wash hands often
stay home if sick or exposed to someone with COVID-19
CDC.GOV
bit.ly/MMWR112020
MMWR

OCTOBER 24, 2020 10:55 AM, UPDATED OCTOBER 24, 2020 11:56 AM

Mecklenburg health officials say 68 COVID-19 cases are connected to the United House of Prayer for All People church in Charlotte NC. Two people have died. The county said it will host a no-cost, drive-thru testing event Thursday and Friday. BY MECKLENBURG COUNTY

COVID-19 Outbreak in an Amish Community — Ohio, May 2020

Weekly / November 13, 2020 / 69(45);1671–1674

Hammad Ali, MBBS, PhD[1]; Karthik Kondapally, MBBS[2]; Paran Pordell, MPH[1]; Brandi Taylor[2]; Gisela Medina Martinez, MS[1]; Ellen Salehi, MPH[2]; Stacey Ramseyer[3]; Susan Varnes[3]; Nikki Hayes, MPH[1]; Sietske de Fijter, MS[2]; Spencer Lloyd, MD[1] (View author affiliations)

View suggested citation

Investigation and Findings

On May 9 and May 11, 2020, respectively, a husband and wife in an Amish community in Wayne County, Ohio, experienced COVID-19–related symptoms. Both had nasopharyngeal samples tested and SARS-CoV-2 infection confirmed by receipt of positive RT-PCR results on May 14. The husband, who had a history of chronic obstructive pulmonary disease, participated in church services on May 2 and 3. He was hospitalized on May 15 with fever, cough, and shortness of breath, and received a diagnosis of COVID-19–related pneumonia; he was discharged on May 17. Another adult family member, with cancer, became symptomatic May 16, received a positive SARS-CoV-2 test result May 18, and died May 21. During May 13–19, four additional symptomatic community members received positive test results. After these initial seven cases were identified, community leaders contacted Wayne County Health Department (WCHD) to report that numerous other community members had symptoms consistent with COVID-19. As a result, WCHD, with support from the Ohio Department of Health and a community bishop, organized a testing clinic at an Amish community school on May 20, where nasopharyngeal swabs were collected for RT-PCR testing. The testing clinic was publicized by the bishop and other community leaders; anyone could attend and receive testing.**

CDC and Ohio health department investigators conducted 11 key informant interviews with community leaders and members. Some interviewees might have had COVID-19, but for reasons of confidentiality, interviewee names were not recorded. Consequently, interviews were not linked to cases. One interview was conducted at the testing clinic; 10 additional interviews, using snowball sampling (*4*), were conducted over the following 10 days. All invited participants orally consented to be interviewed. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.†† Interviews took 1 hour to complete and included open-ended questions to identify knowledge gaps related to COVID-19 prevention, transmission, and testing, and to understand attitudes, practices, facilitators of, and barriers to implementing strategies to decrease transmission. All interview notes were handwritten and reviewed by two interviewers. Theme saturation, a research term defined as the point "when a researcher begins to hear the same comments again and again" (*5*), was reached through iterative review and analysis. The following 10 themes were identified: 1) COVID-19 knowledge, including the spread of SARS-CoV-2; 2) myths and misinformation; 3) facilitators of and barriers to following COVID-19 prevention strategies at home, at work, and in the community; 4) use of traditional communication (e.g., newspapers) for information sharing; 5) access to testing; 6) means of transportation; 7) community cohesion; 8) selflessness; 9) strong work ethic; and 10) individual and community responsibility.

At the May 20 testing clinic and during the interviews, community members reported six social gatherings during the preceding 2 weeks, including a prechurch service§§ (May 2), church services (May 3, 10, and 17), a wedding (May 12), and a funeral (May 16) (Figure). Among 30 community members who had nasopharyngeal swabs collected at the testing clinic, 23 (77%) received positive SARS-CoV-2 test results. All community members with positive results reported multiple COVID-19–related signs and symptoms. The earliest symptom onset date was May 7, 5 days after a prechurch service and 4 days after a church service. On May 27, one person was hospitalized with fever and shortness of breath, received a diagnosis of COVID-19–associated pneumonia, and was discharged on May 30.

Among the 30 persons with laboratory-confirmed COVID-19, the mean age was 46 years (range = 12–86 years), and 21 (70%) were male. Eight of those persons reported having underlying medical conditions (Table). Symptoms most commonly reported included fatigue, headache, cough, myalgias, and chills. Among the 30 persons, none had traveled recently, and 24 (80%) at the time of testing reported contact with a person who was sick, usually at a social or religious event.

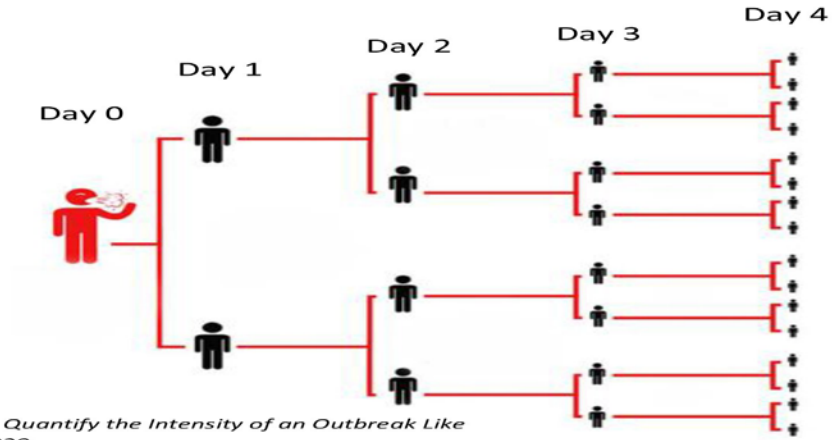
Most interviewees accurately reported knowledge about transmission and prevention measures, including that SARS-CoV-2 spreads through "coughing, sneezing" and can be prevented by "handwashing, social distancing, and staying at home." However, several interviewees reported misconceptions that mask wearing might cause harm ("people wearing them all day long at work and getting a headache and not feeling well"), and that vitamins and herbs can help prevent SARS-CoV-2 infection. Several barriers to use of mitigation strategies were described, including having limited access to updated and trusted guidance ("access to health care is not an issue…access to good information is the problem"); lack of social or cultural acceptability of wearing masks ("the need to wear a mask has never been a part of this community"); and hesitancy around proper and consistent social distancing because of cultural practices and acceptability of the term ("fellowship is as important to us as worship," "call it physical distancing…social distancing has the connotation of social isolation"). Interviewees also stressed the convenience and timing of testing clinics ("transport is a challenge because we need to hire a driver; testing clinic today made it easy" and "testing clinics should be coordinated with the communities").

11. What is this process called?

When speaking to the patient's wife, you find out several alarming facts: The patient was at a large gathering the week before he was diagnosed and that he took public transportation to his place of work daily.

Epidemiologists are estimating R0 (R naught – the term used to describe the intensity of an infectious disease outbreak) for COVID-19 to be anywhere from 1.5 -3.5. In other words, R0 describes how many cases of a disease an infected person will go on to cause. For the question below R0=2.

12. If each person who has tested positive with COVID-19 infects 2 other people each day, how many days will it take for over 100 people to have COVID-19? (See figure)



Adapted from "How Scientists Quantify the Intensity of an Outbreak Like COVID-19," by J. Eisenberg, 2020. (https://labblog.uofmhealth.org/rounds/how-scientists-quantify-intensity-of-an-outbreak-like-covid-19). Copyright 2020 by Michigan Health Lab.

13. What are the implications of these facts for the public?

As one of the nurses who took care of the patient prior to confirmation of COVID-19, you have been notified by the local health department that you need to self-quarantine to your house. You are asymptomatic and question the public health nurse about why you need to self-quarantine.

14. Why does the nurse need to self-quarantine and what is involved in self-quarantine?

As you are quarantined at home, you are watching the news and you hear about social distancing.

25. What do you say to the family member to attempt to de-escalate the situation?

26. When that doesn't work, what do you do?

You and your colleagues are taking care of four patients on the designated COVID-19 unit. All of the patients are critically ill and currently on BiPap for airway management. All four patients are rapidly declining and airway management via endotracheal tube and ventilator is imminent. However, due to over-crowded intensive care units because of the COVID-19 pandemic, there is only one ventilator left in the surrounding area. You have to pick one of the four patients knowing that the other three will die without ventilator support.

27.Who gets the ventilator? Why? (Crisis Standards of Care)

A 51 year old male family practice physician who is married with two teenage children.

A 32 year old grade school principal who is a single mother of two young children.

A 24 year old graduate student who is 20 weeks pregnant with her and her husband's first child.

A 37 year old male paramedic who is the single parent of a 14 year old.

28. After the mass casualty shooting in Las Vegas, Nevada, gunshot victims were able to share ventilators. Would this be possible with COVID-19? Why or why not?

General Discussion Questions

29. What were the differences between how China handled the outbreak and the response in the U.S.?

30. What do you believe could have been done differently?

31. How does all of this make you feel? As a student? As a future healthcare worker?

Apartment buildings in Guangzhou, China, where toilet waste pipes may have carried the novel coronavirus from one infected family's bathroom to people living above them.

PRISMA BILDAGENTUR/UNIVERSAL IMAGES GROUP VIA GETTY IMAGES

Can you catch COVID-19 from your neighbor's toilet?

By Jocelyn KaiserSep. 4, 2020 , 5:05 PM

***Science*'s COVID-19 reporting is supported by the Pulitzer Center and the Heising-Simons Foundation.**

Coronaviruses wafting through a Chinese apartment building's plumbing may have infected some residents, according to a new study, raising fears of yet another way that COVID-19 could spread. The case echoes a 2003 outbreak of severe acute respiratory syndrome (SARS) that spread through the pipes of a Hong Kong apartment building—and some worry that transmission via toilets might have contributed to the COVID-19 outbreak that shut down New York City early in the pandemic.

The study adds to months of warnings that SARS-CoV-2, which causes COVID-19 and is thought to spread mainly through respiratory droplets and aerosols, could also infect via feces. "It's not something that people like to talk about," buildings expert Joseph Allen of the Harvard T.H. Chan School of Public Health **wrote in a *Washington Post* op-ed this week**.

Although fecal transmission of a pathogen is tricky to confirm—and proving that a virus spreads via building waste pipes is even more difficult—it is entirely possible, several researchers tell *Science*Insider. With their help, we try to answer some key questions about this unusual and still speculative risk.

Can people catch COVID-19 from poop?

A number of studies have reported finding RNA from SARS-CoV-2 **in fecal samples from COVID-19 patients**. Some of those patients also had diarrhea, suggesting the virus had infected their intestinal tracts; the RNA could also come from swallowing saliva or respiratory tract fluids containing the virus. Such fecal samples inspired wastewater testing currently being used to watch for incipient COVID-19 outbreaks in cities around the world and at **some U.S. universities**.

Some studies have also found abundant coronavirus RNA in **hospital bathrooms**, and one modeling study suggested that flushing a toilet can **spew viral particles far above the seat**. A person could therefore be exposed to SARS-CoV-2 by breathing aerosolized fecal matter, or by ingesting the virus after touching a contaminated surface.

A key point often glossed over, scientists say, is the limited evidence that viral RNA in stool comes from live, infectious viruses—not just leftover material from "dead" or destroyed viruses. Only a few labs have reported culturing live virus from COVID-19 patient stool samples, which is challenging to do. One team has suggested that **intestinal fluid neutralizes the virus**. The U.S. Centers for Disease Control and Prevention says "it is unclear" whether virus in feces can cause COVID-19 and concludes the risk of spreading the virus this way is "low." To date, there are no documented cases clearly indicating infection via fecal matter.

But Allen and other researchers say the risk should not be ignored. Many animal coronaviruses can be spread through feces, "so it isn't a stretch to believe it might be possible with SARS-CoV-2," says epidemiologist Susan Amirian of Rice University.

But whether that risk is present in sewage is another question. By the time human waste reaches a typical sewer outfall or treatment plant, any potentially intact viruses are likely too diluted to be infectious, says environmental engineer Jordan Peccia of Yale University, who is testing wastewater for SARS-CoV-2 in Connecticut. To date, there is little to no evidence that COVID-19 spreads via sewage.

What about that 2003 SARS outbreak in Amoy Gardens?

Amoy Gardens, a Hong Kong housing complex with multiple apartment towers, **saw 321 residents catch SARS in 2003; 42 of them died.** Researchers traced the outbreak to **a single visitor with SARS who had severe diarrhea**. The bathrooms in the apartments had floor drains for cleaning, and when the U-shaped traps beneath these drains dried out, aerosolized SARS virus from the sick resident reached apartments through an air shaft. Typically, such wafting is blocked by water that has accumulated in the traps. Scientists suggested the wind even carried the aerosols to adjacent buildings.

How does Amoy Gardens compare with the new COVID-19 cases in the Chinese apartment building?

Just nine people got sick from SARS-CoV-2 in Guangzhou, where the apartment building was located, and none died. But there are similarities, says University of Hong Kong mechanical engineer Yuguo Li, who studied both cases**. Li's** group—along with teams from the Guangdong Provincial Center for Disease Control and Prevention and Guangzhou CDC—**describe their new findings** this week in the *Annals of Internal Medicine*. (China CDC mentioned the cases in less detail in a **paper published late last month**, as **first reported by Bloomberg**.)

Here's what is known about the COVID-19 episode: All five members of a family living in a 15th floor apartment tested positive for SARS-CoV-2 in late January, after most of them had visited Wuhan, where the pandemic started. A few days later, two middle-aged couples living on the 25th and 27th floors—part of a stack of vertically arranged apartments directly above the flat in question and all sharing the same

waste pipes—became ill. They had not traveled or been in close contact with a sick person during China's lockdown.

Li's team compiled a range of evidence suggesting the two couples were exposed to fecal aerosols from their neighbors more than 10 floors below through their shared waste pipes. Camera footage from elevators indicated that the families did not cross paths. Among more than 200 air and surface samples collected in the high-rise in mid-February, the only ones testing positive for SARS-CoV-2 came from the 15th floor family's apartment and a vacant apartment's bathroom on the 16th floor directly above. Finally, a tracer gas that Li's team piped into the 15th floor apartment's drainpipe exited in the 25th and 27th floor apartment bathrooms.

The researchers could not verify that any of the three U-shaped traps in the apartments had dried out when the COVID-19 cases happened, however. The apartments had already been cleaned and the traps filled with water when they visited. Evidence for spread via plumbing remains "circumstantial," they write. Still, Li's team tells "a compelling story," Peccia says.

Li says he's aware of three similar cases of possible SARS-CoV-2 transmission via high-rise plumbing, two in Hong Kong and another in Guangdong province. He's investigating one of the Hong Kong cases, which involved five stacked apartments. "We really do not know" how many other cases there may be in China or elsewhere, he says.

Could COVID-19 have spread through plumbing in New York City high-rises?

That depends on many factors and may be impossible to prove, researchers say. A sick person would have had to produce lots of infectious virus, which would have had to reach others quickly and at a high dose, Peccia says. "A lot has to fall in line."

It would also depend on a building's plumbing system and how well it was maintained. In the United States plumbing systems generally "protect people," says Michael Gormley, a water sanitation expert at Heriot-Watt University in Edinburgh, who **wrote a commentary** on Li's study. One difference in New

York City is that most apartment bathrooms don't have floor drains. But even so, there are other drains with U-shaped traps, like those in unused bathtubs, that could dry out.

"There's no reason it couldn't happen," Peccia says. But if it does, he suspects "it's a rare event."

What's the bottom line for apartment building dwellers, and people in general?

There are several steps people can take to reduce their exposure to such fecal aerosols, Gormley and others say. Chief among them is good hygiene—washing hands, cleaning the toilet, and keeping the lid down when flushing. If you live in a high-rise apartment building, make sure U-shaped traps are filled—that's easily done by regularly running water in tubs and sinks. But gases can also leak from aging pipes, Li notes. "If [you] can smell the drain odor in your bathroom, do something."

Poorly Ventilated Restaurant.

A detailed engineering evaluation was performed of conditions at the time of a COVID-19 outbreak at a restaurant in China. After mapping case locations, conditions experienced by both infected and unaffected customers and staff were characterized. The role of different transmission routes was evaluated by comparing factors influencing exposure of the two groups. Findings from this study included:

• **Ten of the 73 restaurant customers were infected.**

• Those 10 were seated at three adjacent tables on one side of the dining room, approximately 1 m to 5 m (3 ft to 16 ft) from a customer who had just arrived from Wuhan before community spread in the rest of China.

• HVAC consisted of five fan coil units (FCU) with no outside air and exhaust fans (off at the time).

• Measured ventilation rates (infiltration only) were an order of magnitude below ASHRAE Standard 62.1- 2019.

• Modeling of airflow patterns established that a "bubble" was formed by each FCU, dividing the room into five separate zones containing contaminants released in that zone.

• Modeling results also suggested that discharge from the FCUs directed air in the breathing zone between customers.

• The three impacted tables were within the same zone.

• Air from the contaminated zone did not mix significantly with the rest of the room, and no customers were infected in those areas.

• Surveillance videos showed that close contact between individuals and fomite contact were not significant. • Waiters did have brief contact with infected customers, but that was insufficient to cause infection.

This study concluded that SARS-CoV-2 was transmitted by a combination of close contact (i.e., droplet exposure within 2 m [7 ft]) and aerosol exposure beyond that distance (extended short-range airborne). Poor ventilation resulting in little dilution of the virus was considered a very important factor. This study cannot be used to draw general conclusions on the prevalence of airborne transmission due to the atypical HVAC configuration. Lack of customer infection in adjacent zones suggests that SARS-CoV-2 was sufficiently isolated to prevent disease transmission. Lack of waiter infection suggests that brief contact was not sufficient to transmit COVID-19.5

Poorly Ventilated Bus.

One hundred twenty-six people traveled to a religious event in China in two buses, each with a recirculating air-conditioning system (no outside air). An infected individual from Wuhan was on one of the buses. All passengers mixed with the infected individual at a three-day religious event, along with 172 other attendees who had not been in the buses. Thirty persons subsequently contracted COVID-19, and they were classified as follows:

• No passengers on the bus without the infected individual had COVID-19.

• Seven attendees who had not been in the buses contracted COVID-19 but were in close contact with the infected individuals during the event.

• Twenty-three riders on the bus with the passenger from Wuhan were infected. By location, there were more cases in individuals sitting beyond 2 m (7 ft) of the infected passenger.6

Poorly Ventilated Conference Center.

Also in China, 30 people attended a three-day event with an infected individual from Wuhan in a building with poor ventilation (HVAC cycled on only 15 minutes per four hours). It was not determined who had been in close proximity to the infected individual, and thus within droplet range. Fifteen attendees were subsequently infected. Investigators concluded that some infections were due to airborne exposure after comparing the infection rate to similar outbreaks and that ineffective dilution because of poor ventilation appeared to be a major contributor.6

Well Ventilated Cruise Ship.

Epidemiological investigation of the 696 COVID-19 cases aboard the Diamond Princess provided an opportunity to evaluate the role of a recirculating HVAC system that was reported to be operating with ventilation rates consistent with ASHRAE standards. Infection cases were classified into three categories:

(a) individuals interacting without restriction (i.e., passengers prior to quarantine);

(b) passengers quarantined in their cabin with no COVID-positive individuals present; and

(c) passengers quarantined in their cabins where they were directly exposed to an infected person. Infections only occurred in categories (a) and (c). Passengers quarantined in cabins free of infected individuals continued to be exposed to recirculated air from spaces with infection. The lack of cases in category (b) suggests that circulation and dilution of air through the HVAC system did not cause infection.7

Oregon Hospital.

Surfaces were tested for SARS-CoV-2 inside a recirculating HVAC system with COVID-19 patients in some **rooms**. Sites with positive samples included the prefilter receiving mixed air (return and outside) and supply air dampers after filtration. These recently reported results establish, for the first time, that the virus can be transmitted through the HVAC system. Analysis did not determine if the virus was still infectious (airborne virus inactivates over time), and air quality was not tested.9

Two Wuhan Hospitals.

Airborne SARS-CoV-2 was sampled at two Chinese hospitals and nearby outdoor locations. Investigators classified some samples by particle size and estimated surface deposition rates. Findings

included:

- Virus was detected in the air at most sites with patients present.
- Concentrations were lower in the temporary hospital, where air infiltration was greater than in the permanent hospital.
- Elevated airborne concentrations were found in a bathroom (potential fecal contribution).
- Deposition tests associated particle settling with fomite contamination.
- Airborne virus settled on surfaces beyond the immediate area surrounding the source and subsequently resuspended, contributing to airborne exposure.
- Elevated air concentrations were measured in a staff changing area with used personal protective equipment (PPE) (suggesting resuspension of settled virus).
- Concentrations were lower in the staff changing area after more rigorous sanitizing was instituted.
- Particle size distribution varied, with >1 micron (droplets) dominating at one site, <1 micron (airborne) dominating at another, and a third site equally divided between droplets and small particles.

Investigators concluded that their findings supported airborne transmission.10

Nebraska Hospital.

This study also detected SARS-CoV-2 in the air more than 2 m (7 ft) from the patient, including in the adjacent hall.11 SARS-CoV-2 was not detected in the air around infected patients in Singapore and Iranian hospitals. Insufficient information was provided to determine if negative results were due to methodological limitations.12,13 A similar virus to SARS-CoV-2 was artificially generated and measured for infectivity. Infectious virus was detected after three hours in the air and three days on surfaces.14 Another study found airborne virus infectious after 12 hours.15 Sampling studies represent occupant exposure, but not necessarily disease transmission. Most analyses cited above were by polymerase chain reaction (PCR), which measures total SARS-CoV-2 RNA, including viruses that have been inactivated and can no longer cause infection. Methods are also available that measure only infectious virus.

Research on Similar Viruses

To understand the spread of COVID-19, it is instructive to review research on similar viruses. During the severe acute respiratory syndrome (SARS) pandemic in 2003, public health agencies and some researchers concluded that respiratory infections were primarily spread by direct exposure to droplets at close range. Other investigators, however, concluded that the disease was also being spread by airborne transmission. SARS in Hong Kong Hospital. Infections spread from one patient (index case) to patients and medical students in a ward with four rooms, each a separate HVAC zone. Outside air was provided by a central system and mixed with recirculated air from a fan coil unit (FCU) n each room. Air was returned to each FCU from a hall running adjacent to the rooms. A model of air distribution and bioaerosol was developed to estimate relative concentrations of airborne virus by location. Simulated exposures generally correlated with actual cases of infection as follows:

• Twenty-one people were infected in the zone with the index case. Some of these were within 3 m (10 ft) of the index case, but others were further away.

• Eleven people were infected in the room across the hall. Because the return grilles for each zone were neareach other in the hall, air mixed between zones.

• Approximately six people were infected in the two rooms further down the hall. They return from the same hall, but airborne virus would be more dilute.16 SARS in Apartment Building. In Hong Kong, a major SARS outbreak was clustered within certain areas of an apartment building. The location of infected individuals was mapped and compared to environmental conditions. Investigators found the disease pattern consistent with airborne transmission. One suggested that sewer gas was a contributor. Others concluded infection sites occurred with typical air distribution in high-rise apartment buildings.17,18

SARS in Airliner. A study of how

respiratory infections spread on an airliner mapped the location of passengers who developed infection in relation to their distance from the index case (individual already infected). Passengers were classified as either within 2 m (7 ft) or further away. An equal number of infected passengers were seated near the index case compared to those seated further away. The same aper examined three flights with clusters of H1N1 (swine flu). Each flight showed different case patterns, one with nearby passengers dominating and the other two with similar numbers of nearby and distant cases.19

Overall, these findings suggested that the spread of SARS included airborne transmission.16

HVAC Operations Ventilation

The studies cited above establish that SARS-CoV-2 can be airborne beyond the immediate vicinity of an infected individual and that concentrations can be diluted by increasing ventilation.20 SARS (2003 pandemic) investigators suggested that increased air exchange may have reduced disease spread, but they lacked information to support a minimum ventilation rate.21,22

At least one investigator has suggested that proper ventilation could play a key role in containing the spread of COVID-19. Although window opening has been suggested as an option to reduce the risk of COVID-19 transmission, no studies related to this were available.

Air Distribution

The authors' field evaluation of wall-mounted fan coil units has identified situations where supply air blows directly on occupants, potentially transmitting virus from an infected individual to other occupants. Our examination of airflow patterns reported in the Guangzhuo restaurant outbreak study5 suggests that this could have been a contributing factor. Air blowing directly on surfaces can also resuspend settled aerosols containing virus.10 Air distribution also determines whether infectious droplets disperse or concentrate locally. Relative pressurization can also contain or spread contamination. No data were found relating airflow patterns to COVID-19 transmission.

Filtration

Newly reported surface sampling inside recirculating HVAC systems in an Oregon hospital provides an indicator of filter efficiency. The amount of virus collected on the prefilter, final filter and supply air damper allows for comparison of virus in mixed air before and after prefilters (MERV 10) and after discharge from the final filters (MERV 15). The amount of virus collected on surfaces decreased by approximately 70% after passing through the prefilters but did not decrease further after the final filters.9 A modeling study of influenza spread found that higher efficiency air filters could lower flu infection risk.24 Although COVID-19 response measures now include installation of filters with higher MERV ratings, there have been no studies to determine whether filter rating makes any difference in transmission of the disease. Experience suggests that, with appropriate design and positioning, HEPA filtration units within a space could potentially reduce SARS-CoV-2 exposure by directly capturing air in the vicinity of infected patients or by removing airborne virus near susceptible individuals. However, designers must also be aware that discharge air could also blow virus between occupants and resuspend settled virus from surfaces.

Air Disinfection

Ultraviolet (UV) light systems for infection control can either be in the space (upper-room) or HVAC system (induct). These systems are occasionally used in hospitals to help control airborne infectious agents but are rarely used in non-healthcare facilities. Upper-room UV was found in one study to prevent the spread of measles, mumps and chicken pox. However, the authors also noted that it might not be effective in the protection of susceptible individuals against other pathogens.25 No studies were found related to the use of UV to control SARS-CoV-2.

Wastewater

SARS-CoV-2 has been found in feces, urine, sewage, toilet surfaces and air in restrooms. The release of droplets containing virus from these sources is likely, but no monitoring results were found.

Mechanical Hygiene

SARS-CoV-2 on surfaces inside HVAC systems was recently documented where hospital systems recirculated air in zones with COVID-19 patients. The virus was detected on prefilters receiving mixed air, the surface of final filters receiving air after prefiltration and supply air dampers after the final filters.9 In an earlier study, the surface of an exhaust outlet in a Singapore hospital tested positive.12

Preliminary Conclusions

Further study is needed to determine whether HVAC systems actually transmit COVID-19 infection and if HVAC modifications can help control its spread. Review of available information revealed very little detail in this regard.

Airborne Transmission. Limited sampling has established that SARS-CoV-2 is airborne and can expose (but not necessarily infect) occupants well beyond 2 m (7 ft). Recent findings further establish that the virus can circulate through some HVAC systems. While several outbreaks of COVID-19 infection have suggested airborne transmission, these have generally been in areas with poor ventilation, raising the possibility that dilution by code-required building ventilation inhibits disease transmission.

Ventilation. Increasing outdoor air dilutes the concentration of airborne SARS-CoV-2. Minimum acceptable ventilation rates have not been established for operation of buildings where infected occupants may be present. It is not known whether increasing ventilation rates above ASHRAE minimums actually reduces disease transmission. Natural ventilation has not been evaluated with respect to COVID-19.

Air Distribution. Studies suggest that how air is discharged and circulates within a space could be an important factor determining whether exposure is sufficient to cause disease. For example, wall-mounted FCUs can discharge air into the breathing zone, potentially directing virus to other occupants. Relative pressurization can also contain or spread contamination. No field data were available showing the impact of air distribution on COVID-19 exposure.

Filtration. Recently reported results of surface sampling inside recirculating HVAC systems provide an indicator of filter efficiency. Data suggest that a MERV 10 prefilter reduced the amount of deposited SARS-CoV-2 by approximately 70% and that a MERV 15 final filter may not have removed additional virus. Insufficient field data are available to guide filter selection for COVID-19. Filtration within the space (i.e., portable HEPA units) could reduce virus exposure in localized areas with appropriate design and placement.

Sewage. SARS-CoV-2 has been found in feces and urine, making sewer gas and sewage a potential source of exposure. Studies are needed to develop effective strategies to avoid infecting occupants.

Mechanical Hygiene. SARS-CoV-2 has been detected on surfaces inside recirculating HVAC systems. It is not known if this can contaminate the airstream.

Recommendations for Expedited Research Research is urgently needed to identify and implement cost-effective measures to operate buildings during the pandemic. While basic research can take years, valuable data could be compiled much faster using available epidemiology and by testing buildings.

Environmental Epidemiology. Studies can suggest the relative role played by the various routes of disease transmission and evaluate the efficacy of control measures. To accomplish this, engineers and health scientists collaborate to compile exposure factors (i.e., ventilation, airflow patterns, filtration, occupant density and spacing) to determine their relationship ith case location and timing. If outbreak investigations, contact tracing and evaluation of widespread testing could include the collection of environmental information, findings would help support the selection of HVAC response measures. Critical questions hat could be addressed by epidemiological studies include:

• What do infection patterns suggest with respect to the significance of airborne and fecal transmission as the cause of infection?

• How do ventilation, air distribution and humidity affect infection rates?

• How effective are various filtration and air disinfection measures in reducing exposure?

Field Studies. Valuable information can be produced by sampling for contaminants in occupied buildings for airborne and surface SARS-CoV-2 (both total RNA copies and infectious virus). Comparison of data collected in buildings with varying systems, uses and infection rates would provide valuable information to guide response efforts. Field measurements of particular value nclude:

• Concentrations of SARS-CoV-2 in air with recirculating HVAC systems in spaces with and without infected individuals;

• Both air and surface SARS-CoV-2 in ducts and air units recirculating air from spaces with infected individuals;

• SARS-CoV-2 concentrations over time after removal of infected occupants;

• SARS-CoV-2 in air over time in relation to opening windows;

• SARS-CoV-2 concentration in air associated with different ventilation rates and filter efficiencies;

• Pilot testing of space conditioning measures, such as portable HEPA filtration and UV light; and SARS-CoV-2 exposure associated with sewage and sewer gas.

(See related story: Construction's COVID-19 record might be worse than you think.)

Here, Construction Dive rounds up some of the larger COVID-19 outbreaks at construction sites across the U.S. and Canada since the pandemic began.

Construction Site Covid Outbreaks

April

Donnelly College, Kansas City, Kansas

At least two clusters of COVID-19 cases involving seven workers were reported at the Donnelly College construction site, which was shut down for disinfecting after each outbreak. Jerry Katlin, the president of Overland Park, Kansas-based general contractor Excel Corp., told KSHB News that the cases came from five different subcontractors for the project.

May

Charlotte, North Carolina, apartment tower

Thirty-eight workers on a Charlotte, North Carolina, apartment tower construction site tested positive and the project was shut down temporarily, the Charlotte Observer reported.

During the closure, general contractor Hoar Construction conducted a deep cleaning and sterilization of the site and worked with a third-party company to beef up screening of workers.

Denver International Airport

An outbreak at a Denver International Airport jobsite affecting 14 employees from an insulation company involved work at the A-West Gate Expansion project.

The site was closed for several days to clean and disinfect, and when employees returned to the site, they participated in an educational orientation program to ensure every employee has the latest information about preventing the spread of COVID-19, an airport spokesperson told the Denverite.

Maine Veterans' Home

Health officials confirmed 26 cases at the Maine Veterans' Home replacement project under construction by Cianbro and VJS Construction Services, raising concerns about the risks of employing out-of-state workers, according to MaineBiz.

Some of the subcontractors on the Augusta project were from New Hampshire and other states that had higher levels of COVID-19 cases than Maine, Maine CDC Director Nirav Shah told the newspaper. He said the workers may be socializing or rooming together, and that could be the source of transmission.

Bryant-Denny Stadium

An unknown number of workers tested positive at the $106 million renovation of the University of Alabama's football stadium in Tuscaloosa.

General contractor Caddell Construction Co. told the Tuscaloosa News that both its employees and those of subcontractors tested positive, so it shut down construction for a weekend to sanitize the site and perform additional testing so that the rest of the project's workers could be cleared before returning to work.

Allegiant Stadium

The Las Vegas Review-Journal reported that up to 31 construction workers building the $2 billion NFL stadium in Las Vegas tested positive.

The joint venture of Mortenson and McCarthy, which said that at least part of the outbreak was localized to electricians working on site, conducted targeted, voluntary on-site workforce testing and sanitized the site.

Nashville private school

More than 70 cases were found among workers and subcontractors at a Nashville private school construction site, according to New Channel 5.

General contractor Brasfield & Gorrie closed the site at the Montgomery Bell Academy for five days for cleaning and testing of workers.

University of North Carolina Greensboro

Work on a UNC Greensboro campus building project was stopped for disinfection after construction workers tested positive.

The university told the Greensboro News & Record that the affected workers were employed by a subcontracting company assigned to do work inside the Nursing and Instructional Building. UNCG said interior work on the project was stopped for one day so the building could be sanitized.

June

Appalachian State University

At least 36 subcontractors working at the site of a $200 million Appalachian State University project in Boone, North Carolina, tested positive in two COVID-19 outbreaks, WBTV reported.

Santa Clara County, California sites

Health officials identified cases of COVID-19 among construction workers at 13 projects in Santa Clara County, California. At least 10 construction workers at a Mountain View development site tested positive with as many as 30 total workers exposed, according to the Mercury News. The project site was voluntarily shut down.

Between three and five workers at two other projects in San Jose and one in Milpitas also tested positive and another nine projects reported at least one confirmed case, health officials said.

The developers associated with the four major projects include Davis Reed Construction on the Mountain View site, Dickinson Cabinetry and CB Group Inc. on the San Jose sites, and Citizen Corp. on the Milpitas project, according to the Mercury News.

Mercedes-Benz Superdome

The Mercedes-Benz Superdome in New Orleans, Louisiana, home to the NFL's New Orleans Saints, is undergoing a four-year, $450 million facelift.

This summer, according to CBS Sports, general contractor Broadmoor LLC sent 32 of the projects' 275 daily workers home after they tested positive.

SoFi Stadium

The $5 billion SoFi Stadium in Inglewood, California, home to the Los Angeles Rams and the Los Angeles Chargers, opened earlier this year.

This summer, a continuous stream of positive coronavirus tests among the project's 3,000 daily workers sent 18 workers home by the second week of June, prompting a Los Angeles County Department of Public Health investigation, according to the Los Angeles Times.

While project officials continued to provide safety gear and to enforce social distancing and other guidelines, construction, led by the joint venture of AECOM and Turner Construction, was not stopped.

Texas A&M University

A construction site on the Texas A&M University campus was shut down after an outbreak that affected 55 workers and subcontractors, according to general contractor Hoar Construction.

The site was closed for four days for disinfection, according to The Eagle.

July

Multiple Colorado sites

Colorado public health officials told the Colorado Sun that it identified multiple outbreaks on construction sites in the state, including 26 workers at a school in Kit Carson and 13 building student housing for Colorado State University in Fort Collins and 15 workers sickened on a hospital project in Rifle.

In the Denver area, a landscaping company had 14 workers infected with COVID-19 and two deaths — and an insulation company had 15 workers with the virus.

Salt Lake City International Airport

Seventy-five construction workers tested positive at the $4.1 billion Salt Lake City International Airport site, meaning that up to 5%of workers were sidelined at a given time, according to the Salt Lake Tribune.

Montage Big Sky

Suffolk Construction confirmed that 116 workers on its luxury resort project in Big Sky, Montana, tested positive.

The outbreak at the $400 million Montage Big Sky in the Spanish Peaks Mountain Club was among the largest in Montana. Suffolk hired a private lab to conduct voluntary testing of workers at the site, the Bozeman Daily Chronicle reported.

August

Shell Chemicals plant

As of August, 35 workers at the $6 billion Shell Chemicals complex construction site in Beaver County, Pennsylvania, had tested positive for the virus, according to the Times.

In late June, company officials paused the workforce expansion amid rising virus cases in the region and implemented an on-site testing lab in mid-July.

October

Portland, Oregon, construction meeting

A preconstruction meeting for a healthcare project held indoors by Andersen Construction led to an outbreak among 13 employees and three close contacts.

Astoria, Oregon, school

The Oregon Health Authority confirmed the outbreak of six cases connected with a Skanska USA construction site at Astoria Middle School. A school official told the Daily Astorian that the affected workers were outside and did not enter the building at any time.

November

Shell Chemicals plant

Shell Pennsylvania Chemicals had another rise in cases among the construction workers building the petrochemical plant in Beaver County, Pennsylvania, according to the Pittsburgh Business Times.

There were 39 active cases among the workforce as of Nov. 12, according to a statement from Shell. This is more than half of the 71 cases that have been identified in the workforce since the pandemic began.

Larimer County, Colorado sites

Five construction companies reported 12 new cases in Larimer County, Colorado. Overall, 10 construction companies have reported a combined 66 cases in total in the county, according to the Coloradoan.

Royal Inland Hospital

Canadian health authorities confirmed seven cases linked to an outbreak among workers building a patient care tower at the Royal Inland Hospital in British Columbia. While the local health agency is working with general contractor EllisDon to try to minimize the risk of additional exposures, no work stoppage has been ordered, according to local media outlet KTW.

Canada LNG plant

Forty-one employees at the LNG Canada project in Kitimat, British Columbia, have tested positive for COVID-19, according to local health officials.

All of the cases are considered to be associated with an outbreak announced on Nov. 19, and all occurred in the same general work location, Victoria News reported. LNG Canada and general contractor JGC Fluor said they are working closely with officials to carry out contact tracing protocols.

Editor's note: This article was updated to clarify outbreak information reported by the Oregon Health Authority at a jobsite at Astoria Middle School. The OHA indicated there were six confirmed cases related to the jobsite, not six workers.

OUTBREAK REPORTING

The table below provides the number of outbreaks that local health departments report to the Michigan Department of Health and Human Services every week.

COVID-19 outbreaks are generally defined as two or more cases with a link by place and time indicating a shared exposure outside of a household.

Local health departments report the number of new and ongoing outbreaks they are investigating by the setting of the outbreak. New outbreaks are those outbreaks that were first identified during the current reporting week. Ongoing outbreaks are those that had already been identified in previous weeks but have had at least one new associated case reported to the local health department in the last 2 weeks. New and ongoing outbreaks are counted only once (i.e., a new outbreak is not also counted in the ongoing outbreak category).

Many factors, including the lack of ability to conduct effective contact tracing in certain settings, may result in significant underreporting of outbreaks. This chart does not provide a complete picture of outbreaks in Michigan and the absence of identified outbreaks in a particular setting in no way provides evidence that, in fact, that setting is not having outbreaks.

This page will be updated on Mondays by 3 p.m.

https://www.michigan.gov/coronavirus/0,9753,7-406-98163_98173_102057---,00.html

Date: December 3, 2020 (Posted 12/07/2020)

New clusters/outbreaks by setting	Region 1	Region 2N	Region 2S	Region 3	Region 5	Region 6	Region 7
Long-Term Care Facility (e.g. skilled nursing facility, assisted living, adult day care, group home, etc.)	11	18	2	16	8	10	8
Agricultural/ food processing/migrant camp (e.g. farm, meat packing, hatchery, etc.)	0	0	1	0	1	2	0
Bar - Employee Associated	1	0	0	0	0	1	1
Bar - Employee and Patron Associated	0	0	0	0	0	0	0

New clusters/outbreaks by setting				Region 1	Region 2N	Region 2S	Region 3	Region 5	Region 6	Region 7
Restaurant - Employee Associated	0	0	0	2	0	3	2	1	**8**	
Restaurant - Employee and Patron Associated	0	0	0	0	0	0	0	1	**1**	
K-12 School (e.g. classroom, before/after school programs, etc.)	7	3	3	6	4	8	3	0	**34**	
College/University/Institute of Higher Learning	0	0	0	0	0	0	0	0	**0**	
Childcare/Youth programs (e.g. daycares, day/overnight camps, extracurricular activities, sports programs, etc.)	1	8	1	2	0	1	0	0	**13**	
Manufacturing, Construction	3	7	0	0	5	22	3	0	**40**	
Office Setting	2	8	2	1	1	6	3	1	**24**	
Retail - Employee Associated	1	3	0	0	0	3	3	0	**10**	
Retail - Employee and Patron Associated	0	0	0	0	0	1	0	0	**1**	
Personal Services (e.g. nail/hair salon, spa, gym)	1	0	0	0	0	1	1	0	**3**	
Jail/prison/detention center	0	0	0	1	0	0	0	0	**1**	
Healthcare (e.g. inpatient, outpatient, dental practices, dialysis, etc.)	2	1	1	1	1	3	2	1	**12**	
Shelters/settings that provide services for people experiencing homelessness	0	0	0	0	0	0	0	0	**0**	
Religious Services	0	0	0	0	1	1	0	0	**2**	

New clusters/outbreaks by setting				Region 1	Region 2N	Region 2S	Region 3	Region 5	Region 6	Region 7
Community Exposure - Indoor (e.g. concert, meeting, etc.)	1	0	2	0	0	0	0	0	**3**	
Outdoor Community Exposure/Mass Gathering (e.g. concert, rally, protest, parade, etc.)	0	0	0	0	0	0	0	0	**0**	
Social Gathering (e.g. birthday party, graduation party, wedding, funeral, etc.)	2	0	0	1	0	0	3	0	**6**	
Other (#)	1	2	1	2	0	3	0	2	**11**	
TOTALS	**33**	**50**	**13**	**32**	**21**	**65**	**29**	**10**	**253**	

Percentage of local health departments reporting: 100%

Ongoing clusters/outbreaks by setting				Region 1	Region 2N	Region 2S	Region 3	Region 5	Region 6	R
Long-Term Care Facility (e.g. skilled nursing facility, assisted living, adult day care, group home, etc.)	43	74	42	69	36	62	20	22	**368**	
Agricultural/ food processing/migrant camp (e.g. farm, meat packing, hatchery, etc.)	3	0	1	0	0	9	1	0	**14**	
Bar - Employee Associated	3	0	0	7	0	1	0	0	**11**	
Bar - Employee and Patron Associated	0	0	0	0	0	0	0	0	**0**	
Restaurant - Employee Associated	10	11	1	2	0	4	2	1	**31**	

Ongoing clusters/outbreaks by setting										
	Region 1		**Region 2N**		**Region 2S**		**Region 3**		**Region 5**	**Region 6**	**R**
Restaurant - Employee and Patron Associated	0	0	0	0	0	0	0	0	0	**0**	
K-12 School (e.g. classroom, before/after school programs, etc.)	19	29	16	34	9	40	20	28		**195**	
College/University/Institute of Higher Learning	10	3	4	5	2	7	0	6		**37**	
Childcare/Youth programs (e.g. daycares, day/overnight camps, extracurricular activities, sports programs, etc.)	3	8	0	4	1	2	1	3		**22**	
Manufacturing, Construction	12	17	12	9	8	39	8	7		**112**	
Office Setting	4	21	6	12	0	7	1	0		**51**	
Retail - Employee Associated	4	3	4	7	0	3	7	0		**28**	
Retail - Employee and Patron Associated	0	0	0	1	0	0	0	0		**1**	
Personal Services (e.g. nail/hair salon, spa, gym)	1	0	3	2	0	0	1	0		**7**	
Jail/prison/detention center	5	0	1	6	2	2	1	11		**28**	
Healthcare (e.g. inpatient, outpatient, dental practices, dialysis, etc.)	5	22	9	10	0	5	13	3		**67**	

Ongoing clusters/outbreaks by setting	Region 1	Region 2N	Region 2S	Region 3	Region 5	Region 6	R
Shelters/settings that provide services for people experiencing homelessness	2	1	0	2	0	0	0	1	**6**
Religious Services	1	2	2	2	0	2	1	0	**10**
Community Exposure - Indoor (e.g. concert, meeting, etc.)	0	0	0	0	0	0	1	0	**1**
Outdoor Community Exposure/Mass Gathering (e.g. concert, rally, protest, parade, etc.)	0	0	0	0	0	0	0	0	**0**
Social Gathering (e.g. birthday party, graduation party, wedding, funeral, etc.)	1	1	1	4	0	2	
Other (#)	1	14	4	3	1	0	
TOTALS	**127**	**206**	**106**	**179**	**59**	**185**	

Percentage of local health departments reporting: 100%

Region1 – Clinton, Eaton, Gratiot, Hillsdale, Ingham, Jackson, Lenawee, Livingston and Shiawassee counties.
Region 2S – City of Detroit and Monroe, Washtenaw and Wayne counties.
Region 2N - Macomb, Oakland and St. Clair counties.
Region 3 - Saginaw, Alcona, Iosco, Ogemaw, Arenac, Gladwin, Midland, Bay, Genesee, Tuscola, Lapeer, Sanilac and Huron counties.

Region 5 - Allegan, Barry, Calhoun, Branch, St. Joseph, Cass, Berrien, Van Buren and Kalamazoo counties.
Region 6 - Clare, Ionia, Isabella, Kent, Lake, Mason, Mecosta, Montcalm, Muskegon, Newaygo, Oceana, Osceola and Ottawa counties.
Region 7 - Manistee, Wexford, Missaukee, Roscommon, Benzie, Leelanau, Grand Traverse, Kalkaska, Crawford, Oscoda, Antrim, Otsego, Montmorency, Alpena, Presque Ilse, Cheboygan, Emmet and Charlevoix counties.
Region 8 - Chippewa, Mackinac, Luce, Schoolcraft, Delta, Alger, Marquette, Dickinson, Menominee, Baraga, Iron, Gogebic, Ontonagon, Houghton and Keweenaw counties.

Date: December 3, 2020 (Posted 12/07/2020)

New clusters/outbreaks by setting	Region 1	Region 2N	Region 2S	Region 3	Region 5	Region 6	Region 7	Region 8	TOTALS
Long-Term Care Facility (e.g. skilled nursing facility, assisted living, adult day care, group home, etc.)	11	18	2	16	8	10	8	4	**77**
Agricultural/ food processing/migrant camp (e.g. farm, meat packing, hatchery, etc.)	0	0	1	0	1	2	0	0	**4**
Bar - Employee Associated	1	0	0	0	0	1	1	0	**3**
Bar - Employee and Patron Associated	0	0	0	0	0	0	0	0	**0**
Restaurant - Employee Associated	0	0	0	2	0	3	2	1	**8**
Restaurant - Employee and Patron Associated	0	0	0	0	0	0	0	1	**1**
K-12 School (e.g. classroom, before/after school programs, etc.)	7	3	3	6	4	8	3	0	**34**
College/University/Institute of Higher Learning	0	0	0	0	0	0	0	0	**0**
Childcare/Youth programs (e.g. daycares, day/overnight camps, extracurricular activities, sports programs, etc.)	1	8	1	2	0	1	0	0	**13**
Manufacturing, Construction	3	7	0	0	5	22	3	0	**40**
Office Setting	2	8	2	1	1	6	3	1	**24**
Retail - Employee Associated	1	3	0	0	0	3	3	0	**10**
Retail - Employee and Patron Associated	0	0	0	0	0	1	0	0	**1**
Personal Services (e.g. nail/hair salon, spa, gym)	1	0	0	0	0	1	1	0	**3**
Jail/prison/detention center	0	0	0	1	0	0	0	0	**1**
Healthcare (e.g. inpatient, outpatient, dental practices, dialysis, etc.)	2	1	1	1	1	3	2	1	**12**
Shelters/settings that provide services for people experiencing homelessness	0	0	0	0	0	0	0	0	**0**
Religious Services	0	0	0	0	1	1	0	0	**2**
Community Exposure - Indoor (e.g. concert, meeting, etc.)	1	0	2	0	0	0	0	0	**3**
Outdoor Community Exposure/Mass Gathering (e.g. concert, rally, protest, parade, etc.)	0	0	0	0	0	0	0	0	**0**
Social Gathering (e.g. birthday party, graduation party, wedding, funeral, etc.)	2	0	0	1	0	0	3	0	**6**
Other (#)	1	2	1	2	0	3	0	2	**11**
TOTALS	**33**	**50**	**13**	**32**	**21**	**65**	**29**	**10**	**253**

Percentage of local health departments reporting: 100%

Ongoing clusters/outbreaks by setting	Region 1	Region 2N	Region 2S	Region 3	Region 5	Region 6	Region 7	Region 8	TOTALS
Long-Term Care Facility (e.g. skilled nursing facility, assisted living, adult day care, group home, etc.)	43	74	42	69	36	62	20	22	**368**
Agricultural/ food processing/migrant camp (e.g. farm, meat packing, hatchery, etc.)	3	0	1	0	0	9	1	0	**14**
Bar - Employee Associated	3	0	0	7	0	1	0	0	**11**
Bar - Employee and Patron Associated	0	0	0	0	0	0	0	0	**0**
Restaurant - Employee Associated	10	11	1	2	0	4	2	1	**31**
Restaurant - Employee and Patron Associated	0	0	0	0	0	0	0	0	**0**
K-12 School (e.g. classroom, before/after school programs, etc.)	19	29	16	34	9	40	20	28	**195**
College/University/Institute of Higher Learning	10	3	4	5	2	7	0	6	**37**
Childcare/Youth programs (e.g. daycares, day/overnight camps, extracurricular activities, sports programs, etc.)	3	8	0	4	1	2	1	3	**22**
Manufacturing, Construction	12	17	12	9	8	39	8	7	**112**
Office Setting	4	21	6	12	0	7	1	0	**51**
Retail - Employee Associated	4	3	4	7	0	3	7	0	**28**
Retail - Employee and Patron Associated	0	0	0	1	0	0	0	0	**1**
Personal Services (e.g. nail/hair salon, spa, gym)	1	0	3	2	0	0	1	0	**7**
Jail/prison/detention center	5	0	1	6	2	2	1	11	**28**
Healthcare (e.g. inpatient, outpatient, dental practices, dialysis, etc.)	5	22	9	10	0	5	13	3	**67**
Shelters/settings that provide services for people experiencing homelessness	2	1	0	2	0	0	0	1	**6**
Religious Services	1	2	2	2	0	2	1	0	**10**
Community Exposure - Indoor (e.g. concert, meeting, etc.)	0	0	0	0	0	0	1	0	**1**
Outdoor Community Exposure/Mass Gathering (e.g. concert, rally, protest, parade, etc.)	0	0	0	0	0	0	0	0	**0**
Social Gathering (e.g. birthday party, graduation party, wedding, funeral, etc.)	1	1	1	4	0	2	9	0	**18**
Other (#)	1	14	4	3	1	0	4	3	**30**
TOTALS	**127**	**206**	**106**	**179**	**59**	**185**	**90**	**85**	**1037**

Percentage of local health departments reporting: 100%

There are 800 Covid Legal Cases in US.

Do not become #801

Wear A Mask & Stay Alive

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