

# Can HVAC Systems Spread the Coronavirus / COVID-19?



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**W**e rely on heating, ventilation, and air conditioning (HVAC) systems for clean, safe air. Frighteningly though, you may have heard how they can spread the coronavirus / COVID-19.

Can HVAC systems spread viruses and other pathogens? In a word, yes.

Now before you terrify your friends by sharing that tidbit on social media, read on. There's much more to it.

For the full picture, this article gives an overview of what prompted concerns about HVAC systems spreading the virus—and why reducing that spread still matters. More importantly, we review how it spreads—including through your facility's central air. But the best part? Properly configured heating, ventilation, and air conditioning (HVAC) systems can neutralize the virus and help stop it from spreading.

***Skip ahead to any chapter if you know what you're looking for***

This article gives an overview of how the coronavirus / COVID-19 spreads, particularly as it affects your building, facility, or space's HVAC system.



**Chapter 1. The Report That Shook the HVAC Industry**



**Chapter 2. Basics You Should Know About the Virus**



**Chapter 3. How Exactly Does the Virus Spread?**



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## Chapter 1: The CDC Coronavirus Report That Shook the HVAC Industry

Early in the pandemic, this case prompted concern about heating, ventilation, and air conditioning (HVAC) systems spreading the coronavirus / COVID-19.

A CDC early report [1] mentioned how the coronavirus / COVID-19 spread among diners at adjacent tables in a busy restaurant in Guangzhou, China in late January. Reports shared this single source widely, while missing some pretty important points.

Let's start with what happened.

A family traveled from Wuhan, eating lunch at a restaurant in Guangzhou. One family member started feeling symptoms later that day and within two weeks, nine others from that restaurant had become ill. Four of these were at the table with the "index patient," the first to fall ill. More uncomfortably, there were also five more people infected at two adjacent tables. The going theory was that the restaurant's air conditioning system had re-circulated virus particles from dried up droplets.

### **The case and initial report were widely spread—without all the report's details.**

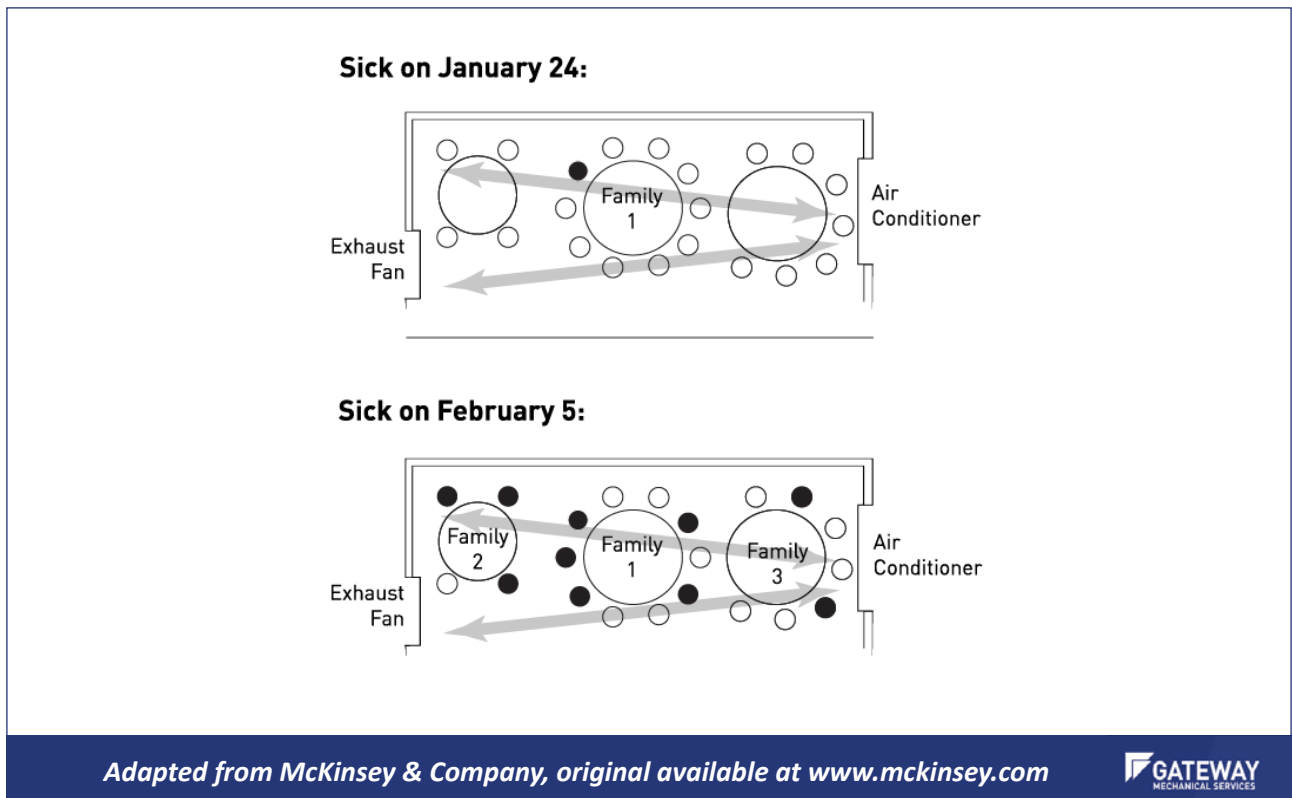
These points are consistently under-reported when discussing this April CDC case study about the restaurant:

1. No virus particles were present [3] in the air conditioning unit and duct work.
2. The CDC report never suggested turning off air circulation units to reduce risks. It also cites improper social distancing measures and uneven air distribution as possible culprits (air velocities over 40 cfm). [4]
3. There were strong air flows, pointing to uneven air distribution [5]. FYI this is something a well-designed, operated, and maintained HVAC system ideally won't do, anyways.
4. When the researchers published the article, airborne spread wasn't yet widely accepted. The authors themselves also acknowledge their study's limits, explicitly focusing on strong crosscurrents spreading droplets, not airborne spread. Aerosol transmission was also initially ignored because the staff, other diners, and air conditioner all tested negative.

Make no mistake, we're not faulting the report. And heck, we're actually grateful to the people who helped bring HVAC into the conversation about slowing the coronavirus / COVID-19 from spreading.

The big takeaway here: there's more to the story about how the virus spreads.

Before you shut off your HVAC system in a panic—know that it can be part of the solution.



There's new information arriving daily, yet some take-aways stay relevant. The next section covers a few of these basics before we dive too deeply into how the virus spreads.

## Chapter 2: The Basics: What You Should Know About the Virus

This section addresses a few basics—including why the coronavirus / COVID-19 is still so serious today.

The coronavirus / COVID-19 pandemic changed how we think about buying groceries, to how we work, to our thoughts on personal space. There's so much that's new that the word 'unprecedented' just falls painfully short. While we collectively struggle through lockdown fatigue, we've surely all met someone who only sees protective measures as an annoyance limiting their freedom.

### **First, what we're calling it here.**

The World Health Organization's naming convention [6] describes the Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2), and the resulting disease it causes (COVID-19). Here, we'll mostly use the term coronavirus / COVID-19. (We may also say novel coronavirus, if we're also discussing the 2003 SARS-CoV-1 outbreak).

### **Second, it affects all of us.**

Severe outcomes disproportionately affect some demographics, but everyone's at risk. Between 25 – 80% of people aren't aware they have the virus [7], so it's easy to spread. Even if you're not in a high-risk group, you can still get sick and expose a loved one (or someone else's) to severe infection.

### **Third, it's really contagious.**

Rate of infection ( $R_0$ ) refers to how many people a sick person can infect. According to the American Council on Science and Health, the novel coronavirus is more infectious than seasonal flus, but not as infectious as the measles [8]. (Someone with seasonal flu spreads to an average of 1.3 people, coronavirus / COVID-19 to an average 2.5 people, measles to an average 12 – 18 people).

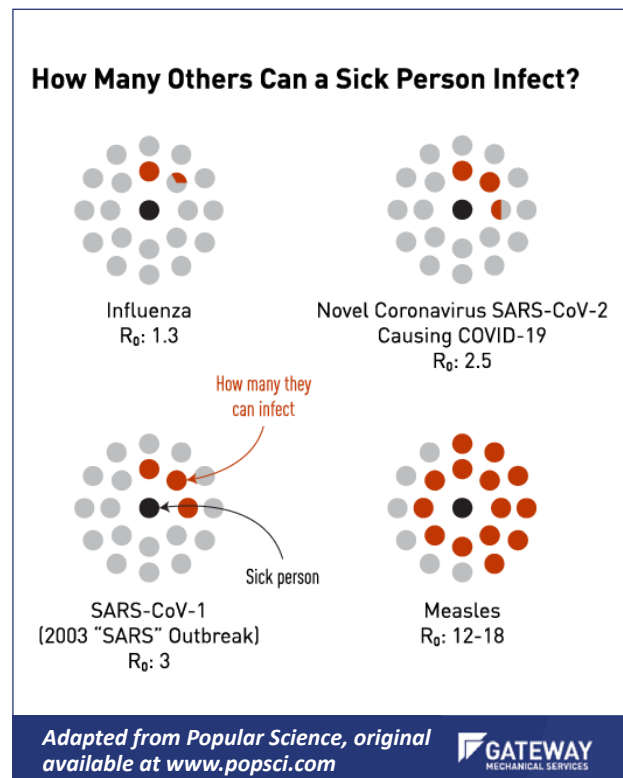


Image source: [10]

Compared to the coronavirus SARS-CoV ("SARS") epidemic in 2003, and the flu pandemics of 1918 ("Spanish flu") and 2009 (H1N1), the novel coronavirus is harder to contain [9]. That's because people with the coronavirus / COVID-19 (a) are more likely to be asymptomatic carriers, and (b) tend to infect more people.

### **Fourth, it's spreading—and while some grow complacent, it's far from over.**

Many places are experiencing a second and third wave [11], before the first has finished. Looking at the World Health Organization's numbers [12] half a year into the pandemic, there are almost 110 million confirmed infections—that's almost 3 times the population of Canada. Almost 2.5 million people have died from COVID-19—imagine massive cities like Caracas, Dubai, Houston, Manchester, or Vancouver dropping off the map in mere months.

Ok, so if reducing transmission risks are still important today, what we can do about it?

Well, if the virus spreads many ways, we'll need a multi-layered approach. To get started, the next section's a primer on how it spreads.

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### Chapter 3: I Keep Hearing Different Things... How Exactly Does the Coronavirus / COVID-19 Spread?

Before you start putting HVAC strategies in place to make your air safer, it helps to know more about how the coronavirus / COVID-19 spreads in the first place. Here's that primer we promised you.

Research linking the spread of the coronavirus / COVID-19 to heating, ventilation, and air conditioning (HVAC) systems often centers on whether it's airborne.

There's a lot we're still learning about this new virus. Here's what many reputable sources seem to agree on though: the coronavirus / COVID-19 can be spread through droplets, surface transfer, and through small particles that hang in the air like an aerosol.

#### Droplets

The World Health Organization currently says we're most likely to be infected by direct contact with respiratory droplets [13].

The virus lives in the mucus membranes of the nose and mouth. When an infected person coughs, talks, and exhales, droplets spread into the air. These comparatively large droplets are typically too heavy to hang in the air but pose a threat to whomever they land on. When these droplets contact the eyes, nose or mouth of another person, they may also contract the virus. That's why authorities ask people to wear masks, and

practice social distancing and good respiratory etiquette [14] (coughing / sneezing into an elbow / tissue, and immediately washing hands). Health Canada currently advises a minimum of 2 meters [15] (6 feet) for social distancing.

#### Contaminated Surfaces

Droplets sprayed out land on surfaces around the infected person. The fancy word for this is fomites [16], inanimate surfaces that may carry pathogens. The next person to touch the fomite may pick up the live virus, which clings to their hands, and transfers to the new host when they touch their face. That's why there's so much emphasis on thorough hand-washing and surface disinfection.

Researchers are investigating how long the coronavirus can survive on various surfaces [17]. The New England Journal of Medicine found under lab conditions, the virus is "viable up to 72 hours on plastics, 48 hours on stainless steel, 24 hours on cardboard, and 4 hours on copper." Researchers found that 72 hours after contamination, the amount of viral material detected on these surfaces is less than 0.1% of the original amount [18].

The likelihood of infection from contaminated surfaces declines over time, and we're now learning there's less evidence for this mode than originally thought [19]. That said, contaminated surfaces are still possible disease-carriers with simple prevention methods. That's why authorities ask people to wash hands, sanitize surfaces, and not touch their faces in public [20].

*Yep, still important – the coronavirus still spreads through droplets.*



**Masks**  
Say it, don't spray it.  
(It protects you, too).

**Distancing**  
Stay 2 meters  
(6 feet) apart

**Proper Etiquette**  
Cough into elbow or  
tissue & wash hands

**GATEWAY**  
MECHANICAL SERVICES

*Yep, still important – the coronavirus still spreads through dirty surfaces.*



**Wash your hands**  
Do it properly,  
and do it often.

**Sanitize surfaces**  
Clean with soap and  
water, then disinfect.

**Don't touch your face**  
Keep what's on your  
hands off your face.

**GATEWAY**  
MECHANICAL SERVICES

## Chapter 4: Is the Coronavirus / COVID-19 Airborne?

Yes, by now most parties agree that the coronavirus / COVID-19 is airborne.

When it comes to circulating air, the concern is that small virus particles are light enough to be recirculated through the system as well. As a result, airborne viruses directly affect heating, ventilation, and air conditioning systems (HVAC).

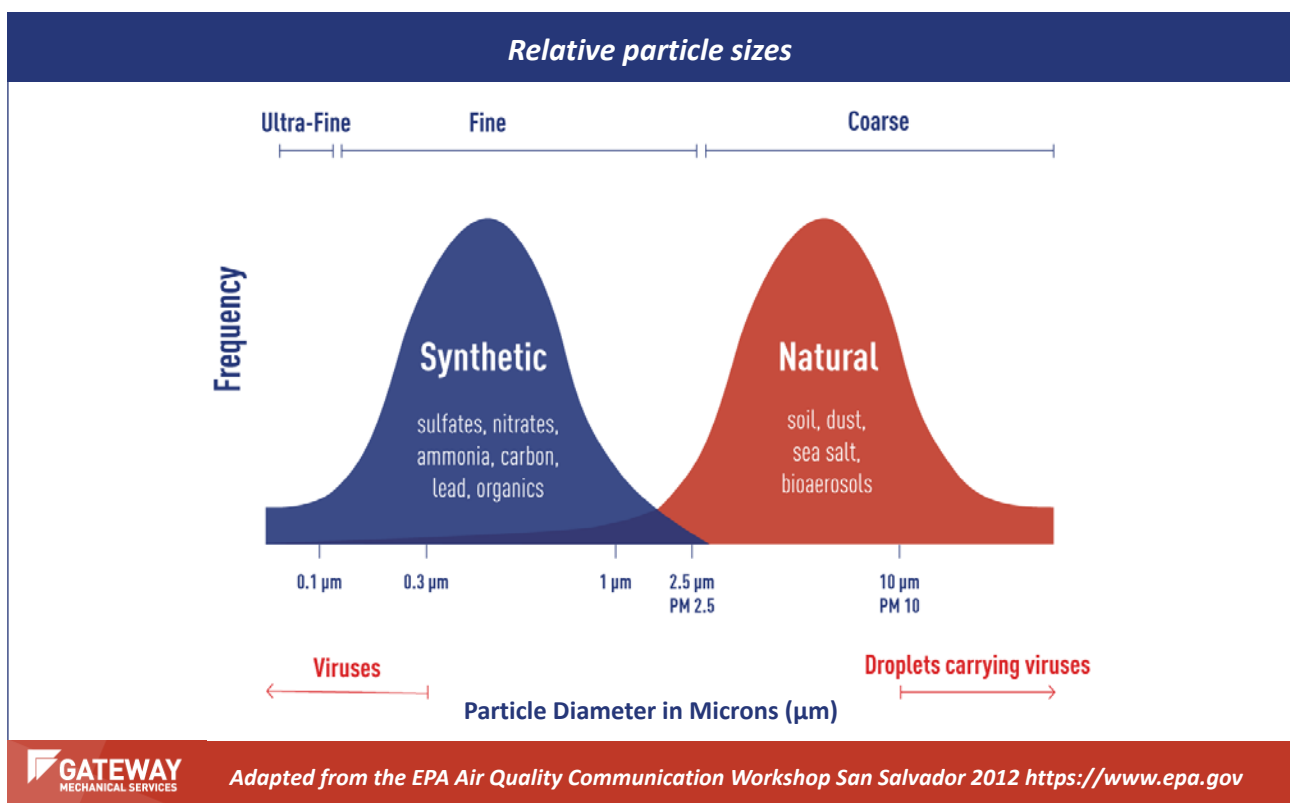
Following pressure from 239 scientists [21], the World Health Organization recently acknowledged aerosol transmission as a possible means of infection. The line between droplet and aerosol comes down to the size of particle carrying the virus. Particles as small as viruses are measured by their diameter in microns (AKA, micrometers,  $\mu\text{m}$ , or a millionth of a meter). As a reference point, the droplets are bigger than 60 microns and aerosol particles are smaller than 10 microns.

Though the WHO only cautiously declared this recently, researchers have been looking at airborne spread since the pandemic began ramping up. For example, earlier evidence from reputable sources agreed aerosol transmission is a significant vector [22] in spreading the coronavirus / COVID-19, and that the coronavirus / COVID-19 remains detectable in the air for three hours [23].

The novel coronavirus / COVID-19 is airborne—which means it’s relevant to your heating, ventilation, and air conditioning (HVAC) system.

### What Else Do I Need to Know, Given the coronavirus / COVID-19 is Airborne?

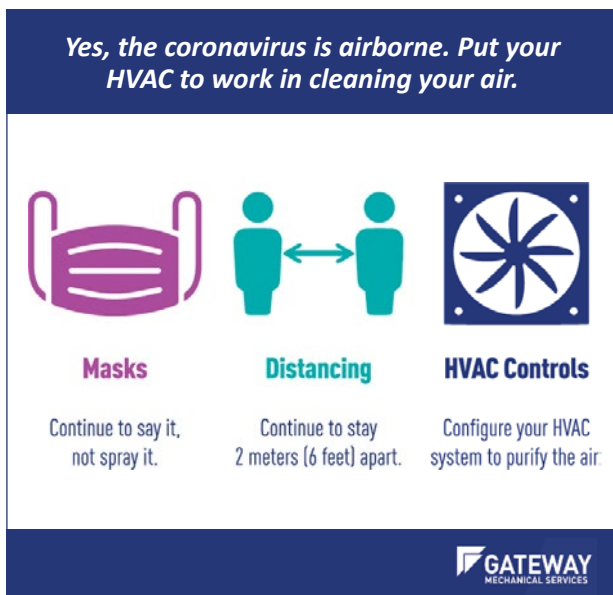
- If there’s one thing to learn from this article, it’s that you can put your heating, ventilation, and air conditioning (HVAC) system to work in neutralizing the coronavirus and helping to stop its spread [24].
- Airborne transmission may only infect others at short range (where it’s hard to tell how a person was infected) [25]. Yep, we mean “say it, don’t spray it,” that’s why authorities ask people to wear masks.
- Putting your HVAC to work in improving ventilation and disinfecting your air doesn’t replace low-tech measures that need to continue. (For example, self-isolation, social distancing, wearing a mask, hand-washing, not touching your face, staying guarded against misinformation, disinfecting very contaminated areas like bathrooms and doorknobs, etc.). Those measures are still important—clean air won’t do you much good if someone sick coughs in your face. Gross.
- It’s airborne, but researchers are still looking into how infectious it is in when airborne. Why? Some infections with multiple transmission modes behave differently in different circumstances. Research



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suggests the flu may work this way. For example, that influenza's airborne transmission may be less infectious than other modes, but lead to a more severe form of the illness [26]. The fancy word for that is anisotropic. And you're likely already familiar with the idea—like how a block of wood's easier to break *with* the grain, rather than *against* it. Basically, it just means behaving differently under different circumstances.

- We always recommend making the World Health Organization [27], Health Canada [28], and the Centers for Disease Control and Prevention [29] your primary sources for up-to-date health information on the coronavirus / COVID-19.



### Need a pep-talk?

We get it. Given how many ways the coronavirus / COVID-19 can spread, it can feel overwhelming at times. And there are many moving parts—but remember every bit we each do counts in making our facilities safer. In the words of Anita Roddick, “If you think you’re too small to have an impact, try going to bed with a mosquito in the room.”

So, my heating, ventilation, and air conditioning (HVAC) system can spread the coronavirus / COVID-19... should I just turn off the system? Nope, nope, nope. Nope.

Here's why: a properly configured and maintained HVAC system can also help neutralize the coronavirus and help stop it from spreading [30] through your facility. Yes, really.

## Chapter 5: Wait... HVAC Systems Can Also Help Stop the Coronavirus / COVID-19 from Spreading?

Earlier in the pandemic, the New York Times [31] remarked sagely “while dense urban conditions can aid the spread of viral illness, buildings can also act as barriers to contamination. It’s a control strategy that’s not getting the attention it deserves.”

Evidence is stacking up now for using buildings as barriers to contamination—especially in the HVAC industry. This next caught our eye, since it’s close to home for our writing team.

A group of Canadian mechanical engineers and researchers from the University of Alberta recently secured federal funding to investigate potential coronavirus spread through heating, ventilation, and air conditioning (HVAC) systems [32]. The project’s still underway but has been approved for rapid review [33].

The team will:

1. Review existing research on viruses and air circulation,
2. Develop a strategy to prevent or reduce airborne spread of the coronavirus / COVID-19 through HVAC systems, and
3. Test the strategy at the University of Alberta campus.

They cite their goal as advancing safe HVAC systems using new designs, modifications, or maintenance adjustments [34].

### And that team of researchers is in good company.

The American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) is a reputable source of industry oversight and information. In light of current events, they established an Epidemic Task Force [35] to investigate all angles of the relationship between HVAC and current and future epidemics. ASHRAE released these official statements and position documents [36]:

1. It’s likely airborne, which should be controlled. Adjusting building operations, including your heating, ventilating, and air conditioning (HVAC) systems, can reduce airborne exposures.
2. Ventilation and filtration through heating, ventilating, and air-conditioning (HVAC) systems

can reduce how many coronavirus / COVID-19 particles are in your air. Fewer particles in your air reduces airborne transmission risks.

3. The ASHRAE Position Document on Infectious Aerosols [37] acknowledges the (minimum) requirements for responsible facilities and building management to reduce airborne spread of the coronavirus / COVID-19.

We unpack these goodies in greater detail soon. Stay tuned for our follow up article. Our experts will share specific strategies and tactics when using your heating, ventilation, and air conditioning (HVAC) system to neutralize the coronavirus and help stop its spread.

### Chapter 6: Summing It All Up: How an Airborne Coronavirus Affects Your HVAC System

To recap, this article walked you through:

1. An early highly publicized case. This case and other similar partially-reported stories helped bring heating, ventilation, and air conditioning (HVAC) systems to the forefront of conversations about the coronavirus / COVID-19.
2. How amidst lock down fatigue and apathy, discussing slowing the coronavirus / COVID-19 is as important as ever. This virus (not just pandemic restrictions) affects us all, regardless of demographic. It's also very contagious, difficult to contain, and continues to spread rapidly.
3. As promised, we shared scientifically-founded, authoritatively-sourced information on just how the virus spreads. We discussed the pathways it follows: droplets, contaminated surfaces—and that

it's indeed airborne. We also discussed the implications that airborne transmission has on your HVAC system.

4. Finally, we discussed that while HVAC systems can indeed spread the coronavirus / COVID-19, when properly configured they can also neutralize the virus and help stop it from spreading [38].

### Conclusion

We hope that sharing our expertise on how the coronavirus / COVID-19 spreads helped you understand what prompted this concern and why reducing that spread still matters—all in relation to your heating, ventilation, and air conditioning (HVAC) system.

There are also glimmers of hope in a time when we all need a boost. There's so much research happening on purifying air in public spaces to reduce transmission risks specific to the coronavirus / COVID-19.

As essential workers on the front lines, we've learned a lot during the pandemic. We're absorbing as much as we can every day. Stay tuned for our next article, where we detail just how to configure your HVAC system to help slow the coronavirus' spread. Spoiler alert: we focus heavily on ventilation, filtration, and disinfection.

Have we missed anything about how the coronavirus / COVID-19 spreads, and how that relates to your heating, ventilation, and air conditioning (HVAC) system? We'd love to hear from you, so please do take a moment to leave a comment below.

We wish good health to you and your loved ones. ■

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