Action Plan

for

Safely Opening-Up Bloomfield School

in the Fall

Amidst the COVID-19 Coronavirus Pandemic

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Schools will open shortly and there is great concern about whether this can be done in a safe manner. Can the schools ensure the safely of its student, teachers, administrators and staff during the time of the COVID-19 coronavirus pandemic! But several approaches exist that can minimize the risk of opening the schools. These approaches have not been in the front-page news, but they are quite real and research backs up these approaches.

I will make 3 suggestions that in my belief will dramatically decrease the risk of coronavirus transmission. These are:

* Maintain classroom humidity to the 40-60% relative humidity range. [This is particularly important during the low humidity winter months.]
* Install germicidal ultraviolet sanitizers in the school's HVAC ductwork.
* Request those individuals that are most at risk to the coronavirus to supplement with "Vitamin D".

Control Relative Humidity Levels Within the School between 40% and 60%

This initial step was derived from a research study by a practicing pediatric oncologist, Dr. Stephanie Taylor, who analyzed the variables associated with infectious control and localized one of the prime infection variables – indoor relative humidity. The findings were discussed in the following article: *This Inexpensive Action Lowers Hospital Infections And Protects Against Flu Season*.[1]

> While practicing pediatric oncology at a major teaching hospital, Taylor wondered why so many of her young patients came down with infections and the flu, despite the hospital's herculean efforts at prevention. Her hunch: the design and infrastructure of the building contributed somehow.
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> She and colleagues studied 370 patients in one unit of a hospital to try to isolate the factors associated with patient infections. They tested and retested 8 million data points controlling for every variable they could think of to explain the likelihood of infection. Was it hand hygiene, fragility of the patients, or room cleaning procedures? Taylor thought it might have something to do with the number of visitors to the patient's room.
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> While all those factors had modest influence, one factor stood out above them all, and it shocked the research team. The one factor most associated with infection was (drum roll): dry air. At low relative humidity, indoor air was strongly associated with higher infection rates. "When we dry the air out, droplets and skin flakes carrying viruses and bacteria are launched into the air, traveling far and over long periods of time. The microbes that survive this launching tend to be the ones that cause healthcare-associated infections," said Taylor. "Even worse, in addition to this increased exposure to infectious particles, the dry air also harms our natural immune barriers which protect us from infections."
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> Since that study was published, there is now more research in peer-reviewed literature observing a link between dry air and viral infections, such as the flu, colds and measles, as well as many bacterial infections, and the National Institutes of Health (NIH) is funding more research. Taylor finds one of the most interesting studies from a team at the Mayo Clinic, which humidified half of the classrooms in a preschool and left the other half alone over three months during the winter. Influenza-related absenteeism in the humidified classrooms was two-thirds lower than in the standard classrooms—a dramatic difference. Taylor says this study is important because its design included a control group: the half of classrooms without humidity-related intervention.
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> Scientists attribute the influence of dry air to a new understanding about the behavior of airborne particles, or "infectious aerosol transmissions." They used to assume the microbes in desiccated droplets were dead, but advances in the past several years changed that thinking. "With new genetic analysis tools, we are finding out that most of the microbes are not dead at all. They are simply dormant while waiting for a source of rehydration," Taylor explained. "Humans are an ideal source of hydration, since we are basically 60% water. When a tiny infectious particle lands on or in a patient, the pathogen rehydrates and begins the infectious cycle all over again."

> These findings are especially important for hospitals and other health settings, because dry air is also associated with antibiotic resistance, which can devastate whole patient populations. Scientists now believe resistant organisms do not develop only along the Darwinian trajectory, where mutated bacteria produce a new generation of similarly mutated offspring that can survive existing antibiotics. Resistant pathogens in infectious aerosols do not need to wait for the next generation, they can instantly share their resistant genes directly through a process called horizontal gene transfer.

The bottom line from her research is that to control viral and bacterial infections (including coronavirus infections) in hospitals and other indoor settings, an inexpensive approach is to maintain these indoor settings within the "sweet spot", the range of 40 to 60 percent relative humidity.

These findings are supported by a recent article in the Annual Review of Virology in a paper titled *"Seasonality of Respiratory Viral Infections"*. [2]

> The term seasonal infection associates a specific infection with a distinct season of the year. Consequently, the perceived relationship between infections and seasonal climate is considered to be causal. This was accurate to some extent when humans lived and worked outdoors with minimal protection from even the most severe climate conditions. The industrial revolutions changed all this. Outdoor agricultural workplaces were relocated into factories and offices, moving human lifestyle away from nature and outdoor climate. With the widespread introduction of central heating and increasingly airtight, insulated building shells, a consistent thermal comfort zone could be maintained indoors, causing even further disconnection from daily and seasonal outdoor climate fluctuations. This disconnection is particularly evident in winter, when indoor heating causes a major divergence of indoor and outdoor temperature and relative humidity (RH).
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> In the industrialized world, most people interact, work, sleep, commute, and spend 90% of their lifetime in enclosed spaces, where they share a limited amount of breathing air. This implies that the overwhelming majority of person-to-person transmission events happen indoors. The multiple factors described in Figure 1 modulate the spatiotemporal onset and progression of seasonal respiratory viral infections. With this in mind and focusing on temperate regions, we discuss the importance of environmental factors on the transmission of respiratory viruses and the host immune response.

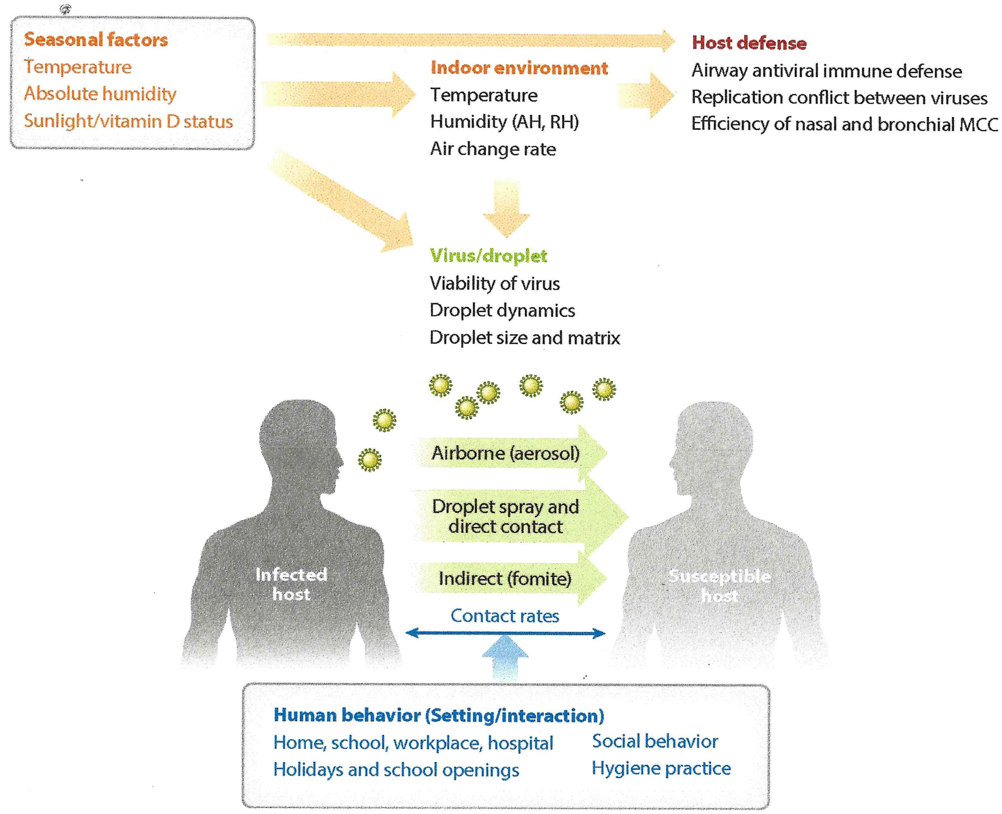


Figure 1

Factors that affect respiratory virus transmission. Seasonal environmental factors modulate host airway immune responses and affect viability and transmission ways of respiratory viruses. Human behavior affects the contact rates between infected and susceptible individuals. Abbreviations: AH, absolute humidity; MCC, mucociliary clearance; RH, relative humidity.

There are numerous findings in current literature that correlate the viability of influenza virus, suspended within the droplet matrix, with the degree of droplet evaporation and the associated supersaturation of the enclosed ingredients. The state of vapor equilibrium in room air, expressed as saturation ratio or RH, affects all infectious droplets with respiratory viruses, independent of their source (respiratory tract or aerosolized from any fluid) and location (in air or settled on surfaces). RH therefore affects all transmission ways but has the most pronounced effect on airborne transmission. Animal transmission studies with guinea pigs and ferrets have revealed that the equilibrium state in high RH (>60%) and low RH (<40%) seems to allow viability of influenza viruses in droplets, while in intermediate RH (40% to 60%) viruses become inactivated (Table 1).

Table 1 Droplet transmission under different relative humidity conditions

Climate/season	Outdoor absolute humidity	Indoor relative humidity (%)	Respiratory virus stability	Proportion of droplet nuclei	Viability of respiratory viruses	Predominant transmission
Tropical	High	60–100	High	Low	High	Fomite, direct and indirect contact
Temperate: spring, fall	Intermediate	40–60	Low	Low	Low	All transmission ways possible
Temperate: winter	Low	10–40	High	High	High	Predominantly airborne

Lowen & Palese predict that aerosol transmission predominates during the winter season in temperate regions (because dry and warm indoor climate allows stability of influenza viruses in desiccated droplet nuclei that stay airborne for prolonged periods), while contact is the major mode of spread in the tropics (because in warm and humid climates, droplets evaporate less water and readily settle on surfaces). This hypothesis is illustrated in Table 1 and has considerable effect on proper precautions and public health measures against respiratory virus infections in different parts of the world and in different seasons.

Additionally, humidity also affects the human immune systems performance.

The intrinsic barrier provides the first line of defense against respiratory viruses on the mucosal surface of the respiratory epithelium. The mucosal surface of the respiratory tract is continuously exposed to inhaled environmental air containing volatile and nonvolatile pollutants and potentially various pathogens. Multi-tiered host airway defense systems prevent infection by incoming respiratory viruses. Seasonal fluctuations of temperature and humidity of the inhaled air have been shown to directly affect the airway mucosal surface defense at multiple levels (Figure 3).

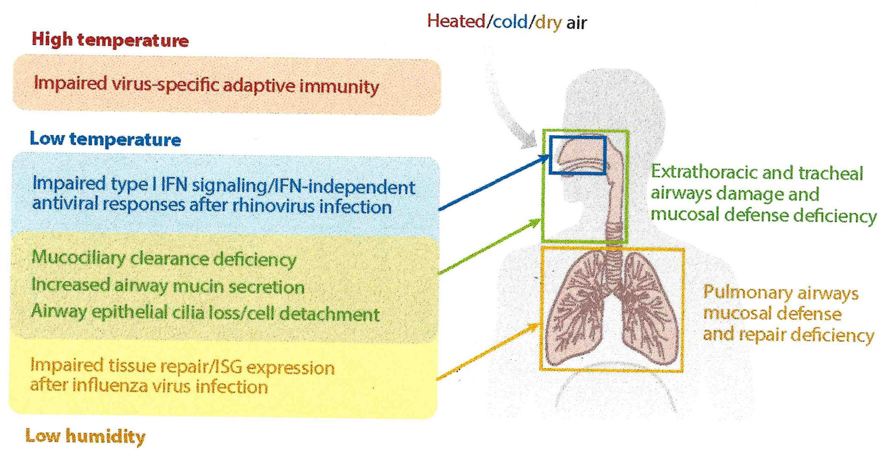


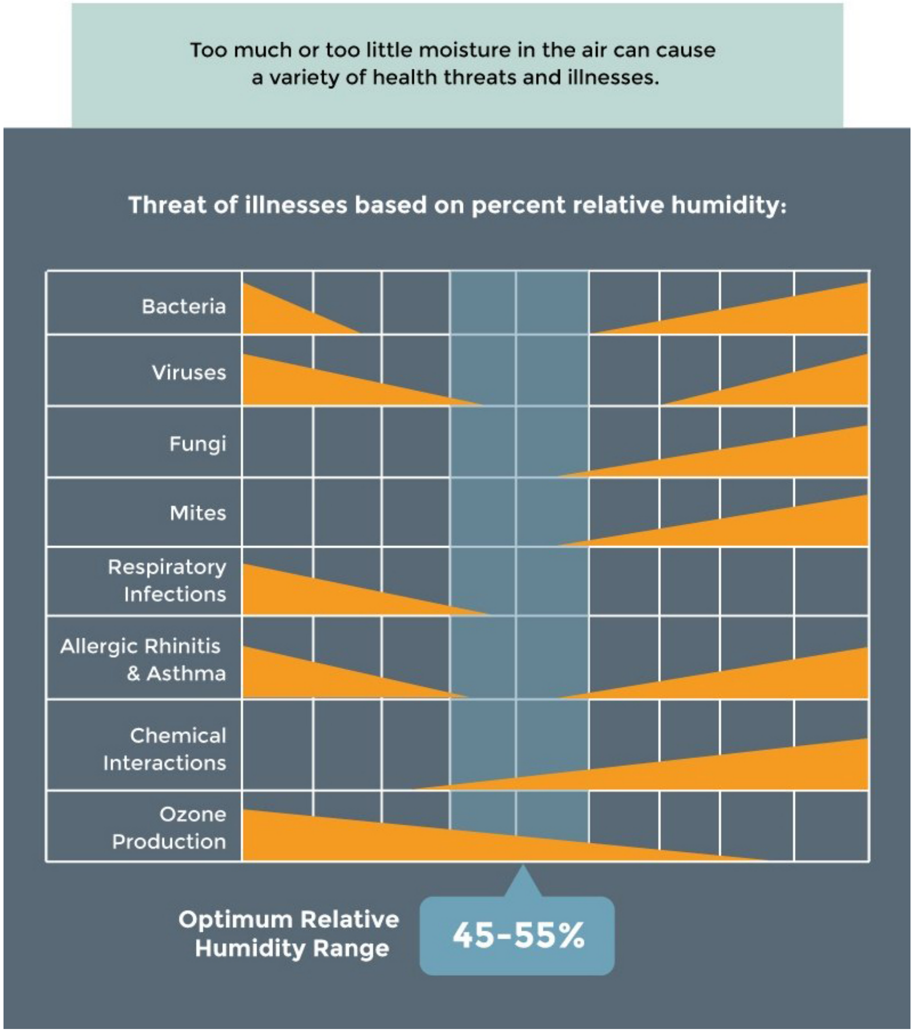
Figure 3

Effect of environmental factors on the host airway defense mechanisms. The extrathoracic and tracheal mucosal surface defense is directly affected by the seasonal changes in temperature and water content of the inhaled air on both infected and susceptible hosts. The immunological part of this effect extends into the lung periphery and lung tissue for unknown reason. Abbreviations: IFN, interferon; ISG, interferon-stimulated gene.

One of the **bottom lines** from this paper is in order to limit respiratory virus transmission in winter, humidify indoor air to maintain relative humidity levels between 40-60% at room temperature.

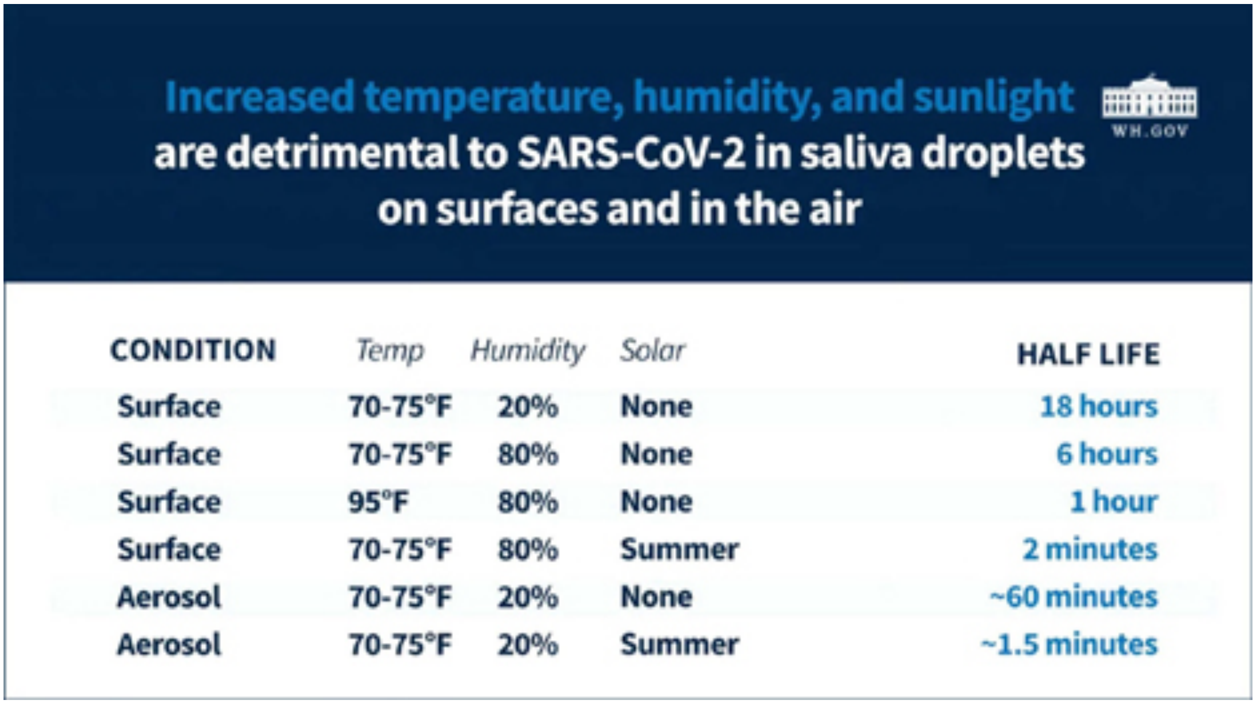
The approach of using humidification to minimize viral transmissions is fairly common knowledge among the building trades. The following graphs was created by the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

Effect of Relative Humidity on Virus Transmissibllity.[3]



Some might argue that the COVID-19 is a novel coronavirus and not like other coronaviruses or influenza viruses. So maybe it is time to remove the novel from the coronavirus. This particular coronavirus is a seasonal virus. In general, these viral infections roar into existence during the cold winter months when humidity levels are at their lowest and then die in the spring when humidity levels return back to normal. The Department of Homeland Security (DHS) has shown that to be the case.

The Science and Technology group within DHS has been performing tests on live COVID-19 viruses in an advanced bio containment lab in Maryland, just outside the national Capital. They presented their research findings at the daily White House briefing a few days ago. Bill Bryan, the head of the science and technology directorate at the Department of Homeland, said that solar light along with high temperatures and humidity have a "powerful effect" of creating environments less favorable for the virus to survive.


Increased temperature, humidity, and sunlight are detrimental to SARS-CoV-2 in saliva droplets on surfaces and in the air

WH.GOV

CONDITION	Temp	Humidity	Solar	HALF LIFE
Surface	70-75°F	20%	None	18 hours
Surface	70-75°F	80%	None	6 hours
Surface	95°F	80%	None	1 hour
Surface	70-75°F	80%	Summer	2 minutes
Aerosol	70-75°F	20%	None	~60 minutes
Aerosol	70-75°F	20%	Summer	~1.5 minutes

A chart released by during the White House coronavirus task force by the DHS showed that the novel coronavirus dies within two minutes in hot summer humidity while on surfaces and a minute and a half while in the air. "Coronavirus dies at a much more rapid pace when exposed to sunlight and humidity," Bryan said during the White House briefing. "The virus dies the quickest in direct sunlight.[4]

So what does this mean? The COVID-19 coronavirus will die off as the humidity levels rise in the spring. Sunlight and especially far ultraviolet light (UVC) component rapidly kills the virus. COVID-19 is a seasonal infection similar to that of the influenza virus.

To implement this finding, two elements are required. The first is an inexpensive but accurate temperature/humidity thermometer in each classroom so each teacher can measure the indoor humidity levels and the second is a means of controlling indoor humidity levels. A humidifier is normally used to interject moisture into the low humidity air. This photograph shows a low cost temperature/humidity thermometer.

Install Germicidal Ultraviolet Sanitizers in the School's HVAC Ductwork

One of the points I found very interesting in the article on Dr. Taylor's research was "Scientists attribute the influence of dry air to a new understanding about the behavior of airborne particles, or "infectious aerosol transmissions." They used to assume the microbes in desiccated droplets were dead, but advances in the past several years changed that thinking. "With new genetic analysis tools, we are finding out that most of the microbes are not dead at all. They are simply dormant while waiting for a source of rehydration," Taylor explained. "Humans are an ideal source of hydration, since we are basically 60% water. When a tiny infectious particle lands on or in a patient, the pathogen rehydrates and begins the infectious cycle all over again."

So consider for a moment that there exist three modes of transmission for the virus. Originally we were told that when an infected person coughs, sneezes or talks, they spray the air with large respiratory mucus droplets, which falls to the ground or on tables or shelves or other objects. We then touch these and then touch our mouth or nose and contaminate ourselves. Thus if we maintain a 3 foot social distance we are safe and wash our hands a million times per day with soap and water to stop the spread. But that was not true. Because when a person coughs they also spread very fine moist aerosols that can travel up to 15 feet, so maybe wearing a face mask might be beneficial after all. But that is not totally accurate either. There is another form of transmission, a third form. [I feel this is a predominant form that is commonly overlooked] Viruses are not living things; they need a host - a living human body to replicate. In a low humidity environment, a virus can dry out and when they become desiccated they become very light and can become airborne and travel great distances (perhaps 100 feet). [Think of a room with a layer of feathers on the floor. The slightest breeze or motion will lift the feathers up into the air and allow them to float. But if you take a garden hose and water down the feathers, they are heavier and cling to the ground.] These desiccated airborne virus cells float through the air looking for a host. You walk along and take a deep breath and pull some into your moist wet throat. They rehydrate and begin to reproduce infecting the host.

In my humble opinion, these airborne desiccated virus cells can be sucked into Heating, Ventilation and Air Conditioning (HVAC) systems and concentrated to produce enhanced viral loads. So is there any evidence this is occurring?

Concerns that COVID-19 can spread through the air have increased after researchers in Wuhan, China discovered the genetic material of the coronavirus in airborne droplets in two hospitals, according to a new study. The research, published in the scientific journal Nature, found the virus' ribonucleic acid (RNA) in different areas of the two hospitals in February and March. Although the RNA discovered in isolation wards and ventilated patient rooms were "very low," there was an "elevated" level in patients' toilet areas, the researchers found. "Although we have not established the infectivity of the virus detected in these hospital areas, the authors propose that SARS-CoV-2 may have the potential to be transmitted via aerosols," the researchers wrote in the study's abstract.[5]

In March, a joint study by the University of Nebraska Medical Center, the National Strategic Research Institute at the University of Nebraska, and others found genetic material from the virus that causes COVID-19 in air samples from both in and outside of confirmed coronavirus patients' rooms. The findings offer, "limited evidence that some potential for airborne transmission exists."

A newly published research letter suggests that three healthy families in China may have contracted the coronavirus virus after it traveled via air conditioning at a restaurant that also served infected people. The early-release research letter, which will be published in the Emerging Infectious Diseases journal in July, notes that 10 people from 3 different families were affected during the period of Jan. 26-Feb. 10, 2020, at a restaurant in Guangzhou, China. Those who became infected were a result of where they sat in the restaurant, which was in relationship with strong airflow from the air conditioner. They found that the other 73 patrons were not affected.[6]

Bill Bryan, chief of the science and technology directorate at the U.S. Department of Homeland Security indicated, "Our most striking observation to date is the powerful effect that solar light appears to have on killing the virus [COVID-19], both on surfaces and in the air." Bryan explained the mechanics of the COVID-19 temperature tolerance experiment in simple terms. "We're able to take a particle of a virus and suspend it in the air inside of this drum and hit it with various temperatures, various humidity levels, multiple different kinds of environmental conditions to include sunlight. And we're able to measure the decay of that virus while it's suspended in the air. This is how we do our aerosol testing". He said in a room at 70-75ºF temperatures with 20 percent humidity, the half-life of the virus is about an hour. "But you get outside and it cuts down to a minute and a half, very significant difference when it gets hit with UltraViolet (UV) rays". Bryan said the DHS bio containment lab is the only one in America that has the capability to do the kind of testing that has led to the research on the virus' UV and temperature tolerance.[7]

Far UltraViolet (UVC) radiation (100nm-290 nm) has germicidal properties. UVC light is well known to possess a very powerful germicidal effect capable of inactivating a wide spectrum of microorganisms, such as viruses, bacteria, protozoa, fungi, yeasts, and algae, through the formation of pyrimidine dimers, the photoproducts of genetic materials.

Bacteria and viruses are of micrometer or smaller dimensions; UVC can penetrate and inactivate them. For example, research studies on influenza virus demonstrated that UVC radiation can efficiently inactivates airborne aerosolized viruses, with a very low dose of 2 mJ/cm^2 of 222-nm light inactivating >95% of aerosolized H1N1 influenza virus.[8]

Scientific studies show that the majority of infections are occurring indoors and not outdoors. The infections are being passed indoors. But that problem is not difficult to solve. There is a simple cheap solution that exists. It is installing germicidal UVC sanitizers into the HVAC ductwork. It kills any airborne viruses passing through the ductwork.

So the second step is to kill the microbes freely moving about in the air using ultraviolet light. This can be done using off-the-shelf far ultraviolet (UVC) technology that has been around since mid-20th century. It is commonly referred to as ultraviolet germicidal irradiation, (UVGI) technology.

Some homes and business currently are equipped with this technology built into their HVAC (heating, ventilation, and air conditioning) systems. Ultraviolet light can eliminate many types of fungi, bacteria, germs, viruses and pathogens. This dramatically reduces the level of the viruses within buildings.[9]

The goal of such UV tools isn't to kill every virus. The human body has a built-in immune system that deals with most of the threat. But it is important to not overload the immune system and allow the body time to develop the antibodies that will be needed to provide protection. So basically the desire is to minimize the exposure level. This technology will reduce the number of viruses by a number of orders of magnitude so that the remaining viruses can be killed by the immune system.

This is an example of the technology. The unit is installed in the return duct that runs into the furnace. One unit is required for each HVAC within the school. The unit is called a REME HALO® Whole Home In-Duct Air Purifier.[10] These units cost around $600 each; but that does not include installation. It is commercial grade unit. This is an item that a professional Heating and Cooling Contractor would need to install. This particular unit runs on 24 volts and therefore requires a transformer that isn't supplied with the unit.

These commercial grade units are produce by several different manufacturers. I am not specifically making a recommendation for this brand but rather citing it as an example of the technology that is currently available.

Request those Individuals that are Most-at-Risk to the Coronavirus to Supplement with "Vitamin D"

When your skin is exposed to sunlight, it makes vitamin D from cholesterol. The sun's ultraviolet B (UVB) rays hit cholesterol in the skin cells, providing the energy for vitamin D synthesis to occur. Vitamin D has many roles in the body and is essential for optimal health.

Vitamin "D" is not easy to get from food and is widely deficient across populations, including in the U.S. This deficiency is amplified during the winter months because of diminished sunshine and the fact that the cold weather tends to keep people indoors.

And the vitamin D/COVID-19 research bandwagon is certainly moving apace. These are snippets from three different three papers released in April 2020 alone.[11]

* In one study it was found that 100% of Intensive Care Unit (ICU) COVID-19 patients less than 75 years old had vitamin D insufficiency.

* In another, out of 55 patients with higher blood serum levels of vitamin D metabolite (more than 30ng/ml 25-hydroxycholecalciferol), 47 had mild symptoms, 4 had "ordinary" symptoms, 2 had severe symptoms and 2 had critical symptoms. Of the 157 patients with lower vitamin D (less than 30ng/ml 25-hydroxycholecalciferol), 2 had mild symptoms, 55 ordinary symptoms, 54 severe symptoms and 46 critical symptoms.

* The third found that across European countries, there was a strong association between vitamin D levels and per capita COVID-19 cases and mortality.

Nevertheless, the current rush of COVID-19 vitamin D studies didn't just come out of nowhere. Previous studies have noted that vitamin D deficiency may be a biomarker of sepsis risk, while data has been growing around a potential benefit of the vitamin D in prevention of and mortality from infections.

In particular, a systematic review and meta-analysis collating evidence from 25 randomized controlled trials (RCTs) that gave vitamin D supplements to all age groups with acute respiratory infections found protective effects among all participants, but particularly among those with baseline 25-hydroxyvitamin D levels indicative of deficiency.

Who are the most at risk for dying from this COVID-19 coronavirus infection? According to the Centers of Disease Control and Prevention (CDC), the vulnerable are:

* People 65 years and older

* People who live in a nursing home or long-term care facility

* People of all ages with underlying medical conditions, particularly if not well controlled, including:

  - People with chronic lung disease or moderate to severe asthma
  - People who have serious heart conditions

- People who are immunocompromised [Many conditions can cause a person to be immunocompromised, including cancer treatment, smoking, bone marrow or organ transplantation, immune deficiencies, poorly controlled HIV or AIDS, and prolonged use of corticosteroids and other immune weakening medications]
- People with severe obesity (body mass index [BMI] of 40 or higher)
- People with diabetes
- People with chronic kidney disease undergoing dialysis
- People with liver disease

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