Airborne Influenza in Dry Wintertime Indoor Air

Is 50%rh Indoor Humidity One Cure for “Flu Season”?

Environmental Protection Agency
Federal Interagency Committee for Indoor Air Quality
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1. Flu viruses are airborne and within that state are highly infectious. Airborne flu viruses penetrate deep into your lungs.

2. Breathing in only one to three airborne flu viruses can infect you and make you ill with severe flu.

3. Humidity is the critical factor in how long flu viruses can live and far they can travel. Controlling indoor humidity (grains of moisture) is one key to preventing airborne flu transmission.

4. Schools with “super-emitter” children are “petri dishes” for flu.

5. Washing your hands to prevent the flu is not very helpful.

6. There are plenty of solutions to prevent man-made “flu season”.
Airborne Influenza Topics

- Current explanations for “flu” season
- How do people eject flu viruses into the air?
- How does airborne flu infect people?
- What different forms do airborne flu viruses take?
- How far can airborne flu viruses travel in a room, circulate within buildings and inside their HVAC units?
- What conditions increase airborne flu virus survival?
- What technologies are available to sterilize, capture and/or kill (inactivate) airborne flu viruses?
Three incorrect explanations for “flu season”

1. “Crowding” - people spend more time indoors so they breathe & cough in closer crowded situations creating “flu season”.

2. “Cold weather makes people sicker in the wintertime” which is around the time “flu season” occurs.

3. Low humidity, wintertime indoor air “dries up people’s mucus membranes” which allows germs to more easily infect them.
This study looked at the correlation between cold weather “episodes” when people would have to spend more time together in closer “crowded” situations, and they found no correlation to increased influenza illness.

”No consistent relations were found between various combinations of monthly mean temperatures and normalized excess deaths.”

“Confidence intervals on the number of deaths attributed to cold weather are large, so we cannot conclude that influenza is a more important cause of winter mortality on an annual timescale than is cold weather.”¹


This study is available @ GreenCleanAir.com
It’s assumed that cold weather can cause you to “catch a cold”. There is no science linking being cold and being more likely to be infected with a virus as a result.

“Researchers (the authors) have worked to identify and measure a seasonal component of influenza transmission with the goal of explaining large annual fluctuations in incidence. But, as we have seen here using simple models, these large fluctuations may be caused by exogenous seasonal changes in transmission that are too small to detect, amplified by the endogenous population dynamics of the host–pathogen system.”¹

In non-scientific speak: The change in seasons is not the cause of increased influenza infections.

1. NIH Scientist Jonathan Dushoff, et al. Dynamical resonance can account for seasonality of influenza epidemics 2004 PNAS v101 p16,915

This study is available @ GreenCleanAir.com
CDC’s Top Influenza Scientist states that flu is Airborne

Dr. Nancy J. Cox  Director of CDC Influenza Division

“It is generally accepted that influenza viruses are spread primarily by aerosols* of virus-laden respiratory secretions that are expelled into the air during coughing, sneezing, or talking by an infected person.”¹

“School Absenteeism due to influenza often occurs early in the epidemic and children are believed to play an important role in disseminating the virus into the community during both epidemics and pandemics.”²

2. Cox, N  Fukuda, K  Influenza  Chapter 1999

*Droplet Nuclei are aerosols and are 5-10 microns which can stay airborne indefinitely. Even aerosols less than 20 microns can stay airborne for long periods of time. Aerosols are Not Large Droplets which are greater than 20 microns and are easily captured by the nose. Large droplets can travel 3-6 feet (via a sneeze) but quickly fall to the ground preventing them from being breathed in.
“Influenza virus infection is acquired by a mechanism involving the transfer of virus-containing respiratory secretions from an infected to a susceptible person. A number of lines of evidence indicate that small particle aerosols are the predominant factor in such person-to-person transmission.

The explosive nature and simultaneous onset in many persons suggest that a single infected person can transmit virus to a large number of susceptible persons.”
“The infectivity of airborne virus in small respiratory droplets—approximately <5 micrometers (1 millionth of a meter) in diameter can be very high: the infectious dose of influenza virus in humans following aerosol inhalation was reported to be as low as three (from .6-3 viruses) 50% tissue culture infectious doses (TCID50).”

“Smaller particles (<5 μm in diameter, or droplet nuclei) are capable of remaining suspended in air for longer durations of time and can be carried farther distances than large droplets, depending on the rate of particle desiccation and other environmental factors. Particles of this size are capable of penetrating deep into the respiratory tract following inhalation, which is generally not the case for inhaled large droplets.”
How do people eject viruses into the air?

1. Coughing
2. Sneezing
3. Talking
4. Singing
5. Flatulence
6. Toileting “event” especially diarrhea
7. Toilet flush aerosolization (indirectly)
Studies using DNA testing show that airborne flu viruses are everywhere!

- As an Indoor Air Quality (IAQ) testing consultant, I can attest to the difficulty of trying to capture and isolate airborne germs. Harvard’s Don Milton said it best: “Infectious aerosols are usually extremely dilute, and it is hard to collect and culture fine particles.”¹
- In 2006, CDC scientists perfected virus sampling equipment to collect and enumerate airborne viruses. They used layers of sieves to filter out particles, bacteria and fungi to finally end up with viruses.
- The next breakthrough was DNA/RNA testing called Polymerase chain reaction (PCR). Now viruses can be precisely measured.
- Studies have found thousands of airborne flu viruses by this method.
- Approx. 90 flu “copies” found by PCR testing equals 1 “viable” particle.


More information on this study is available @ GreenCleanAir.com
CDC NIOSH study used viral replication assay showing coughs expel viable airborne flu viruses

“Viable Influenza A Virus in Airborne Particles from Human Coughs” 2014
CDC NIOSH’s Dr. Stephen B. Martin and Drs. Noti, Lindsley, Beezhold and Blachere, et al.

Seventeen of these participants tested positive for influenza A virus by viral plaque assay (VPA) with confirmation by viral replication assay (VRA). Viable influenza A virus was detected in the cough aerosol particles from 7 of these 17 test subjects (41%). Viable influenza A virus was found in the smallest particle size fraction (0.3 μm to 8 μm), with a mean of 142 plaque-forming units (SD 215) expelled during the 6 coughs in particles of this size. These results suggest that a significant proportion of patients with influenza A release small airborne particles containing viable virus into the environment. Although the amounts of influenza A detected in cough aerosol particles during our experiments were relatively low, larger quantities could be expelled by influenza patients during a pandemic when illnesses would be more severe.

**Our findings support the idea that airborne infectious particles could play an important role in the spread of influenza.**
How Airborne Droplet Nuclei are created

Airborne viral droplets are coughed, sneezed or expelled by humans. Toilet aerosolization also creates viral droplets. This illustration shows how the mucus droplets filled with viruses eventually evaporate to create microscopic masses of viruses, salt and protein called Droplet Nuclei. Named and discovered by William F. Wells in 1934, droplet nuclei are the key to understanding airborne infectious disease transmission.
How many viruses do people eject into the air?

Table 5. The calculated numbers of the respiratory droplets which are likely to contain pathogenic or commensal organisms

The calculations were based on the figures given in Tables 3 and 4.

<table>
<thead>
<tr>
<th>Expiratory activity</th>
<th>30,000,000 commensals per ml.</th>
<th>1,000,000 pathogens per ml.</th>
<th>30,000 pathogens per ml.</th>
<th>1000 pathogens per ml.</th>
</tr>
</thead>
<tbody>
<tr>
<td>One sneeze:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 100µ</td>
<td>62,000</td>
<td>4,600</td>
<td>150</td>
<td>5</td>
</tr>
<tr>
<td>All sizes</td>
<td>73,000</td>
<td>14,000</td>
<td>3,100</td>
<td>430</td>
</tr>
<tr>
<td>One cough:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 100µ</td>
<td>710</td>
<td>64</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>All sizes</td>
<td>910</td>
<td>230</td>
<td>47</td>
<td>6</td>
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<tr>
<td>Counting to ‘100’</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Under 100µ</td>
<td>36</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>All sizes</td>
<td>50</td>
<td>14</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

J.P Duguid  The size and duration of air carriage of Respiratory Droplets and Droplet nuclei  1946 Journal of Hygiene (London)  v44 p471

This study is available @ GreenCleanAir.com
Natural flu infection (airborne into lungs) is worse than intranasal (contact into nose)

(For nasal induced flu it takes 330 infectious flu viruses (TCID50) to get infected versus 1-3 infectious flu viruses for airborne infection in the lung.)

“To assess the relative effect of natural versus experimental (intranasal) influenza illness on pulmonary function, we compared 43 normal adults with documented non-pneumonic influenza A infection during three outbreaks, 1974 (A/Port Chalmers/74), 1975 (A/Port Chalmers/74), and 1976 (A/Victoria/75) to 24 normal volunteers following nasal inoculation with wild-type influenza A/England/42/72, A/Scotland/74 or A/Victoria/75.”

In naturally acquired illness, abnormalities in small airway function and transiently increase airway reactivity were observed. In contrast, no such dysfunction was observed in experimentally induced illness. This group manifested milder illness and significantly shorter duration of cough.”

How many viruses are floating in a room to infect you?

In 2011 Dr. Linsey Marr of VA Tech published: “Concentrations and size distributions of airborne influenza A viruses measured indoors at a health centre, a day-care centre and on aeroplanes”

“To determine the potential for influenza to spread via the aerosol route, we measured the size distribution of airborne influenza A viruses. Over 1 hour, the inhalation dose was estimated to be between 12 and 48 median tissue culture infectious dose (TCID50), adequate to induce infection. These results provide quantitative support for the idea that the aerosol route could be an important mode of influenza transmission.”

Since it takes only 1-3 airborne viruses to infect you, at 1 virus per naïve person, fully 48 new people could be infected! Keep in mind that these were adults who are less infectious than children who can become “super-emitters” and spew out up to 200 viable flu viruses in a short time.

Linsey Marr et al. Concentrations and size distributions of airborne influenza A viruses measured indoors at a health centre, a day-care centre and on aeroplanes J. R. Soc. Interface 2011 v8 p1176

This study is available @ GreenCleanAir.com
Dr. Walter Bischoff discovered that flu infected persons at Wake Forest Hospital were spewing flu viruses in volume and distance. One 8yr old super-emitter spewed out 20,000 RNA copies = 200 infectious flu viruses.

This child could infect 66 (3 viruses) to 200 (1 virus) naïve classmates within 1 hour!

Exposure to Influenza Virus Aerosols During Routine Patient Care
Walter Bischoff et al.  Journal of Infectious Diseases Feb 2013
How does Influenza A Virus infect people?

1. Fingers to nose?
2. Fingers to eye?
3. Fingers to mouth?
4. Inhale Large droplets
5. Inhale Intermediate droplets
6. Inhale droplet nuclei
7. Toilet flush aerosolization
8. Sewer pipe aerosolization
What’s Influenza A Virus and how does it infect people?

- Influenza A causes disease primarily in the lungs as it loves to infect the lower respiratory tract (LRT).
- It is not a rhinovirus which primarily causes infection in the nose and upper respiratory system.
- Since your fingers can’t reach into your lungs, washing your hands can’t prevent flu viruses from entering deep into your lungs.
- No matter how sterile your hands are, you’ll still be fully exposed to airborne Influenza viruses entering and depositing into your lungs and lower respiratory tract to cause disease.
• **Influenza A** likes to multiply at 98.6°F which is the temperature of the lower respiratory system. (The upper respiratory system - nasal cavity & pharynx - are approx. 94°F which rhinoviruses favor for multiplication).

• **Influenza A** infects and destroys its victim’s lung tissue.

• Damaged lung tissue has compromised its protective layers which can lead to severe pneumonia or overwhelming bacterial infection.

• Victims can die from aggressive Staph infections like Methicillin Resistant Staphylococcus Aureus (MRSA).
Why are schools perfect petri dishes for Flu Transmission?

- **Super-emitters** Flu infected children can, with their immature immune systems, become “super-emitters” and Wake Forest’s Dr. Walter Bischoff discovered\(^1\) that an 8yr old super-emitter spewed out **20,000** RNA copies = **200 infectious flu viruses**.

- **Dry environments** Many schools can have 15-25% relative humidity levels indoors! This is the PERFECT environment for airborne Viral transmission and contagion.

- **Low MERV Filter Ratings** Many schools have low MERV rated filters like MERV 4-6. You need a MERV 13 or higher to have any real effect on airborne viral capture.

- **No Ultraviolet Lights** Few schools in the US use ultraviolet lights. Schools with UV lights have enjoyed lower airborne germ transmission rates and higher indoor air quality.

- **Bathrooms with ceiling exhaust fans** Most bathroom designs do not incorporate floor level exhaust vents. Ceiling exhaust fans pull toilet aerosolized viruses up into the breathing zone where they are breathed into the lungs of unsuspecting victims.

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1. Exposure to Influenza Virus Aerosols During Routine Patient Care
Walter Bischoff et al. Journal of Infectious Diseases Feb 2013
A 2013 Mayo Clinic study done over two years in Minnesota elementary schools showed just how low the humidity was inside when the outdoor air was dry and cold.

Schools are required to bring in outdoor air which, in a Minnesota winter, is very cold and dry. Most importantly this cold dry air had very little “grains” of moisture so when it is brought indoors, it dries out the indoor air to as little as 12% relative humidity. My 2010 article on airborne flu survival puts 15%rh and 65ºF in the high flu transmission zone and illustrates how influenza viruses survive so well in low grain air.

The Mayo study showed that by humidifying the air to 60% relative humidity (from 15%) would reduce the Airborne Flu survival rate by over 50% in just one hour! So just by adding humidity, which is toxic to airborne flu viruses, you’d kill (inactivate) more than half of them. With less airborne viruses to breathe, the less chance that a child will become ill with flu.

The Mayo Clinic researchers conclude: “raising wintertime indoor AH to levels typically experienced indoors during fall and spring (60%rh) offers a strategy to reduce transmission of influenza in schools, and potentially the community.”

1. Predictors of indoor absolute humidity and estimated effects on influenza virus survival in grade schools  Koep et al. BMC Infectious Diseases 2013, v13 p1
2. Save Lives! Become a mechanical engineer. Steven Welty Engineered Systems January 2010 page 57

This open source study and article are available @ GreenCleanAir.com
CDC/NIOSH researchers demonstrated how low humidity air was the key factor in increasing airborne flu survival, infectivity and therefore successful transmission from a flu infected “simulated” (ie. manikin) to a healthy healthcare worker manikin (shown at right as Breathing Simulator).

CDC/NIOSH researchers conclude:

1. At low relative humidity (≤23%) influenza retains maximal infectivity (70.6–77.3%)
2. At higher relative humidity (≥43%) influenza has much lower infectivity (14.6–22.2%)
3. Inactivation of the virus at higher relative humidity (≥43%) occurs rapidly after coughing (within 15 minutes.)

Their Recommendation: “Maintaining indoor relative humidity above 40% will significantly reduce the infectivity of aerosolized virus.”


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This open source study available @ GreenCleanAir.com
Children, Super-Emitters and National “Flu Season”

Children Infected with Influenza-“Super-Emitters” go to school

In school, they cough & also flush toilets creating Fecal Clouds

Naïve Children breathe Coughed Droplet Nuclei & toilet aerosolized Fecal Clouds and get Infected

Family members infect others at work and in community via Fecal clouds & cough aerosols

They go home and infect their families via fecal clouds or by emitting droplet nuclei

First Community, then State, then National “flu Season” erupts
1. In schools, the combination of low humidity, super-emitter children and toilet flush aerosolization is a toxic combination.
2. Low humidity ensures that airborne viruses will stay aloft and travel throughout the school.
3. Super-emitter children continuously add airborne viruses into the air through breathing, coughing and sneezing, and add even more with every toilet flush.
Leading virologists Peter Wright, Gabrielle Neumann and Yoshihiro Kawaoka state that flu epidemics start in schools

Virologists Peter Wright¹, Gabrielle Neumann² and Yoshihiro Kawaoka³ state: “Increases in school absenteeism mark the beginning of a new epidemic, suggesting that school-age children play a critical role in disseminating influenza viruses. Increases in school absenteeism are typically followed by increases in work absenteeism.”⁴

These experts support my thesis that Schools are the “petri dish” for flu. Since flu infected children can, with their immature immune systems, become “super-emitters”, they easily infect their classmates as they all intermingle while traveling from classroom to bathroom to gym to lunchroom all the while super-emitters are spewing out infectious flu viruses.

Parents and the companies they work for have many good reasons to take a vested interest in advocating for clean and properly humidified air in schools especially in the dry wintertime.

1. Professor  Pediatrics, Pathology, Microbiology and Immunology  Chief, Division of Pediatric Infectious Diseases  Vanderbilt University  School of Medicine
2. Associate Professor  Department of Pathobiological Sciences  School of Veterinary Medicine  University of Wisconsin
3. Professor  Department of Microbiology and Immunology  University of Tokyo
## How far can Airborne Viruses Travel?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Large Droplets/Aerosols</th>
<th>Droplet Nuclei</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Coughing</td>
<td>1-6 feet</td>
<td>200+ feet</td>
</tr>
<tr>
<td>2. Sneezing</td>
<td>8-15 feet</td>
<td>200+ feet</td>
</tr>
<tr>
<td>3. Singing, Talking</td>
<td>1-3 feet</td>
<td>200+ feet</td>
</tr>
<tr>
<td>4. Mouth Breathing</td>
<td>1-3 feet</td>
<td>200+ feet</td>
</tr>
<tr>
<td>5. Diarrhea*</td>
<td>1-5 feet+</td>
<td><strong>600+ feet</strong></td>
</tr>
</tbody>
</table>

*As a Result of Toilet Water Aerosolization and Mechanical Fan Dispersion into outdoor air (2003 Hong Kong Amoy Gardens SARS Virus Epidemic)
Wang Kaixi was infected by airborne SARS viruses that he breathed in at the Prince of Wales Hospital. Since SARS produced diarrhea in the majority of patients, he flushed his toilet water likely heavily laced with his SARS thereby aerosolizing his SARS viruses into the most toxic Fecal Cloud ever recorded. His window fan blew his SARS Fecal Cloud(s) outdoors where the wind and rising air currents spread them on to his unsuspecting Amoy Gardens neighbors.
The largest airborne infection event ever recorded—Amoy Gardens March 19-20, 2003

Retrospectively, Professor Yuguo Li documented the airborne toilet aerosolization SARS Plume created by Wang Kaixi. The plume traveled mostly upwards and infected nearly 100 neighbors in his building (Block E). It then traveled over 200 feet (70 meters) to infect more Amoy residents. Over 40 died.

Li, Yuguo et. al. Evidence of Airborne Transmission of the Severe Acute Respiratory Syndrome Virus 2003 NEJM

This study is available @ GreenCleanAir.com
Wang Kaixi infected 440 people downwind-40+ were killed @ Amoy Gardens by 1 person!

Wang Kaixi’s SARS toilet flush fecal cloud visually demonstrated both the ability & power of airborne viruses to travel long distances to infect and kill new healthy naïve victims.

Li, Yuguo et. al  Evidence of Airborne Trans-mission of the Severe Acute Respiratory Syndrome Virus  2003  NEJM

This study is available @ GreenCleanAir.com
Stages of Infectious Droplets & Droplet Nuclei

1. Mucus/water coated Viruses are aerosolized and they can’t evaporate fast enough and quickly fall to the ground.

2. Mucus/water coating evaporates. These droplets will travel 3-6 feet before falling to the ground.

3. Mucus/water coating has mostly evaporated leaving the virus with protein & salts. This is a Droplet Nuclei. Droplet Nuclei are so microscopic that they can float in the air indefinitely.

µ = micron or 1 millionth of a meter
Infectious Droplets & Droplet Nuclei travel lengths

- Large Infectious Droplets: 1-3 Feet
- Small Infectious droplets/aerosols: 1-6 Feet
- Infectious Droplet Nuclei: 1-200+ Feet
Droplet Nuclei Viruses are 0.3µ or Less & Penetrate Deeply into the Human Lungs

A µm is a micron or 1/1,000,000 of a meter. The smallest particle you can see is 30µm.
Droplet Nuclei Travel Within Buildings
How Toilets Aerosolize Flu Viruses
Recirculation Vents suck them back in
Since 1955, many studies have documented how a toilet flush aerosolizes bacteria and viruses into the air above the bowl and into the room’s air.

Many scientists flushed toilet bowl water infected with a known quantity of viruses and measured just how far they stayed airborne.

British Scientist John Barker\(^1\) in 2005, (post 2003 SARS Metropole & Amoy Garden events) replicated the viral load and consistency of diarrhea using agar. He added that to toilet water, flushed the toilet and took air samples to capture the aerosolized droplets. They were full thousands of viruses and bacteria. For 60 minutes afterwards, every toilet flush aerosolized additional viruses because porcelain is porous enough to harbor viruses and bacteria also.

\(^1\) Barker, John The potential spread of infection caused by aerosol contamination of surfaces after flushing a domestic toilet. 2005 Journal of Applied Microbiology v99 p339

This study is available @ [GreenCleanAir.com](http://GreenCleanAir.com)
“It may be concluded from the peer-reviewed studies discussed above that flush toilets of various designs spanning at least 50 years of production in Europe and the U.S. have been shown to produce substantial quantities of aerosol, that these aerosols are capable of entraining microorganisms at least as large as bacteria (includes viruses which are 10 timer smaller*), that such bioaerosols will be produced during multiple flushes after toilet contamination, that sufficiently small microbe-laden droplets will evaporate to form droplet nuclei bioaerosols the size of which can be consistent with that associated with respirable penetration, and that these droplet nuclei bioaerosols may remain viable in the air for extended periods and travel with air currents.”  

* Added by Steven Welty
The 2003 SARS epidemic showcased the lethality of toilet water aerosolization which created Fecal Clouds in these published accounts:

1. **Dr. Liu Jianlun** was the Chinese Doctor who initiated the worldwide SARS pandemic. He stayed one night in Hong Kong on the 9th floor (room 911) at the Metropole Hotel on the evening of February 21st to the morning of the 22nd in 2003.
   - Infected with SARS and likely having diarrhea, he infected 16 fellow hotel guests and 1 visitor through toilet water aerosolization. Some of those travelers flew around the world and one brought SARS to Toronto thereby devastating the city.

2. **Wang Kaixi** was infected with SARS at the same hospital which was treating a SARS infected patient who visited a hotel guest’s whose room was on the same hall as Liu Jianlun at the Metropole hotel.
   - Infected with SARS and likely having diarrhea, he eventually infected over 320 Amoy Garden residents through toilet water aerosolization. Many lived over 200 feet away from his apartment. He killed over 40.
The above scenario contradicts the current belief that Dr. Jianlun spread his SARS viruses to his fellow Hotel guests by vomiting on the carpet outside his room. The currently accepted vomit theory may be due to the World Health Organization’s investigators speculating that Dr. Liu Jianlin may have vomited on the carpet outside his room. “It was speculated that he might have vomited, spit or heavily coughed near his room and, thus, contaminated this area of the corridor. In case of a vomit, the hotel staff might have been called for clean up. However, there is no record of such an incident.” Most importantly, Thomas Tang, who was the epidemiologist with The Hong Kong Health authority, contacted Mrs. Jianlun who said her husband Liu never vomited.²

1. Page 8 The WHO Metropole Hotel Report 2003 - available @ GreenCleanAir.com
WHO investigators validated major parts of the above scenario confirming that Metropole guest rooms: “proved to be at positive pressure with respect to the corridor....(so) contaminated air could leave a room and transfer into the corridor with all doors closed.”

Guest rooms had wall air conditioning units (fan coil) which brought in outdoor air. When operating, the fan coil units created this situation: “The positive pressure slightly increased when the operating status of the fan coil was changed from stopped to low, medium and high fan speed. As expected, the higher fan speed produced higher room pressure and thereby higher room airflow from below the door” (and out into the hallway corridor to wreak havoc).
The 2003 WHO investigators confirmed the Fecal Cloud creation scenario using a laser particle counter: “Particle counting was done at the rim of the WC and again approx. 300 mm (12 inches) above the WC during flushing. The tank flush produced approximately 0.2 mg/m$^3$ in air.” These airborne droplet readings are the material evidence of Dr. Jianlun’s Fecal Cloud creation albeit post-facto the event. The 2006 WHO report adds this validation: “Professor LJL’s infected body fluids must have been aerosolized, as indicated by the traces on the inlet of the elevator lobby fan. See Barker for airborne virus creation with diarrhea laced toilet water.

2. Page 147 How SARS was stopped WHO 2006

All available @ GreenCleanAir.com © 2013 Steven A Welty
This illustration from a 2006 WHO report\(^1\) shows how the airflows were moving on April 27\(^{th}\), 2 months post-facto but this needs clarification using the WHO’s 2003 Final report. The air flowing out of the rooms is correct. But, “Corridor air also drifted towards the elevators. Corridor air movement in the vicinity of the rooms under study is very slow, with a drift towards the elevator lobby where an air extraction takes place… aerosols would slowly travel towards the elevator lobby”\(^2\). In addition, the report notes: “The air movement is so slow that a person walking into the corridor can cause a reversal of airflow”\(^2\).

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1. SARS: How a global epidemic was stopped 2006 WHO

Both are available @ GreenCleanAir.com

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This illustration from a 2003 WHO report\(^1\) shows how the airflows were moving on April 27\(^{th}\). See how the air was flowing out of Dr. Jianlun’s door at 170 feet per minute!

As per the previous slide, the airflow was moving both ways up and down the hallway so the yellow arrows illustrate only half the story.

You can visualize just how the Fecal Cloud(s) moved up and down the corridors of the 9\(^{th}\) floor. They were probably created in the evening of the 21\(^{st}\) and likely existed into the morning of the 22\(^{nd}\). The clouds may have existed in an ever weakening state even after Dr. Jianlun walked 500 yards to Kwong Wah hospital that morning.

Each person walking through the Fecal Cloud, unaware of its presence, sucked in its toxic viruses and went on to spread them worldwide.

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1. Final Report Metropole Hotel  WHO  2003  available @ GreenCleanAir.com
The WHO investigators found SARS viruses on the carpet area outside Dr. Jianlun’s room and the two rooms on either side of him on April 27, 2003 (2 months later). Since the SARS debris field is at least 30 feet long, the vomit theory becomes less tenable. It’s more logical that the WHO investigators found the settled droplet nuclei SARS viruses of Dr. Jianlun’s Fecal Cloud on the carpet. In addition, they found SARS viruses on the air vent opening on the wall near the elevators probably 6 feet above the floor and over 15 feet from room 911. That SARS viruses were found in spite of massive cleaning efforts to “sanitize” the Metropole’s 9th floor: “It is interesting to note that genetic material (SARS) could be detected after almost two months and following an extensive decontamination and clean up in the hotel, particularly floor 9 and the associated guest rooms.”

1. Page 5, Final Report Metropole Hotel WHO 2003 available @ GreenCleanAir.com
What conditions increase airborne flu virus survival, which increases infection probability?

1. Not being removed from indoor air by exhaust fans to outdoor air
2. Indoor Relative humidity below 40% at 70º (20% even better)
3. Not Captured by Gasket Sealed Nano-Rated HEPA Filters
4. No Exposure to Ultraviolet Light- “C” band, “germicidal” photons
Does Humidity matters to airborne flu viruses? Yes.

In 2011 Dr. Linsey Marr of VA Tech also published: “Dynamics of Airborne Influenza A Viruses Indoors and Dependence on Humidity”

“Humidity is an important variable in aerosol transmission of Influenza A Viruses because it both induces droplet size transformation\(^1\) and affects Influenza A Viruses inactivation rates\(^2\)……aerosol transmission route plays a significant role in the spread of influenza in temperate regions and that the efficiency of this route depends on humidity.”

Her recommendation: “Maintaining a high indoor Relative Humidity and ventilation rate may help reduce chances of Influenza A Viruses infection.”

1. Since mucus is mostly water and surrounds the virus(es), low humidities evaporate mucus faster making the virus aerosol lighter and easier for human to breathe down into their lungs. Droplet nuclei are the easiest to inhale deeply.
2. Since viruses aren’t alive, you technically can’t “kill them, you “inactivate” them making them non-viable/noninfectious.
VA Tech’s Dr. Linsey Marr discovered why flu viruses love low humidity!

In 2012 Dr. Linsey Marr of VA Tech published her experiments spraying human mucus with flu into the air with different humidities. She discovered that mucus’s protein protects flu viruses from mucus salts in 50%rh or less air!

“Our findings in human mucus could help explain, at least in part, the transmission patterns of influenza. In temperate regions, wintertime heating reduces RH in the indoor environment to low levels, usually 40% (or less*).”

“Low RHs not only help preserve the viability of Influenza A Virus but also enable Influenza A Virus carrier aerosols to persist longer in air because of their smaller size and lower settling velocities that result from more vigorous evaporation. Thus, transmission of influenza in temperate regions could be enhanced in winter primarily via the aerosol route.”

1. Viruses are not “alive”, so viable means being able to infect someone. Viruses hijack your own cells, tricking them into making more copies of viruses which explode out of the cell to infect more cells and repeat the process.

2. A carrier is a person who may be sick and experiencing flu symptoms. Asymptomatic carriers have no symptoms but can infect people via aerosols or toilet aerosolization.

3. Settling velocities is how fast aerosols fall to the ground. Microscopic droplet nuclei aerosols are so light that they have a negligible settling velocity meaning that they can stay airborne for days or more!

Linsey Marr, et al.  Relationship between Humidity and Influenza A Viability in Droplets and Implications for Influenza’s Seasonality 2012  PLOS Journal v7, e-page 46789

*Added by Steven A Welty

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Dr. G.J. Harper-1963 Experiment showed Influenza Survived in low humidity

"These results do show that relative humidity, temperature..are of great importance in determining the ability of viruses to survive in air long enough ... for transmission to the respiratory tracts of susceptible hosts"

Harper, GJ  The influence of environment on the survival of airborne virus particles in the laboratory. Arch Gesamte Virusforsch. 1963 v13 p64
Dr. G.J. Harper - Experiments on Low Humidity’s effect on Influenza Survival

Airborne micro-organisms: survival tests with four viruses

By G.J. Harper

Microbiological Research Establishment, Porton Down, Salisbury, Wilts

Table 1. Viability of airborne virus 0–23 hr. after spraying

<table>
<thead>
<tr>
<th>Temp. (°C.)</th>
<th>R.H. (%)</th>
<th>No. of tests</th>
<th>Percentage viable at given times (hr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>0*</td>
</tr>
<tr>
<td>7.0–8.0</td>
<td>23–25</td>
<td>3</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>51</td>
<td>3</td>
<td>66</td>
</tr>
<tr>
<td>20.5–24.0</td>
<td>20–22</td>
<td>5</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>34–36</td>
<td>3</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>50–51</td>
<td>3</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>64–65</td>
<td>3</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>81</td>
<td>4</td>
<td>67</td>
</tr>
</tbody>
</table>
Dr. G.J. Harper - Low Humidity’s effect on Airborne Influenza Survival

Viable decay of influenza (Fig. 3)
Influenza virus showed a uniformly high viable decay rate at relative humidities above 50%. (Values at 50%, 65%, and 80% were so similar they are represented here by a single line.) After 4 hours, viabilities were around 6%. At lower relative humidities, 20% and 35%, viable decay was slow, 14–22% viability being found in clouds 23 hours old.

Fig. 3. Viable decay of airborne influenza virus (PR 8) at 21–24°C.
Leading virologists Peter Wright, Gabrielle Neumann and Yoshihiro Kawaoka state that low humidity is a critical factor to flu transmission

Virologists Peter Wright¹, Gabrielle Neumann² and Yoshihiro Kawaoka³ state: “The low relative indoor humidity during the winter months is believed to prolong the survival of influenza in aerosols and is believed to be responsible for the seasonal pattern in the northern hemisphere. The most effective spread among humans are aerosols. Most aerosol droplets formed during sneezing or coughing are less than 2 microns in diameter (droplet nuclei), and are preferentially deposited in the lower airways of the lung. Volunteers are readily infected by aerosol transmission. The often sudden onset of epidemics suggests that an infected individual can transmit the virus to a relatively large number of people.”⁴

1. Professor Pediatrics, Pathology, Microbiology and Immunology  Chief Division of Pediatric Infectious Diseases  Vanderbilt University  School of Medicine
2. Associate Professor Department of Pathobiological Sciences  School of Veterinary Medicine  University of Wisconsin
3. Professor Department of Microbiology and Immunology  University of Tokyo

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• Viruses Evaporate faster in Low Humidity levels (technically low grains\textsuperscript{1}) thus creating More Droplet Nuclei.

• Low humidity allows droplet nuclei to stay airborne longer as the droplets do not absorb extra water weight which would cause them to fall to the ground.

• Indoor Air currents both created by HVAC systems and people movement and their heat plumes assure that droplet nuclei will remain airborne nearly \textit{indefinitely} indoors.

• This allows HVAC systems to redistribute droplet nuclei viruses throughout the building to infect more occupants.

\textsuperscript{1} See my January 2010 article about this @ Greencleanair.com
1. Indoor wintertime humidity levels in the Northern Hemisphere especially in North America and Europe are between 15-35%.

2. Since influenza loves low humidity air, the correlation between low indoor humidity and increases in influenza morbidity and mortality is logical given the correlation of airborne droplet nuclei creation and available contagion to infect humans.

3. What now establishes how “flu season” is created is a new study by the University of Virginia’s Robert Davis linking the correlation between dry cold arctic air masses which descend upon New York City and subsequent flu deaths 17 days later.


This open source study is available @ GreenCleanAir.com
The Answer, My Friend, Is Blowing in the Wind* (Blame Canada!**)  

Scientific Study: 17 days after **Dry & Cold** Canadian Air hits New York City: Influenza deaths increase

Cold & Dry Arctic air masses descend upon NYC. Cold and dry Outdoor air is sucked indoors lowering indoor humidity.

Cold & Dry air allows efficient Outdoor flu transmission. More outdoor Flu Viruses can live longer to infect humans both outdoors and be sucked indoors.

Cold & Dry air is sucked into buildings increasing **Indoor** flu transmission. Heated air lowers Indoor Humidity even more. Indoor Flu Viruses can live longer to infect more naïve humans.


© 2013 Steven A Welty

This open source study is available @ GreenCleanAir.com
What technologies can sterilize, capture and/or kill (inactivate) airborne flu viruses?

1. Being removed from indoor air by exhaust vents to outdoor air
2. Indoor Relative humidity above 40% at 70º (45% even better)
3. Captured by Gasket Sealed Nano-Rated HEPA Filters
4. Exposure to Ultraviolet Light- “C” band, “germicidal” photons
Ultraviolet Light can “Kill”/Sterilize/inactivate this % of Flu Viruses:

<table>
<thead>
<tr>
<th>UVR Rating</th>
<th>%Viruses Killed/Sterilized/Inactivated</th>
</tr>
</thead>
<tbody>
<tr>
<td>6- (75mw)</td>
<td>4.4%</td>
</tr>
<tr>
<td>7- (100mw)</td>
<td>5.8%</td>
</tr>
<tr>
<td>8- (150mw)</td>
<td>8.5%</td>
</tr>
<tr>
<td>10- (500mw)</td>
<td>25.7%</td>
</tr>
<tr>
<td>13- (2000mw)</td>
<td>69.5%</td>
</tr>
<tr>
<td>15- (4000mw)</td>
<td>90.7%</td>
</tr>
<tr>
<td>16- (5000mw)</td>
<td>94.9%</td>
</tr>
</tbody>
</table>

mw=Microwatt

More information on this study is available @ GreenCleanAir.com
Ultraviolet Germicidal (germ-killing) light is UV light in the “C” band (254 nanometers). It is invisible and is mostly filtered out of sunlight before it reaches earth’s surface. UV-C light Sterilizes germs by destroying the “T” bonds in their DNA or RNA. This prevents them from reproducing and they die soon after.

UV was artificially created in the 1890’s and later commercially used to kill waterborne viruses & bacteria in France in 1909 for safe drinking water in Paris and other cities.

By the 1930’s Duke University surgeons were using in operating rooms to reduce airborne bacterial and viral infections. In the 1930’s and 1940’s UV light was used in schools to successfully prevent airborne measles epidemics and in hospitals to prevent airborne disease transmission in the nurseries.
How Upper UV Room works to prevent airborne virus transmission

Infectious Viruses rise up into the upper air and are sterilized by UV light.

UV light “irradiates” the upper air and is safe because people’s eyes are not exposed to the UV light.
Fig. 4. Illustrates the plan of the hospital grounds and depicts the area which was isolated from the rest of the hospital by radiant disinfection of the upper air of all rooms and corridors.

McLean, RL  International Conference on Asian Influenza at The National Institutes of Health 1960  p36
Professor McDevitt installed upper room UV lights to replicate the success of the 1957 Flu pandemic.

“Air disinfection using upper-room (UV) light can lower the airborne concentrations of infective organisms in the lower part of the room, and thereby control the spread of airborne infections among room occupants. These data demonstrate that upper-room UVC has the potential to greatly reduce exposure to susceptible viral aerosols. These data may also be relevant to influenza, which also has improved aerosol survival at low RH.”

99.9% of airborne viruses were killed (inactivated) in just 6 minutes (.1 hour).

Inactivation of Poxviruses by Upper-Room UVC Light in a Simulated Hospital Room Environment McDevitt, James 2008 PloS ONE v3 e-page 3186.

This open source study is available @ GreenCleanAir.com
Again in 2012, Professor McDevitt published the results of installing upper room UV lights to replicate the success of the 1957 Flu pandemic experiment by Dr. RL McLean and this time he used airborne influenza viruses.

“Using our experimental system, we measured influenza reductions as low as 98.2% by comparing samples with the UV light on to subsequent samples control samples with the UV light off.

This work provides an essential scientific basis for designing and utilizing effective upper-room UV-C light installations for the prevention of the airborne transmission of influenza.”


This study is available @ GreenCleanAir.com
# Inactivation of Airborne Viruses by Ultraviolet Irradiation

**MARCUS M. JENSEN**

*Department of Medical Microbiology and Immunology, School of Medicine, University of California, Los Angeles, California*

Received for publication 11 May 1964

**TABLE 1. Inactivation of viral aerosols during passage through a helical baffled UV cell**

<table>
<thead>
<tr>
<th>Virus</th>
<th>Conc of virus suspension†</th>
<th>Amt of viral suspension dispensed per min</th>
<th>Air-flow rate through UV cell</th>
<th>No. of virus PFU collected per ft³ of air with</th>
<th>Percentage of virus inactivated by UV light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenovirus</td>
<td>3.4 × 10⁸</td>
<td>0.144</td>
<td>100 ft³/min</td>
<td>29,235</td>
<td>96.88</td>
</tr>
<tr>
<td>Coxsackie B-1</td>
<td>4.0 × 10⁷</td>
<td>0.143</td>
<td>200 ft³/min</td>
<td>28,010</td>
<td>91.31</td>
</tr>
<tr>
<td>Influenza A</td>
<td>1.0 × 10⁷</td>
<td>0.145</td>
<td>100 ft³/min</td>
<td>10,755</td>
<td>99.95</td>
</tr>
<tr>
<td>Sindbis</td>
<td>7.5 × 10⁴</td>
<td>0.150</td>
<td>200 ft³/min</td>
<td>9,000</td>
<td>97.50</td>
</tr>
<tr>
<td>Vaccinia</td>
<td>1.0 × 10⁸</td>
<td>0.128</td>
<td>100 ft³/min</td>
<td>27,522</td>
<td>≥99.99</td>
</tr>
<tr>
<td></td>
<td>2.0 × 10⁷</td>
<td>0.142</td>
<td>200 ft³/min</td>
<td>2,265</td>
<td>≤99.96</td>
</tr>
</tbody>
</table>

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This study is available @ GreenCleanAir.com

Jensen, Marcus INACTIVATION OF AIRBORNE VIRUSES BY ULTRAVIOLET IRRADIATION Applied Microbiology 1964 v12 p418

0 Infectious Flu Viruses at 100 & 200 cubic feet per min (cfm)
**Mechanical Air Filters can trap this % of Influenza Viruses:**

<table>
<thead>
<tr>
<th>MERV Rating</th>
<th>%Viruses Arrested (captured)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>1-5%</td>
</tr>
<tr>
<td>6</td>
<td>6.2%</td>
</tr>
<tr>
<td>7</td>
<td>7%</td>
</tr>
<tr>
<td>8</td>
<td>11%</td>
</tr>
<tr>
<td>10</td>
<td>12%</td>
</tr>
<tr>
<td>13</td>
<td>46%</td>
</tr>
<tr>
<td>15</td>
<td>71%</td>
</tr>
<tr>
<td>16</td>
<td>76%</td>
</tr>
<tr>
<td>17 (HEPA)</td>
<td>99.9%</td>
</tr>
</tbody>
</table>
Viruses can be captured & sterilized with a combination of MERV Filters & URV rated UV-C Light

- Adding filters and UV together in successive layers can provide a lethal force to both prevent the recirculation and reduce the levels of airborne viruses in occupied spaces.
- A MERV 10 filter alone captures only 10% or flu viruses whereas adding a Ultraviolet rating of URV 10 triples that total single pass capture/sterilization to 35%.
- A MERV 13 filter plus a URV 13 UV light rating can have an 84% capture/sterilize rate for influenza. That is a very achievable goal for any indoor space.
- Adding additional UV lamps to an URV 16 level combined with a MERV 16 rated filter can achieve a total single pass capture/sterilize/inactivation rate of 98.8% for influenza.
### Table 1. Filtration Rates of Design Basis Biological Weapon Agents

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Mean size, ( \mu m )</th>
<th>Filter Model and Removal Rates, Fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influenza</td>
<td>0.098</td>
<td>MERV 6 0.062, MERV 7 0.07, MERV 8 0.11, MERV 10 0.12, MERV 13 0.46, MERV 15 0.71, MERV 16 0.76</td>
</tr>
</tbody>
</table>

### Table 2. Ultraviolet Germicidal Irradiation Kill Rates of Design Basis Biological Weapon Agents

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Rate constant ( \text{cm}^2/\mu \text{W-s} )</th>
<th>ULTRAVIOLET GERMICIDAL IRRADIATION KILL RATES, FRACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influenza</td>
<td>0.001187</td>
<td>URV 6 0.044, URV 7 0.058, URV 8 0.085, URV 10 0.257, URV 13 0.695, URV 15 0.907, URV 16 0.949</td>
</tr>
</tbody>
</table>

### Table 3. Combined Removal Rates for Biological Weapon Agents

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Filtration and Ultraviolet Germicidal Irradiation Removal Rates, Fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influenza</td>
<td>MERV 6 0.10, MERV 7 0.12, MERV 8 0.19, MERV 10 0.35, MERV 13 0.84, MERV 15 0.97, MERV 16 0.988</td>
</tr>
</tbody>
</table>

More information on this study is available @ [GreenCleanAir.com](http://GreenCleanAir.com)
## Combined UV Light & Filtration Capture/Kill/Sterilize this % of Flu Viruses:

<table>
<thead>
<tr>
<th>MERV &amp; UVR Combined</th>
<th>% Viruses Killed/Sterilized</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>10%</td>
</tr>
<tr>
<td>7</td>
<td>12%</td>
</tr>
<tr>
<td>8</td>
<td>19%</td>
</tr>
<tr>
<td>10</td>
<td>35%</td>
</tr>
<tr>
<td>13</td>
<td>84%</td>
</tr>
<tr>
<td>15</td>
<td>97%</td>
</tr>
<tr>
<td>16</td>
<td>98.8%</td>
</tr>
</tbody>
</table>
HEPA Air Filters, UV Lights can Kill, Sterilize & Capture Viral Droplet Nuclei
Cases of Ultraviolet Lights Preventing Indoor Virus transmission and infection


## Japanese Hospital Humidity Guidelines

Table 1. An example of environmental control recommendations for hospitals in Japan. Used with permission (translated and slightly edited) from the Human and Society Environment Science Laboratory Co. Ltd, Japan (http://www.h-and-s.biz/index2.htm).

<table>
<thead>
<tr>
<th>section</th>
<th>location</th>
<th>summer dry-bulb temperature (°C)</th>
<th>summer RH (%)</th>
<th>winter dry-bulb temperature (°C)</th>
<th>winter RH (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>hospital ward</td>
<td>patient bedroom</td>
<td>24–26–27</td>
<td>50–60</td>
<td>22–23–24</td>
<td>40–50</td>
</tr>
<tr>
<td></td>
<td>nurse station</td>
<td>24–26–27</td>
<td>50–60</td>
<td>20–22</td>
<td>40–50</td>
</tr>
<tr>
<td></td>
<td>day room</td>
<td>26–27</td>
<td>50–60</td>
<td>21–22</td>
<td>40–50</td>
</tr>
<tr>
<td>outpatient department</td>
<td>consulting room</td>
<td>26–27</td>
<td>50–60</td>
<td>22–24</td>
<td>40–50</td>
</tr>
<tr>
<td></td>
<td>waiting room</td>
<td>26–27</td>
<td>50–60</td>
<td>22–24</td>
<td>40–50</td>
</tr>
<tr>
<td></td>
<td>dispensary</td>
<td>25–26</td>
<td>50–55</td>
<td>20–22</td>
<td>40–50</td>
</tr>
<tr>
<td></td>
<td>ER</td>
<td>23–24–26</td>
<td>50–60</td>
<td>22–26</td>
<td>45–55–60</td>
</tr>
<tr>
<td>central medical care areas</td>
<td>operation room</td>
<td>23–24–26</td>
<td>50–60</td>
<td>22–26</td>
<td>45–55–60</td>
</tr>
<tr>
<td></td>
<td>recovery room</td>
<td>24–26</td>
<td>50–60</td>
<td>23–26</td>
<td>45–50–55</td>
</tr>
<tr>
<td></td>
<td>ICU</td>
<td>24–26</td>
<td>50–60</td>
<td>23–26</td>
<td>45–50–55</td>
</tr>
<tr>
<td></td>
<td>general survey room</td>
<td>25–26–27</td>
<td>50–60</td>
<td>20–22</td>
<td>40–50</td>
</tr>
<tr>
<td></td>
<td>X-ray studio</td>
<td>26–27</td>
<td>50–60</td>
<td>24–25</td>
<td>40–50</td>
</tr>
<tr>
<td></td>
<td>X-ray operation room</td>
<td>25–26</td>
<td>50–60</td>
<td>20–22</td>
<td>40–50</td>
</tr>
<tr>
<td></td>
<td>hydrotherapy treatment room</td>
<td>26–27</td>
<td>50–65</td>
<td>26–28</td>
<td>50–65</td>
</tr>
<tr>
<td></td>
<td>dissection room</td>
<td>24–26</td>
<td>50–60</td>
<td>20–22</td>
<td>40–50</td>
</tr>
</tbody>
</table>

Julian Tang, MD, PhD. J. Royal Soc. Interface (2009) v6, pS737

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Now Liquid Desiccation systems can produce Clean Humidity

- New Patented Liquid Desiccant systems can add humidity to the air through micro-pores.
- This solves the problems of bacterial and fungal contamination that current steam and water spray humidification systems have. These systems can cause downstream contamination in the ductwork when droplets fall out and wet the surfaces.
- See my May 2010 article in Engineered Systems for more information @GreenCleanAir.com.
Public Health Officials advice on preventing the Flu

1. Wash your hands.
2. Cover your cough.
3. If you’re sick, stay home.
4. Get a Flu vaccination

This advice doesn’t address the problem of studies showing that up to 40% of infected influenza carriers have no symptoms.

It also doesn’t address both human airway aerosolization and toilet water flush aerosolization of viruses. These both are critical modes of airborne infectious disease transmission within indoor spaces.
Can Hand washing prevent flu transmission? CNN’s Elizabeth Cohen challenged the CDC

In my June 2009 EPA Flu presentation, I said: “Since your fingers can’t touch your lungs, washing your hands won’t likely prevent flu viruses from entering deep into your lungs.” I did this to indirectly challenge the CDC’s recommendation, widely heralded by the media that, aside from a flu shot, the best advice to prevent you from getting the flu was to “wash your hands”. I knew that there was no published scientific study anywhere which showed that someone with flu viruses on their fingers could infect themselves.

In September 2009, CNN Medical reporter Elizabeth Cohen was the first correspondent that pressed the CDC to produce the scientific documentation backing up their hand washing/sanitizing recommendation.

She pressed the CDC to admit that hand washing to prevent influenza flu transmission by self inoculation was not supported by any peer-reviewed, published papers anywhere: "We don't have solid data on the effect that hand washing has on the transmission of H1N1 (flu virus)," CDC spokesman Tom Skinner wrote in an e-mail to Ms. Cohen. That “lack of solid data” really means there’s no published data or paper or successful experiment showing someone getting the flu by hand inoculating themselves by touching their nose, lips, eye or mouth.

“Some doubt hand washing stops H1N1” CNN Elizabeth Cohen September 24, 2009
In Ms. Cohen’s article “Some doubt hand washing stops H1N1” (link below) she posits: “Hand washing: A false sense of security from H1N1? Some infectious disease experts said they're concerned messages from the CDC to wash hands to prevent H1N1 have given people too much faith in hand washing.

‘Washing hands really is wonderful for preventing many diseases, such as the common cold, but it's not very helpful to prevent influenza,’ said Arthur Reingold, professor of epidemiology at the University of California-Berkeley. ‘Everyone’s eager to promote hand washing, and certainly it won't do any harm, but to rely on a hand washing as a way to prevent influenza is a serious mistake,’ said Reingold.

Dr. Monto is a world renown influenza expert with over 60 peer reviewed & published articles on influenza: ‘Don't kid yourself that you're going to protect yourself from the flu completely by washing your hands,’ said Arnold Monto, a professor of epidemiology at the University of Michigan School of Public Health.”

She also reported: “Dr. Peter Palese, a professor of medicine and infectious diseases at Mount Sinai School of Medicine in New York City, said ‘hand washing isn't all that helpful against the flu because the flu isn't like other respiratory diseases. ‘The flu virus isn't very stable on the hand,’ he said. ‘The virus has a lipid membrane that flattens out when it's on your hand, and it gets inactivated.'
Recommendations to prevent and mitigate airborne flu transmission

1. **Seal** your filter rack & HVAC system.
2. Get the **highest MERV** rated filter that your air handling fan can tolerate.
3. Put as much **UV light** within your coil plenum to achieve a 99.9% single pass kill rate along with **Upper Room UV**.
4. Add **MERV 17 HEPA** Filtration for viral capture and inactivation.
5. Install **bathroom exhausts 1-12”** above the floor behind the toilet to capture aerosolized toilet water. **Supply in ceiling.**
6. **Coughing/sneezing occupants wear a mask** or stay at home.
How to Solve “Flu Season”

- Raise Humidity to 45%+
- Increase air changes to 12 per hour
- In-Duct UV Upper Room UV
- Toilet Seat Lowered Exhaust behind & below toilet
- MERV 13 + URV 13 UV Lights
- MERV 17 HEPA (best)

Flu Season Mitigated!
Toilet Aerosolization Studies

1959. Infective hazards of Water Closets. Darlow, HM, Bale WR  
Lancet  v6;1(7084) p1196  
“Any process involving the splashing or frothing produces droplets, which remain suspended in the air for a variable period depending upon the mass and evaporation-rate of the droplets, and the velocity and direction of the local air currents. Apart from explosive exhalations such as coughs and sneezes, the commonest process predisposing to the formation of infective aerosols must surely be the flushing of a water-closet.”  
More information about this article is available @ GreenCleanAir.com

1975. Microbial Hazards of Household toilets: Droplet Production and the Fate of Residual Organisms. Gerba, Charles  
Applied Microbiology 1975  v2 p229  
“It appeared that significant numbers of bacteria and viruses were being absorbed to the toilet porcelain and then eluted during the flushing action… viruses from experiments performed several days earlier were still present in the room.  
Click here for copy @ National Library of Medicine

Recovered an average of 1500 airborne viruses due to a toilet flush.  
Click here for copy @ National Library of Medicine

Click here for copy @ Journal of Applied Microbiology

2005. The potential spread of infection caused by aerosol contamination of surfaces after flushing a domestic toilet. Barker, John  
Journal of Applied Microbiology v99 p339.  “Aims: to determine the level of aerosol formation and fallout within a toilet cubicle after flushing a toilet contaminated with indicator organisms (viruses) at levels required to mimic pathogen shedding during infectious diarrhea.”  
Airborne viruses were still aerosolized 30 minutes and 60 minutes after the first flush.  
Click here for copy @ Journal of Applied Microbiology

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1966. Human Influenza from Aerosol inhalation. **Alford, RH**. *Proceeding of the Society Environmental Microbiological Medicine* v22 p800. Found that it took only .6 to 3 viruses to infect “volunteers” with aerosolized influenza. Contrast that with studies showing it took 330 viruses to infect someone nasopharyngeally. [More information about this article is available @ GreenCleanAir.com](http://www.greencleanair.com)

1970. An Airborne Outbreak of Smallpox in a German Hospital and its Significance with Respect to other Recent Outbreaks in Europe. **Bulletin of the World Health Organization**. “In a recent outbreak ... detailed epidemiological studies have clearly indicated that 17 of the cases were infected by virus particles disseminated by air over a considerable distance within a single hospital building ... several features ... were common similar to a similar outbreak in the Federal Republic of Germany in 1961 in which airborne transmission also occurred. [This open source study is available @ GreenCleanAir.com](http://www.greencleanair.com)

Nosocomial Influenza Infection as a cause of Intercurrent Fevers in Infants. **Hall, Caroline Breese**. **Pediatrics. V55 p673**. “Six of seven infants shed the virus for 7 to 21 days.” [More information about this article is available @ GreenCleanAir.com](http://www.greencleanair.com)

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Airborne Influenza in Dry Wintertime Indoor Air

Is 50%rh Indoor Humidity One Cure for “Flu Season”?

Environmental Protection Agency
Federal Interagency Committee for Indoor Air Quality
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