making wellness epidemic

Humidity Impacts Infection Spread and Susceptibility

Our health and our bodies are connected to indoor moisture

Our health and our bodies are directly connected to indoor moisture. Viable or infectious viruses are far more potent in low humidity than higher humidity. To compound this, while our immune system depends on well-hydrated tissues inside, our respiratory system depends on well hydrated mucus that lines surfaces from sinuses to lungs. When we are hydrated, we give up 43 g/m^3 ($grams/meter^3$) of warm moist air during exhalation. Only a fraction of that returns upon our next inhalation. The sweat glands within our lungs must rehydrate to make up the difference. When our bodies are dehydrated, this doesn't occur. With a loss of moisture in the lungs, neutrophil and other immune system activity is weakened. When hydration falls below 65%, your immune system becomes ineffective against most inhaled pathogens, as is the case with cystic fibrosis.[1]

Viruses are 10-100X more viable in dry air

A virus exhaled into drier air has droplet sizes from 100-2000 nanometers. These are instantaneously dried and potent and can be infectious for months. This relationship has been observed and tested by releasing virus laden mucus into varying levels of relative humidity (RH). An overwhelming volume of viable virus laden nano-droplets are dispersed and found in low RH conditions.[2] As even the lowest grade fever is associated with viral shedding, the presence of most any fevered person in a low moisture environment is a highly contagious combination.

Dry lungs → inactive immune cells

While relative humidity (RH) between indoor and outdoor seem to have nothing in common, both indoor and outdoor absolute humidity (AH) are near identical when the outdoor is below room temperature. Therefore, if outdoor AH changes in a region from moist to dry then it follows that the indoor AH of homes and buildings in the region do the same. The dehydrated mucous linings of the respiratory tracts of that regional population will become more susceptible to infection. This occurs when temperature and/or dew point is below 70°F. The lower the AH or dew point, the more likely transmission of virus will occur.

Dryness in cold weather or moisture changes in warm weather → super spread conditions

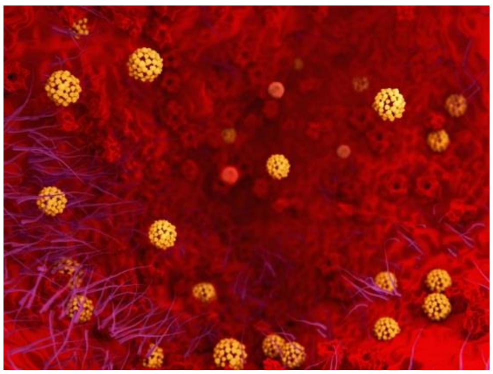
All large scale airborne epidemics and pandemics are viral and are spread indoor during times of low AH or low dewpoint. welloWatch is a free app that signals risk of disease spread and susceptibility in real-time using a three color, red, yellow, green scale. Assuming room temperature is 70°F, then severe, super-spread risk is when RH is at 28% or lower, high risk is between 29-39% RH, and RH between 40-70% correlates to low risk. Similarly, when the changes in dew point averaged over the prior 3 days is -15°F or greater, susceptibility is severe. A 5-15°F change in dew point equates to high risk susceptibility. Changes less than 5°F in dewpoint are low risk for susceptibility.[2,3]

3939 Belt Line Road ◦ #540 ◦ Addison, TX 75001 P: 469.522.5200 www.welloinc.com

Historical Data from welloWatch reveals SARS path in Hong Kong

During March 2003, Hong Kong experienced their normal subtropical high level of humidity. An otherwise healthy 27-year-old checked into the esteemed Prince of Wales Hospital in Hong Kong with influenza symptoms in early March that turned out to be SARS. He and six others had been exposed from a fevered spreader at a hotel in late February they had no casual or direct contact with. The spreader had merely stayed on the same floor of the hotel after being infected from treating patients with "atypical pneumonia" in Mainland China.[4] The incubation period for SARS in healthy adults is two to seven days.

welloWatch illustrates super-spreader conditions present 5 days prior to outbreak



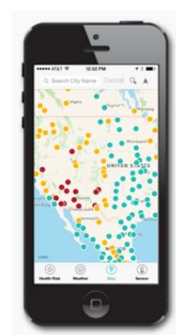
Weather patterns contained in the Wello historical data reveal that five days before the widespread and deadly SARS outbreak, Hong Kong had an unusual drop in dew point, absolute humidity, and indoor relative humidity resulting in an increased susceptibility of the population from a more potent excretion of viable SARS virus. A population of six million residents in an island-like region were susceptible to these super-spreading conditions.

welloWatch shows low indoor humidity before SARS outbreak

By March 6th the indoor humidity of most apartments and offices dropped to approximately 15 g/m^3. The hydration of the well population's respiratory system was compromised due to these dry conditions. By noon on March 7th, 2003, the residents of Hong Kong, patients and non-patients at Prince of Wales Hospital were subjected to extremely dry conditions now 6 g/m^3 or 14% of their breath's moisture.

Catastrophic conditions present at outbreak point according to welloWatch

By March 10th and 11th over 50 more people were afflicted including eighteen healthcare workers. By the time this new SARS outbreak was detected on March 10th, the moisture level in Hong Kong almost tripled resulting in a cessation of the super-spread conditions. These events were then detectable and avoidable by rigorous sub-acute fever screening and improved indoor isolation of the acutely ill to protect the healthcare workers.



Sources:

1 Matsui H, Verghese MW, Kesimer M, Schwab UE, Randell SH, Sheehan JK, Grubb BR, and Boucher RC. Reduced Three-Dimensional Motility in Dehydrated Airway Mucus Prevents Neutrophil Capture and Killing Bacteria on Airway Epithelial Surfaces. *J Immunol*. 2005; 175: 1090-1099

2 Yang W, Elankumaran S, Marr LC. Relationship between Humidity and Influenza A Viability in Droplets and Implications for Influenza's Seasonality. *PLOS ONE*. October 2012; 7(10): e46789

3 Yang W and Marr LC. Mechanisms by Which Ambient Humidity May Affect Viruses in Aerosols. *Applied and Environmental Microbiology.* October 2012; 78(19): 6781-6788

4 Hung LS, MD FFCM. The SARS epidemic in Hong Kong: what lessons have we learned? *JR Soc Med*. August 2003; 96:374-378