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Humidification and Novel Coronavirus

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Executive Summary

- Maintaining between 40% and 60% RH in living and working spaces improves overall health and lowers potential risk for transmission of viral diseases including influenza and COVID-19.
- Our bodies natural defense mechanisms are impaired under dry indoor conditions.
- Humidification plays a vital role in indoor air quality.

Coronavirus, SARS-2-CoV, and COVID-19

In January 2020, a novel strain of Coronavirus, SARS-2-COV, emerged in mainland China, and became pathogenic to humans.[1] This virus is responsible for the current pandemic of COVID-19 (Coronavirus Disease). Symptoms of COVID-19 appear approximately 2-14 days from the point of infection. The symptoms include fever, cough and body ache. A subset of infected individuals will experience more dire symptoms including shortness of breath, persistent pain and pressure in the chest, which can lead to pneumonia. These individuals should seek emergency medical care. Approximately 20% of total cases require hospitalization. About half of hospital admissions are older adults (ages 65 and over), an age group that faces the most serious complications of the disease.[2]

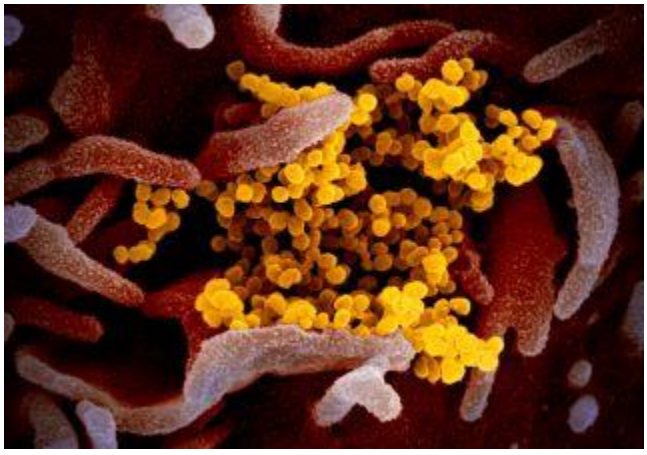

Figure 1: Scanning electron microscope image shows SARS-CoV-2 (yellow) among human cells (pink). This virus was isolated from a patient in the U.S. (Color has been added to the image to better show the virus and its environment.) (Image: © NIAID-RML)

Humidification, Human Health, and Viral Infection

In cold climates where buildings and homes are heated during winter months, relative humidity can fall below values ideal for human health (i.e. <30%). This can cause dry skin[3], irritated eyes[4], and a persistent cough[5].

Humidifiers are an ideal solution for making dry indoor air more comfortable. Simple plug-in countertop humidifiers are popular in homes for temporary use when a resident is suffering upper

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respiratory illness. Whole-home evaporative pad style humidifiers are often installed in the supply-air duct near the furnace. These work well with heating systems that have high plenum temperatures (>120°F). More and more homes are being heated by “heat pumps” which have low plenum temperatures (<80°F), where pad style humidifiers are ineffective and electric steam (isothermal) humidifiers are recommended.

In commercial spaces, isothermal humidifiers have become more prevalent in the last 40 years, especially in healthcare facilities. This, in part, is due to ASHRAE guidelines[6].

By raising relative humidity in indoor environments, humidifiers can improve general health and well-being[7-8]. In addition, a variety of studies have shown the incidence and the severity of viral diseases, such as those caused by coronavirus and influenza, are lower when relative humidity is between 30% and 60%[9-10].

People contract viruses (such as influenza or coronaviruses) when touching surfaces or through contact with air contaminated with droplets of virus (e.g. from a cough or sneeze). The viruses generally enter the body through the eyes, mouth, or airways. Experiments have shown coronaviruses to survive for up to five days on stainless steel, other metals, glass, paper, and Teflon[11]. They can remain active on some plastics for up to 9 days. While we have limited understanding of SARS-2-COV, other coronaviruses and influenza viruses are least infectious when RH is maintained near 50%[12].

Once airborne, temperature and relative humidity influence the viability of viruses by affecting the properties of the viral surface proteins and lipid membrane. Results from experiments where viruses were nebulized into various indoor environments show the highest stabilities at low (e.g. <40%) and high (>80%) relative humidity. These studies show the virus remains infectious longer at low RH conditions typical of non-humidified spaces in winter[13]. Thus, humidifying spaces may reduce transmission of influenza and coronaviruses.

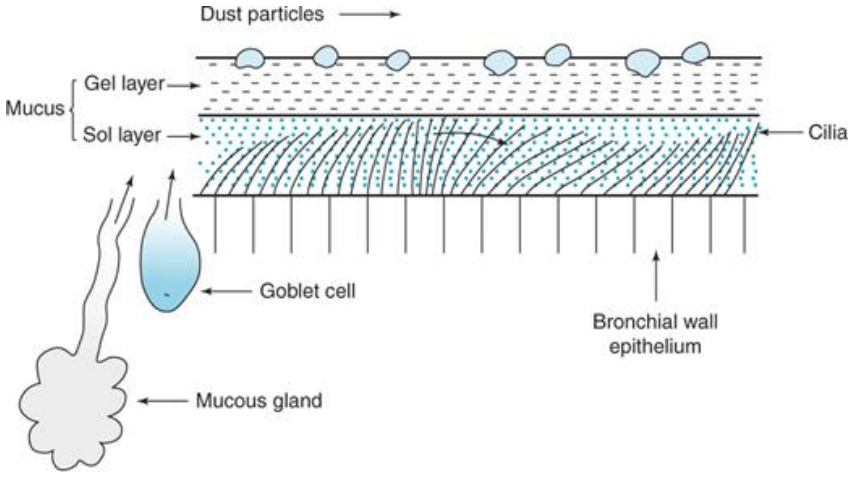

Figure 2: The MCC and underlying epithelium. Damage to the MCC from dry air can increase risk of viral infection. Both mucous glands and goblet cells contribute mucuous to the MCC (Levitzky, MG; Pulmonary Physiology. Eighth Edition.

We are most commonly exposed to viruses through our respiratory tracts. Mucus lines our upper airways and acts as the first intrinsic barrier against viral infection. Mucus is over 90% water, thus it is important for our bodies to maintain hydration. The inhalation of cold air, which is always dry due to the limited water vapor capacity, can cause impairment of our mucocillary clearance (MCC, part of the self-clearing mechanism of the airways in the respiratory system, Figure 2). When we warm cold environments without adding humidity, it has the same effect. The MCC acts as a key mechanism for eliminating inhaled pathogens, microbes and irritants from the respiratory epithelial surface. An impaired MCC will leave an individual more susceptible to risk of viral infection.

Dry air can also damage the respiratory epithelial surface, which is the second line of defense against viral infection. The continued inhalation of dry air can cause epithelial cell loss, and the inhibition of cellular repair. Overall, the impact dry air has on the integrity of our respiratory surfaces is thought to influence the prevalence of respiratory viral infections during winter months[14-15].

The impact of humidity on increased infection rates has been borne out in empirical and population studies. Virus transmission between guinea pigs has shown to be most efficient under low relative humidity[16], similarly, low outdoor relative humidity was found to contribute to the severity of MERS-CoV (Middle East Respiratory Syndrome) outbreaks[17]. These studies concluded that in cold and dry climates, dry indoor conditions promoted transmission from aerosolized viruses entering the respiratory tract, while in warmer more tropical environments contact transmission was more prevalent.

In fact, recent building guidelines have outlined the critical need for humidification to help optimize indoor air quality for human health[18].

In summary, these points emphasize the positive role humidification plays in offices and health care facilities on par with frequent cleaning of surfaces and handwashing.

Neptronic Humidification Solutions

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Electric

- Capacities from 6 - 300 lb/hr
- Remove chamber easily, without tools
- Outdoor unit available

SKG4

Gas Fired

- Capacities from 110 - 810 lb/hr
- Modular design
- Outdoor unit available

SKS4

Steam to Steam

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- Insulated external panels

SKR

Residential

- Capacities from 4.5 - 12 lb/hr
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- Reliable siphon drain

SKH

High Pressure Atomizer

- Capacities up to 4638 lb/hr
- Up to 10 zones
- Installation in-duct or in-space

SKV

Evaporative

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- Custom design to fit your application
- Hygienic operation with silver ion dosing system

SKD

Direct Steam

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- Jacketed or Multi-Steam™ SD/HD
- Unique electronic steam controller
- Optional pressurized condensate return (PCR) system

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Steam Distribution

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- SDU (Space distribution unit)

Controls

Humidity Controls

- Humidity controls/sensors
- Safety controls
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