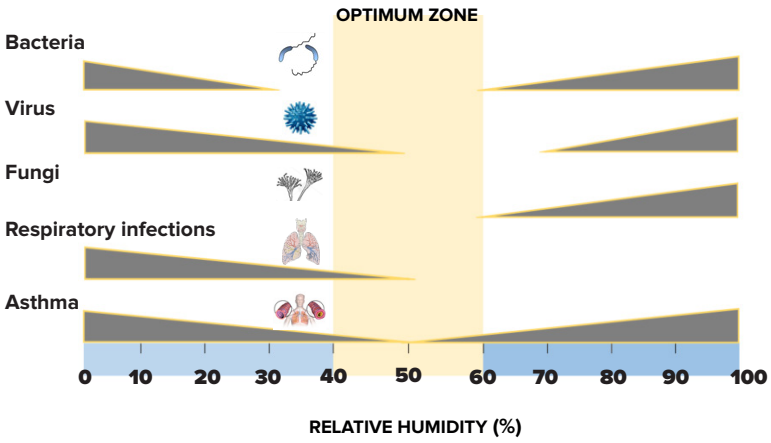
HUMIDIFICATION

FIGHTS AGAINST BIOAEROSOL INFECTIVITY - WHITE PAPER

1.0 BARRIER GESTURES

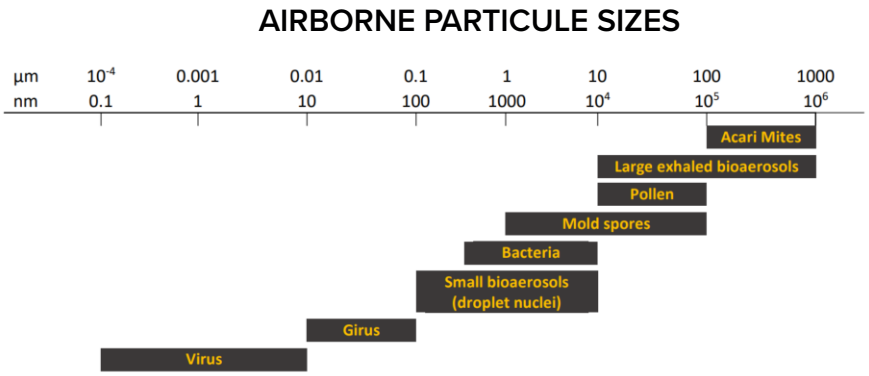
Masks and barrier gestures like regular hand washing and coughing and sneezing into one's elbow are key to controlling transmission of bioaerosols. But they also requires people to accept and execute the practices. By controlling relative humidity in the air to 40 - 60% you can help reduce the bioaerosols and ultimately the transmission of germs in the air.



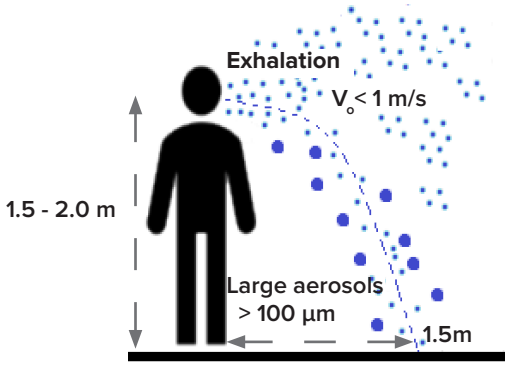
2.0 Bioaerosol Transmission

2.1 What are bioaerosols?

Bioaerosols are airborne biological particles derived from virus, bacteria, fungi, protozoa, algae, mites, plants, insects and their by-products, fragments and cell mass components [11].



Exhaled bioaerosols



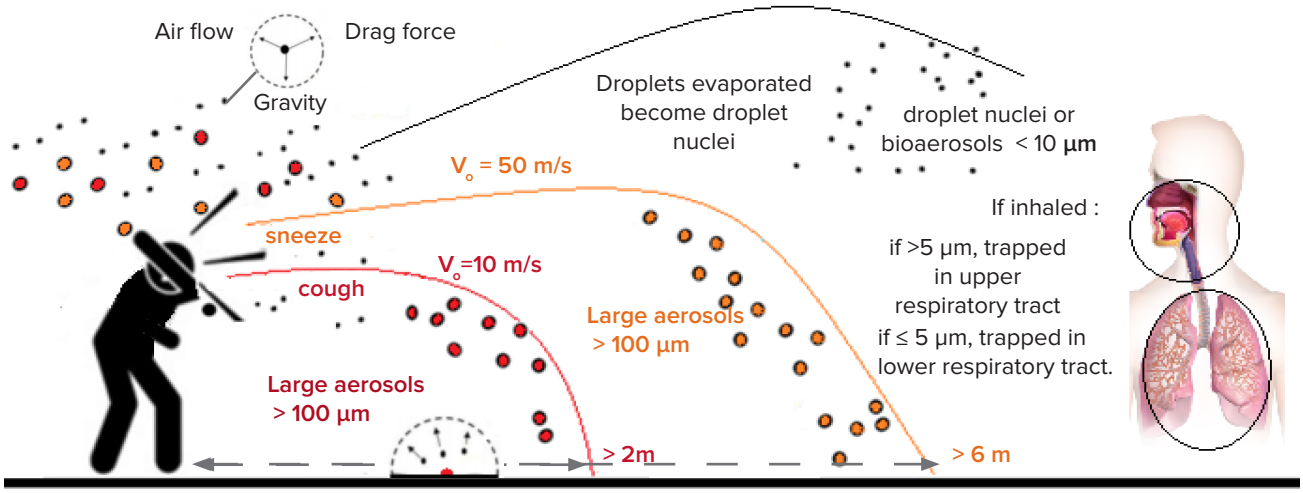
They fall 1.5 -2.0 m:

- in less of 6 seconds if diameter > 1mm
- in ~ 6 seconds if diameter ~ 100 µm
- in ~ 8 minutes if diameter ~ 10 µm
- in ~ 1.5 hours if diameter ~ 3 µm
- in ~ 12 hours if diameter ~ 1 µm
- in ~ 41 hours if diameter ~ 0.5 µm (4) (5)(7)

Note: 87% of exhaled bioaerosols are < 1 µm. (6)

2.2 Bioaerosols emited by coughing or sneezing

Droplets are swept by air motion and fall due to gravity. Their fall is resisted by drag force.



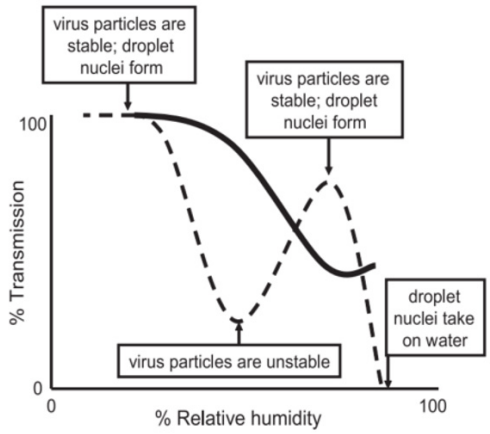
(1)(5)(6)(10)

3.0 Correct Relative Humidity Reduces Bioaerosol Transmission

To reduce the droplet evaporation process [5]**:** large droplets are less rapidly changed into droplet nuclei.

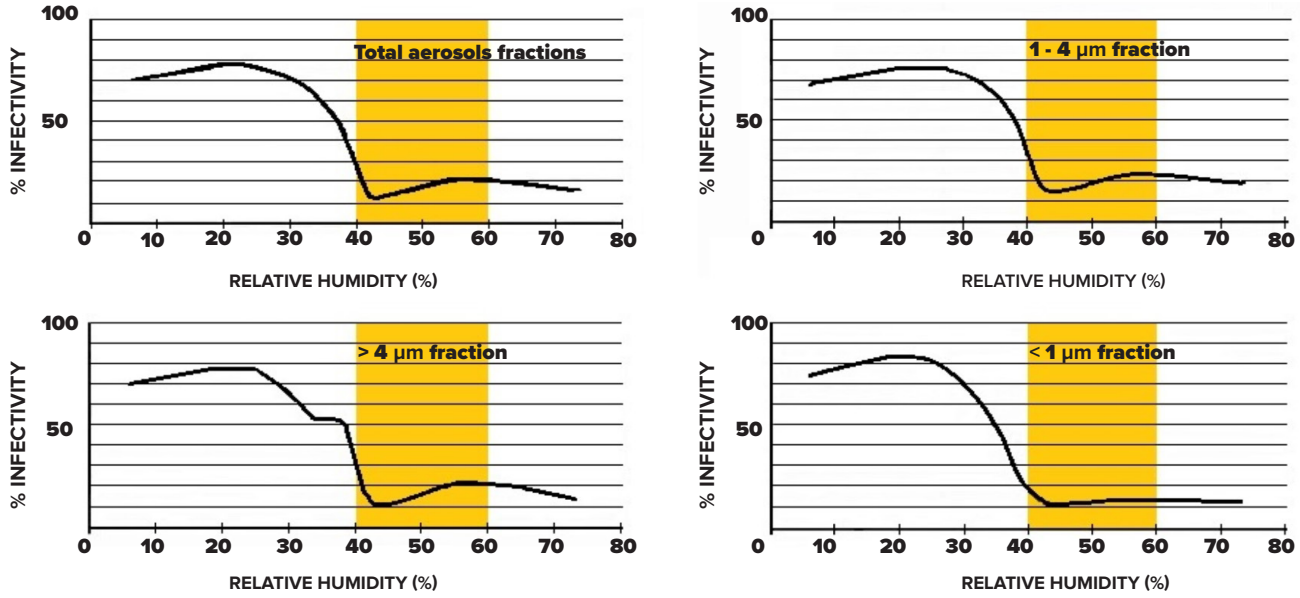
To reduce the transmission efficiency of virus airbornes:

"At 20°C (dashed line), transmission efficiency is highest at low RH, when influenza virions in an aerosol are relatively stable, and desiccation of exhaled respiratory droplets produces droplet nuclei. Transmission is diminished at intermediate RH when virus particles are relatively unstable, but improves in parallel with influenza virus stability at higher humidities. At high RH, evaporation from exhaled particles is limited, respiratory droplets settle out of the air, and transmission is blocked" [8]



Variation of transmission efficiency with relative humidity

To reduce the bioaerosols infectivity:



"At constant temperature (20°C) high humidity reduces the infectivity of influenza." [9]

Sources:
(1) COVID-19: Why We Should All Wear Masks, Sui Huang.
(2) C. Mike Scofiel, P.E., and Elia Sterling. Dry Climate evaporative cooling with refrigeration backup, ASHRAE Journal 1992
(3) 2016 ASHRAE HVAC Systems and Equipment Handbook, Chap 22. Humidfiers
(4) Wells, W. F., On Air-borne Infection. Study II. Droplets and Droplet Nuclei. Journal article: American Journal of Hygiene 1934 Vol.20 pp.611-18
(5) ASHRAE Position Document on Airborne Infectious Diseases Approved by ASHRAE Board of Directors April 14 , 2020
(6)Fabian P, McDevitt JJ, DeHaan WH, Fung ROP, Cowling BJ, et al. (2008) Influenza Virus in Human Exhaled Breath: An Observational Study. PLoS ONE 3(7):e2691. doi:10.1371/journal.pone.0002691
(7) Natural Ventilation for Infection Control in Health-Care Settings Editors: James Atkinson, Yves Chartier, Carmen Lúcia Pessoa-Silva, Paul Jensen, Yuguo Li, and Wing-Hong Seto. Geneva: World Health Organization; 2009.
(8) Lowen AC, Mubareka S, Steel J, Palese P (2007) Influenza virus transmission is dependent on relative humidity and temperature. PLoS Pathog 3(10): e151. doi:10. 1371/journal.ppat.0030151
(9) Noti JD et. al, High Humidity Leads to Loss of Infections Influenza Virus from Simulated Coughs, PLoS ONE 8(2): e57485, 2013
(10) Blausen.com staff (2014). "Medical gallery of Blausen Medical 2014".
(11) 2017 ASHRAE Fundamentals Handbook, Chap 10. Indoor environment health

Author: P.E. David, Pharmacist and HVAC Specialist at Armstrong International