Overview of Disease Resilient and Energy Efficient Centralized Air-conditioning Systems

INTRODUCTION

- Indoor Air Quality
  - Thermal Comfort
  - Indoor Air Pollutants
  - Particulate Filtrations
- Indoor Air Quality and Health
  - Long and short-term Effects
  - Identifying problems in Indoor Air Quality
  - Methods to improve indoor air Quality

Indoor Environment:

- Aerosolization of infection
- Relative Humidity
- Temperature

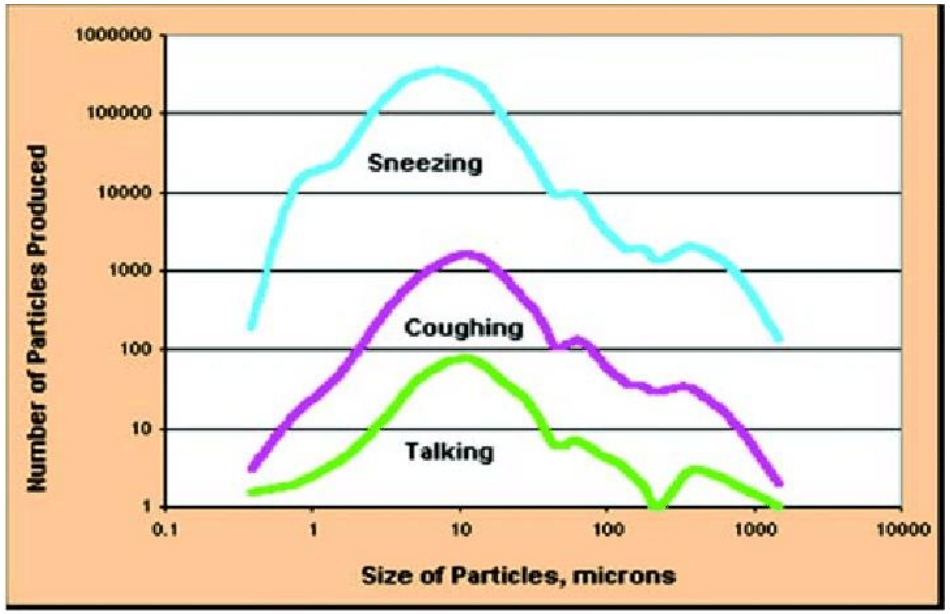
Disease Resilience and Indoor Air

Is the Virus Air-Borne & can it spread thru Air-con?

Ventilation and filtration provided by heating, ventilating, and air-conditioning systems can reduce the airborne concentration of SARS-CoV-2 and thus the risk of transmission through the air.

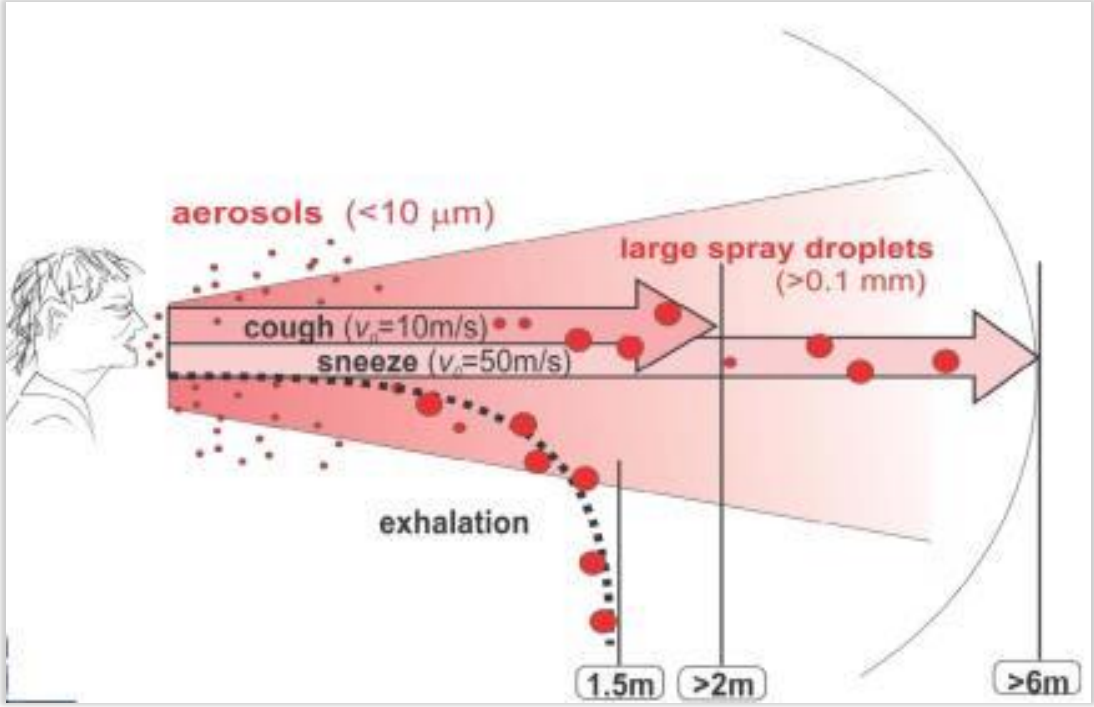
Unconditioned spaces can cause thermal stress to people that may be directly life threatening and that may also lower resistance to infection.

COVID 19 TRANSMISSION ROUTES



Droplets and small particles of a broad spectrum of diameters get generated during the course of coughing & sneezing and to a lesser extent by even talking and breathing

COVID 19 TRANSMISSION ROUTES



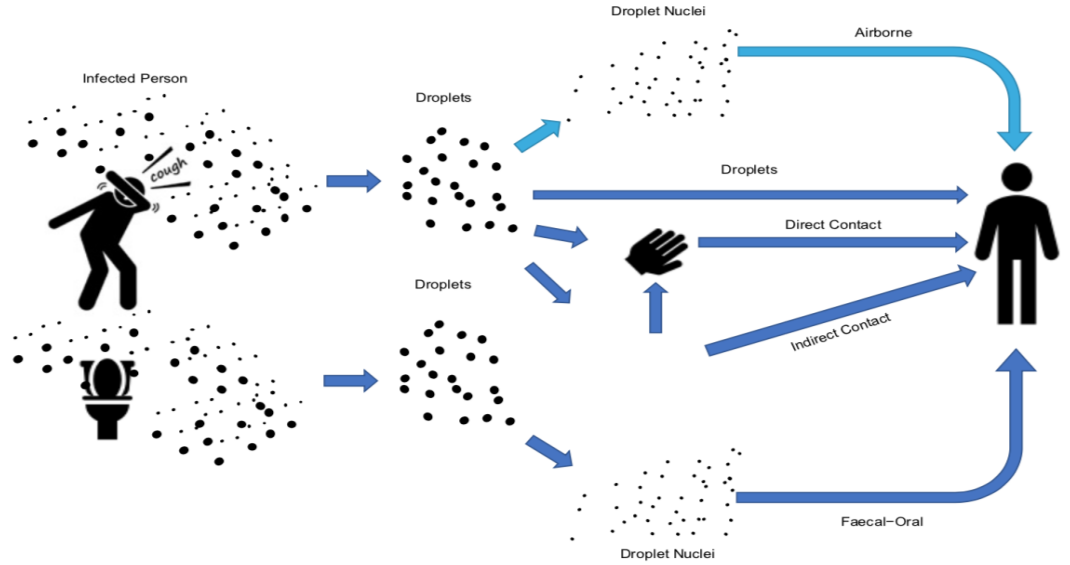


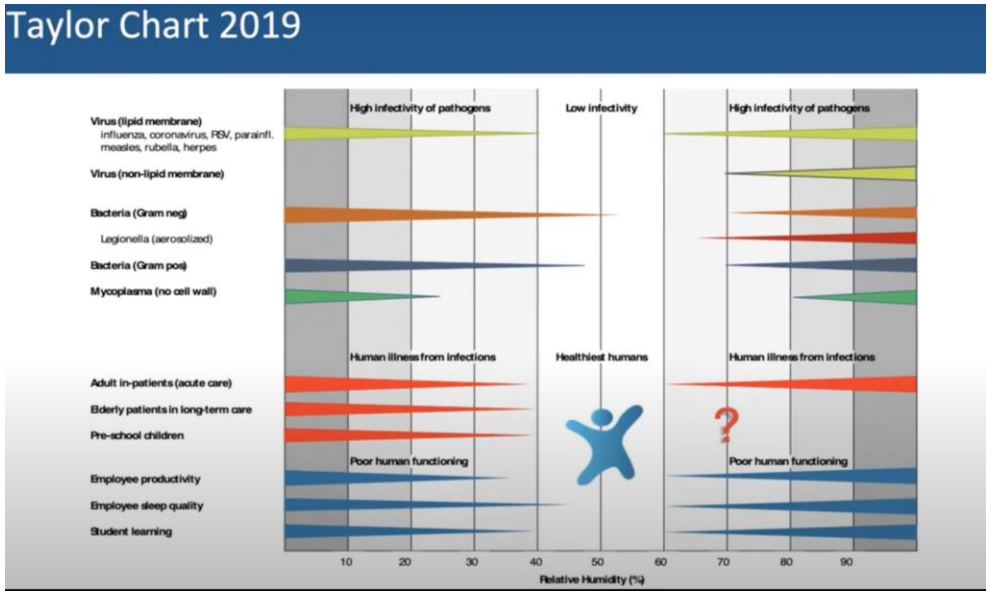
Figure 1. WHO reported exposure mechanisms of COVID-19 SARS-CoV-2 droplets (dark blue colour). Light blue colour: airborne mechanism that is known from SARS-CoV-1 and other flu, currently there is no reported evidence specifically for SARS-CoV-2 (figure: courtesy Francesco Franchimon).

The large cough droplets fall on nearby surfaces & objects, such as desks & tables. People can get infected by touching those contaminated surfaces; and then touching their eyes, nose or mouth.

Relative Humidity

- ***Infectivity and survival of Virus***
- ***Impact on air borne transmission***
- ***Impact on respiratory route***

RH : Effectivity of Virus



Researchers have found that higher humidity decelerates the spread of the virus.

RH : Impact on air borne transmission

With lower humidity, infected droplets from cough, especially smaller than 0.5 micron evaporate fast & become even smaller & remain suspended in air for a long time. Thus, with lower humidity more such small infected particles would remain suspended for a long time in the air.

When air is dry it is more difficult to clean surfaces due to re-suspension and re-settling of particles

Infectious droplets shrink, travel far and evade surface cleaning when air is dry

ADB

Temperature

- ***AIRBORNE*** :: Studies conducted at various RH levels have shown that using viral culture methods low temperatures (7–8 °C) were optimal for airborne influenza survival, with virus survival decreasing progressively at moderate Temperatures (20.5–24 °C) and further decreases at higher (greater than 30 °C) temperatures.

- ***SURFACES*** :: As per some recent studies, SARS-CoV-2 has been found highly stable on surfaces for 14 days at 4 °C; one day at 37 °C and 30 minutes at 56 °C were needed to inactivate the virus.

Strategies for SAFE ENVIRONMENT

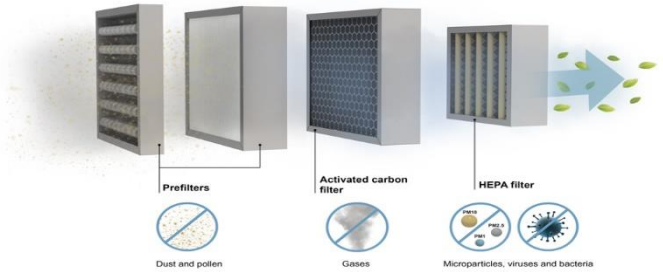
- Use of Standards from ASHRAE and ISHRAE for good Air Quality
- Increase the filtration levels in case of recirculation’s.
- Add maximum fresh air possible.
- Use UVGI technologies at AHU and Ducts and upper surfaces
- Maintain good thermal conditions including RH
- Maintain social distances
- Must wear Masks

Strategies for SAFE ENVIRONMENT

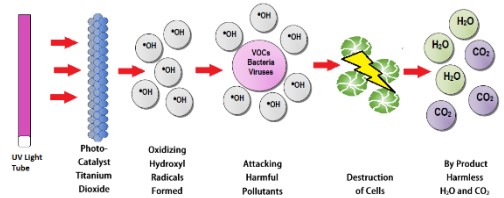
- **Passive Filtration**

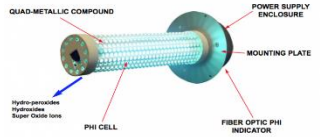
The various combinations of these filters

are also used for more critical requirements



- UVGI
- **Active Technologies –**
  - Ionisations
  - Electro Static Precipitators (ESP)
  - Photocatalytic Oxidation (PCO)
  - Photo-hydro-ionization PHI





NOTE - Few of the active technologies are called as Emerging Technologies by WHO and the efficacy of these systems in real applications are yet to be established

RECOMMENDATION

Few strategies for maintaining safe indoor environment from COVID-19 in enclosed areas are as mentioned below.

- Increase Ventilation rate – Mechanical or natural. By adding with 2 to 4 outdoor Air Changes per hour.
- Increase Filtration level – The filter rating of MERV 13 or above is recommended
- Temperature – For good and acceptable Thermal comfort

RECOMMENDATION

- Humidity - For good and acceptable Thermal comfort and to reduce the survival rate of Covid-19
- Air distribution – Check the flow to reach out to all areas
- Balancing of Air for supply and exhaust for ventilation.
- Monitoring of Indoor Air Quality to check the outdoor air.

THANK YOU FOR YOUR ATTENTION