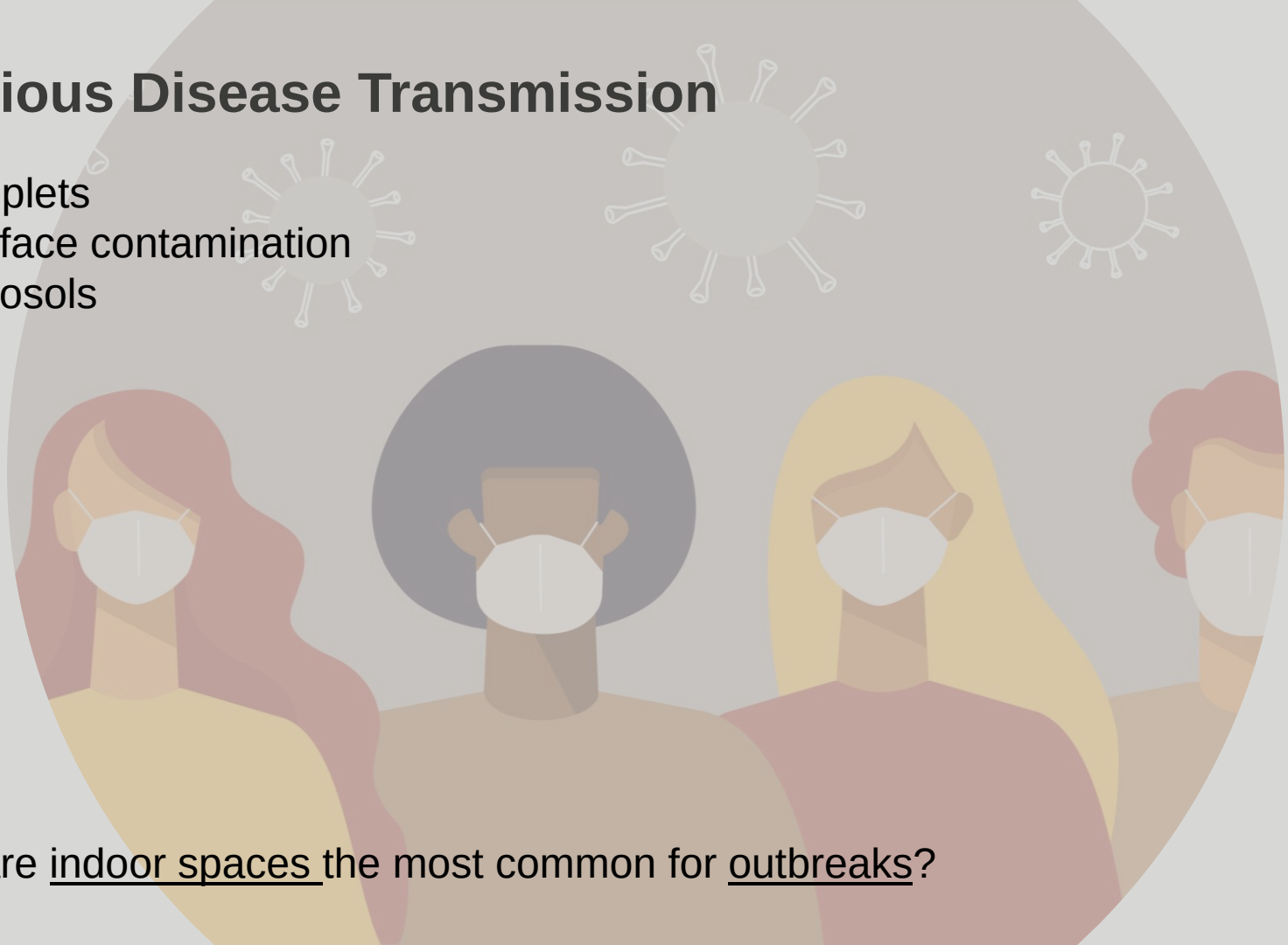
# *NOT* Another COVID-19 Webinar

# Infectious Disease Transmission

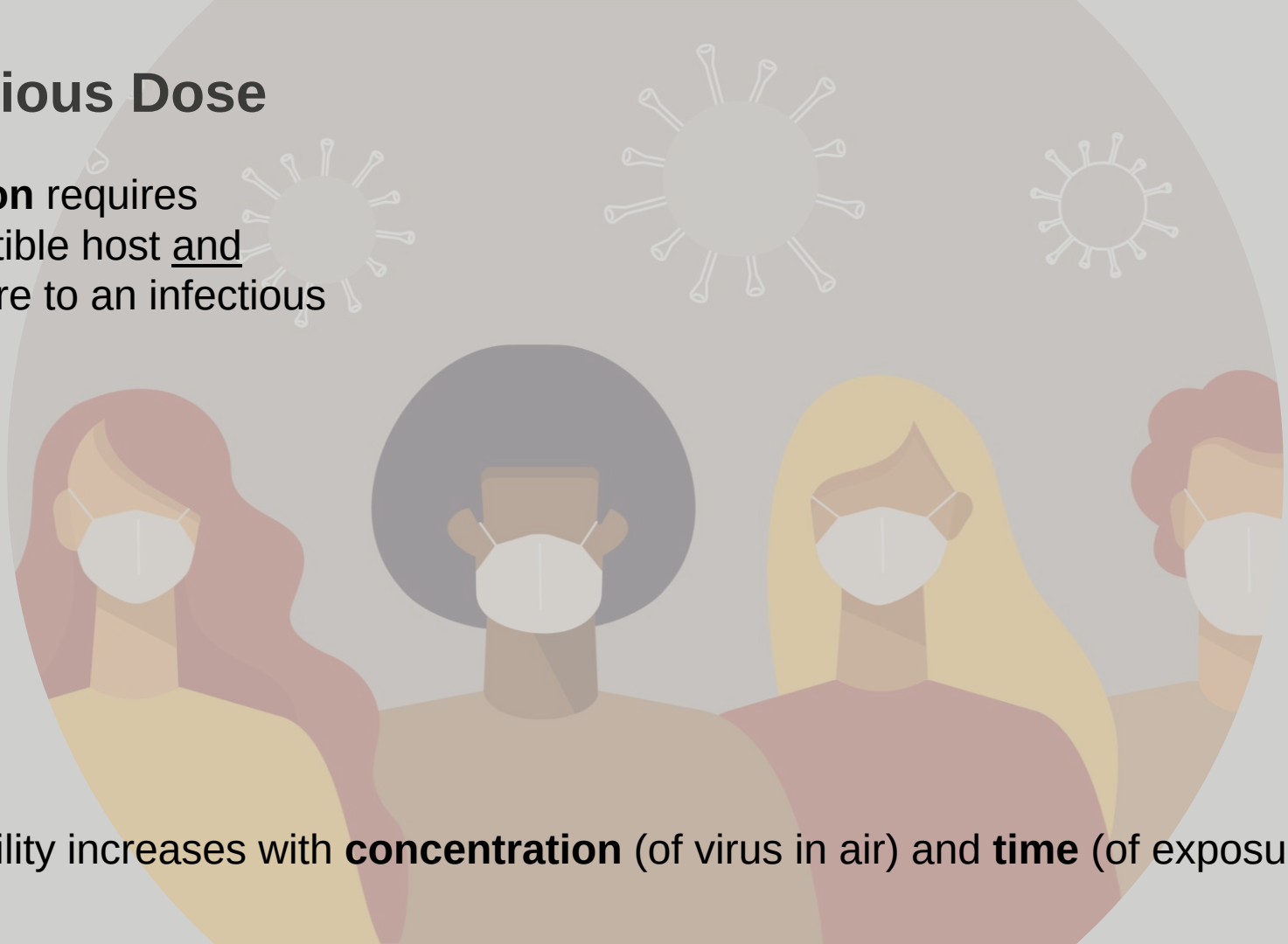
- Droplets
- Surface contamination
- Aerosols



Why are indoor spaces the most common for outbreaks?

# Infectious Dose

**Infection** requires susceptible host and exposure to an infectious dose.

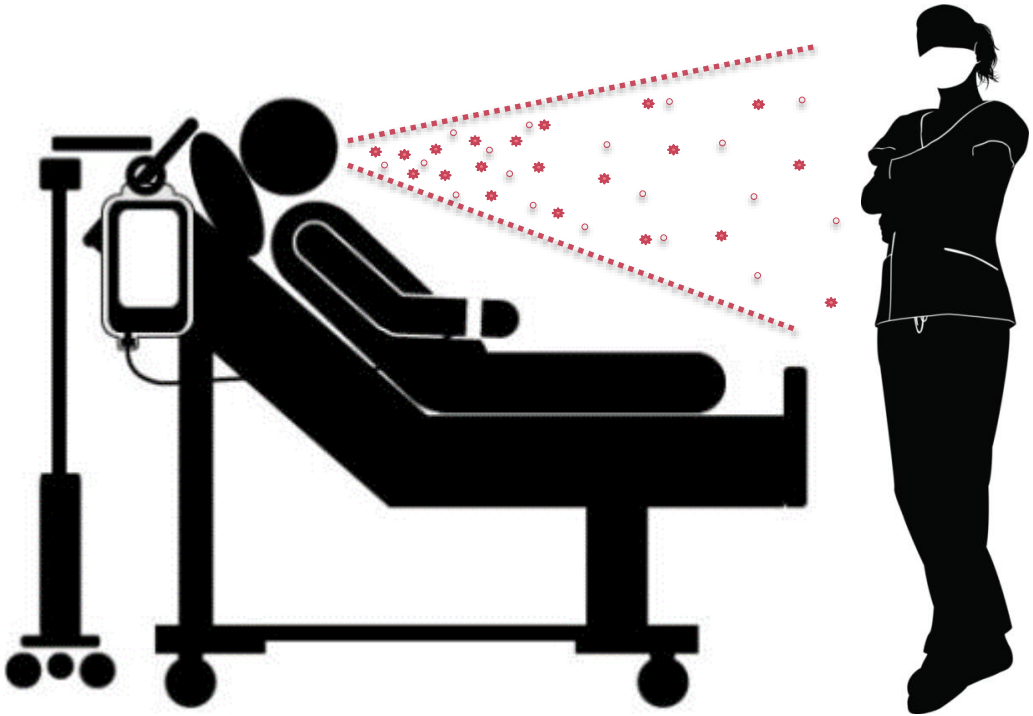


Probability increases with **concentration** (of virus in air) and **time** (of exposure)

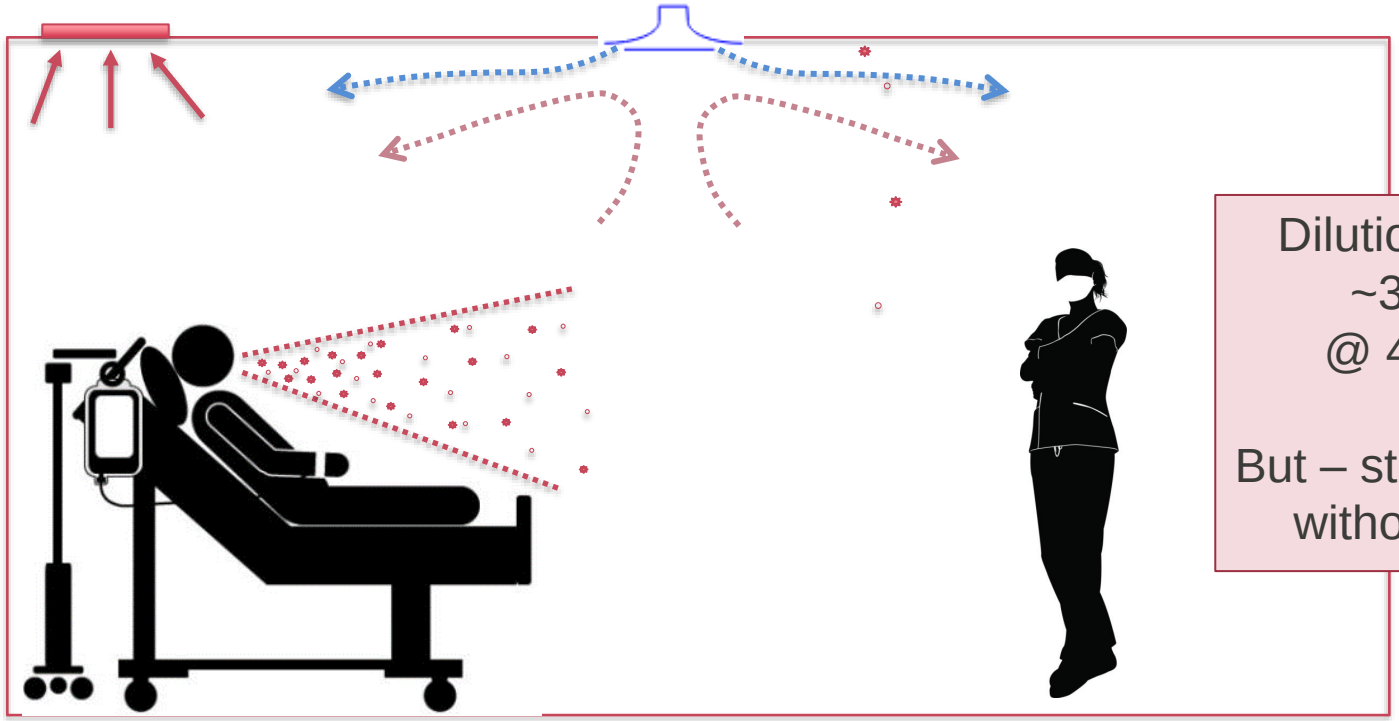
# Aerosol Transmission

1. Plume
2. Room
3. System or building

# Plume



# Room



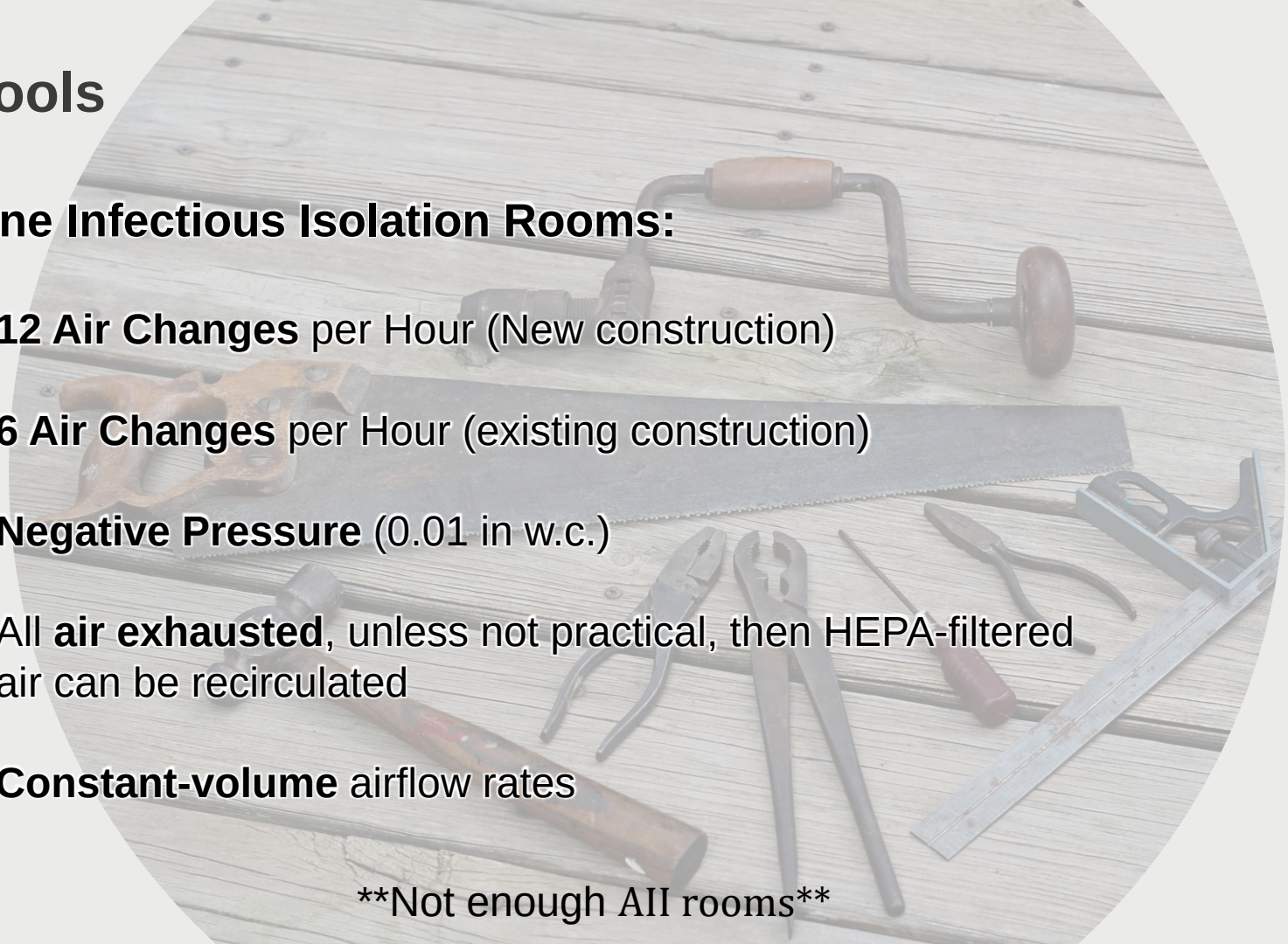
Dilution factor
~300:1
@ 4 ACH

But – still not safe without PPE

# System or Building


Dilution factor Could be 10,000:1 or more

# Old Tools

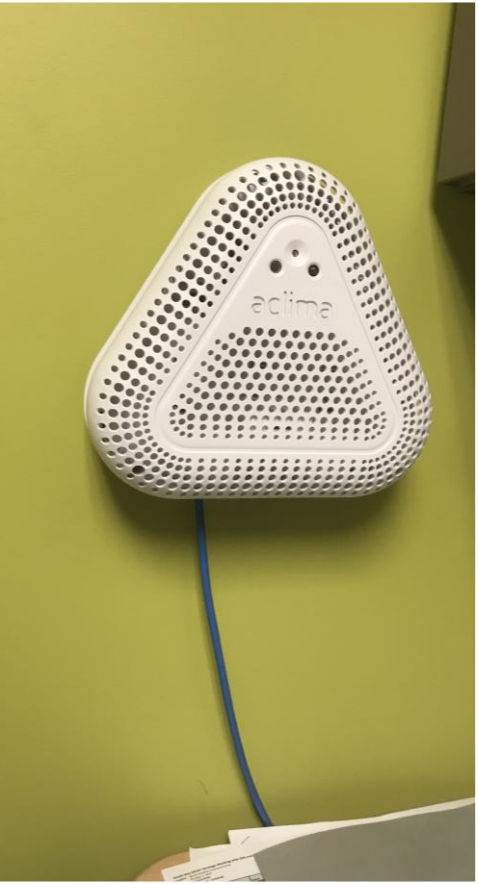


**Airborne Infectious Isolation Rooms:**

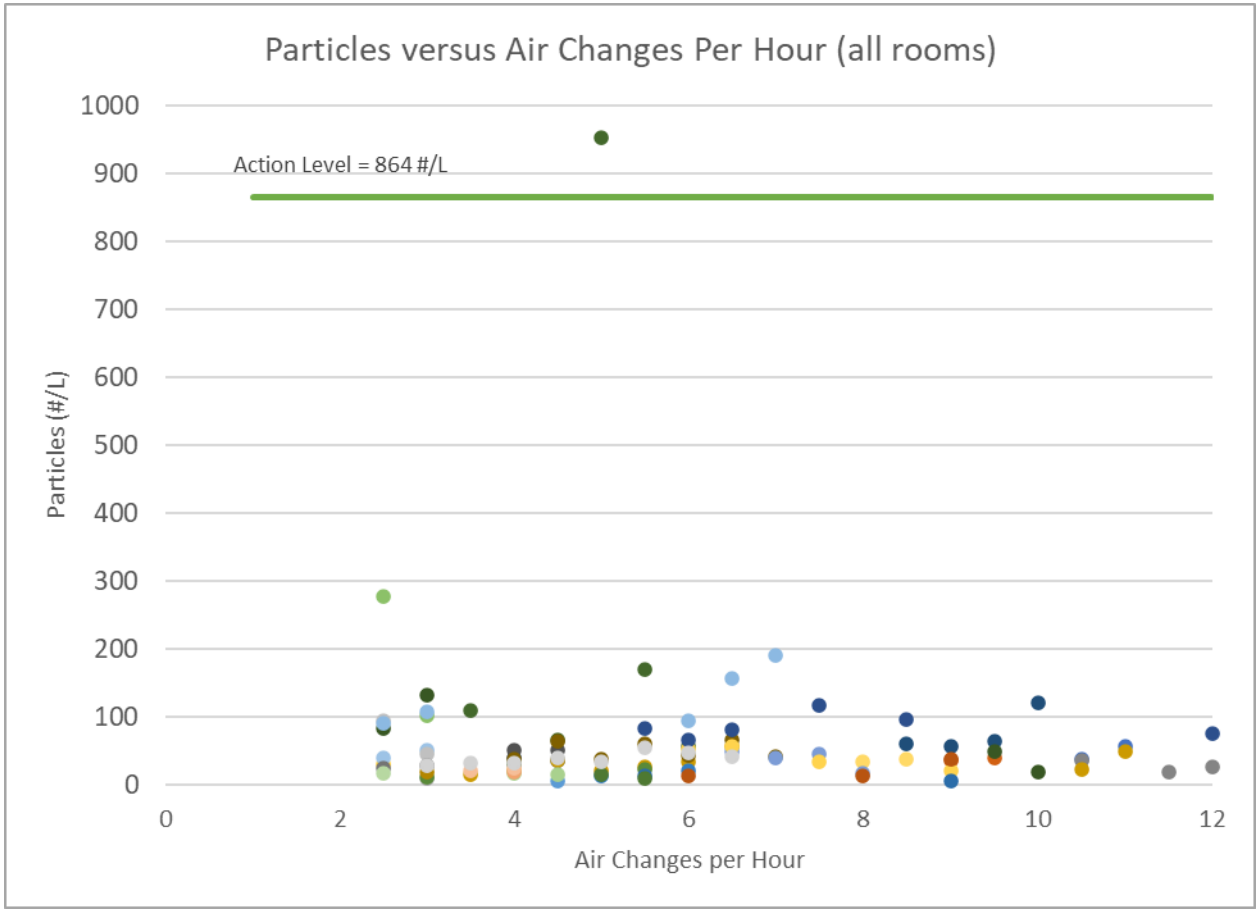
- **12 Air Changes** per Hour (New construction)
- **6 Air Changes** per Hour (existing construction)
- **Negative Pressure** (0.01 in w.c.)
- All **air exhausted**, unless not practical, then HEPA-filtered air can be recirculated
- **Constant-volume** airflow rates

**Not enough AII rooms**

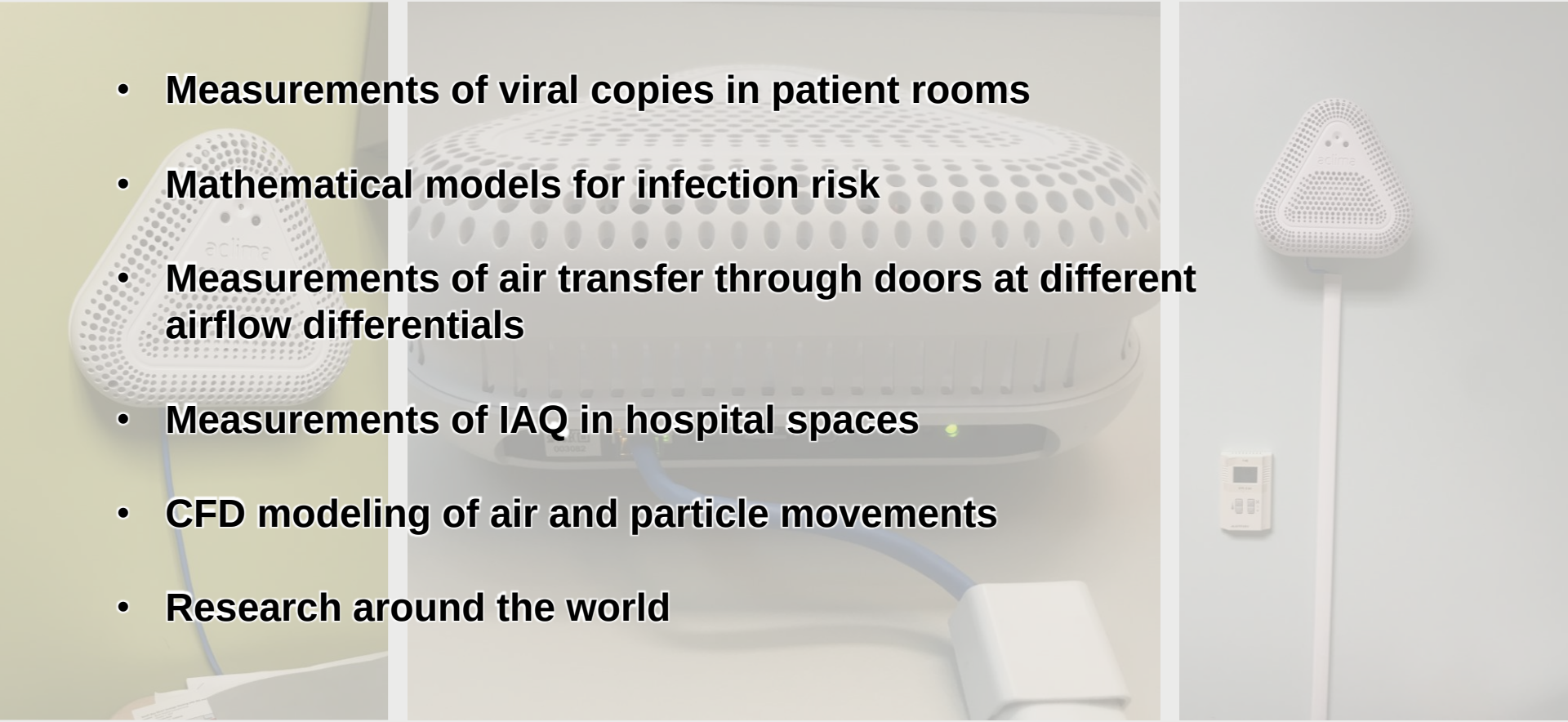
# NEW Tools



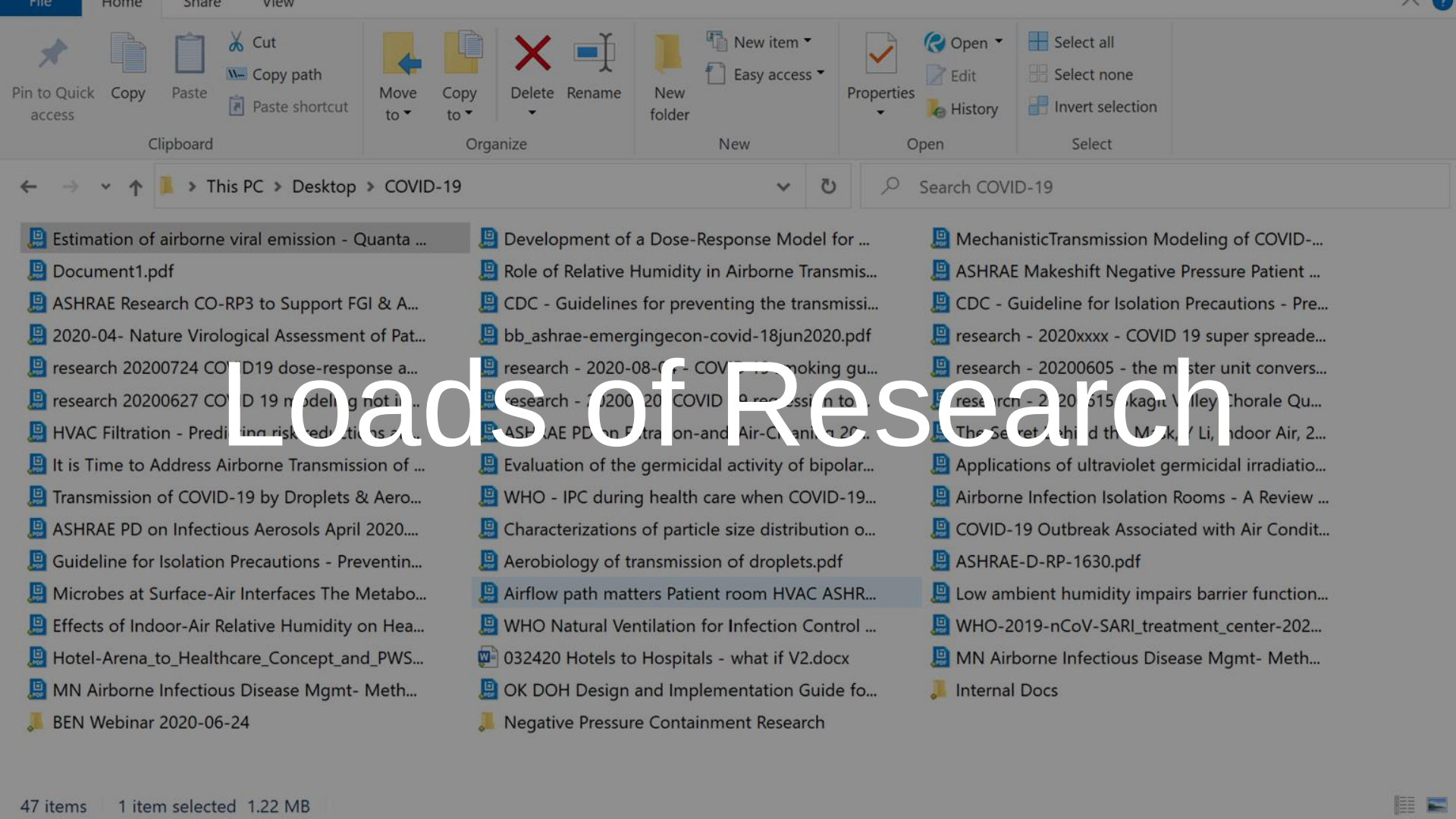

# Particulate Measurements in Hospital Spaces



# NEW Tools

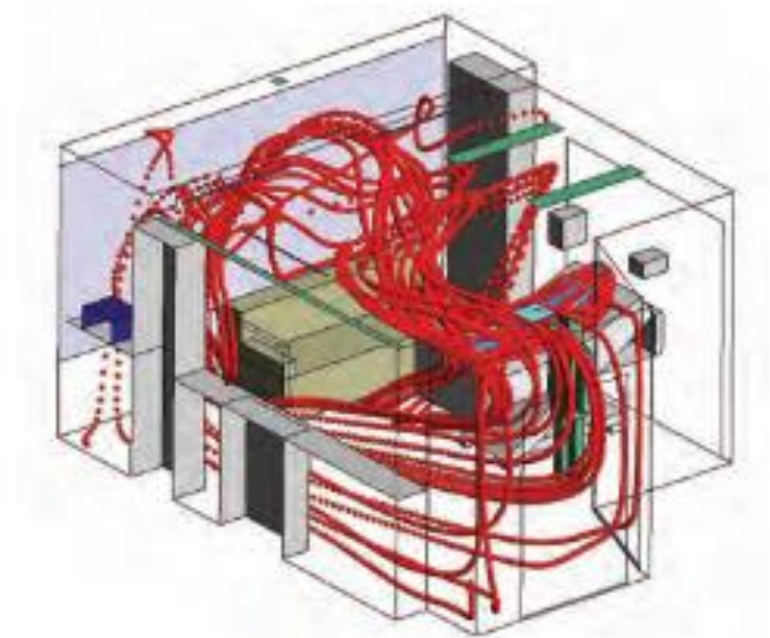


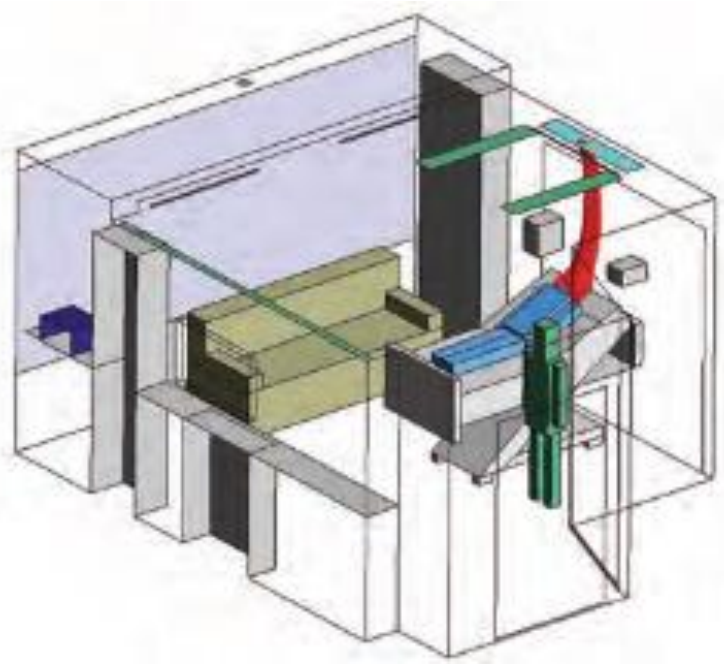
- Measurements of viral copies in patient rooms
- Mathematical models for infection risk
- Measurements of air transfer through doors at different airflow differentials
- Measurements of IAQ in hospital spaces
- CFD modeling of air and particle movements
- Research around the world




# Loads of Research

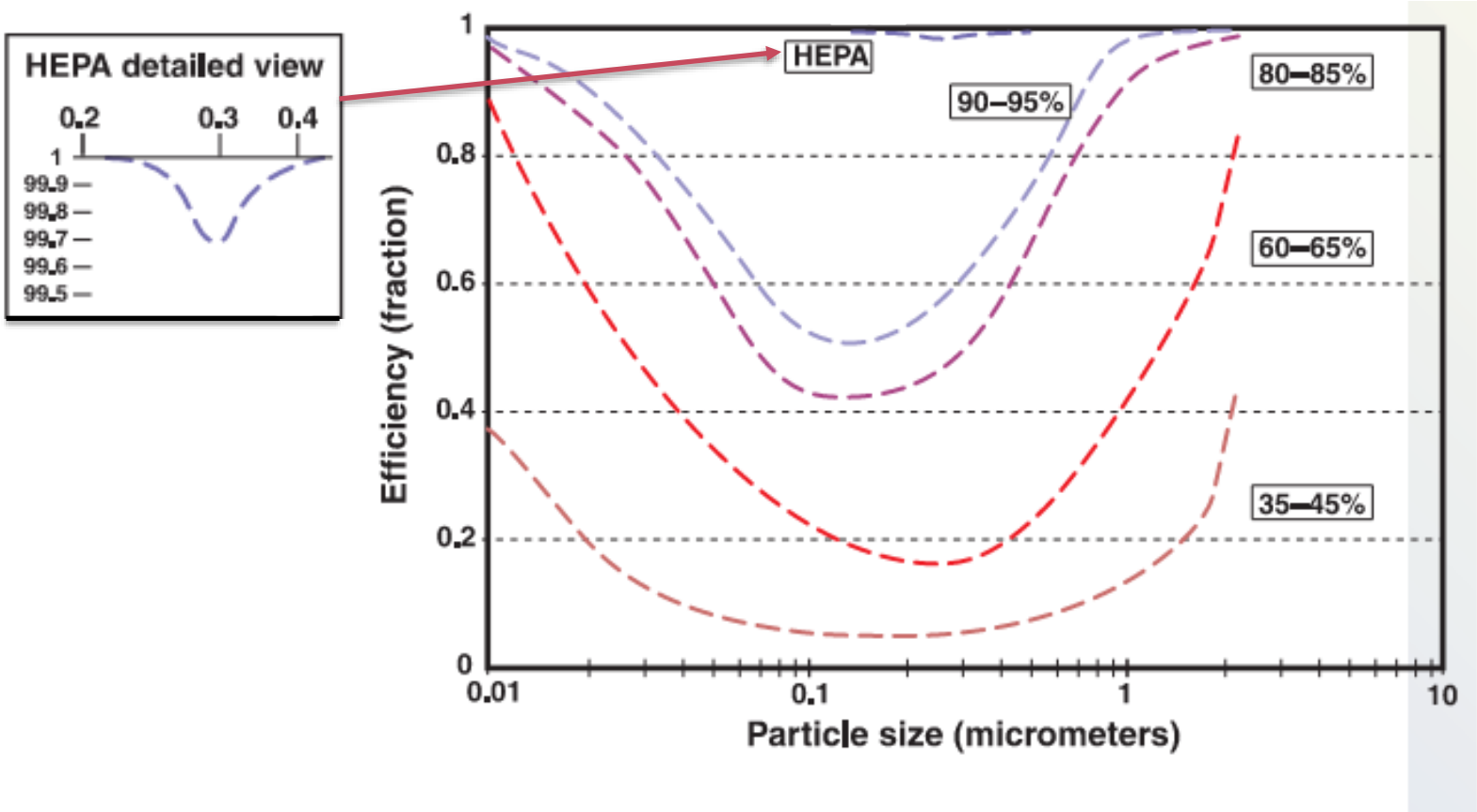
# Airflow Path Matters





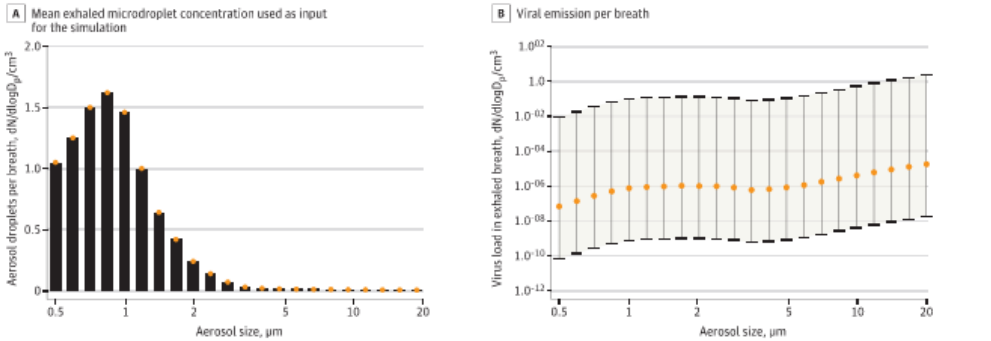
Kishor Khankari, ASHRAE Journal, 2016

# HEPA is VERY Effective



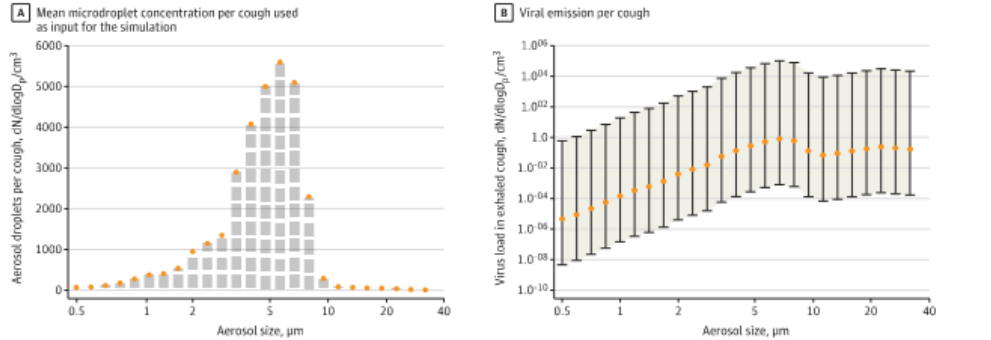
# Estimating viral particle emissions and concentrations

**Figure 1. Size Distribution of Exhaled Microdroplets and Resulting Viral Emissions During Regular Breathing**




A, The typical exhaled microdroplet concentration used as input for the simulation. B, The modeled viral emission per breath for typical (orange), high, and low (whiskers) emitters. dN/dlogD$_p$/cm$^3$ is the number concentration normalized by the aerosol size-bin width.

**Figure 2. Size Distribution of Exhaled Microdroplets and Resulting Viral Emissions During Coughing**

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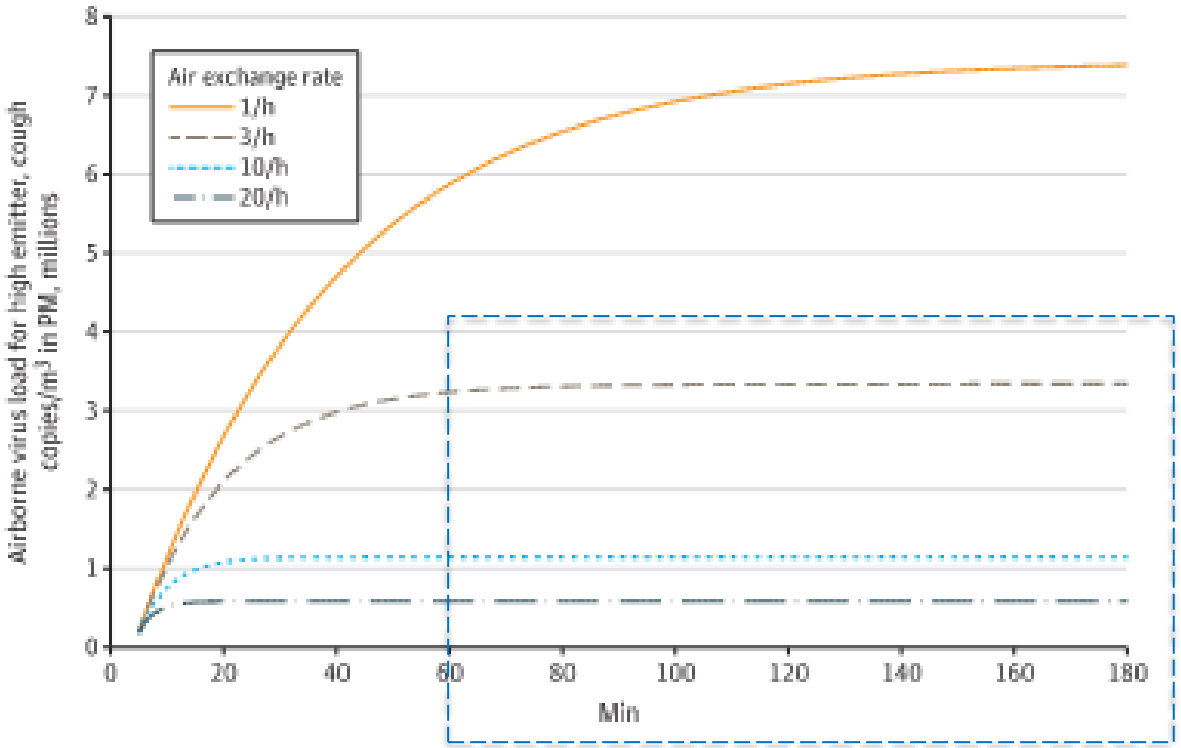
# Estimating viral particle emissions and concentrations

Figure 3. Temporal Course of Airborne Virus Load in a Perfectly Mixed Room of 50 $m^3$




Steady-state concentration relates to ventilation rate, not room volume

# Ventilation Strategies

Develop a **consensus model** for infectious aerosol emission and behavior, adaptable to specific organisms

Use **math, physics, biology, and actual measurements** to determine ventilation requirements

- Outdoor air for gas-phase contaminants
- Clean air (filtered) for particulates
- Ventilation rate, not ACH

Use **CFD modeling** to design airflow in hospitals

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