

# Impacts of Ventilation and Building Airflows on Indoor Aerosol Transport

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**An Overview of COVID in the Workplace for  
Tribes: Re-Opening Tribal Buildings**

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# **Outline**

**Which airflows and their magnitudes**

**Reducing aerosol exposure with airflow**

**Ventilation suggestions to reduce viral exposure**

**Summary**

# **Some Key Concepts**

**Ventilation** (ASHRAE Standard 62.1) the process of supplying air to or removing air from a space for the purpose of controlling air contaminant levels, humidity, or temperature within the space

**Every building is different**

**Buildings not tight unless built that way**

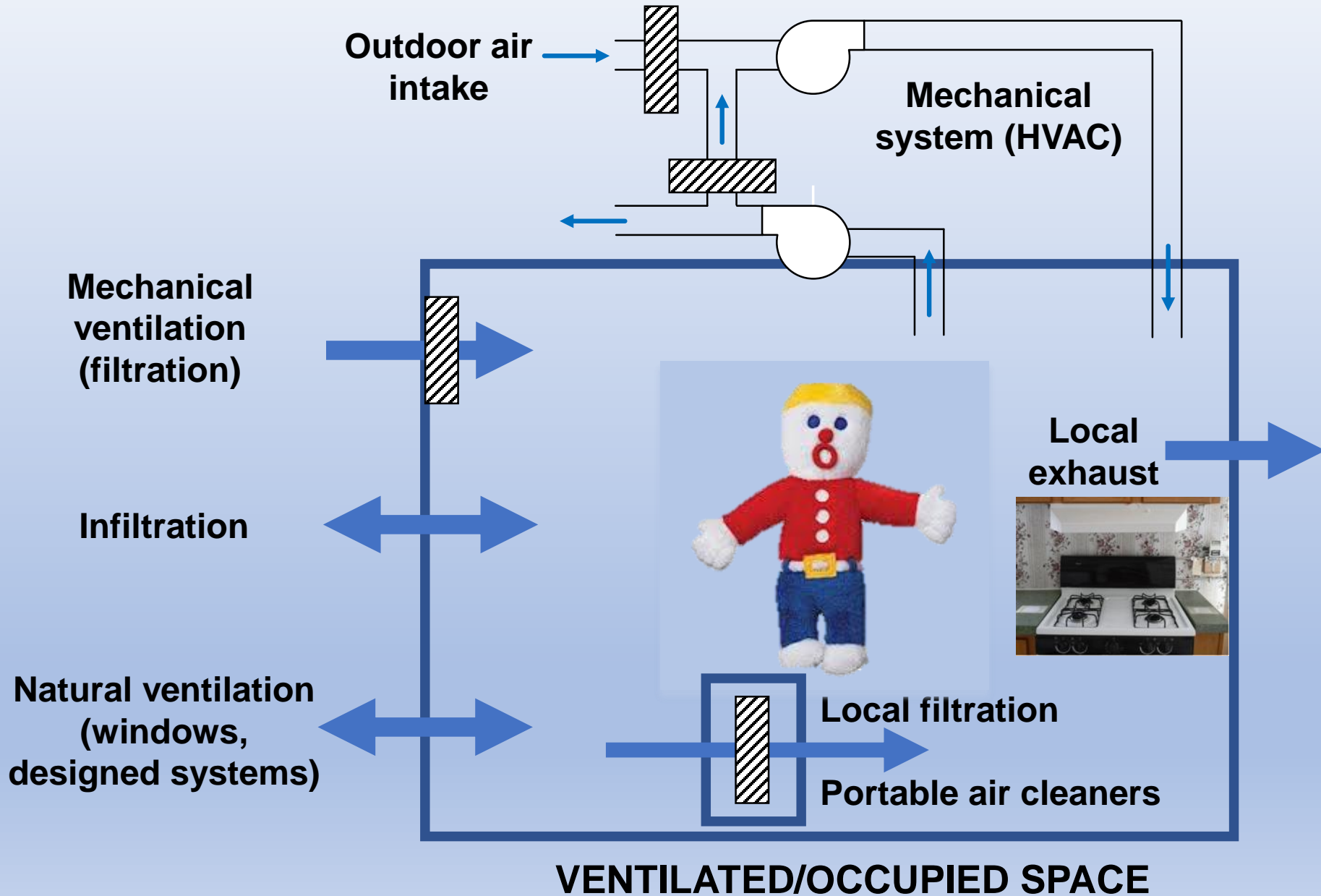
**Air moves based on physics, not design intent**

**Airflow has been studied in very, very few buildings**

**Outdoor air isn't necessarily fresh air**

**1 air change per hour doesn't mean all the air in a building is replaced in 1 hour**

# Which Airflows



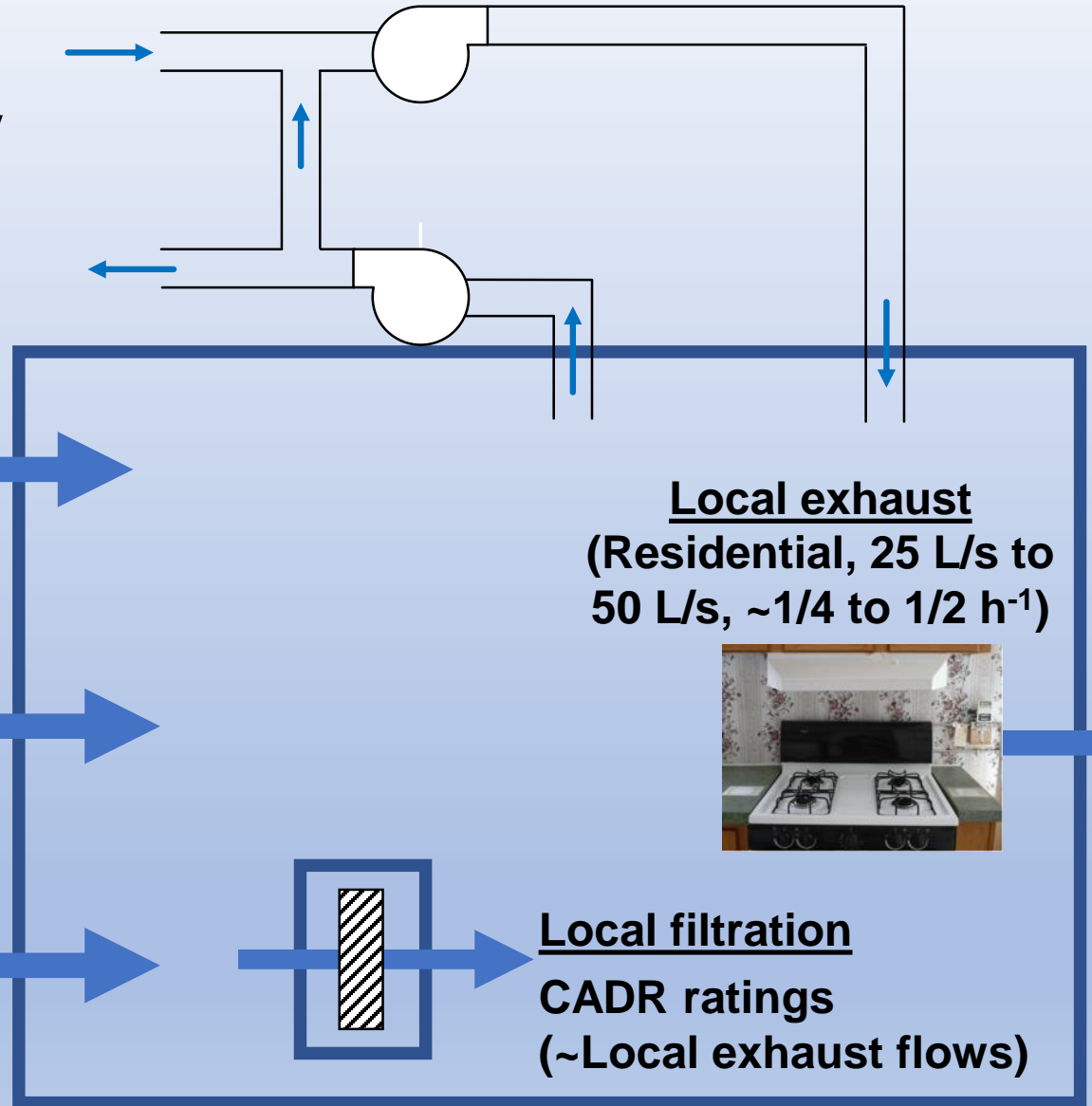
# Magnitudes

Mechanical/Commercial  
Outdoor air:  $\sim 1 \text{ h}^{-1}$ , highly variable, up to  $\sim 5 \text{ h}^{-1}$   
Supply air:  $\sim 3$  to  $5 \text{ h}^{-1}$ , higher in healthcare

Mechanical/Residential  
OA:  $\sim 0.1$  to  $0.5 \text{ h}^{-1}$

Infiltration  
 $\sim 0.1$  to  $1.0 \text{ h}^{-1}$   
 $\sim 5$  to  $1$  variation in individual building

Natural ventilation  
 $> 1 \text{ h}^{-1}$ , hard to measure and predict



Local exhaust  
(Residential, 25 L/s to 50 L/s,  $\sim 1/4$  to  $1/2 \text{ h}^{-1}$ )



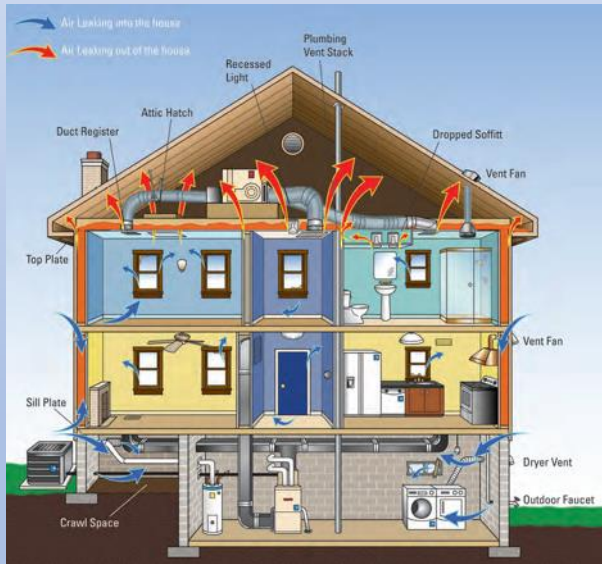
Local filtration  
CADR ratings  
( $\sim$ Local exhaust flows)

# Interzone airflows

Magnitudes similar to airflows from outdoors

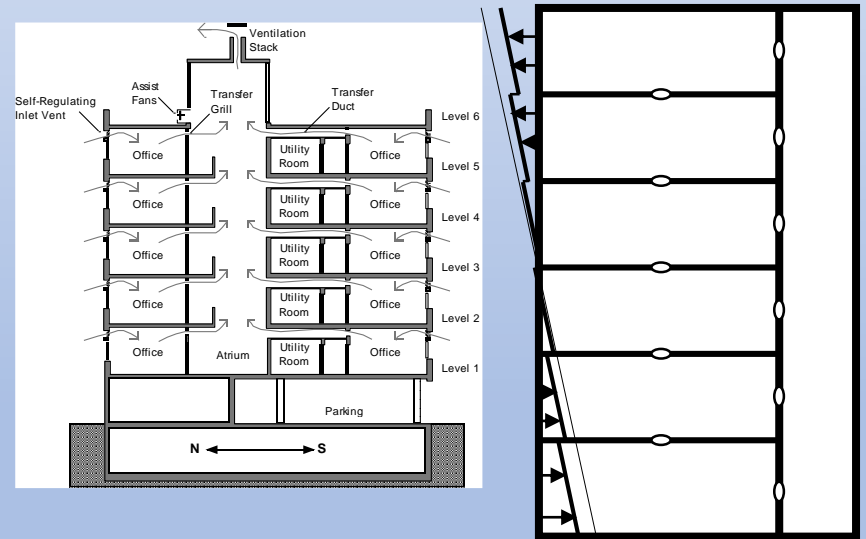
## Residential

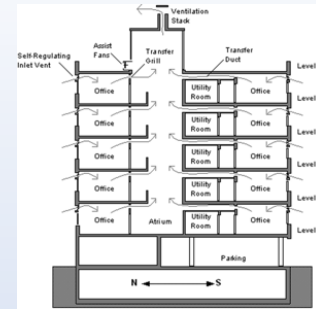
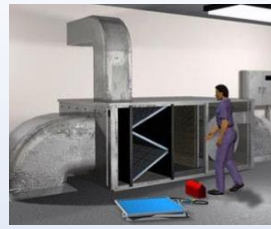
Crawl spaces, basements, attics, ...



## Commercial

Return air plenums, plumbing chases, mechanical rooms, ...





## Buildings are diverse

USA: 100 million dwellings; 6 million commercial

## Building systems vary and matter

Layout, design & controls, occupant activities, operation & maintenance (O&M), ...

## Ventilation has been studied in very few buildings

Impacts of HVAC & ventilation on aerosol transport in even less



# **Reducing Aerosol Exposure with Airflow**

**Build tight, ventilate (filter) right**

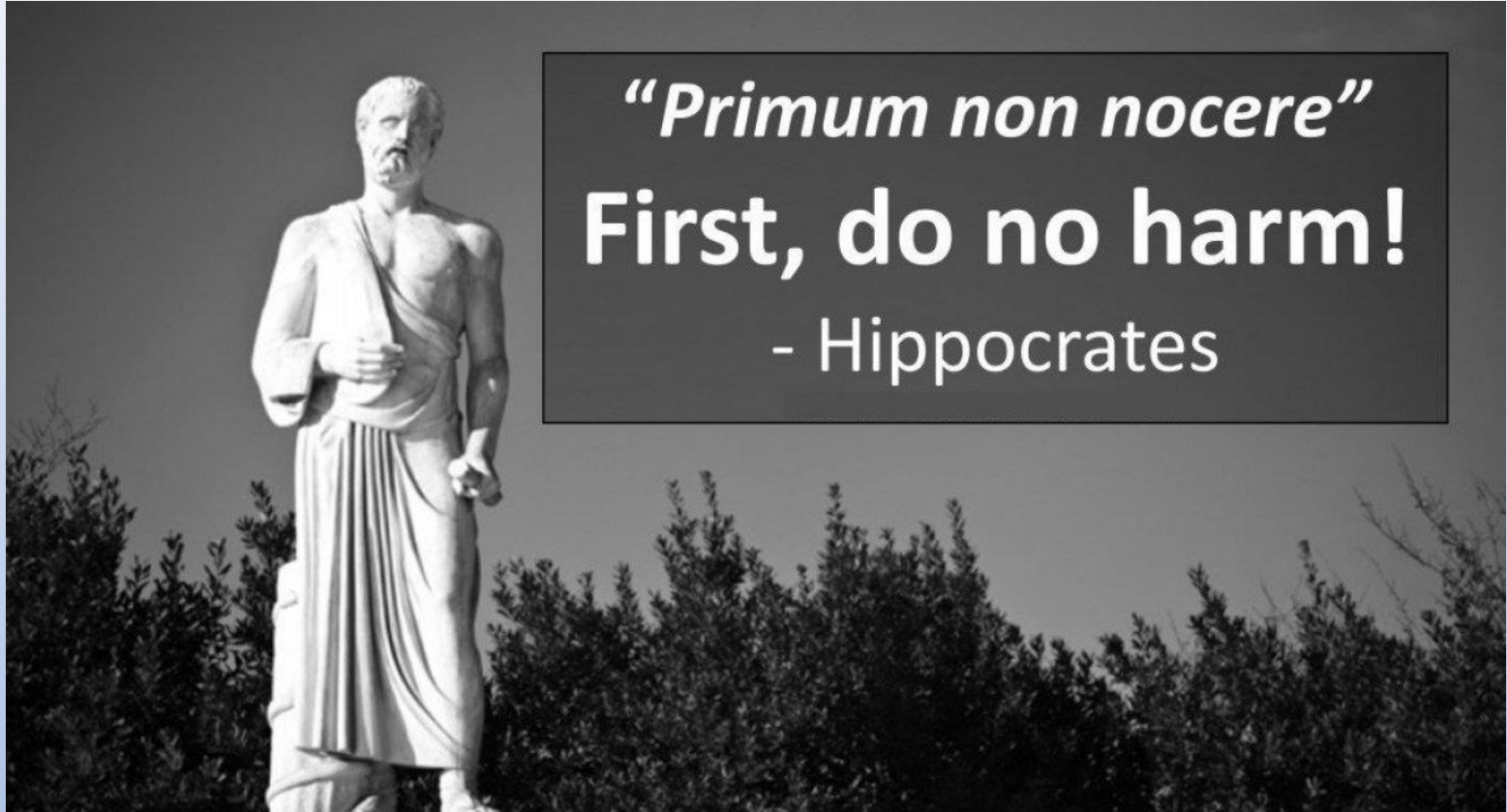
**Overpressure buildings (careful with moisture)**

**Airflow/pressure from clean spaces to dirty**

**Commissioning, Operations & Maintenance**

***Ventilation limited for strong, local sources***





*“Primum non nocere”*

**First, do no harm!**

- Hippocrates

# Some suggestions to reduce viral exposure

## Increase outdoor air ventilation rates

System capacity

Outdoor air quality

Moisture management

Assuming good HVAC control



## More efficient filtration

System capacity

Sealing

Maintenance



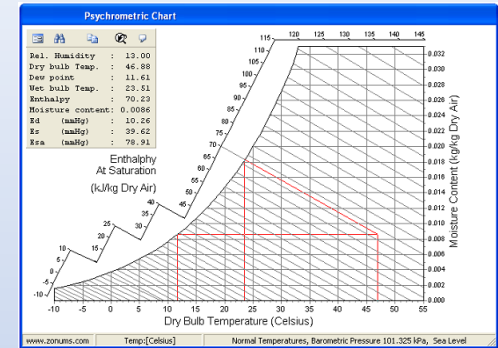
# Some suggestions to reduce viral exposure

## Change relative humidity

Do we know the right number?

System capacity

Condensation potential/microbial growth

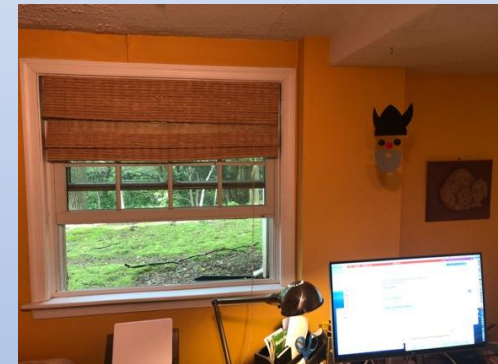


## Open windows

Outdoor air quality

Moisture

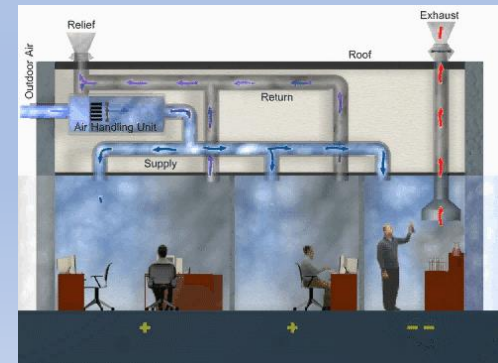
Direction, magnitude, distribution



## Change air distribution

System configuration

Options may be limited



# Summary

Do no harm

Good ventilation is good practice

Excellent time to check system, review O&M practice (Schoen 2020 and ASHRAE guidance)

<https://www.ashrae.org/technical-resources/resources>

NIST on-line tool for comparing impacts of ventilation, filtration, etc. on indoor aerosols

<https://www.nist.gov/services-resources/software/fatima>

