



# Humidification, Health & IAQ



Stephanie Taylor, MD, M Arch

Hello! I am happy to be here with you today

Stephanie Taylor, MD, M Arch

ASHRAE Distinguished Lecturer  
Epidemic Task Group  
Environmental Health Committee



# Presentation Summary

## The cloud of COVID–19 and a “silver lining”

- This pandemic has rearranged our priorities
- The built environment and health

## Studies on *Homo Indooris*

- Humans and microbes share many things
- New studies bring humidification to the forefront

## Buildings can and must support healthy occupants

- Resistance to minimum humidity is high
- Resolving misconceptions to move forward

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My journey to you started around 1983



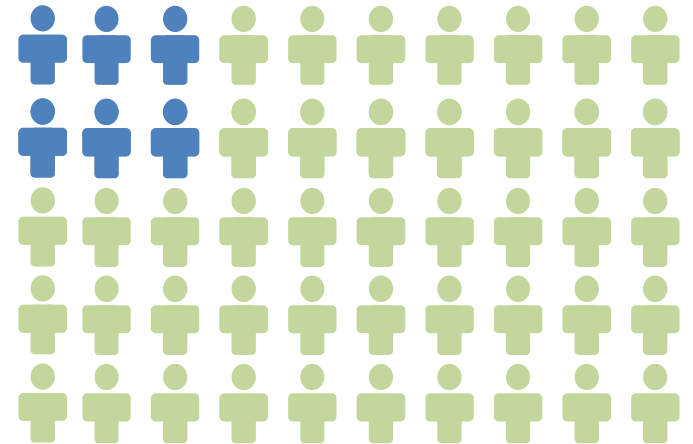


# Non-hygienic hospital conditions, yet few infections

Wewack General Hospital,  
Papua New Guinea 1983



Yet, in N. America 1,700,000 patients/year get an infection from their hospitalization (HAI)



“Never underestimate the power of the environment!”

Harvard Medical School  
Chief-of-Surgery,  
Judah Folkman, M.D.  
working with medical  
student, S. Taylor, 1986





# Our environment (90% indoors) has become very sophisticated

timeline:	10,000 BC	800 BC - 500 AC	1900 AC	2020
housing:	primitive housing, no sanitation systems	simple sanitation, in rural villages	industrial revolution: central sewage & water systems, heating, electricity	post-industrial cities, tighter buildings, dryer and warmer indoor air



# However, many diseases have increased

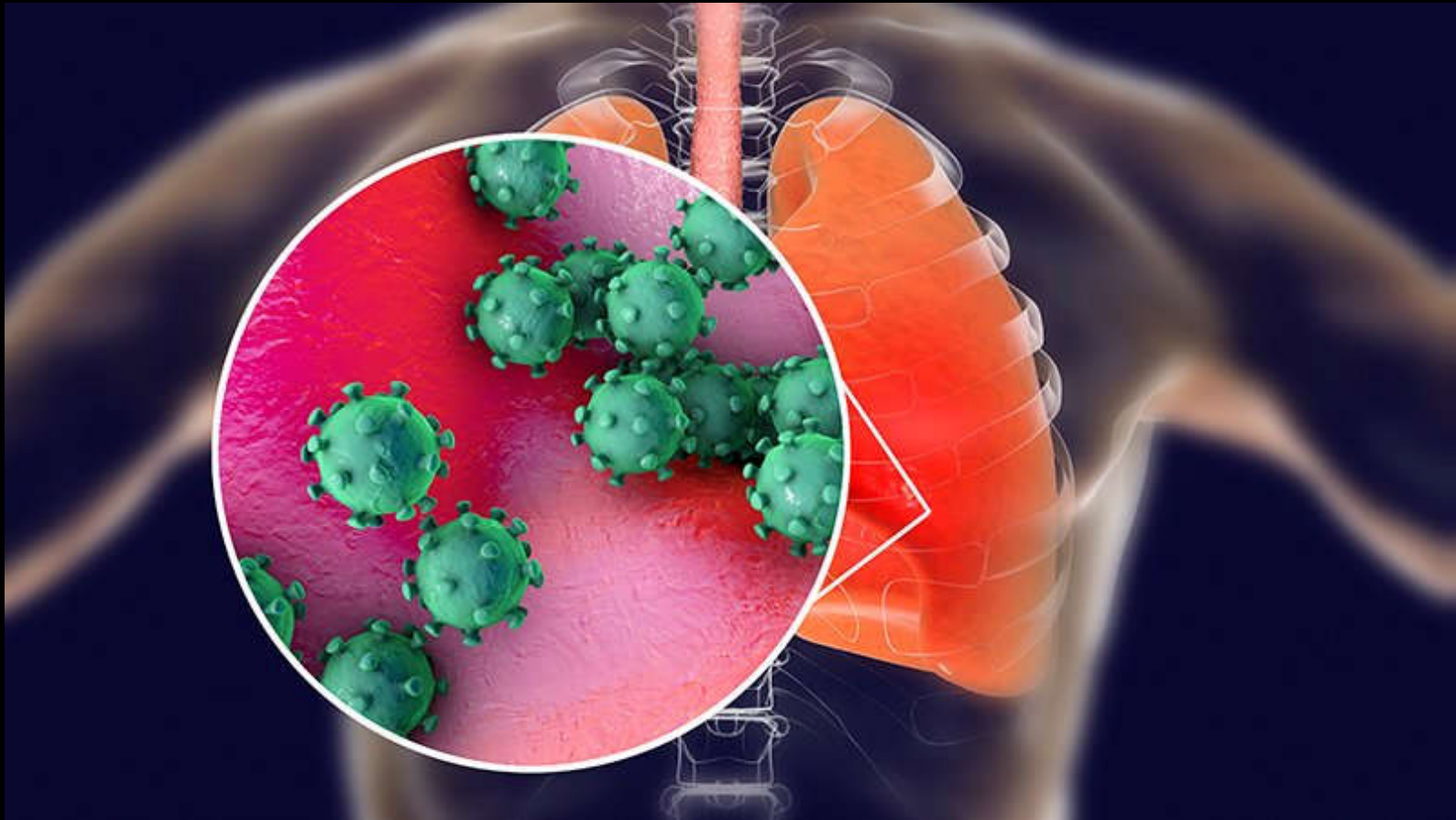
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<b>infectious diseases:</b>	parasites, zoonosis	1 <sup>st</sup> epidemics: small pox, measles, influenza, plague	1 <sup>st</sup> pandemic "Spanish flu" introduction of antibiotics & vaccines	Increasing infections, zoonotic transmis., ABX-resistant bacteria



**Infectious diseases**



The COVID-19 virus mutated, allowing attachment to our deep lung tissues, and we have no immunological defenses from prior exposure



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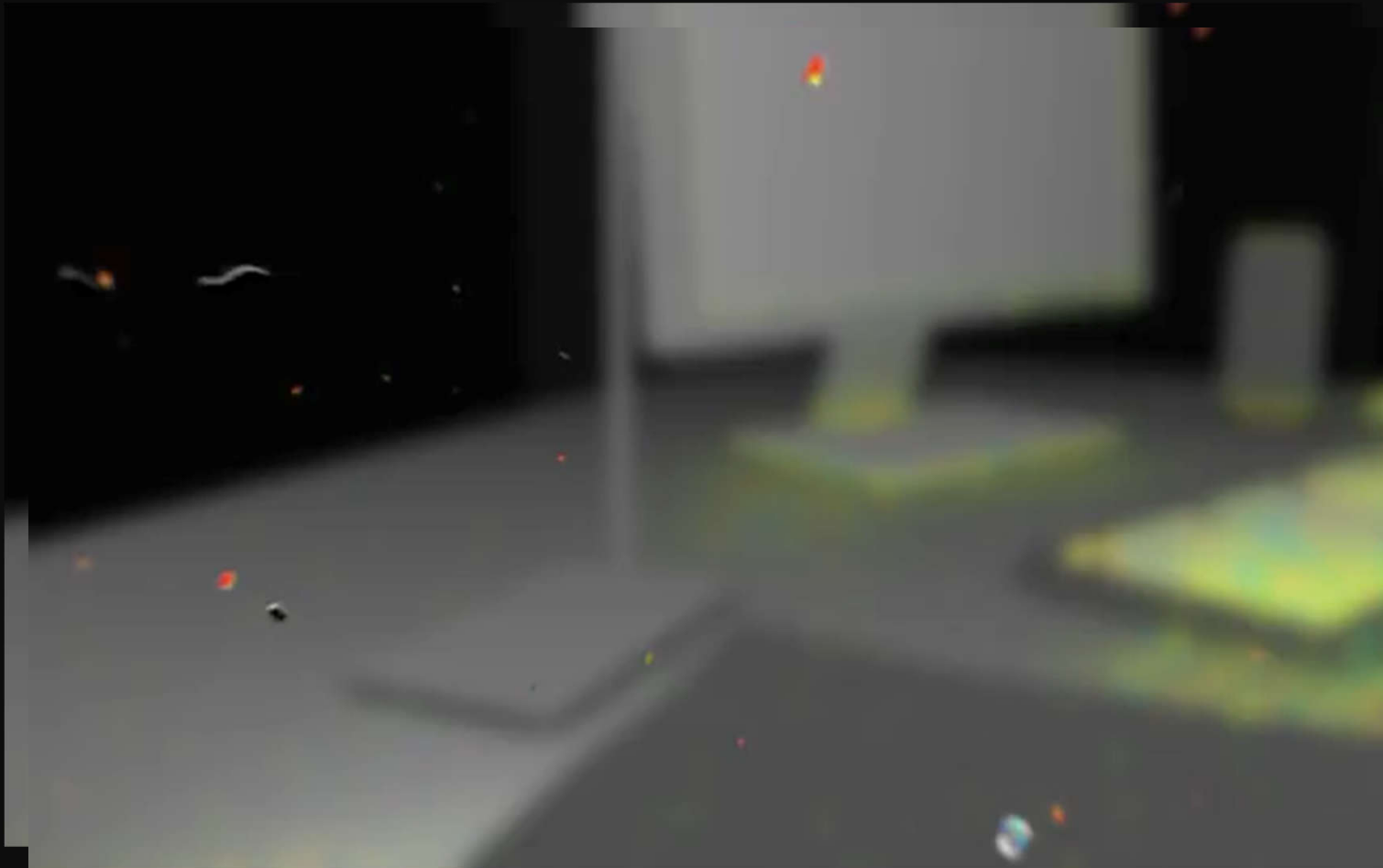
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Buildings can and must  
support healthy occupants

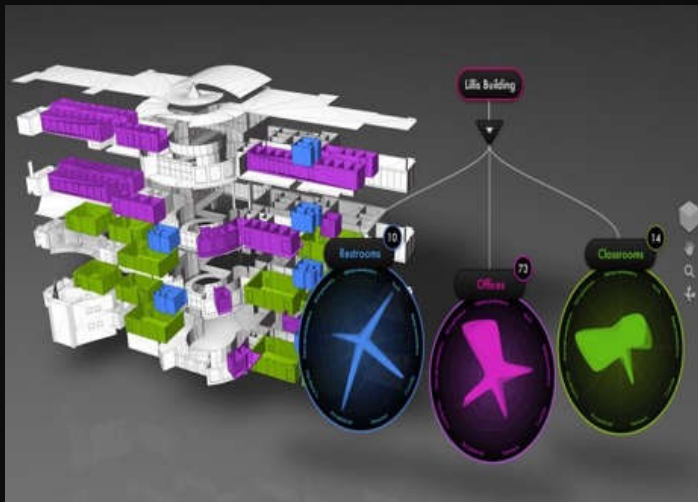
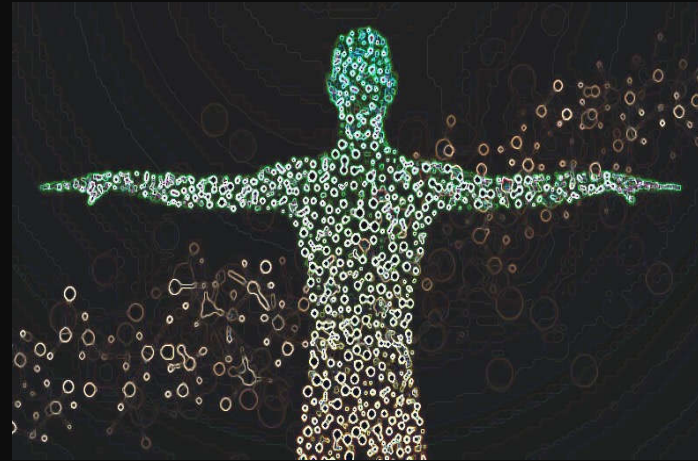
- Resistance to minimum humidity is high
- Resolving misconceptions to move forward



## A closer look at ourselves indoors



# Survival of the fittest

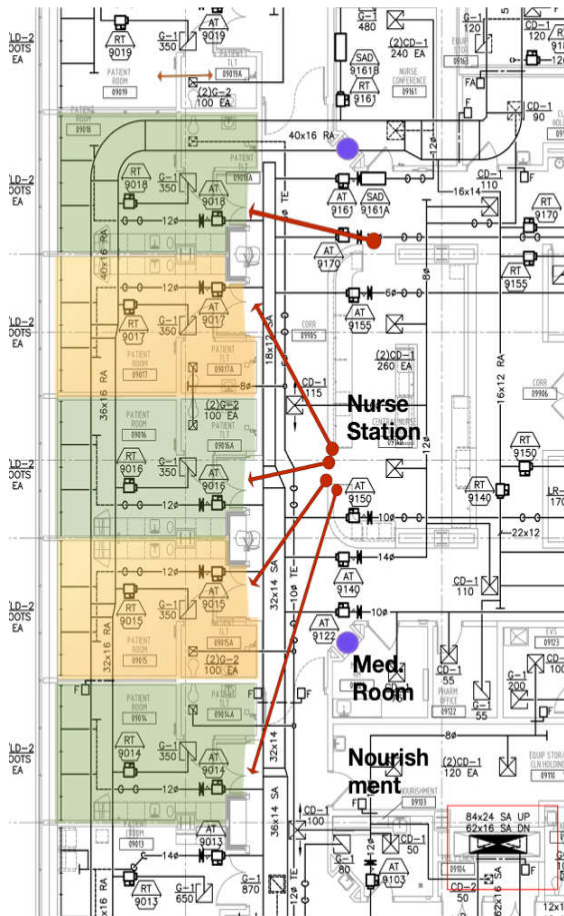


**Indoor environments determine which microbes will survive and interact with occupants**

Occupants send their microbes into buildings



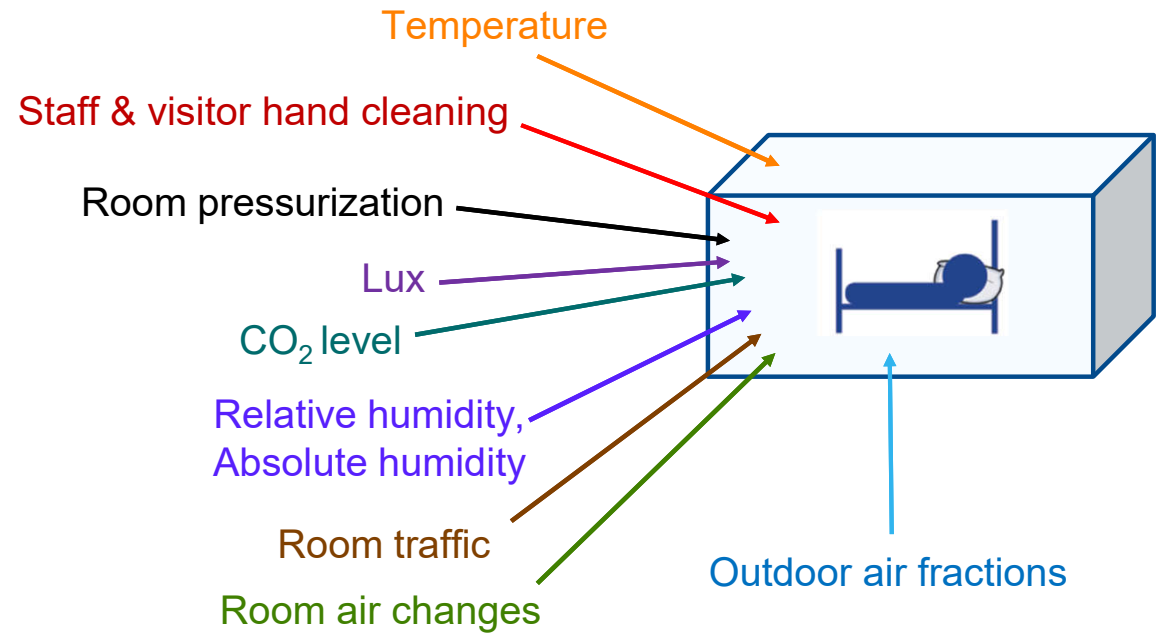
# Do indoor factors contribute to infections?



Patient room data

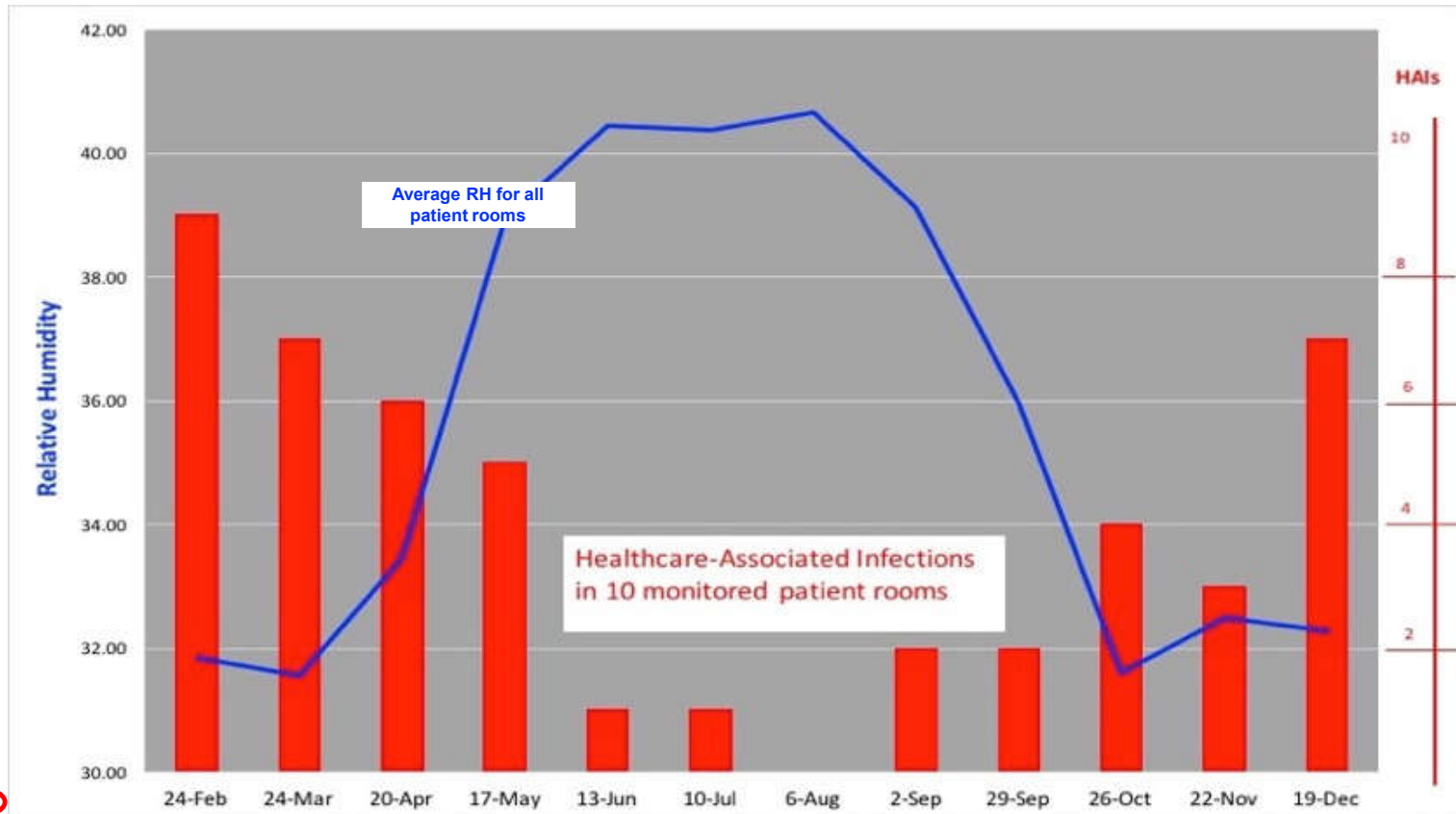
vs.

Patient HAIs



**8 million room data points ~ 300 patient outcomes**

# As patient room RH went down, infections went up!



Coefficients<sup>a</sup>

Standardized Coefficients	t	Sig.
Beta		
-9.060	-2.348	.023
	-2.396	.020



# Indoor climate and health outcomes in residents in a long-term care facility (over 4 yrs)

## Patient infections



### Infections

- respiratory (viral & bacterial)
- GI (Norovirus, Rotavirus, C. diff)
- urinary tract
- conjunctivitis
- cellulitis

VS

## Environmental data



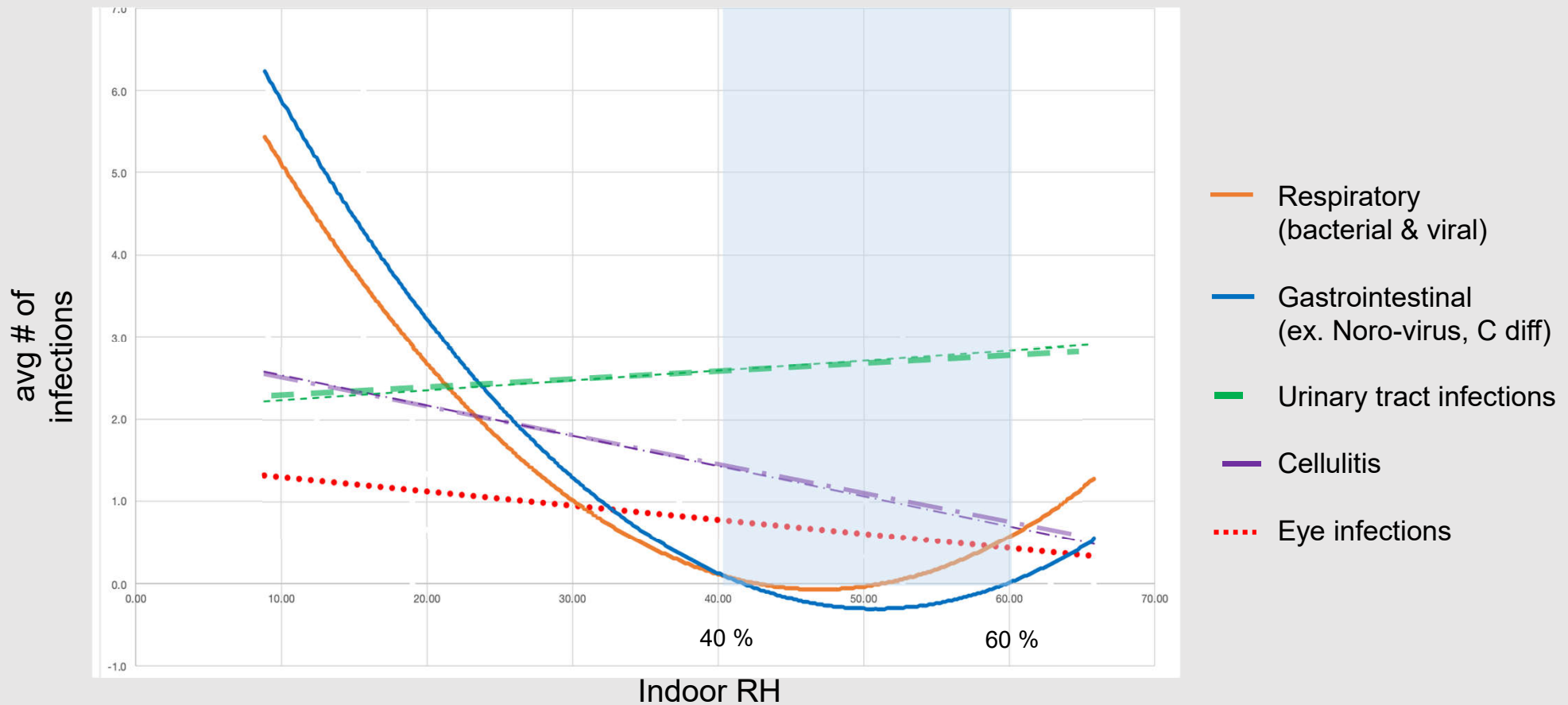
### Indoor factors

- temperature
- relative humidity
- visitors
- staff absenteeism

### Outdoor factors

- temperature
- relative humidity
- flu outbreaks

# Infection rates were lowest when indoor RH = 40-60%



# 2018: Humidity decreased Influenza A illness in a pre-school



January 25 – March 11 (32 days)

Half of the classrooms were humidified, the other half were not



RH of classrooms	% Airborne particles carrying virus (PCR)	Virulence of airborne virus	# children absent due to influenza illness
20%	49%	75%	22
45%	19%	35%	9

What determines if this COVID-19 cough will infect others?





# Yes, the SARS-CoV-2 genetic material is spread through the air



Contents lists available at [ScienceDirect](#)

Environment International

journal homepage: [www.elsevier.com/locate/envint](http://www.elsevier.com/locate/envint)

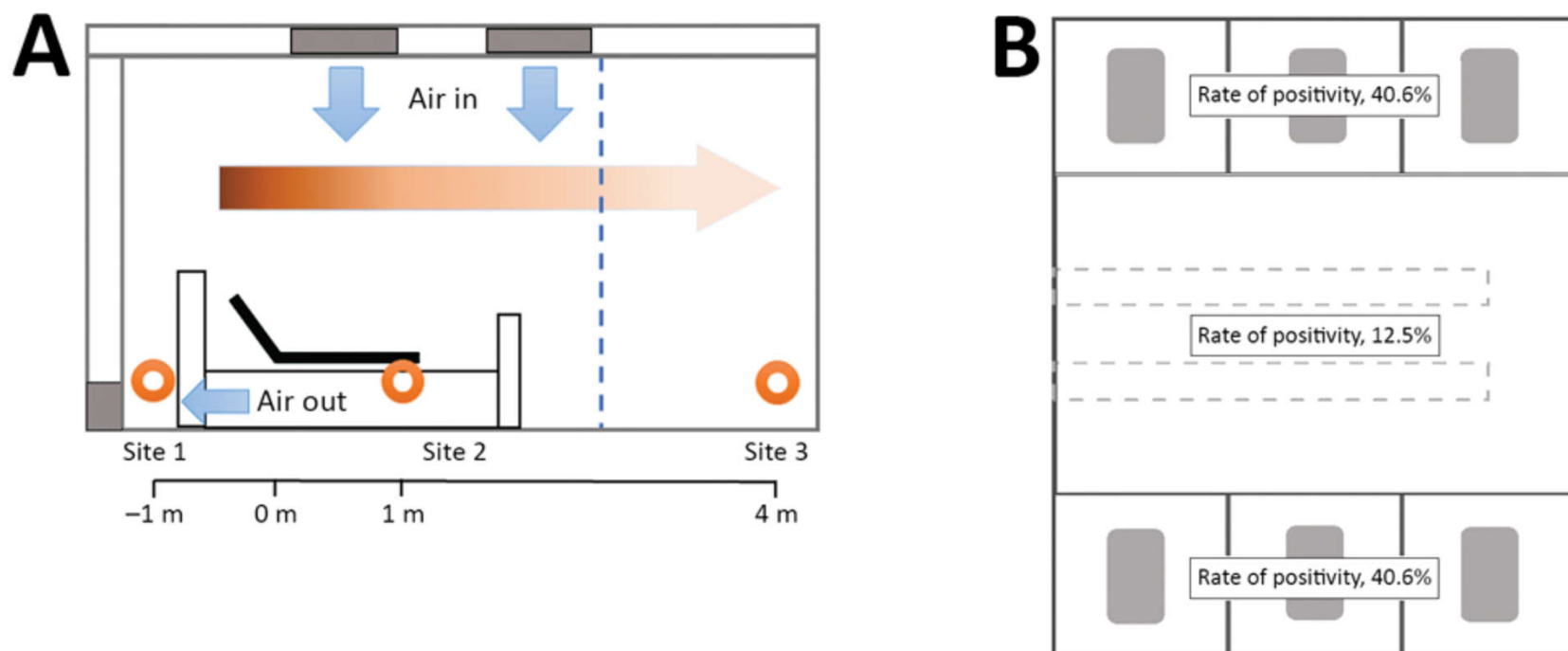
## Airborne transmission of SARS-CoV-2: The world should face the reality

Lidia Morawska<sup>a,\*</sup>, Junji Cao<sup>b</sup>

<sup>a</sup> *International Laboratory for Air Quality and Health (ILAQH), School of Earth of Atmospheric Sciences, Queensland University of Technology, Brisbane, Queensland 4001, Australia*

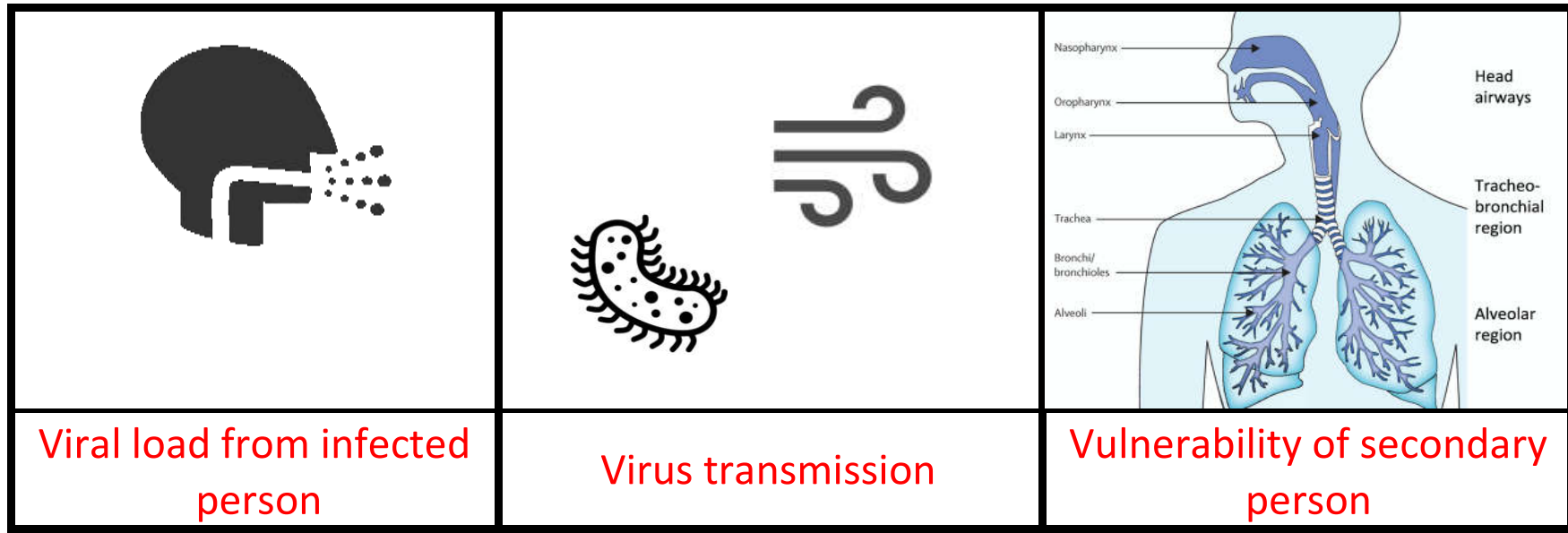
<sup>b</sup> *Key Lab of Aerosol Chemistry & Physics (KLACP), Chinese Academy of Sciences, Beijing, China*

# The air and surfaces in Wuhan ICU with COVID-19 were widely contaminated by SARS-CoV-2 up to 14 feet away



Guo Z-D, Wang Z-Y, Zhang S-F, Li X, Li L, Li C, et al. Aerosol and surface distribution of severe acute respiratory syndrome coronavirus 2 in hospital wards, Wuhan, China, 2020. *Emerg Infect Dis.* April 10.

# There are 3 possible steps where we can intercept the spread of COVID-19 disease



Behaviors (masks, distancing)

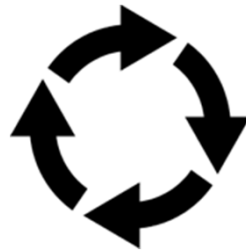
Indoor air and surface "cleanliness"

Increase health and immunity

# Pathogen infectivity is high when $RH < 40\%$



Greater aerosol  
transmission



Evasion from surface  
cleaning through  
resuspension



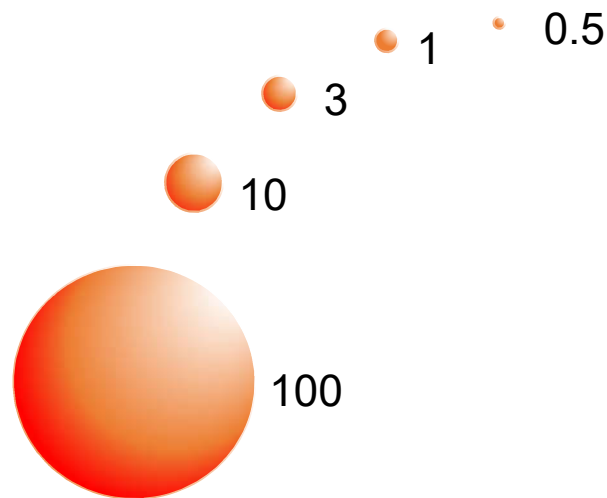
Increased survival and  
virulence of pathogens



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

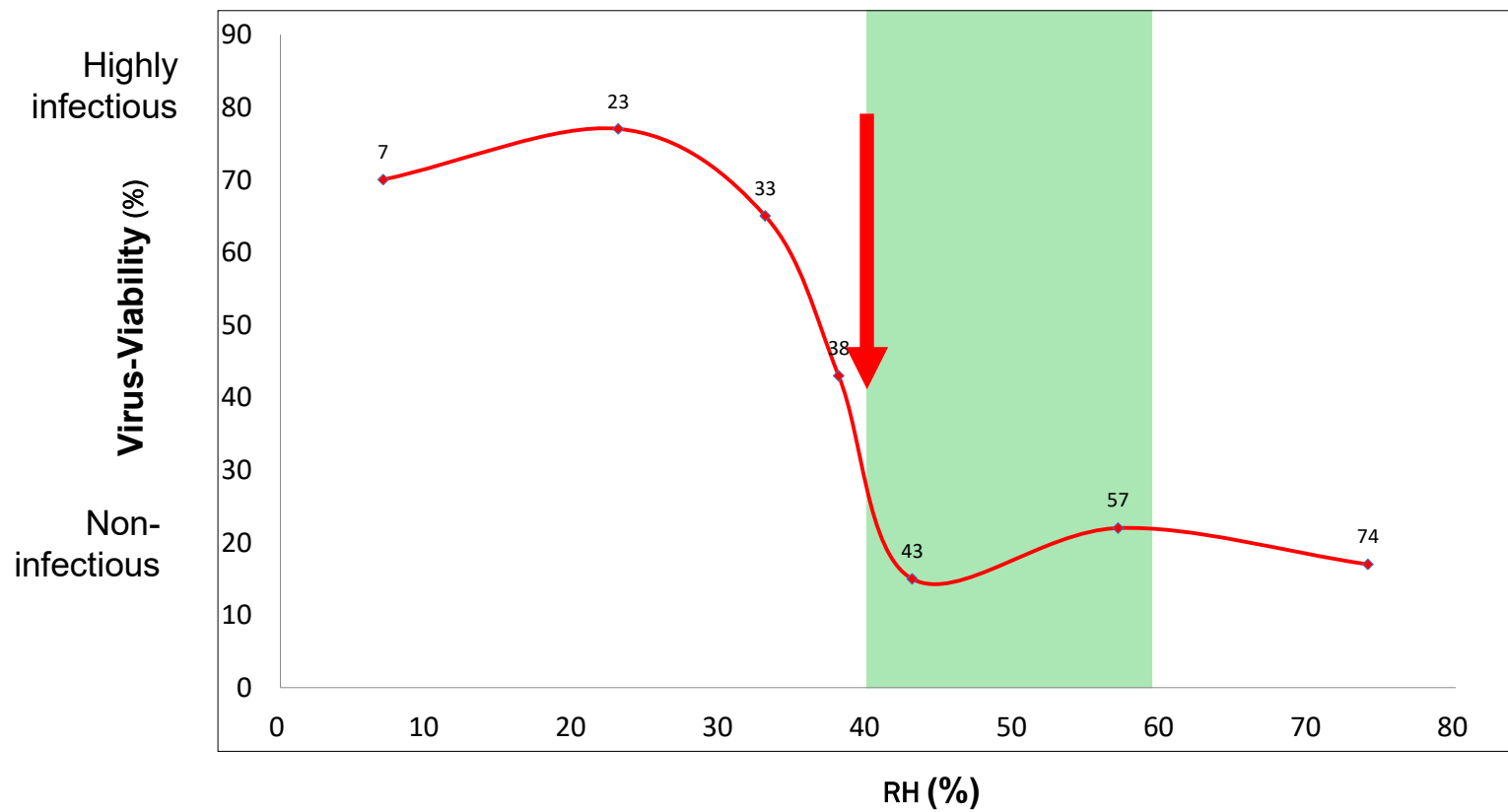
Droplet diameter in microns (um)

Float time



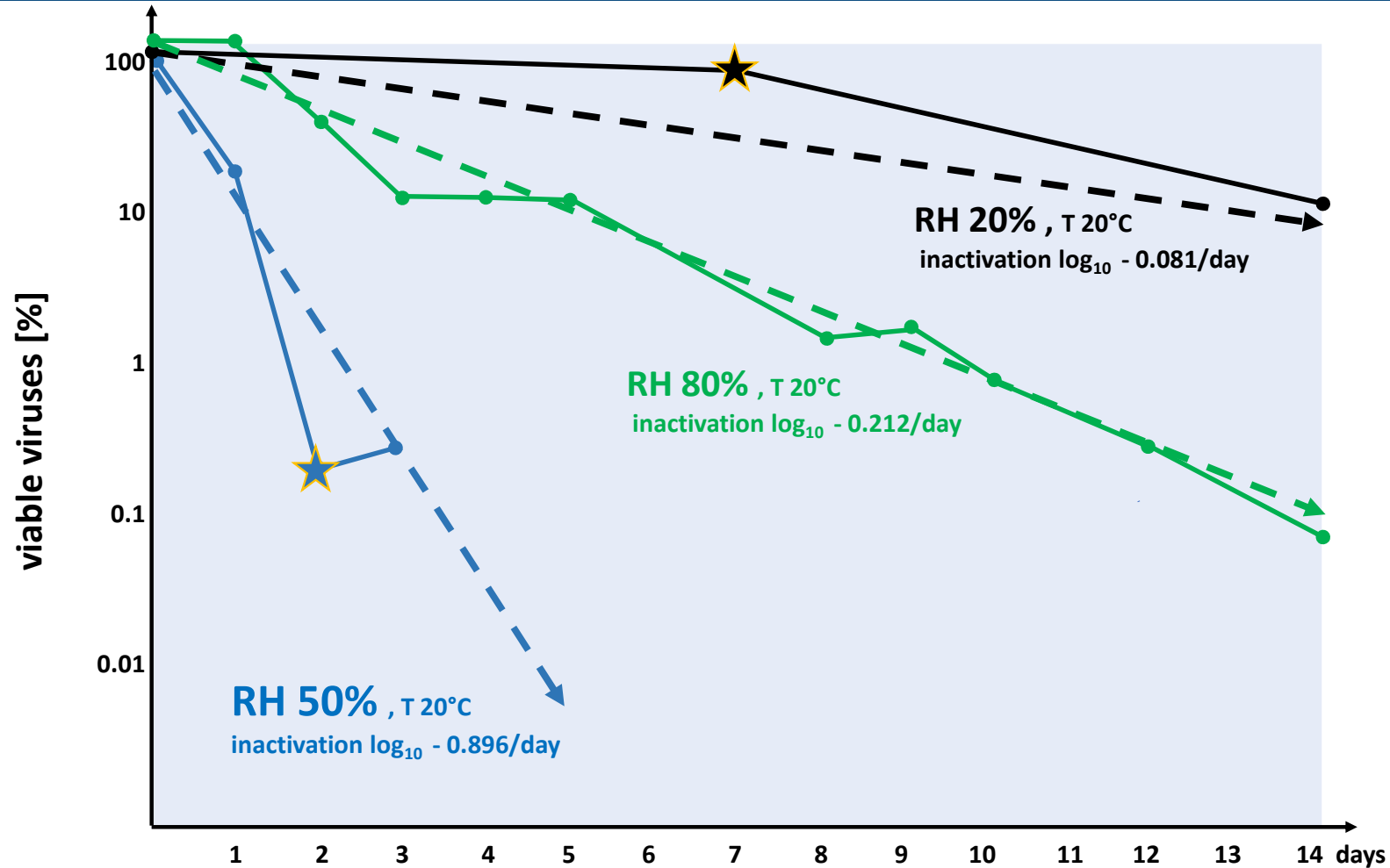
Distance travelled: 1m  10m+

# Influenza A virus is more infectious when RH is below 40%



Noti 2007

Humidification to 50% RH reduces the viable Coronavirus to less than 1% in 2 days, significantly decreasing the infection risk (blue line).



# Conversely, humans suffer in low RH

*Sitting in room air with 20% RH, the average person becomes clinically dehydrated in 8 hours*

## Brain

- decreased function
- fatigue
- anxiety, depression

## Respiratory tract

- infections
- allergies
- asthma



## Eyes

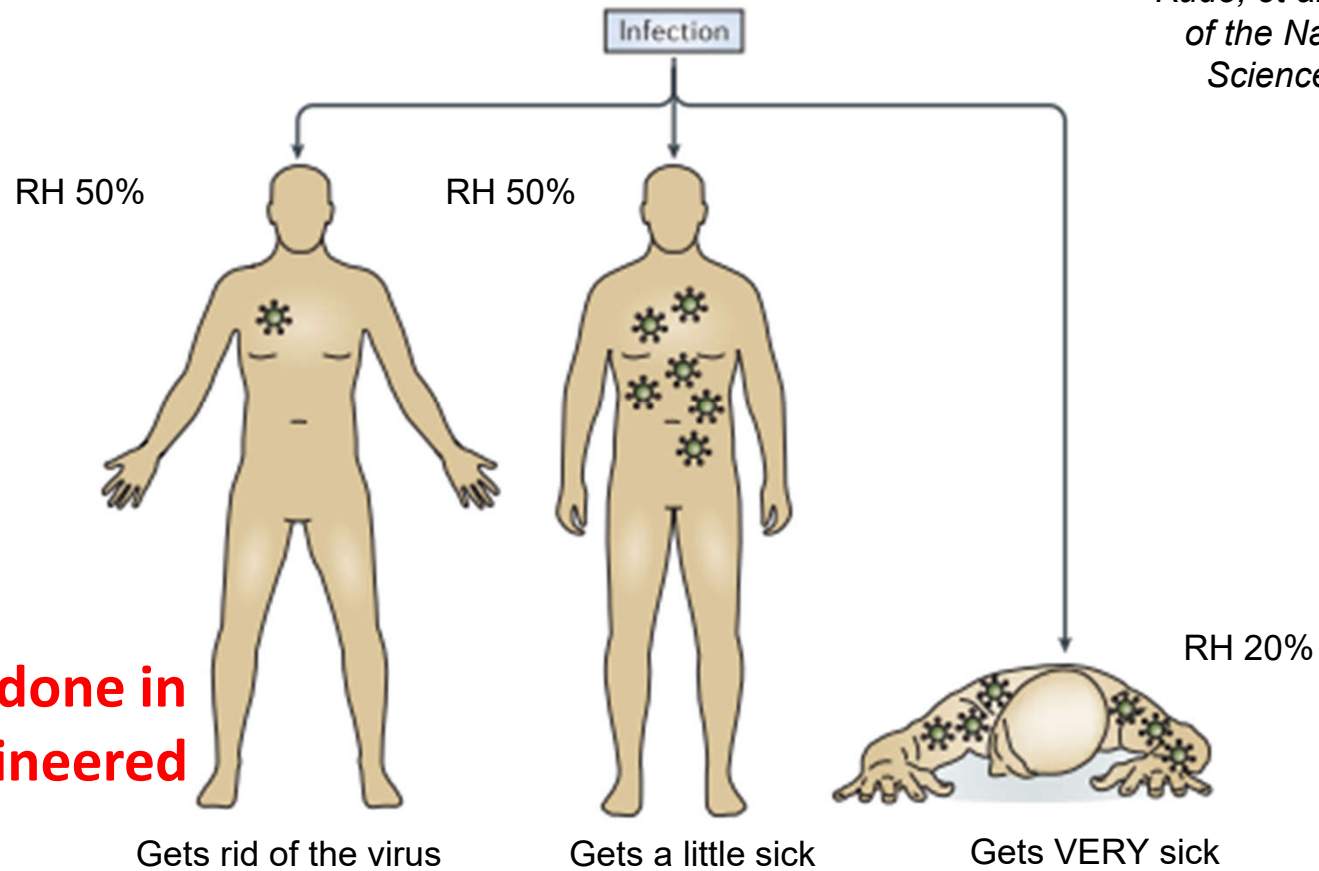
- dry eyes
- blurry vision
- corneal inflammation

## Skin

- dryness, cracking
- dermatitis
- auto-immune disease

# Low ambient humidity impairs barrier function and innate resistance against influenza infection

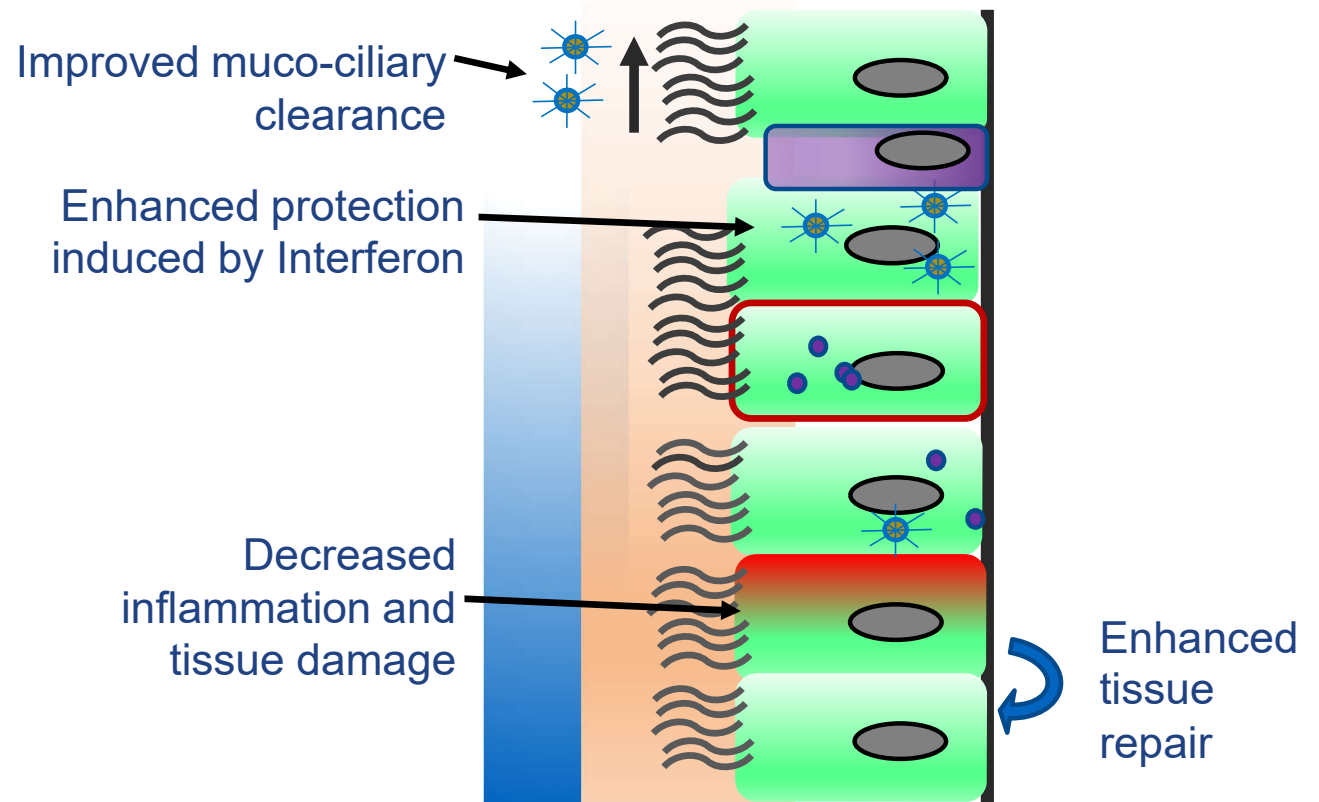
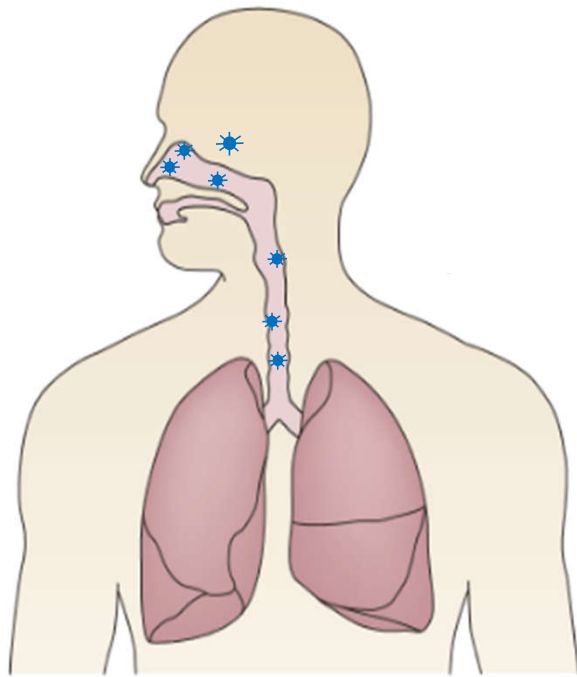
*Kudo, et al. 2019. Proceedings of the National Academy of Sciences, USA. May 19.*



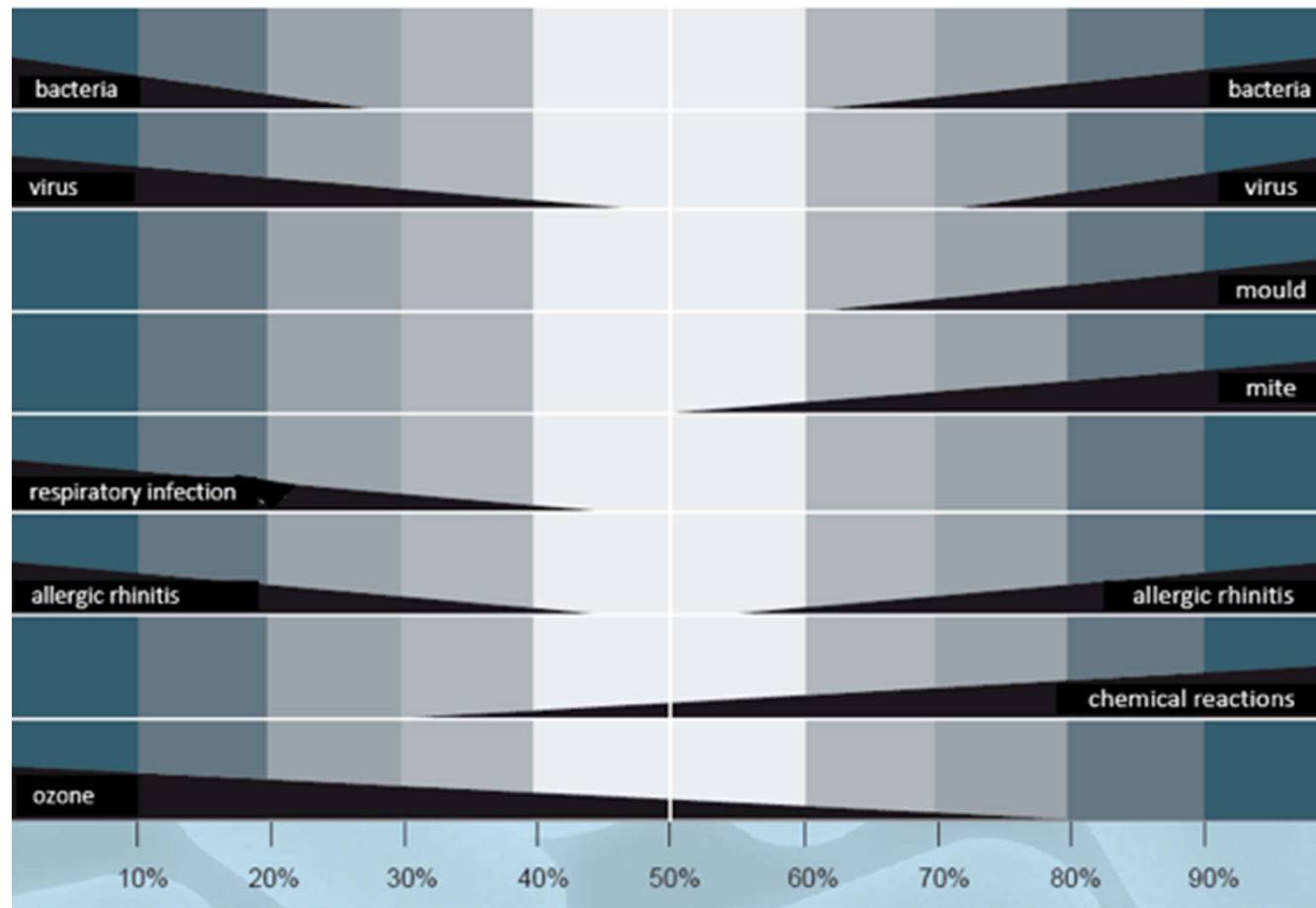
**This study was done in genetically engineered mice**



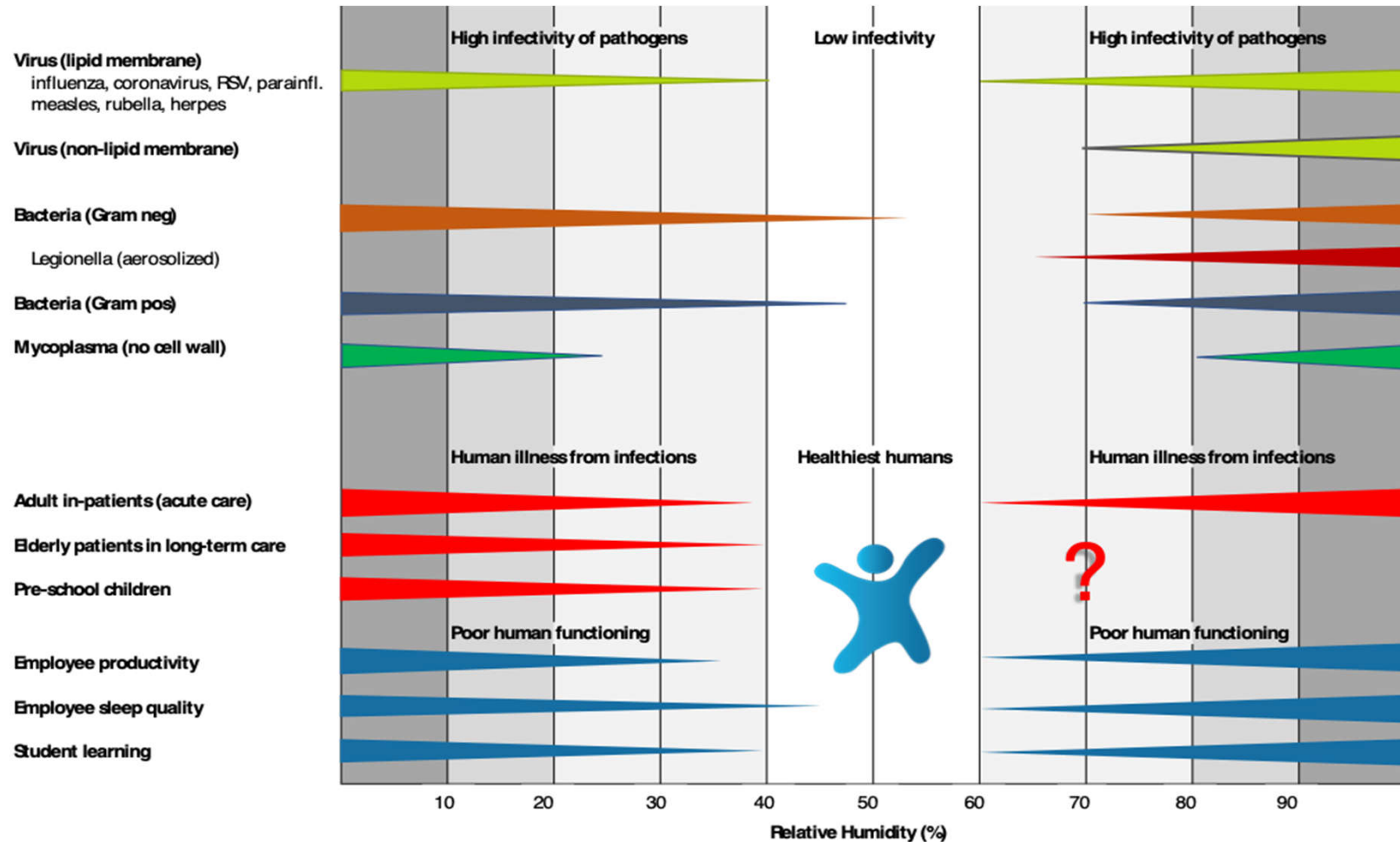
All of these protective mechanisms are impaired at RH 20% and are optimal at 50% RH



# ASHRAE 1985: “Optimal RH Level For Health” = 40%–60%



# Taylor Chart 2019



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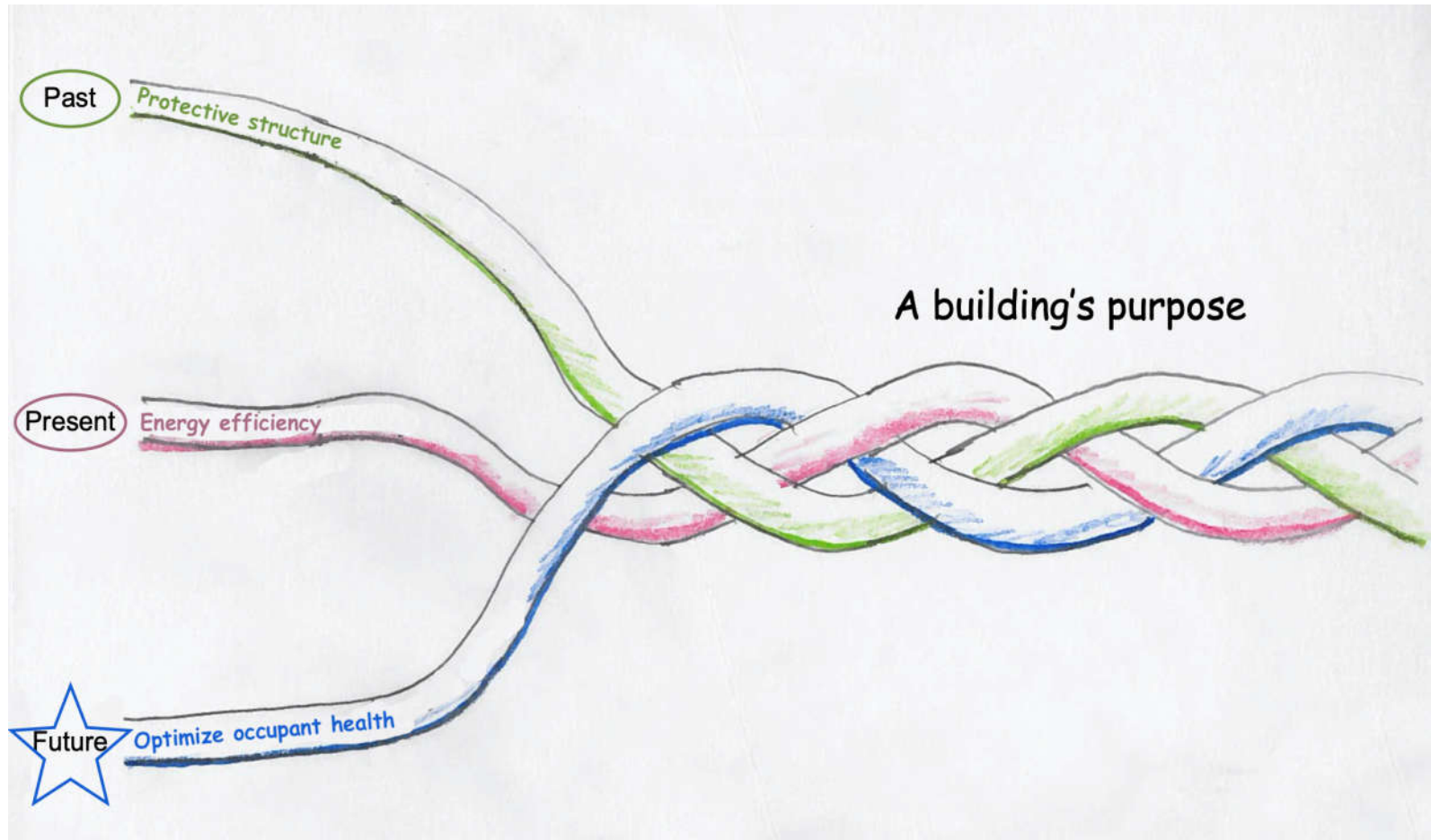
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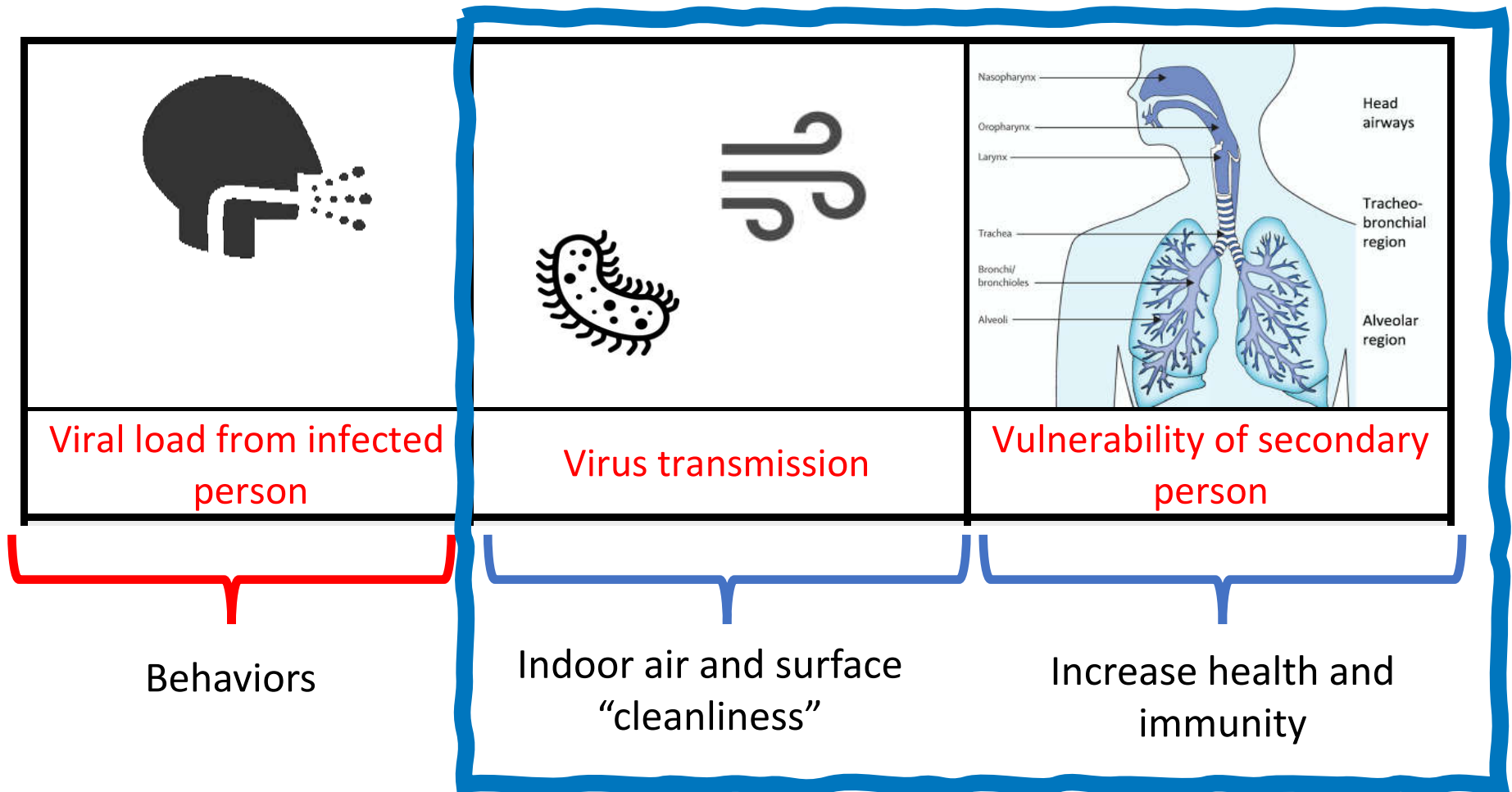
Buildings can and must  
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# The future of building design and operation



# RH 40–60% is an effective and holistic approach to decreasing COVID-19 spread





# RH maintained 40–60% effectively accomplishes two tasks

**1.**

Decreases the burden of infectious COVID-19 virus:



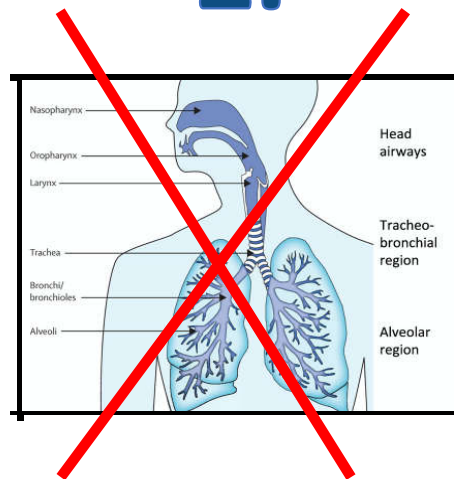
- Decreases number of airborne infectious aerosols in our breathing zone
- Optimizes social distancing by limiting spread of virus in airborne droplets
- Decreases the actual infectivity of SARS-CoV-2 virus in airborne aerosols and surface particles
- Optimizes hand and surface cleaning by decreasing resuspension and resettling

# RH maintained 40–60% effectively accomplishes two tasks

## 2.

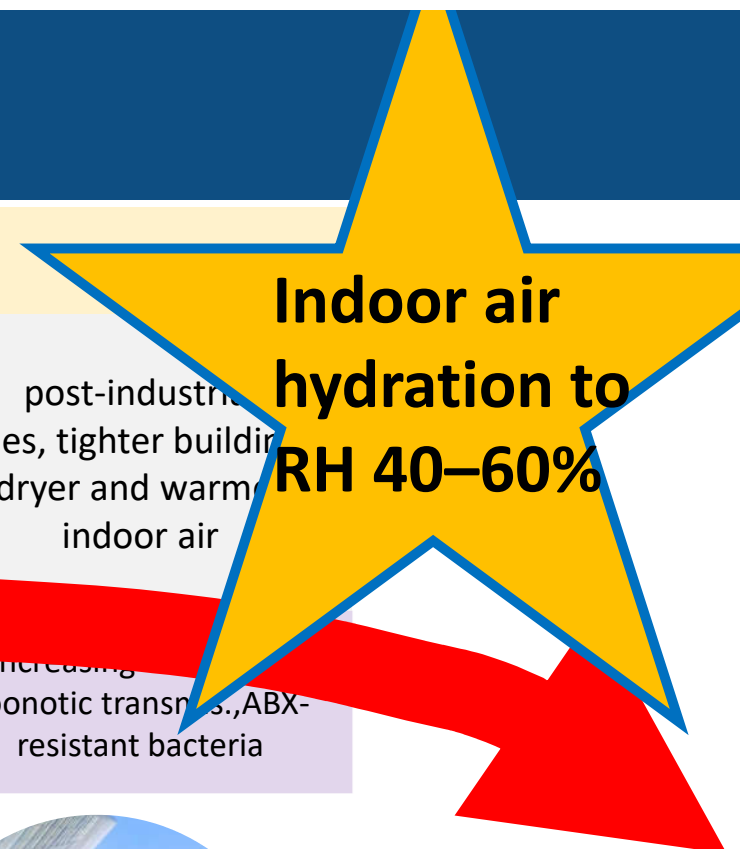
Supports the health of building occupants:

- RH 40–60% is immune-supportive to our respiratory tract and skin natural defenses
- Decreased tissue levels of the immuno-suppressant cortisol
- Improved sleep, decreased daytime fatigue and increased overall health



# Indoor RH 40–60% will correct this trend

timeline :	10,000 BC	800 BC - 500 AC	1900 AC	
housing:	primitive housing, no sanitation systems	simple sanitation, in rural villages	industrial revolution: central sewage & water systems, heating, electricity	post-industrial cities, tighter buildings, dryer and warmer indoor air
infectious diseases:	parasites, zoonosis	small pox, measles, influenza, plague	"Spanish flu" introduction of antibiotics & vaccines	increasing zoonotic trans., ABX-resistant bacteria



PLEASE – sign this petition



**40TO60RH.COM**

THE HEALTHY HUMIDITY

*Take action and join me in the fight against respiratory infections! Relative humidity of 40-60% in buildings will reduce respiratory infections and save lives.*

# Thank you!

## **Stephanie Taylor, M.D., M. Arch., ASHRAE DL**

Harvard Medical School, Primary Care  
CEO Taylor Healthcare Consulting

e-mail: [MD@taylorcx.com](mailto:MD@taylorcx.com)

phone: (860) 501-8950

Thank you to my colleague,  
**Walter Hugentobler, MD**

**and Luigi!**



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## **AIR CONDITIONING**

The process of regulating the quality, temperature, **HUMIDITY**, and circulation of air in a space enclosure.

Webinar- May 13, 2020  
Nathan Martin, P.Eng.



## Isothermal

## Adiabatic

Gas Steam

Electric Steam

Resistive  
Element

Live Steam



### Steam



### Evaporation

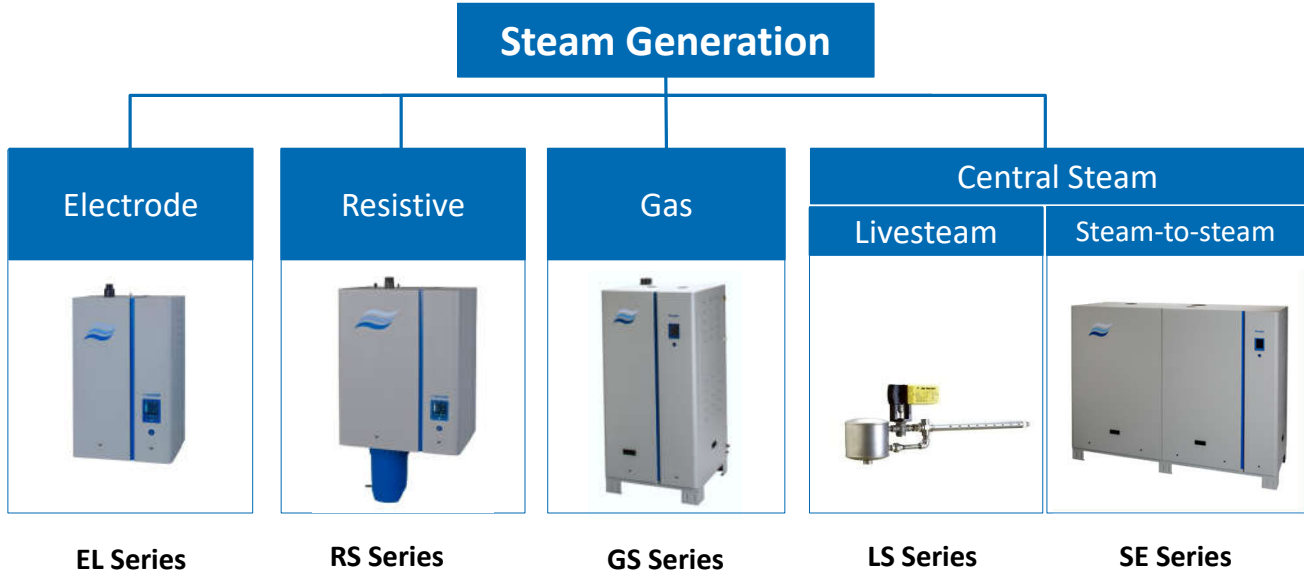
Evaporative  
Media

Nozzles

High  
Pressure

Isothermal – involving or possessing a constant temperature. (We add energy. Air temp stays the same.)

Adiabatic – relating to or denoting a process or condition in which heat does not enter or leave the system concerned. (Air temp changes. No energy added.)



- Nortec EL launched in January 2016 replacing existing NH-EL
- NHTC, NHPC, NHMC, etc. legacy models
- Capacities from 5 lbs./h to 200 lbs./h

Feature	Benefit
Cylinder	Easy maintenance, brings humidifier performance back to brand new
Touch screen integrated controller	Full control over the humidifier, BMS integration
OSHPD certification	Seismically safe



- Nortec RS has been launched since August 2015
- Resistive element sales have increased significantly since the launch
- Capacities from 10 lbs./h to 180 lbs./h

Feature	Benefit
Resistive elements	no dependency on water (De-ionized, Reverse Osmosis, potable)
Touch screen integrated controller	Full control over the humidifier, BMS integration
SSR option	unit is able to achieve +/- 1% RH
Scale Management	reduced maintenance



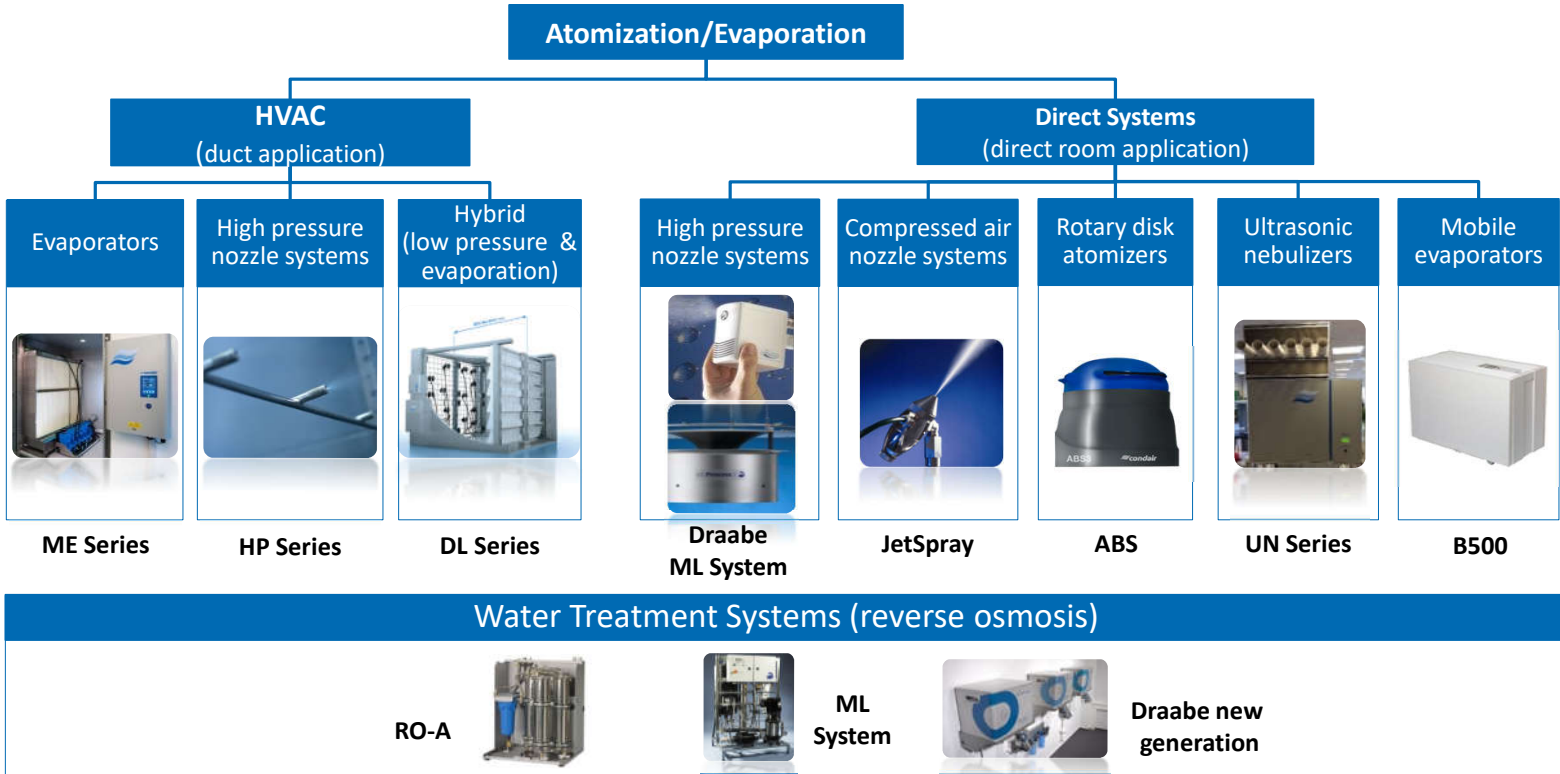


- Nortec GS launch Series 2 is newly launched (2020)
- First secondary heat exchanger humidifier on the market
- Available in 3 different options: CS, NX, MT
- Capacities from 50 lbs./h to 600 lbs./h

Feature	Benefit
Secondary Heat exchanger	Up to 93% efficient (GS CS)
Touch screen integrated controller	Full control over the humidifier, BMS integration
Low NOx available	Reduced GHG emissions
New Exhaust Options	CPVC venting, BH venting, sealed combustion standard, all available for the CS



# Condair's Humidification Product Line



Evaporators



- + Compact
- + Easy to install & use
- + Affordable
- + No need of RO water

- Poor Regulation
- Maintenance/Spares

High Pressure nozzles



- + Regulation
- + Efficiency (if enough humid. distance)
- + No recirculation

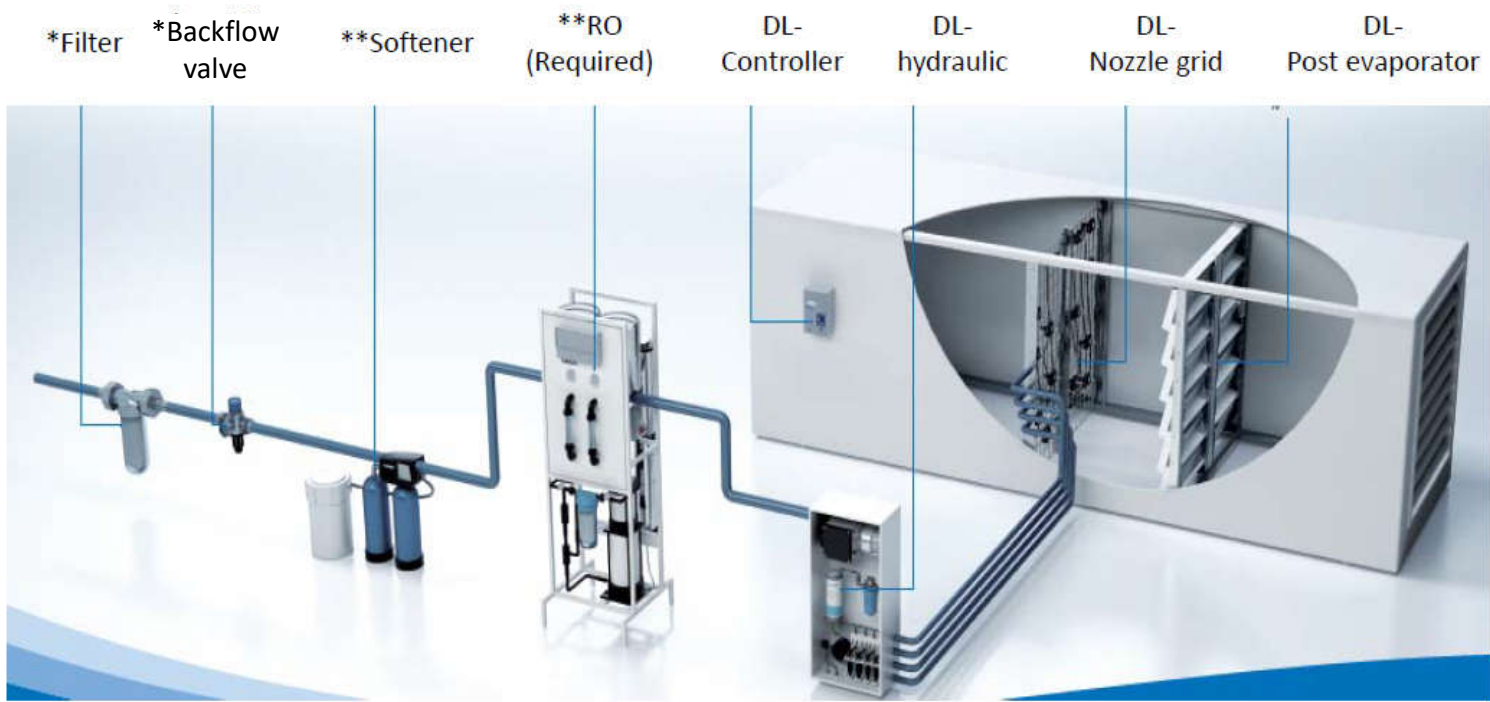
- Possibility of aerosols
- Waste water (if not enough absorp. distance)
- Wearing

Hybrid



- + Efficiency
- + Aerosol free
- + No wear
- + Maintenance
- + No recirculation

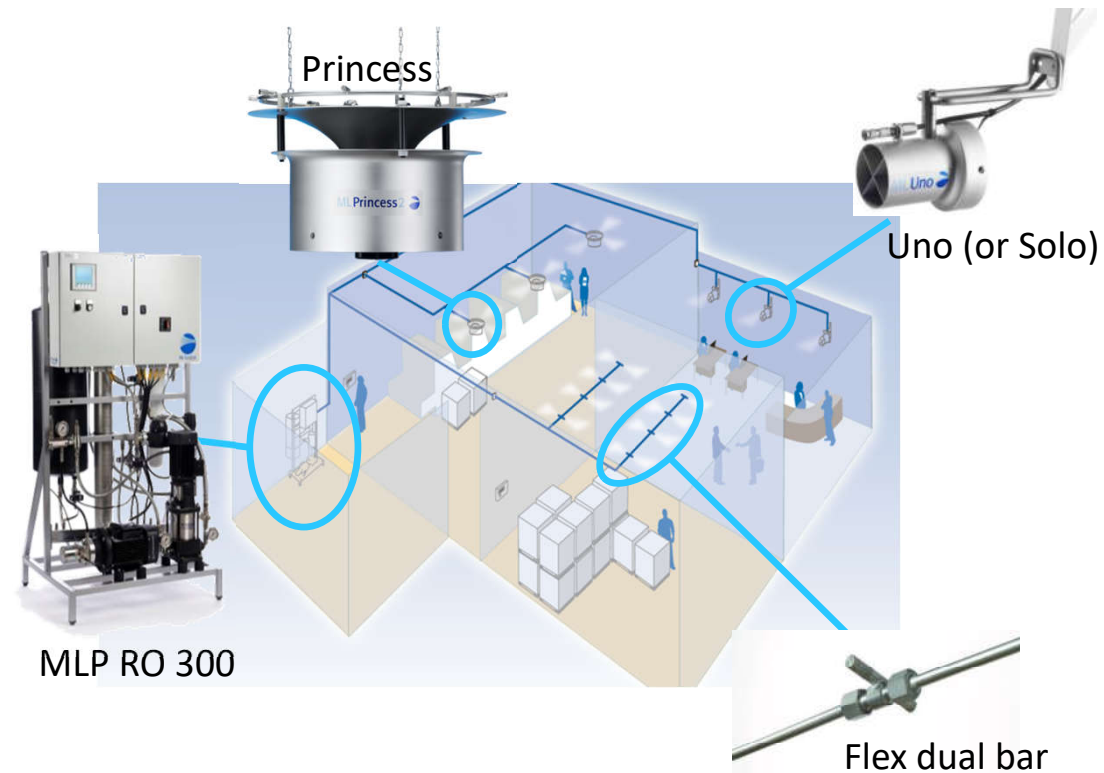
- Installation time



\*Provided by Others   \*\*Optional



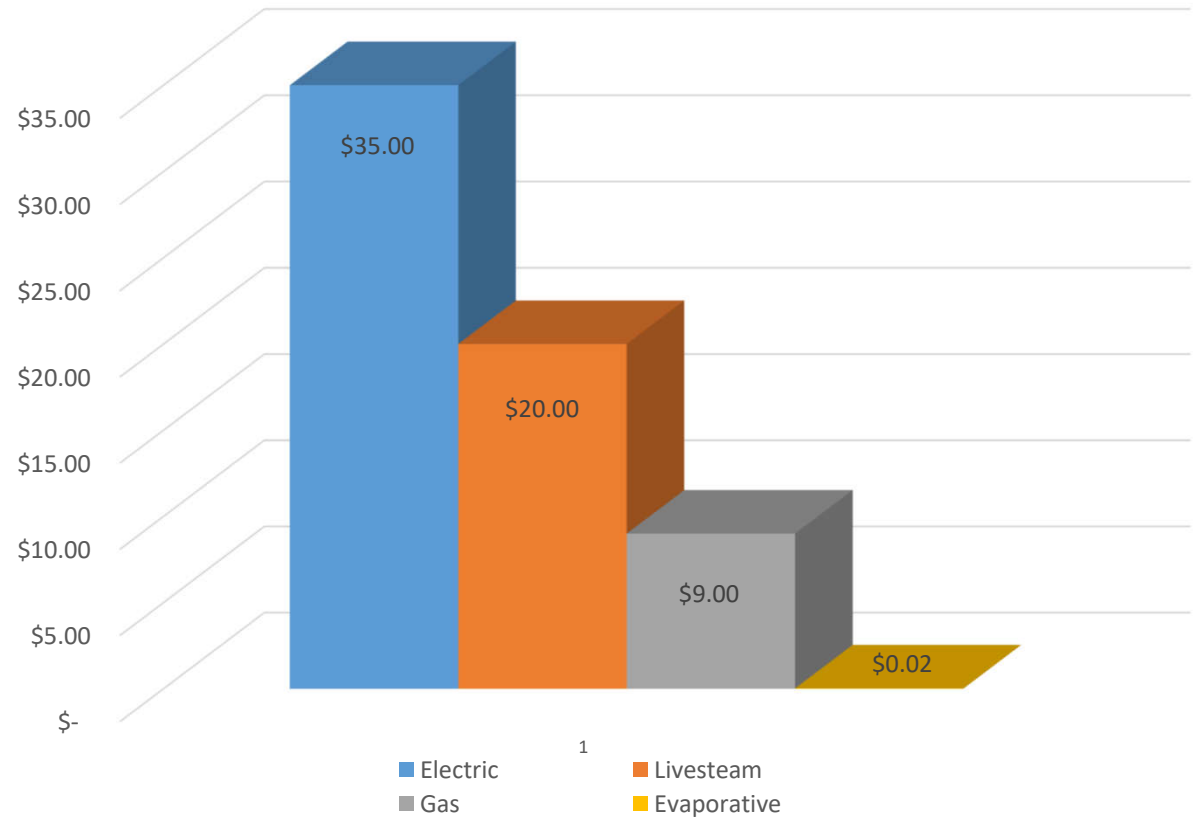
- ✓ No compromise on components
  - ✓ Danfoss oil free high pressure pump
  - ✓ Stainless steel valves, fittings and couplings
- ✓ Tailor made for any application
  - ✓ Variant configuration of pre-defined modules
- ✓ Long time robustness and reliability
  - ✓ Designed for industrial application
- ✓ Also for dust intolerant applications
- ✓ No compromise on hygienic safety
  - ✓ Bureau Veritas Quality International
  - ✓ ISO 22000/HACCP certified



- Utilize basic laws of physics to achieve cooling with an associated reduction in energy consumption and costs
  - Green approach
  - Potential for utility rebates
  - Reduced energy consumption
  - Expand the numbers of hours in Economizer

### Hourly Operation Costs

1,000 lbs/hr



## 4 BIG TAKEAWAYS



1. HUMIDIFICATION CONTROL IS A PRIMARY DRIVER OF INDOOR AIR QUALITY
2. DESIGN FOR 40-60% RH
3. CONDAIR IS A FULL LINE SUPPLIER OF ALL AVAILABLE TECHNOLOGIES IN HUMIDIFICATION
4. YOUR LOCAL HUMIDIFICATION EXPERT IS O'DELL ASSOCIATES





**Thank you for Joining!**

Nathan Martin, P.Eng  
[nathan@odellassoc.com](mailto:nathan@odellassoc.com)  
C: 519-570-5992

