



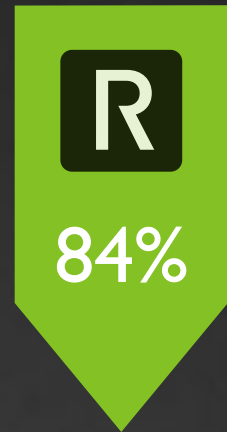
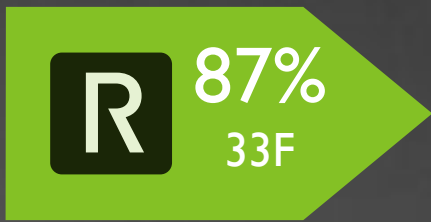
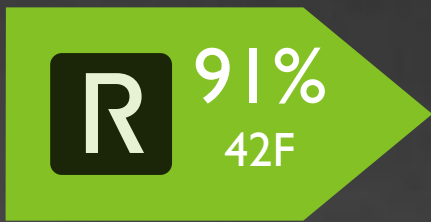
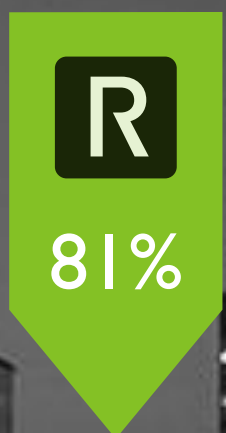
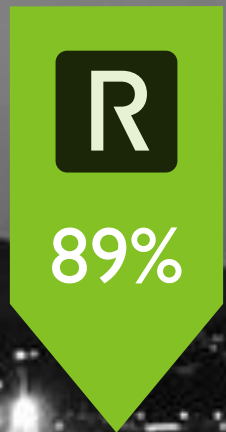
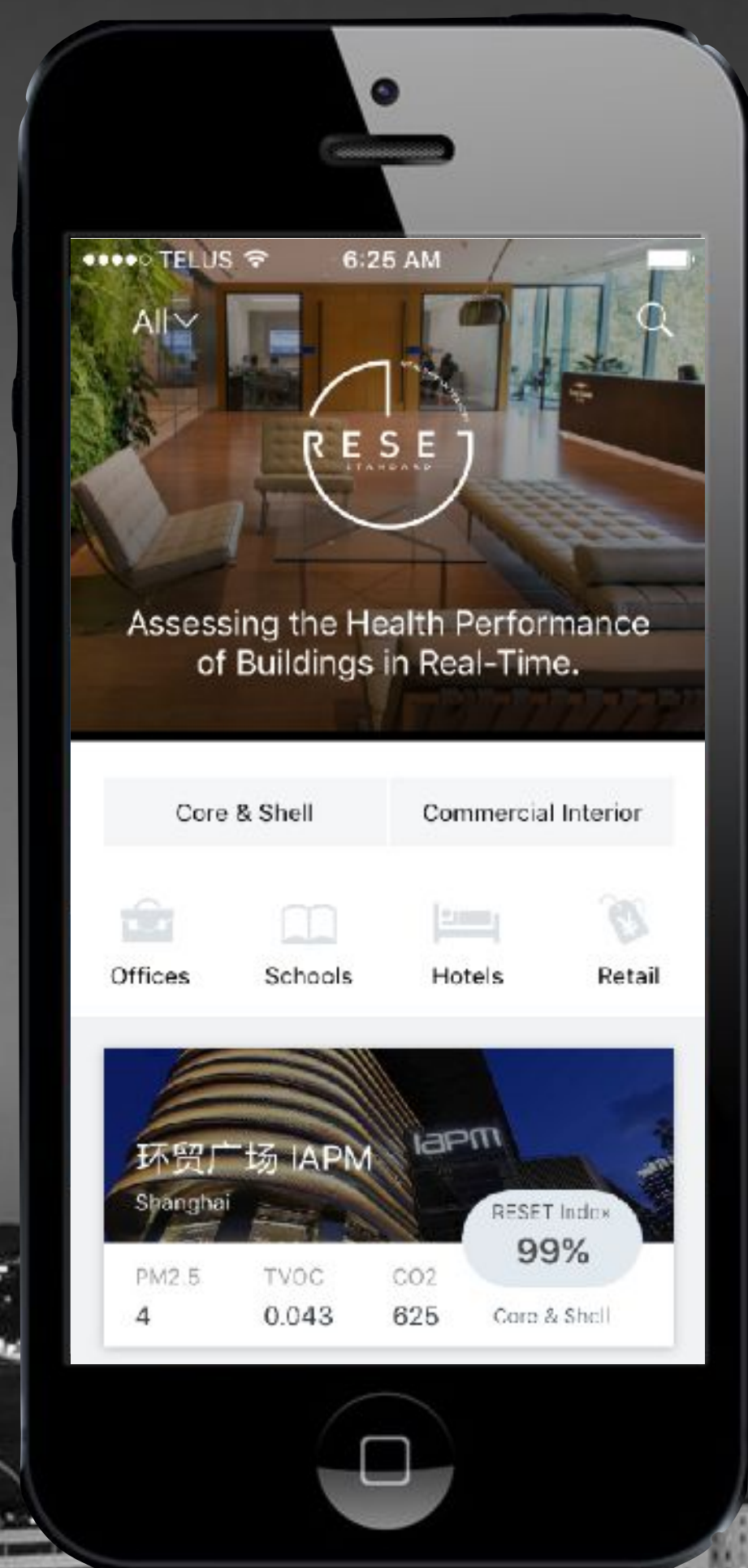
**Measurably Healthy Buildings™**  
The World's Standard for Data Quality in Real-Estate



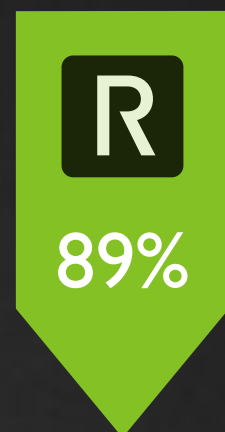
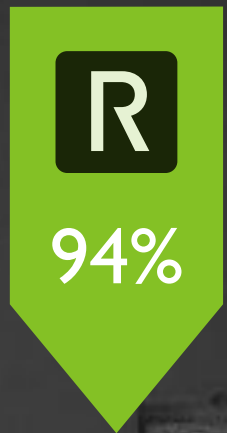


# RESET® Standard

RESET® is an international performance standard and certification program for healthy buildings based on data that is collected and analyzed on a daily basis.



*\*84% Optimized for health*



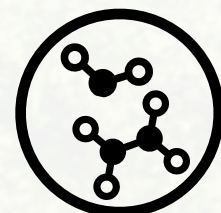


# RESET® Standard - Modules

RESET® can be implemented over-time, module by module. It does not attempt to do everything at once. Rather, it focuses on mastering and deploying one field of research at a time.

## Materials

- Pilot Stage -



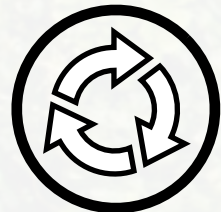
**Health**

*Material Ingredients / Chemical Emissions*



**Carbon**

*Embodied / Operational*



**Circularity**



**Water**

*Embodied / Operational*



**Social**



**Safety**

## Air

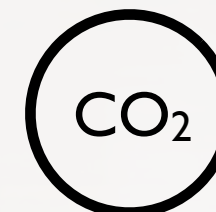


**Particulate Matter**

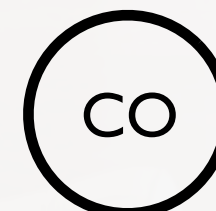
*Indoor / Outdoor*



**Chemical Off-gassing**



**Carbon Dioxide**



**Carbon Monoxide**



**Other \***

*\*RESET continuously tests sensors that detect other parameters of interest such as formaldehyde, Ozone and NO<sub>2</sub>. New parameters are added as sensors are proven to meet the RESET Standard.*

## Energy

- Pilot Stage -

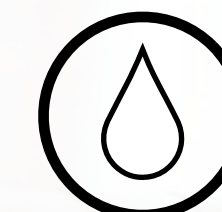


**Operational**

*Energy / Carbon*

## Water

- Pilot Stage -

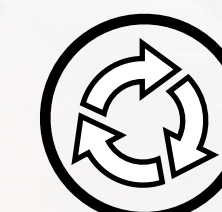


**Operational**

*Quality / Quantity*

## Waste

- In Development -

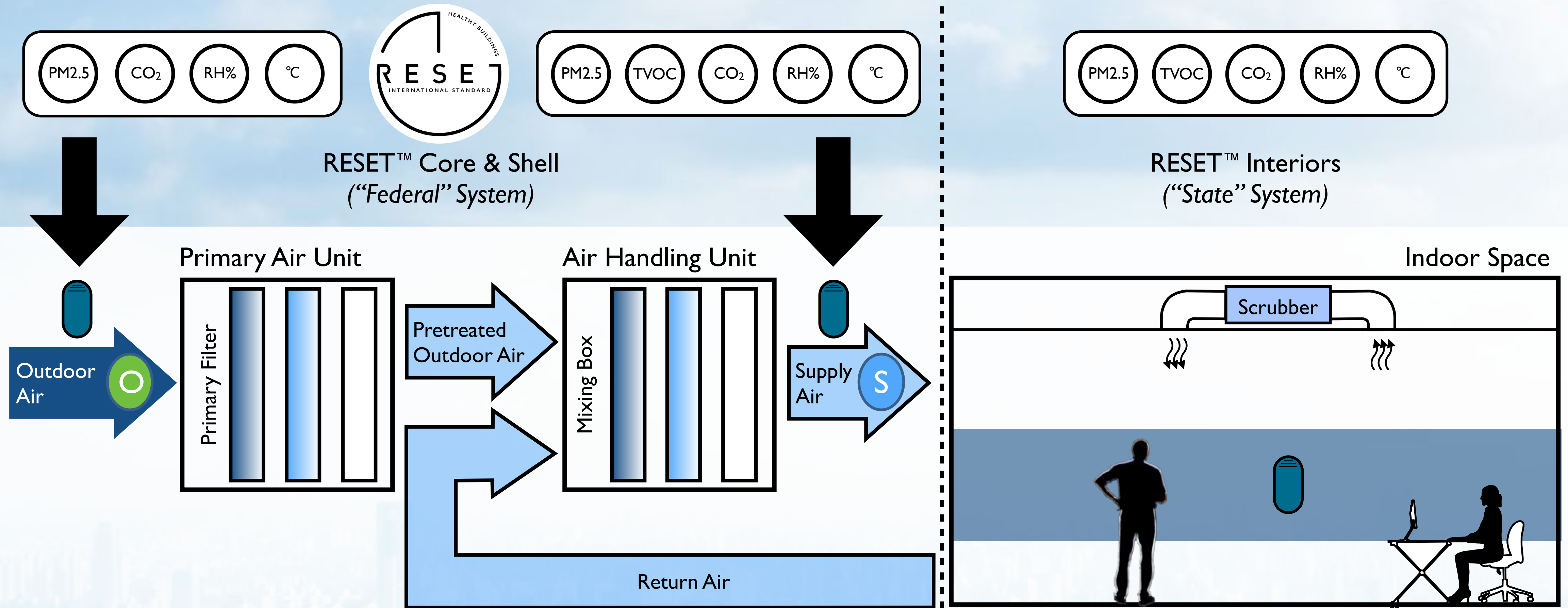


**Circularity**



# RESET® Air - At a Glance

RESET® helps owners, operators and tenants achieve healthy performance targets by clearly defining and communicating their respective roles and responsibilities.



# RESET® Air - A Comprehensive Standard for Quality

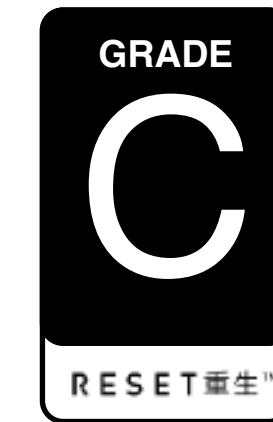
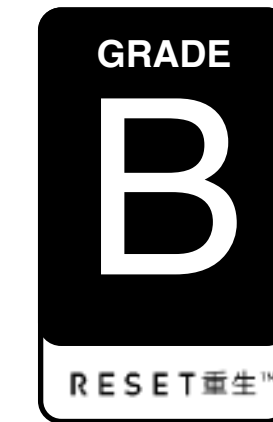
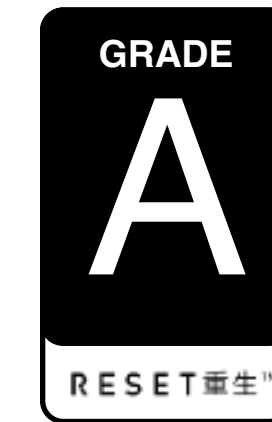
RESET® tracks the pulse of buildings primarily via monitors and sets standards for their performance, installation, calibration and data reporting.



## 1. RESET™ Monitor Standards



**R** BUILDING GRADE ACCREDITED MONITOR



## 2. RESET™ Installation & Maintenance Standards



RESET™ AP

RESET™ Accredited Professionals (AP) are independent professionals trained to guide projects from the design of solutions through to installation & maintenance.



## 3. RESET™ Data Communication Standards



The RESET™ cloud collects data from accredited project networks and sub-clouds, analyses the data and reports the result.







Hines

New Office Tower



KERRY PROPERTIES  
嘉里建設

Existing Office Tower



lendlease

Office Interior



CORDIS

Hotel

STARBUCKS RESERVE™

Retail

SCHWARZMAN SCHOLARS

Educational





# RESET® Air - Building Block for the Industry

As the industry's reference for data quality, the RESET® Standard can be used in combination with most building standards.





There is no lack of guidance on how to operate buildings during the SARS-CoV-2 pandemic.

What's lacking is empirical evidence.

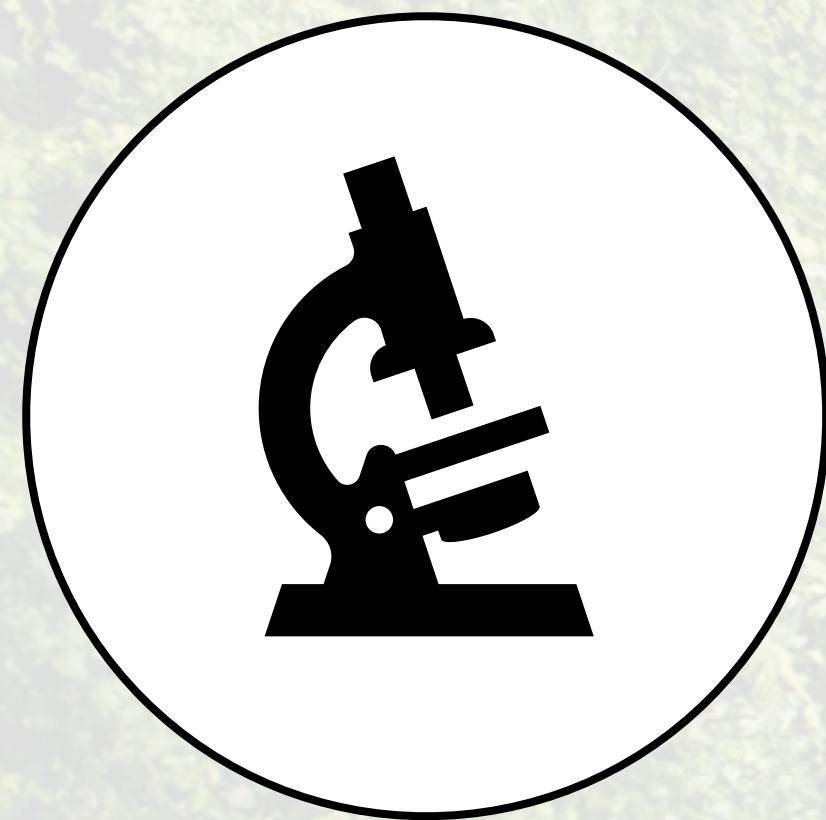




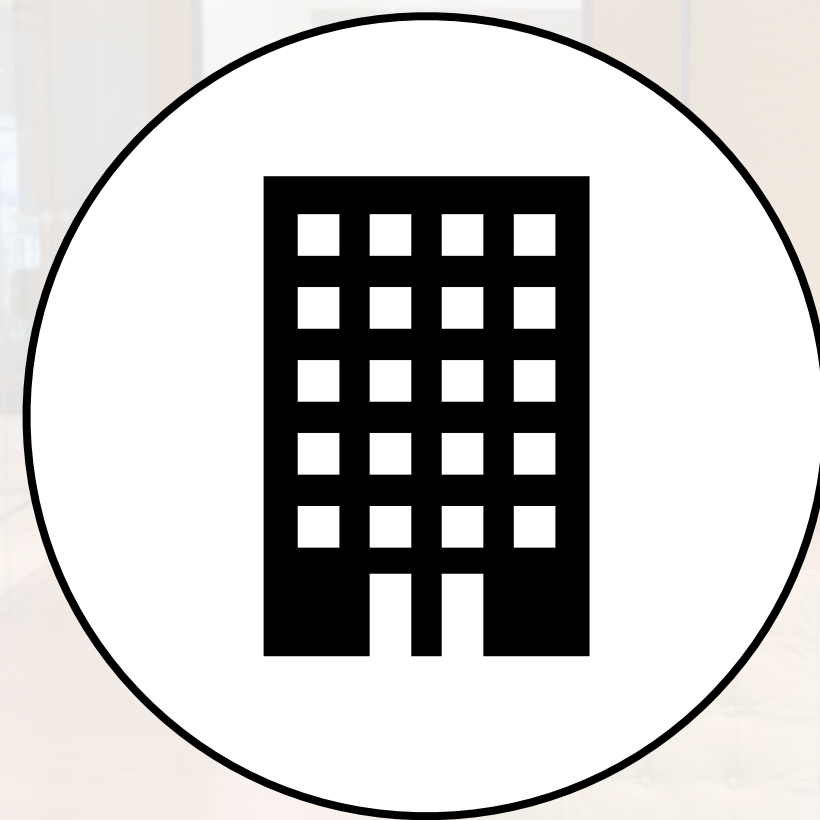
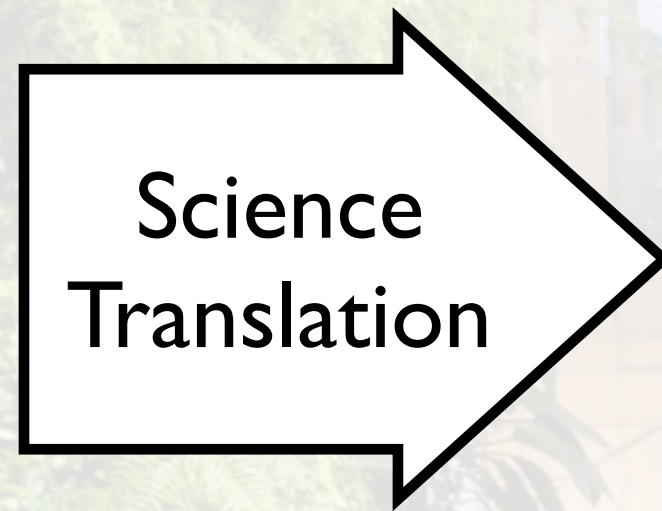
As an industry, we are doing remarkably little monitoring for an airborne pathogen that is influenced by air quality controls in buildings.





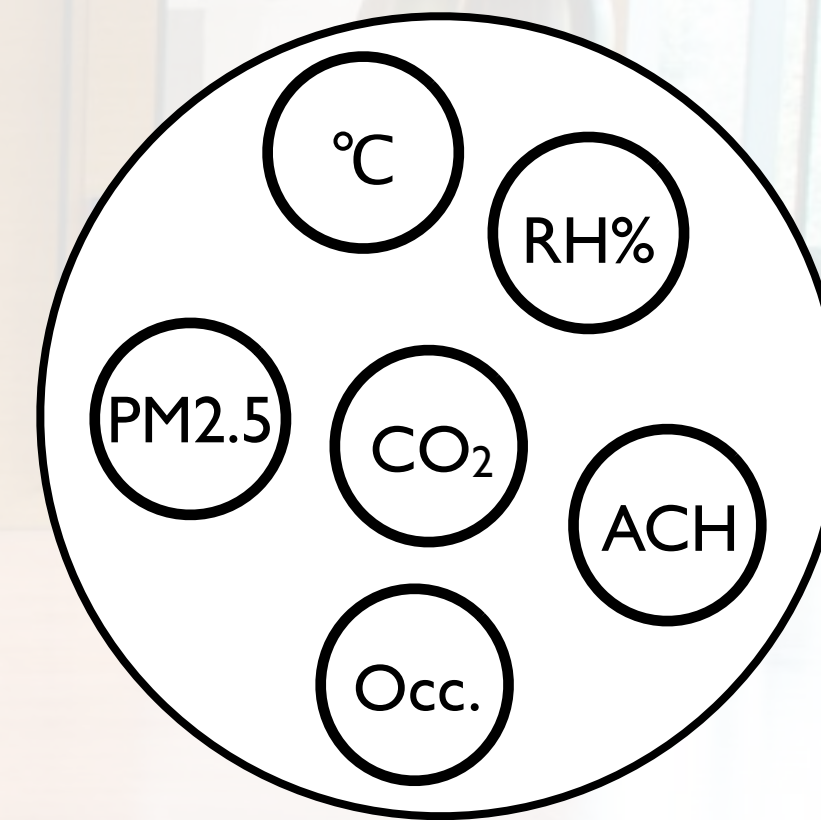


Scientific Literature



Applied Science  
*(Standardized)*

+



Sensor Data  
*(Standardized)*

=



Real-time score  
*(Standardized)*





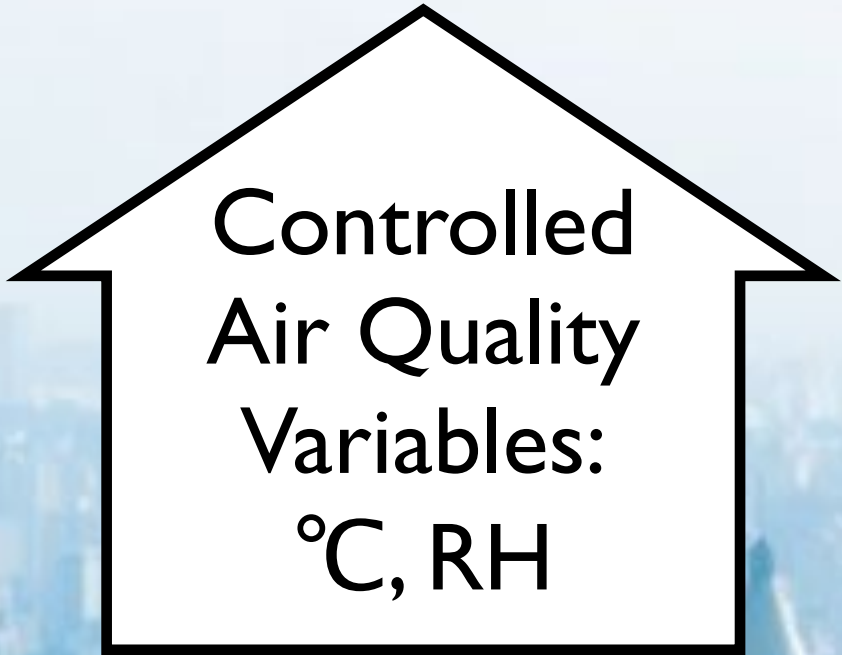
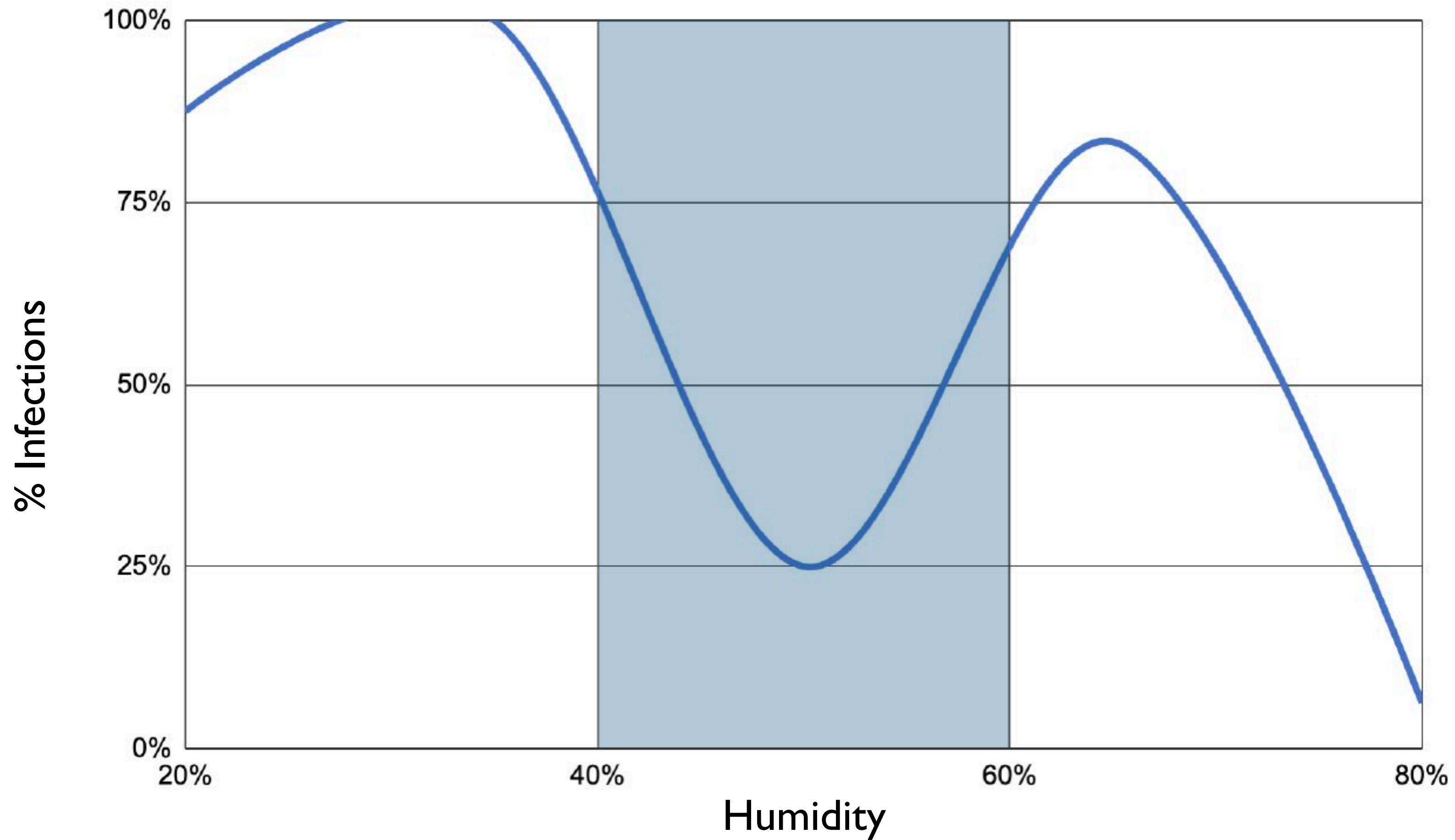
# Estimating the risk of virus transmission in real-time



**We can't monitor airborne concentration of SARS-CoV-2 in real-time...**

**...but we can monitor the parameters that influence infection:  
Temperature, Humidity, PM, Occupant Density, etc.**





Roles of Humidity and Temperature in Shaping Influenza Seasonality, Anice C. Lowen, John Steel, Department of Microbiology and Immunology, Emory University School of Medicine, Atlanta, Georgia 2014





I heard humidity doesn't affect SARS-CoV-2. Is this graph relevant?

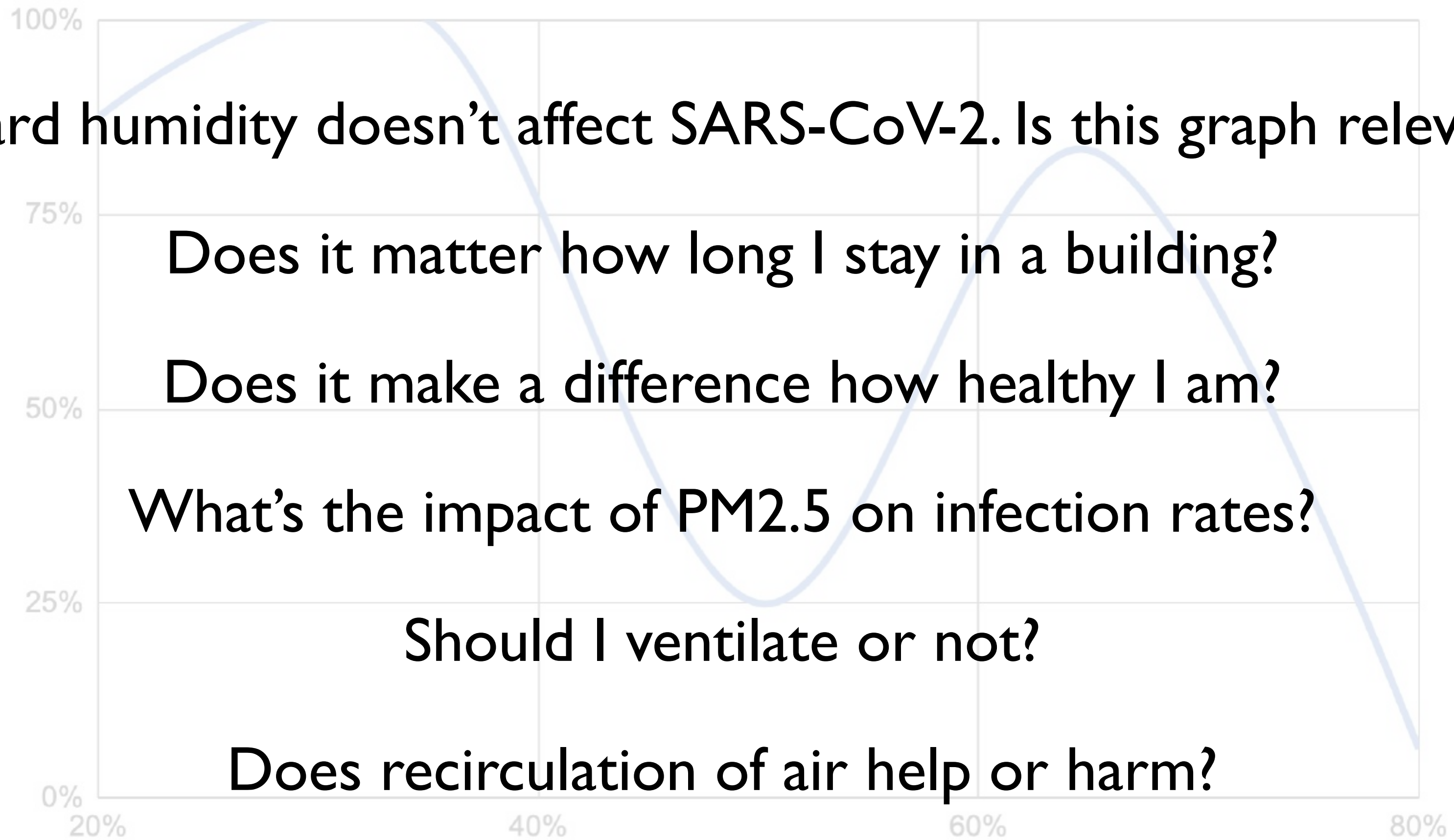
Does it matter how long I stay in a building?

Does it make a difference how healthy I am?

What's the impact of PM2.5 on infection rates?

Should I ventilate or not?

Does recirculation of air help or harm?

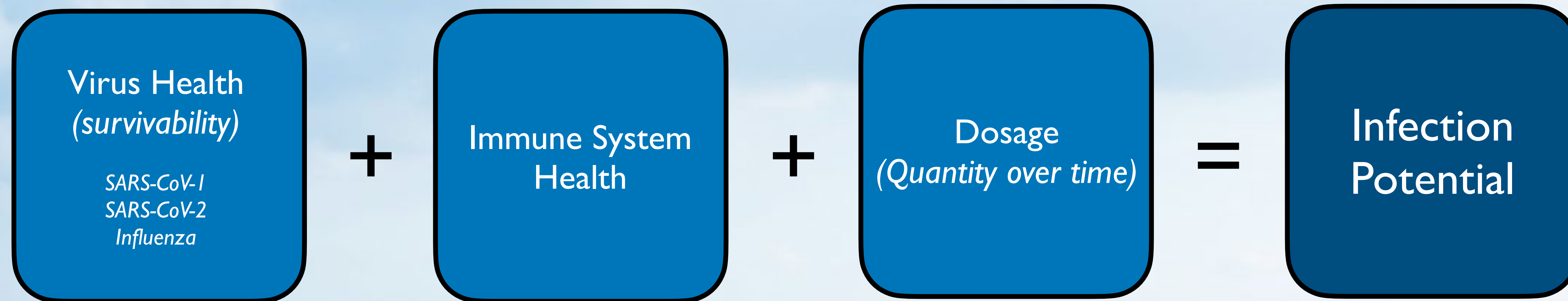


Scientific  
Research Data

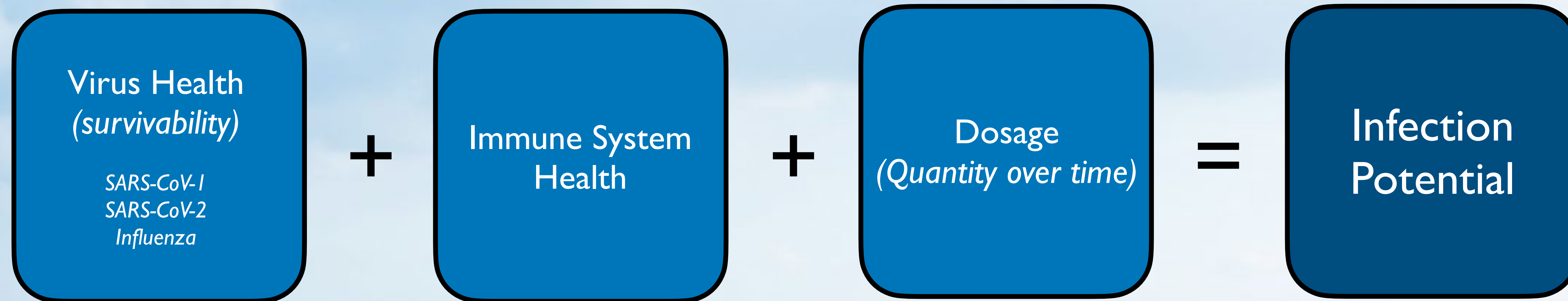
Infection  
Potential

Controlled  
Air Quality  
Variables:  
°C, RH

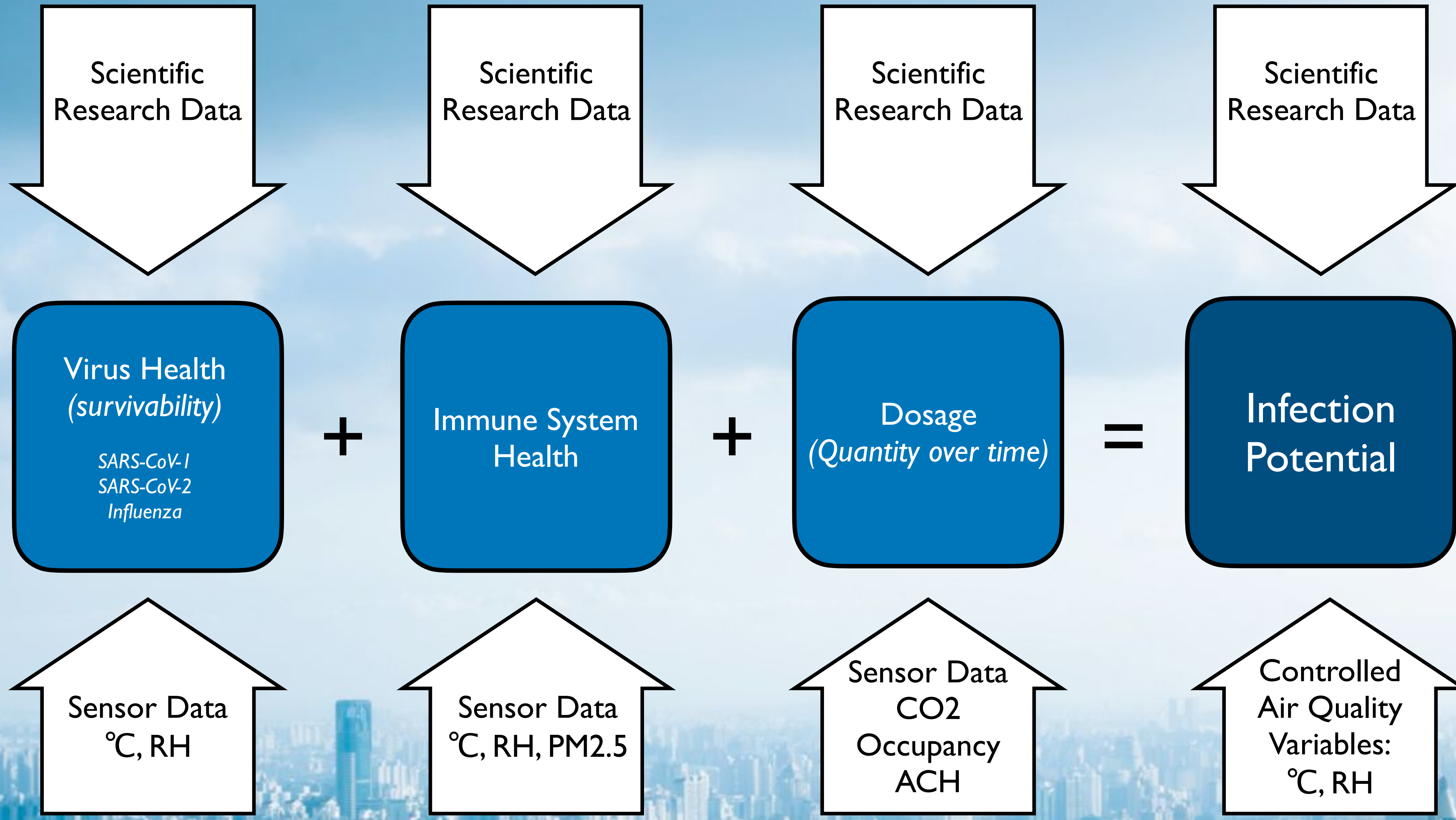














# Indirect Health Effects of Relative Humidity in Indoor Environments

Environmental Health Perspectives  
Vol. 65, pp. 351-361, 1986

Science of the Total Environment 727 (2020) 138704

Contents lists available at ScienceDirect

Science of the Total Environment

Journal homepage: www.elsevier.com/locate/scitotenv

Association between short-term exposure to air pollution and COVID-19 infection: Evidence from China

Roles of Humidity and Temperature in Shaping Influenza Seasonality

Anice C. Lowen, John Steel

Really important to note this study is focused on transmission; not virus survivability on either surfaces or in aerosols

Department of Microbiology and Immunology, Emory University School of Medicine, Atlanta, Georgia, USA

Experimental studies in guinea pigs demonstrated that influenza virus transmission is strongly modulated by temperature and humidity. A number of epidemiological studies have followed up on these findings and revealed robust associations between influenza incidence in temperate regions and local conditions of humidity and temperature, offering a long-awaited explanation

Environmental Health

BMC

PMCID: PMC293432  
PMID: 14629774

## EVIDENCE BASED PUBLIC HEALTH POLICY AND PRACTICE

### An initial investigation of the association between the SARS outbreak and weather: with the view of the environmental temperature and its variation

Running head: Indoor transmission of SARS-Cov-2

### Indoor transmission of SARS-CoV-2

Hua QIAN<sup>1,\*</sup>, Te MIAO<sup>2,\*</sup>, Li LIU<sup>3</sup>, Xiaohong ZHENG<sup>1</sup>, Danting LUO<sup>1</sup>, and Yuguo Li<sup>2,4,\*</sup>

1. School of Energy and Environment, Southeast University, Nanjing, China  
2. Department of Mechanical Engineering, The University of Hong Kong, Pokfulam, Hong Kong, China

## INTERFACE

### Mechanistic insights into humidity on airborne influenza virus survival, transmission and seasonality

royalsocietypublishing.org/journal/rsif

Review

Linsey C. Marr<sup>1,2</sup>, Julian W. Tang<sup>1,3</sup>, Jennifer Van Dyke<sup>4</sup>, and Seema S. Lakdawala<sup>5</sup>

### Airborne micro-organisms: survival tests with four viruses

### Survival Characteristics of Airborne Human Coronavirus 229E

By M. K. IJAZ, A. H. BRUNNER, S. A. SATTAR, RAMA C. NAIR<sup>1</sup> AND C. M. JOHNSON-LUSSENBERG<sup>2\*</sup>

PLOS PATHOGENS

Influenza Virus Transmission is Dependent on Relative Humidity and Temperature

PMCID: PMC2034399  
PMID: 17953482

## 100+ Science Publications

ENVIRONMENTAL Science & Technology

High ambient temperature dampens adaptive immune responses to influenza A virus infection

Miyu Moriyama<sup>a</sup> and Takeshi Ichinobe<sup>a,1</sup>

HEALTH EFFECTS OF RELATIVE HUMIDITY

Table 1. Epidemiological studies on relative humidity (RH) and respiratory infections (RI).

Study	Population	Date	Unhumidified buildings			Humidified buildings			% Change	Significance level (p)
			Pop'n size	% RH	RI or absence (Aba) rate	Pop'n size	% RH	RI or absence (Aba) rate		
not stated	not stated	not stated	49	3.0%	Aba	47	47	<0.01		

### A physicist view of the airborne infection

Luis A. Anchordoqui and Eugene M. Chudnovsky

Physics Department, Herbert H. Lehman College and Graduate School, The City University of New York  
250 Bedford Park Boulevard West, Bronx, New York 10468-1589, USA

(Dated: March 2020)

Naturally produced droplets from humans (such as those produced by breathing, talking, sneezing, and coughing) include several types of cells (e.g., epithelial cells and cells of the immune system), physiological electrolytes contained in mucous and saliva (e.g., Na<sup>+</sup>, K<sup>+</sup>, Cl<sup>-</sup>), as well as, potentially, several infectious agents (e.g. bacteria, fungi, and viruses). The SARS-CoV-2 epidemic, which has become a major public health concern, has provided a didactic overview of airborne germ transmission and a recommendation that could help to slow down its spread.

Interface focus

The effect of environmental parameters on the survival of airborne infectious agents

Julian W. Tang\*

Department of Microbiology and Immunology, National University Hospital, 5 Lower Kent Ridge Road, Singapore 119074, Republic of Singapore

Environmental Research

Effects of air pollutants on the transmission and severity of respiratory viral infections

José L. Domingo<sup>a,\*</sup>, Joaquim Rovira<sup>a,b</sup>

## The role of absolute humidity on transmission rates of the COVID-19 outbreak

Wei Luo<sup>1,2</sup>, Maimuna S. Majumder<sup>1,2</sup>, Diambo Liu<sup>1,2</sup>, Canelle Poirier<sup>1,2</sup>,

RESEARCH

Open Access

### Impact of ambient fine particulate matter (PM<sub>2.5</sub>) exposure on the risk of influenza-like-illness: a time-series analysis in Beijing, China

Feng et al. Environmental Health (2016) 15:17  
DOI 10.1186/s12940-016-0115-2

ANNUAL REVIEWS

Seasonality of Respiratory Viral Infections

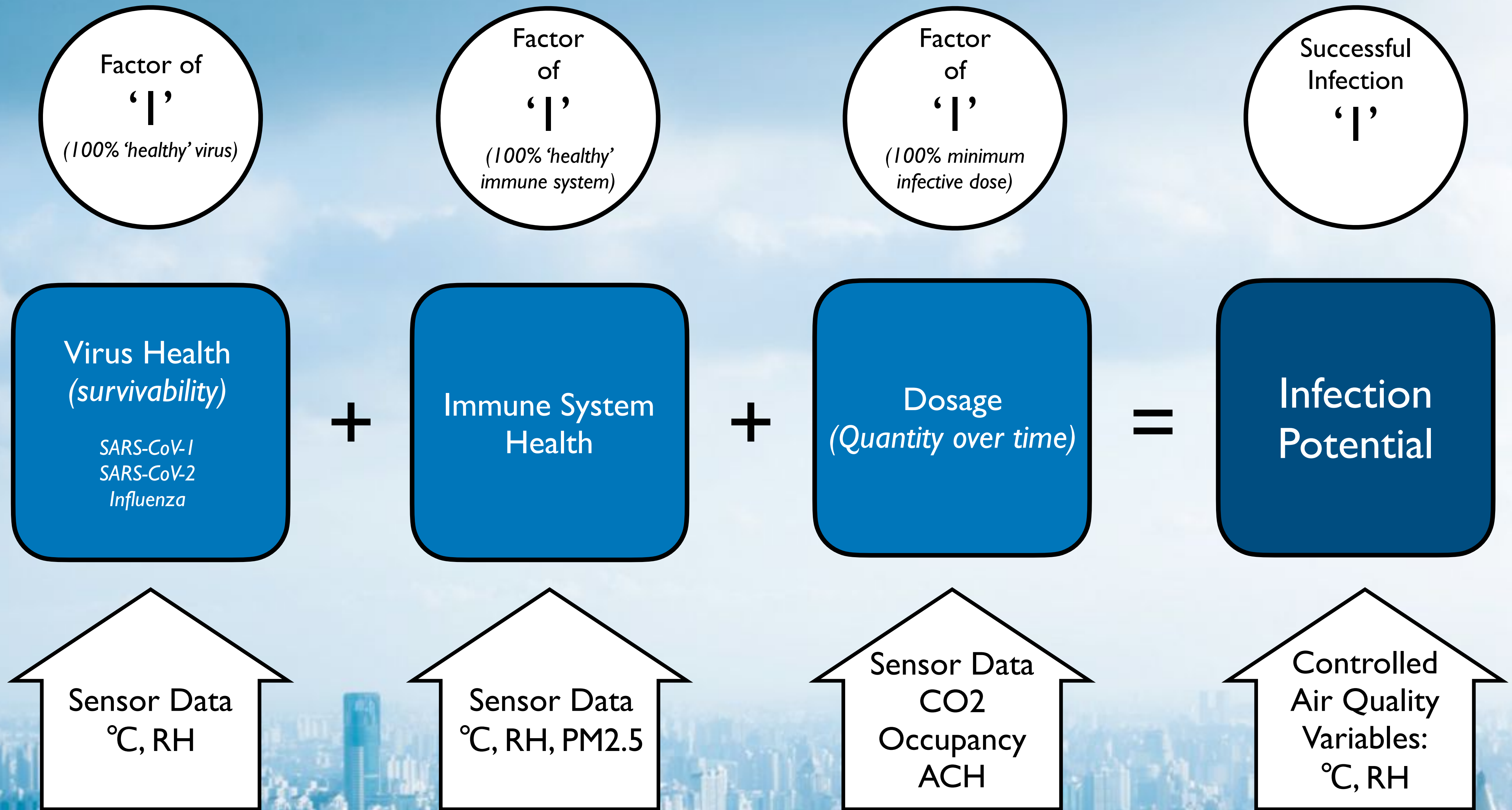
Miyu Moriyama,<sup>1</sup> Walter J. Hugerter,<sup>2</sup> and Akiko Iwasaki<sup>1,3,4</sup>

**Keywords**  
respiratory infection, antiviral immune response, seasonality, indoor climate, outdoor climate

**Abstract**  
The seasonal cycle of respiratory viral disease for thousands of years, as annual epidemics of influenza disease hit the human population like





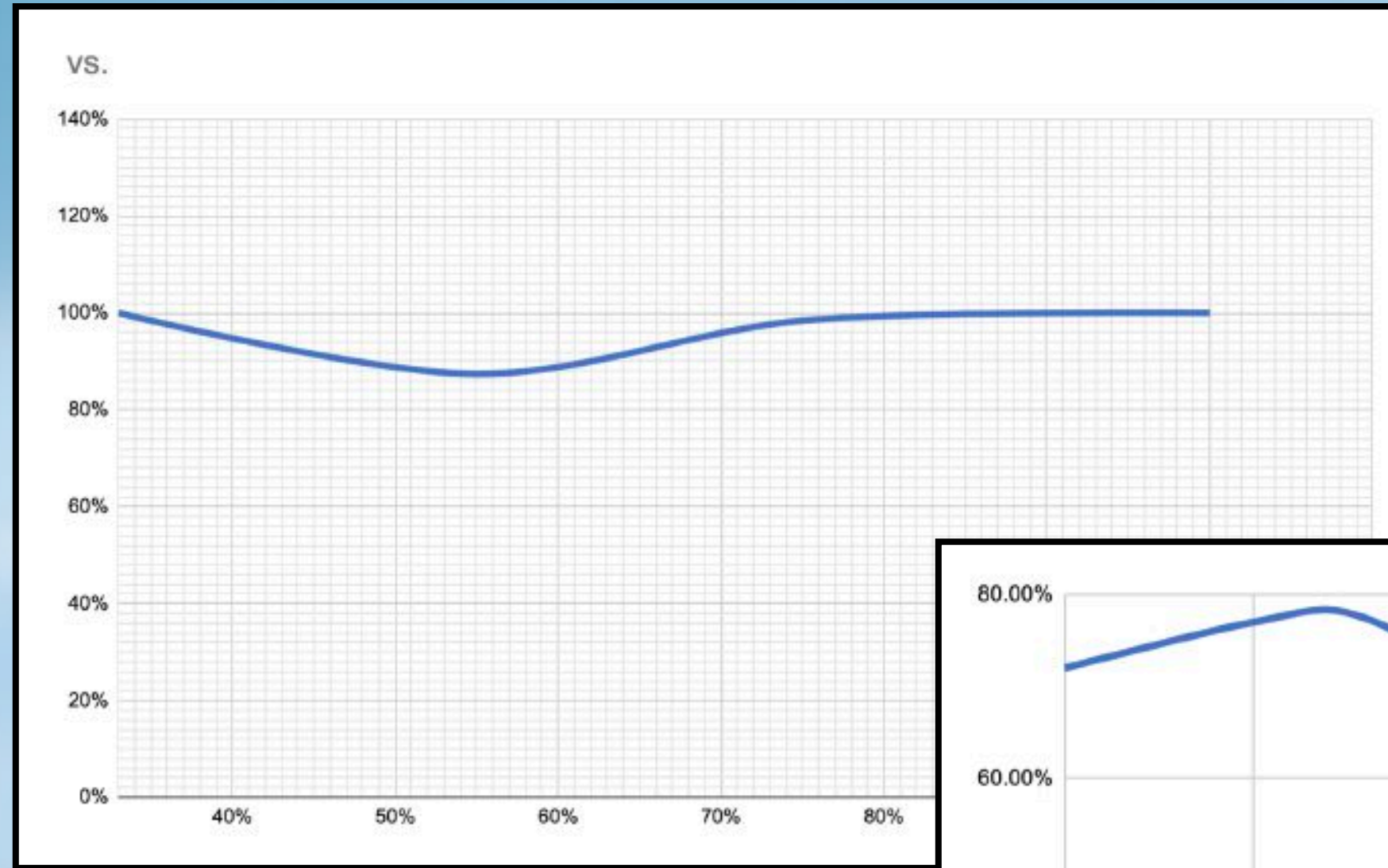




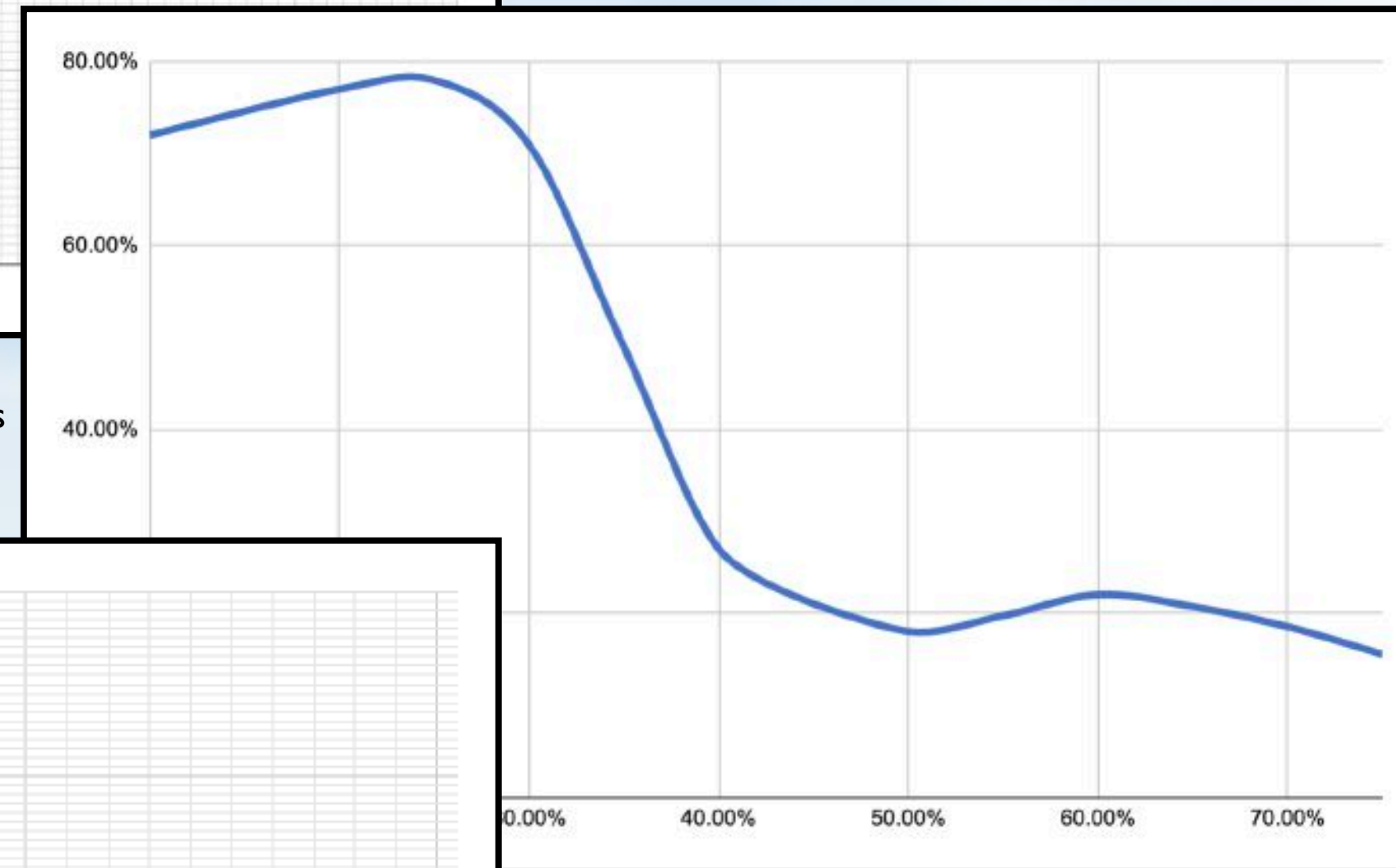
Scientific  
Research Data

## Virus Health (survivability)

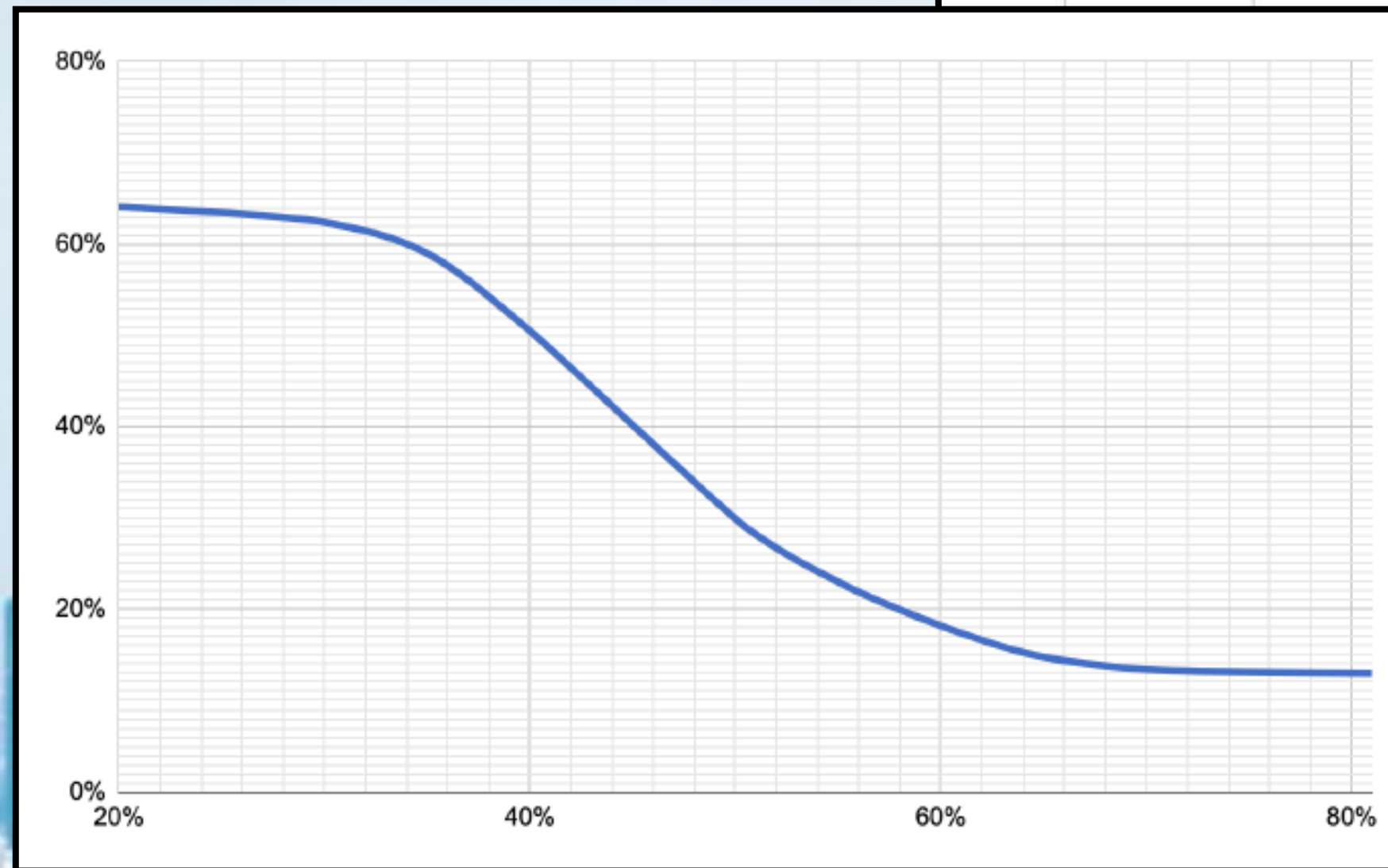
SARS-CoV-1  
SARS-CoV-2  
Influenza



Influenza (humidity impact): K. Lin, L.C. Marr: Humidity-Dependent Decay of Viruses, but Not Bacteria, in Aerosols and Droplets Follows Disinfection Kinetics, 2020



Influenza (humidity impact) J.D. Noti; High Humidity Leads to Loss of Infectious Influenza Virus from Simulated Coughs, 2013



Influenza (humidity impact) G.J. Harper, Airborne micro-organisms: survival tests with four viruses, 1961

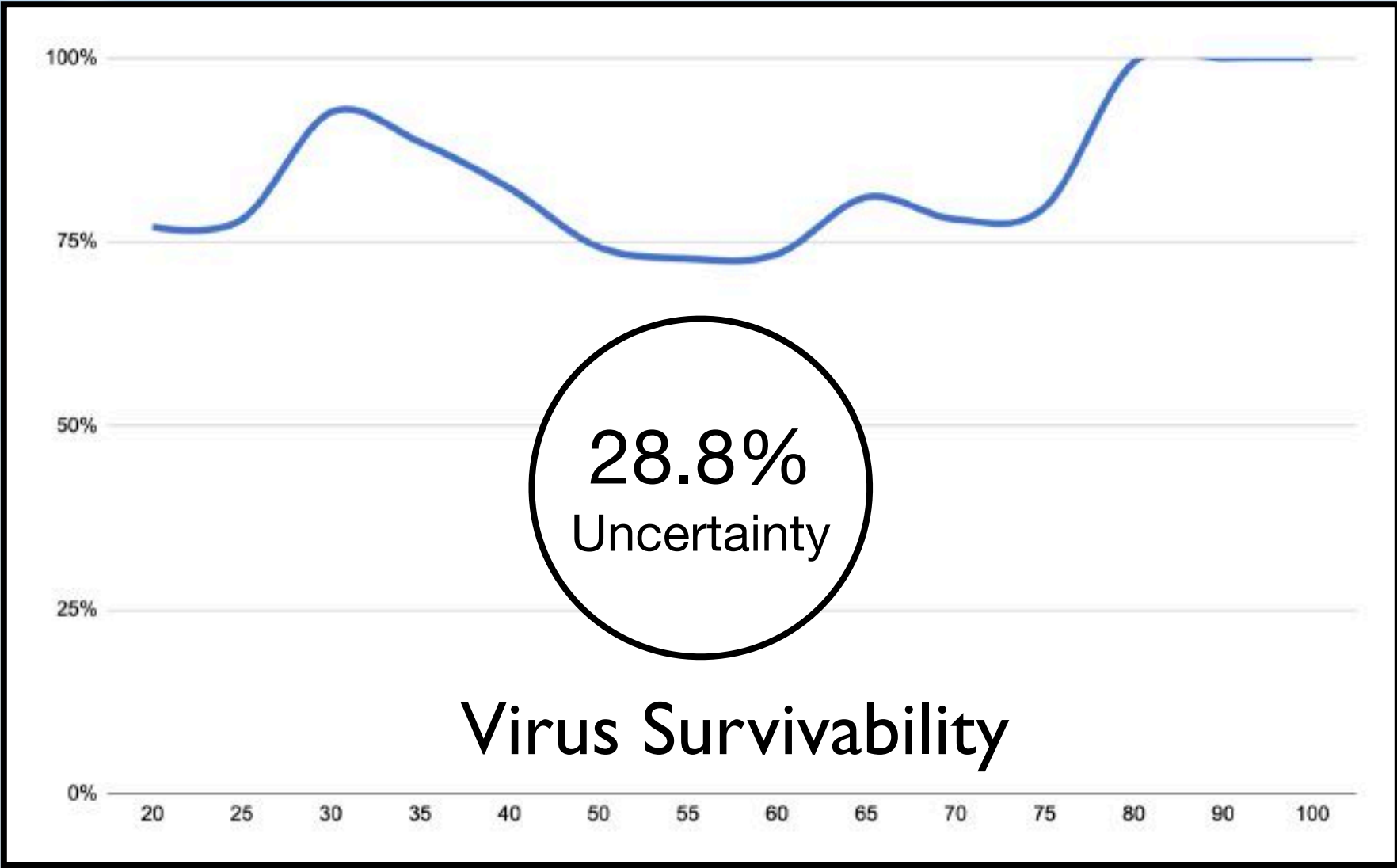






**Virus Health  
(survivability)**

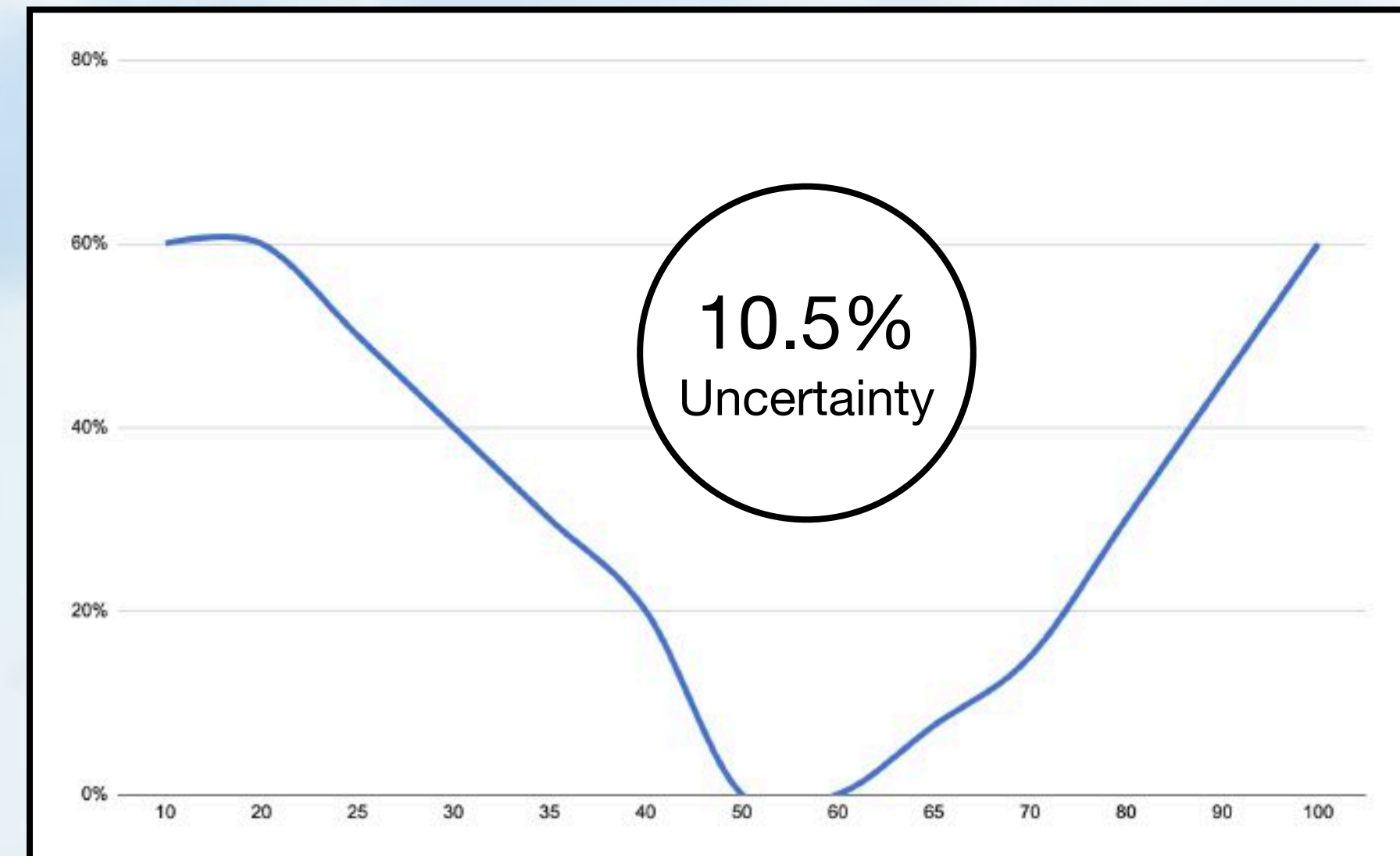
SARS-CoV-1  
SARS-CoV-2  
Influenza





Scientific  
Research Data

Immune System  
Health



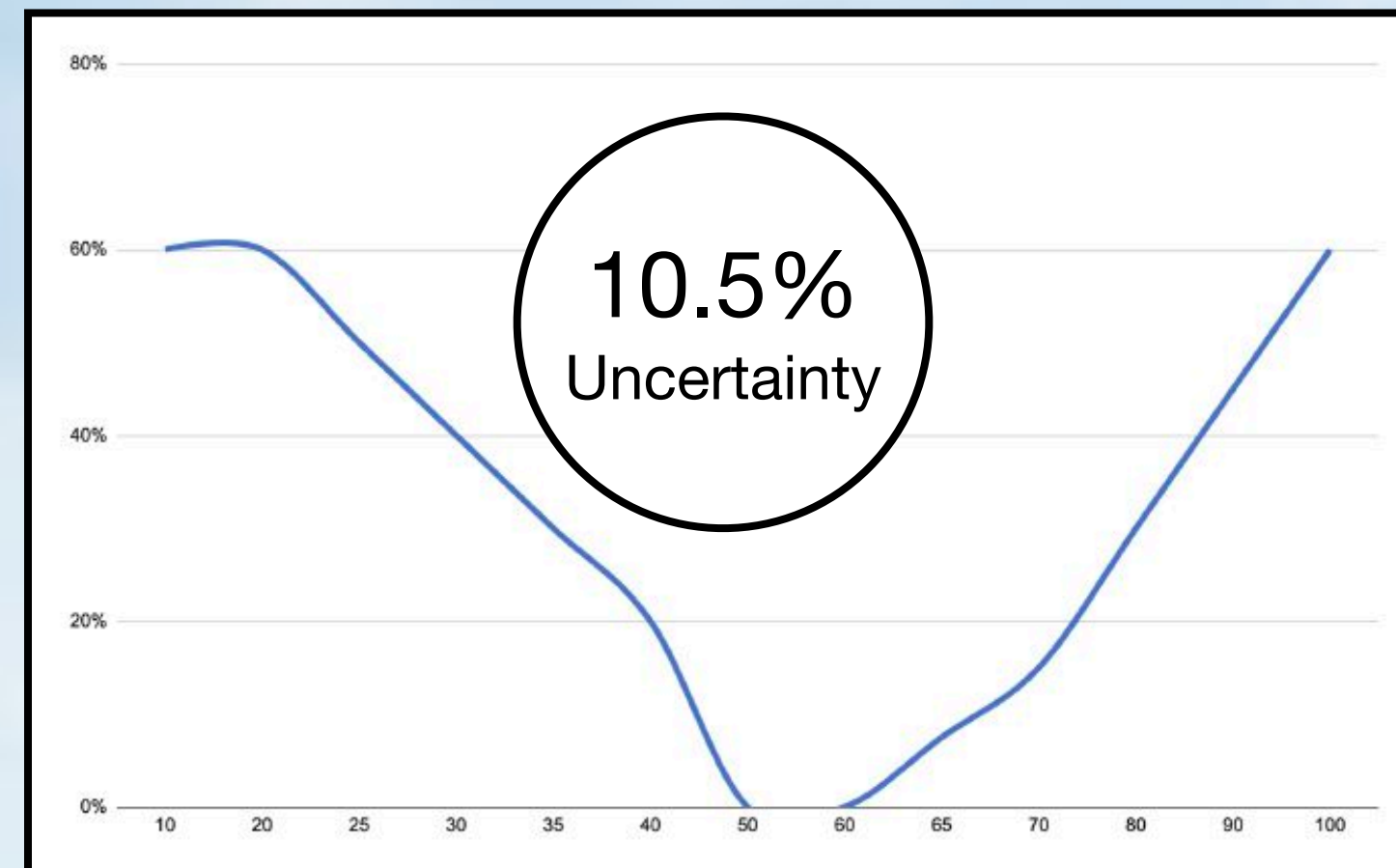


### Virus Survivability



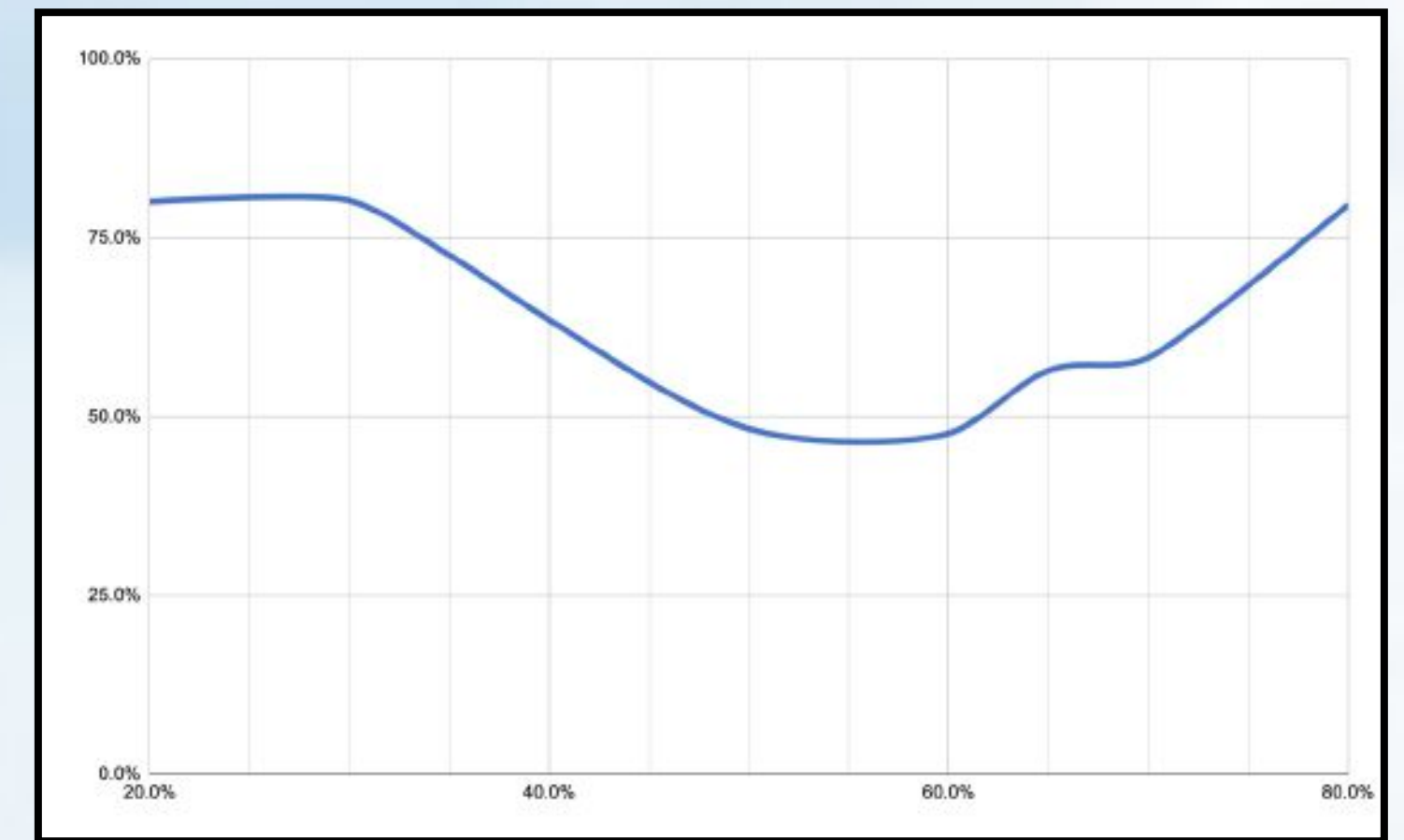
+

### Immune System Impact



=

### Infection Potential





## Virus Survivability



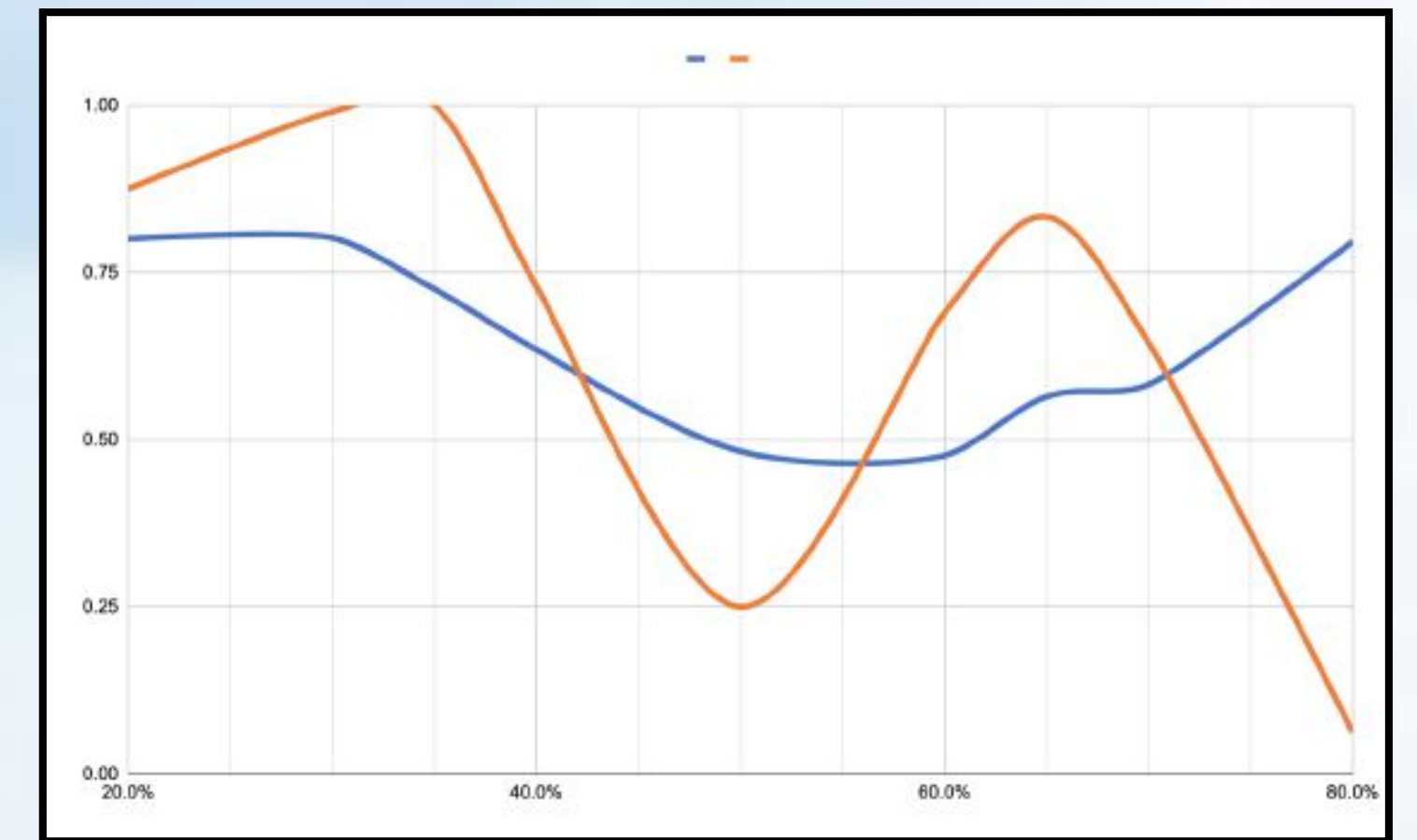
+

## Immune System Impact



=

## Infection Potential

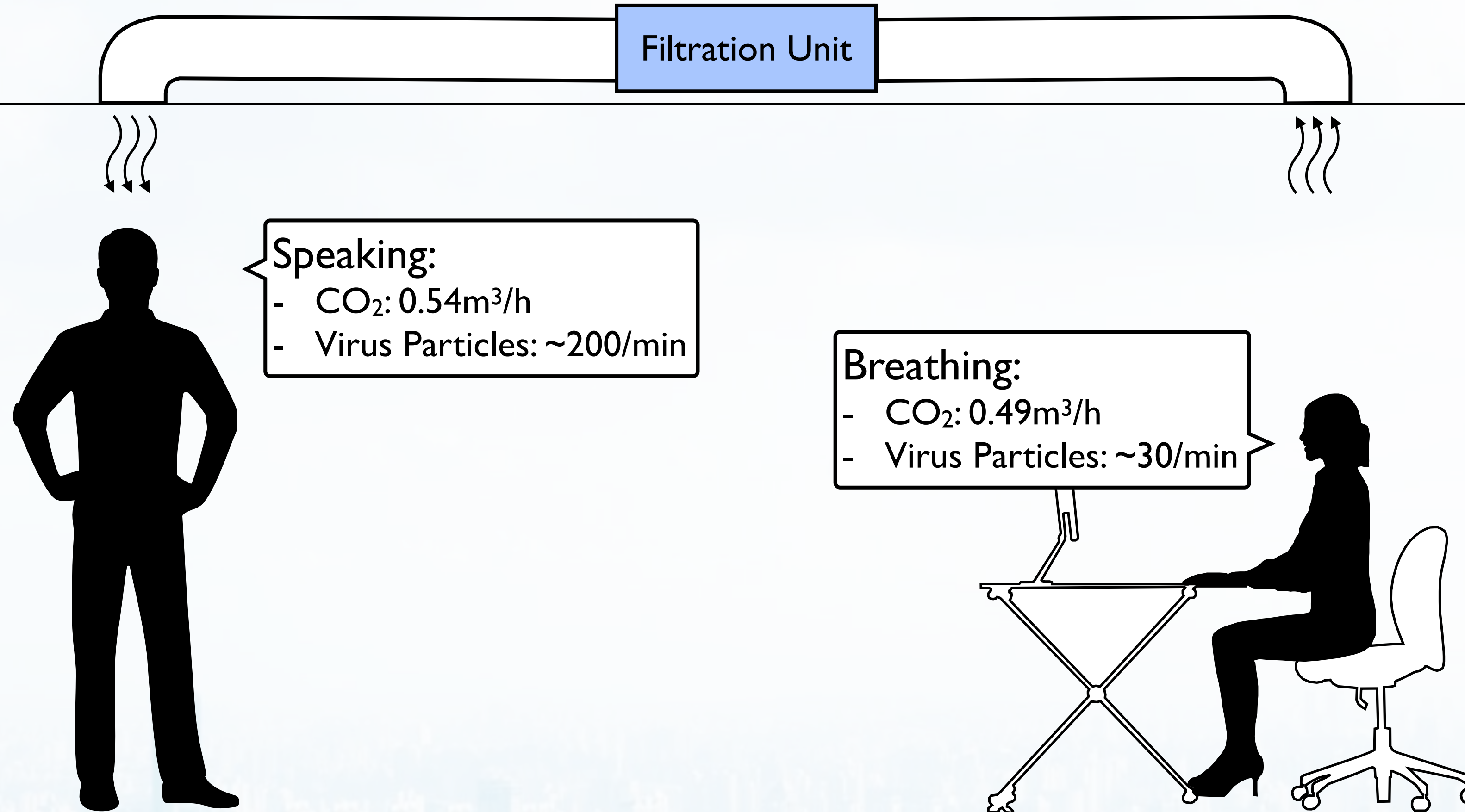


Roles of Humidity and Temperature in Shaping Influenza Seasonality, Anice C. Lowen, John Steel, Department of Microbiology and Immunology, Emory University School of Medicine, Atlanta, Georgia 2014



# Dosage: Quantity over time

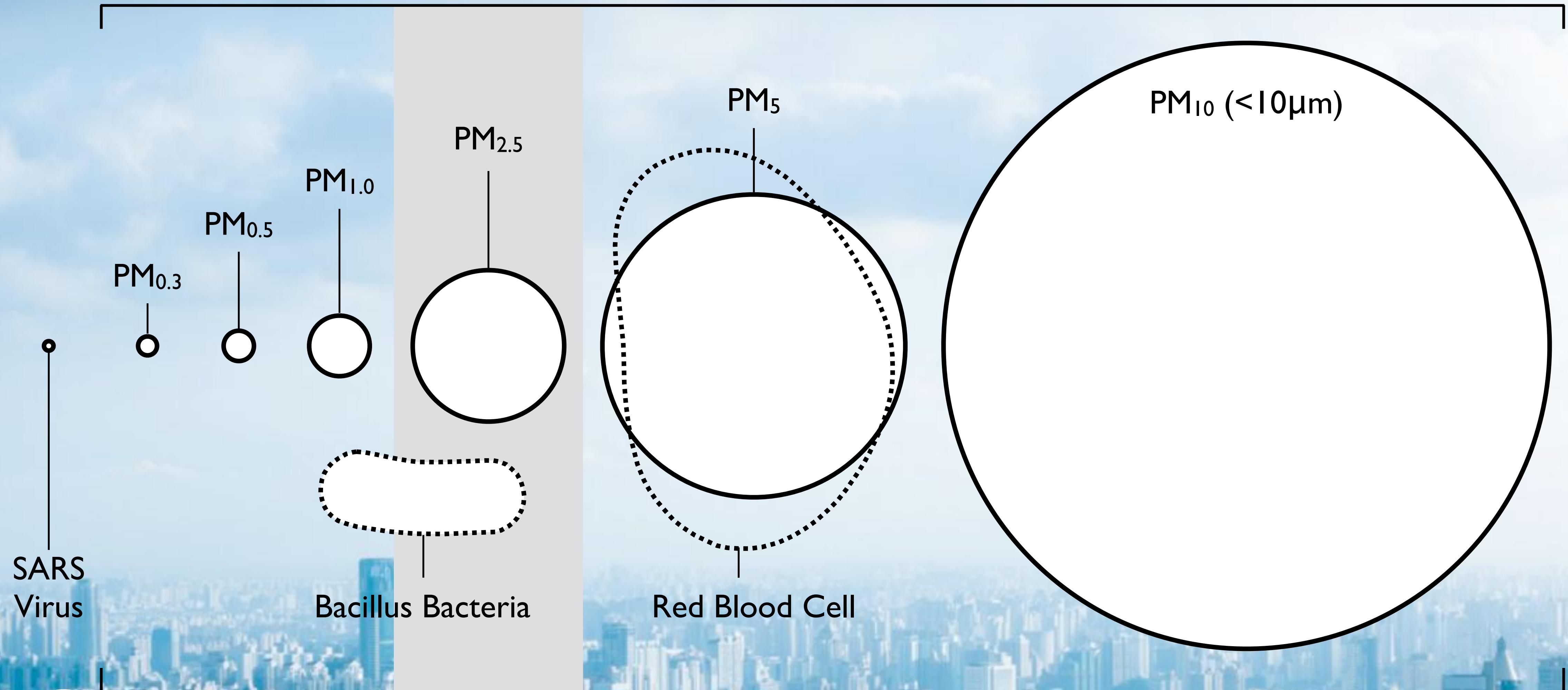
- Using CO<sub>2</sub> as a proxy for virus particle accumulation
- Air Cleaning Rates





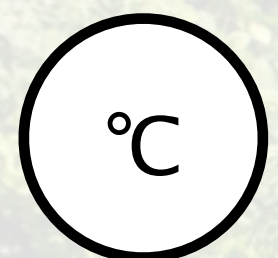
# Dosage: Quantity over time

- Broad Spectrum Monitoring: PM<sub>0.3</sub> to PM<sub>10</sub> (common range of SARS-CoV-2 virus in airborne respiratory fluid)
- Occupancy Sensors





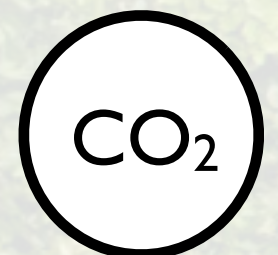
## Fundamental Sensor Data



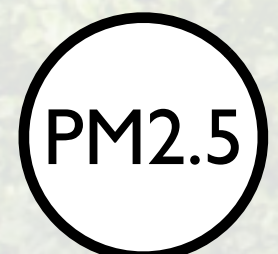
Real-Time



Rolling average (days)



Real-Time



Rolling average (months)

RESET Air Index

98%

Optimized For  
Human Health

<1%

Aerosol Infection  
Potential: SARS-  
CoV-2\*

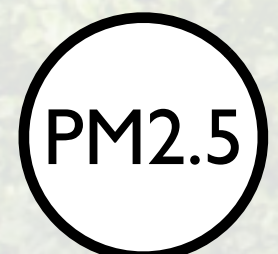
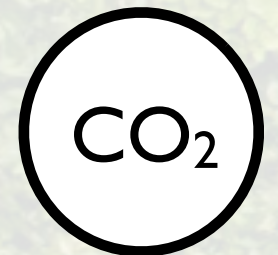
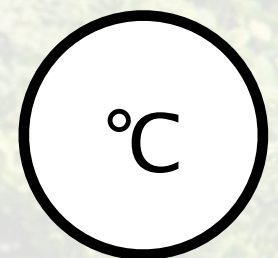
72.2%

Certainty

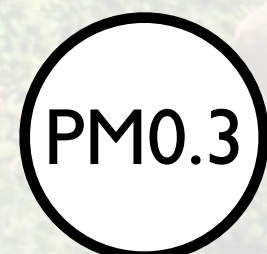




Fundamental  
Sensor Data



Additional  
Sensor Data



RESET Air Index

98%

Optimized For  
Human Health

<1%

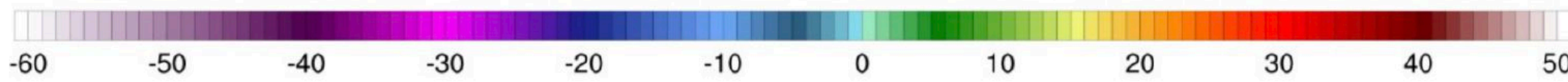
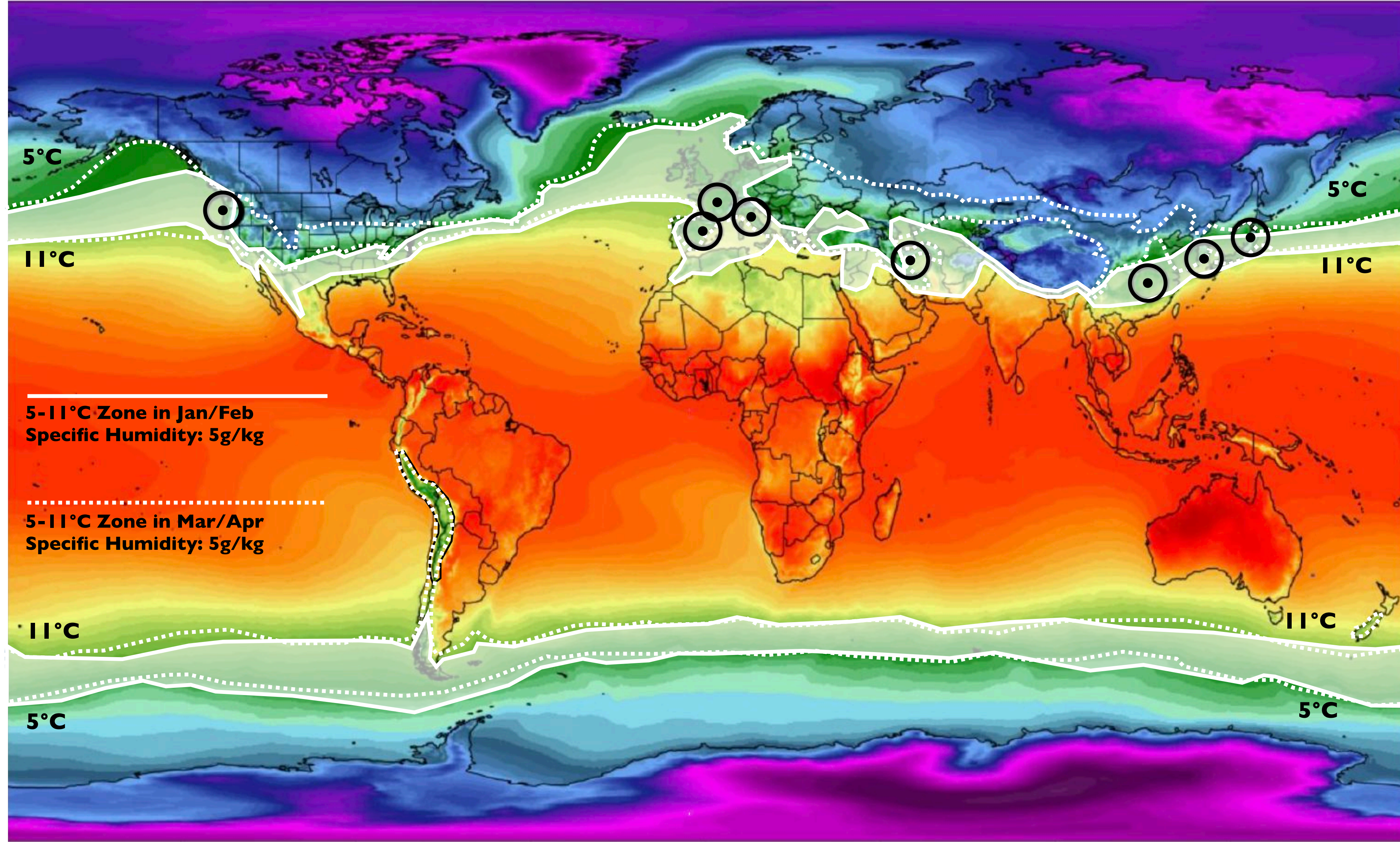
Aerosol Infection  
Potential: SARS-  
CoV-2\*

72.2%

Certainty



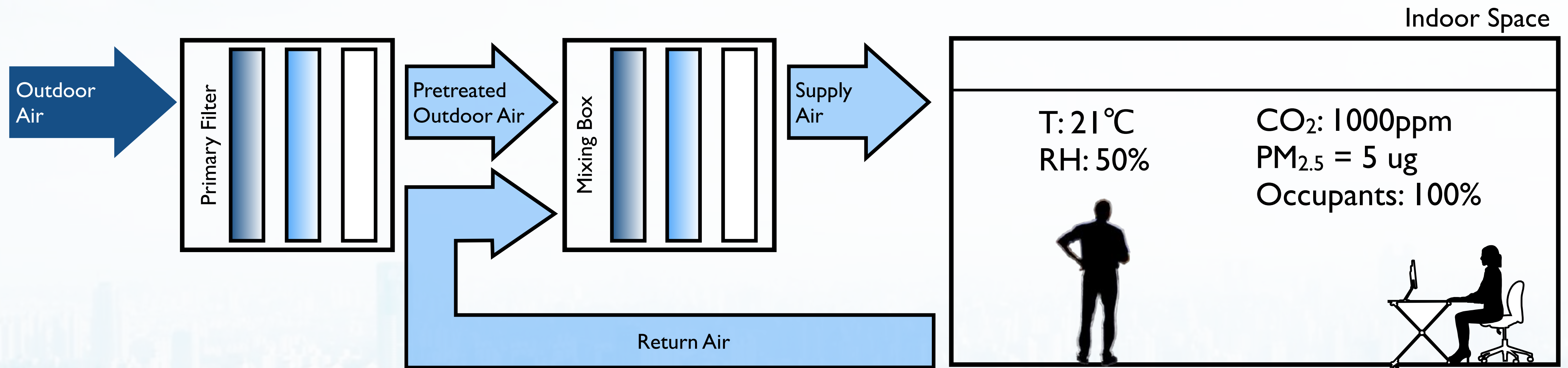
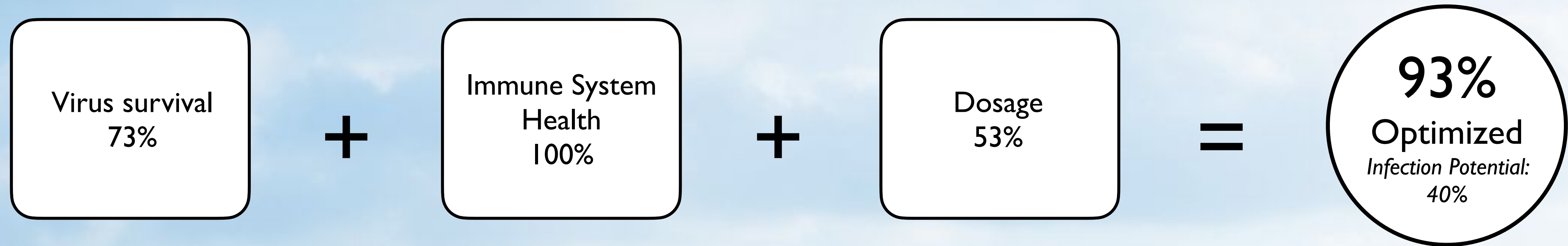






# Case Study Example

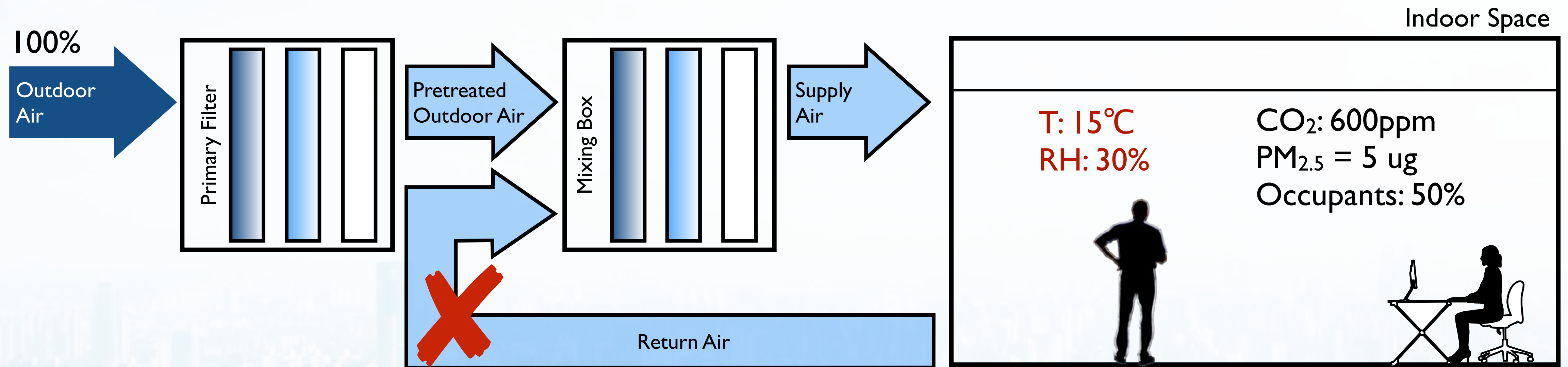
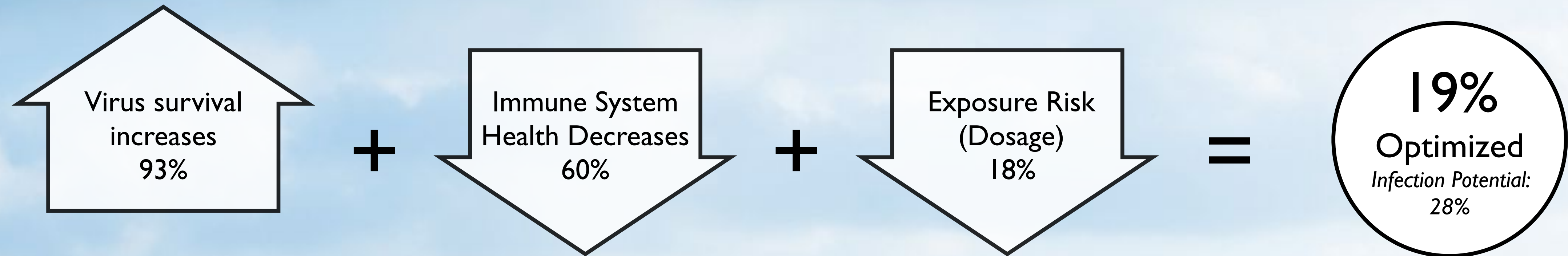
Standard office. Pre-pandemic. Winter scenario.





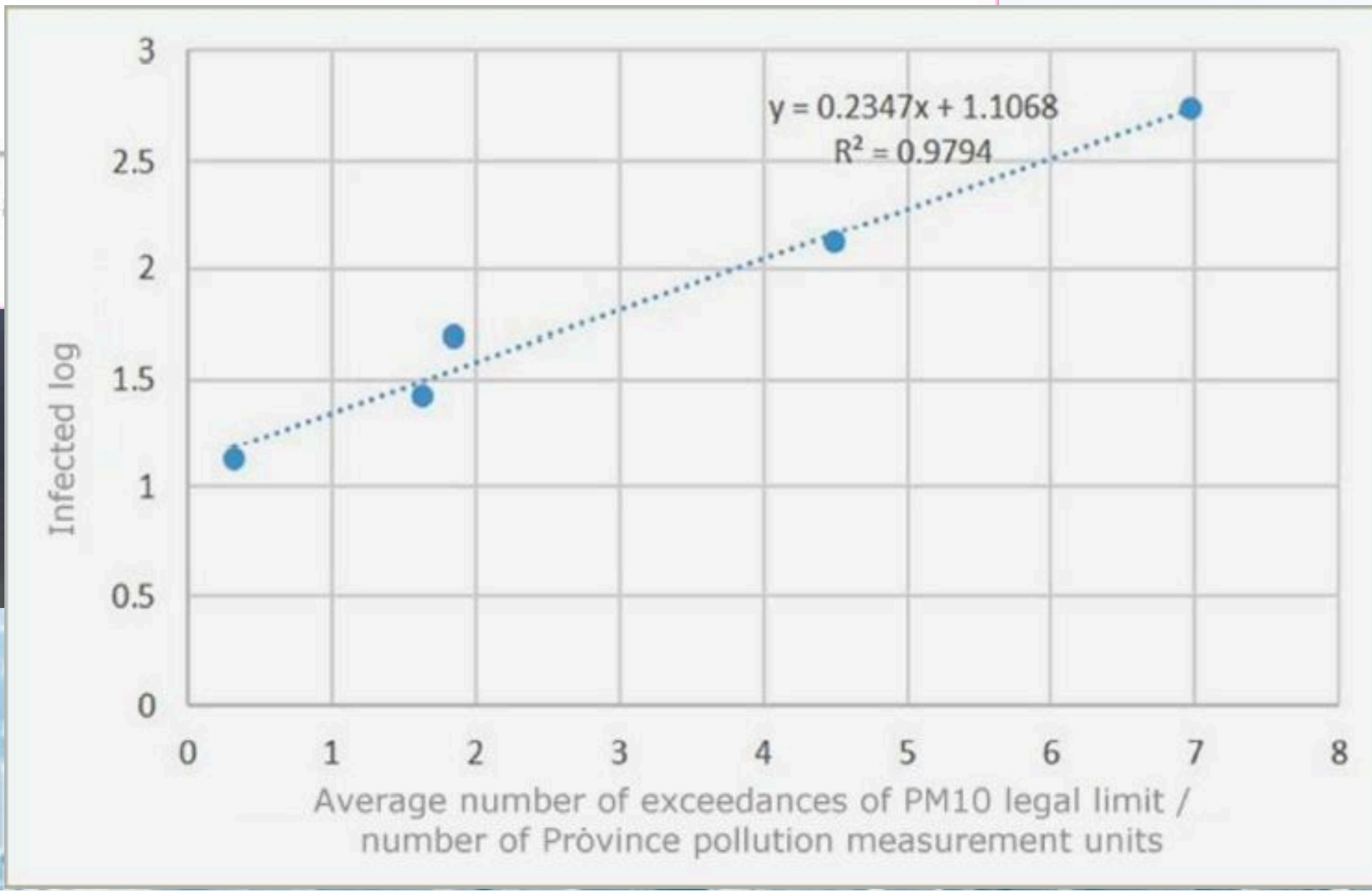
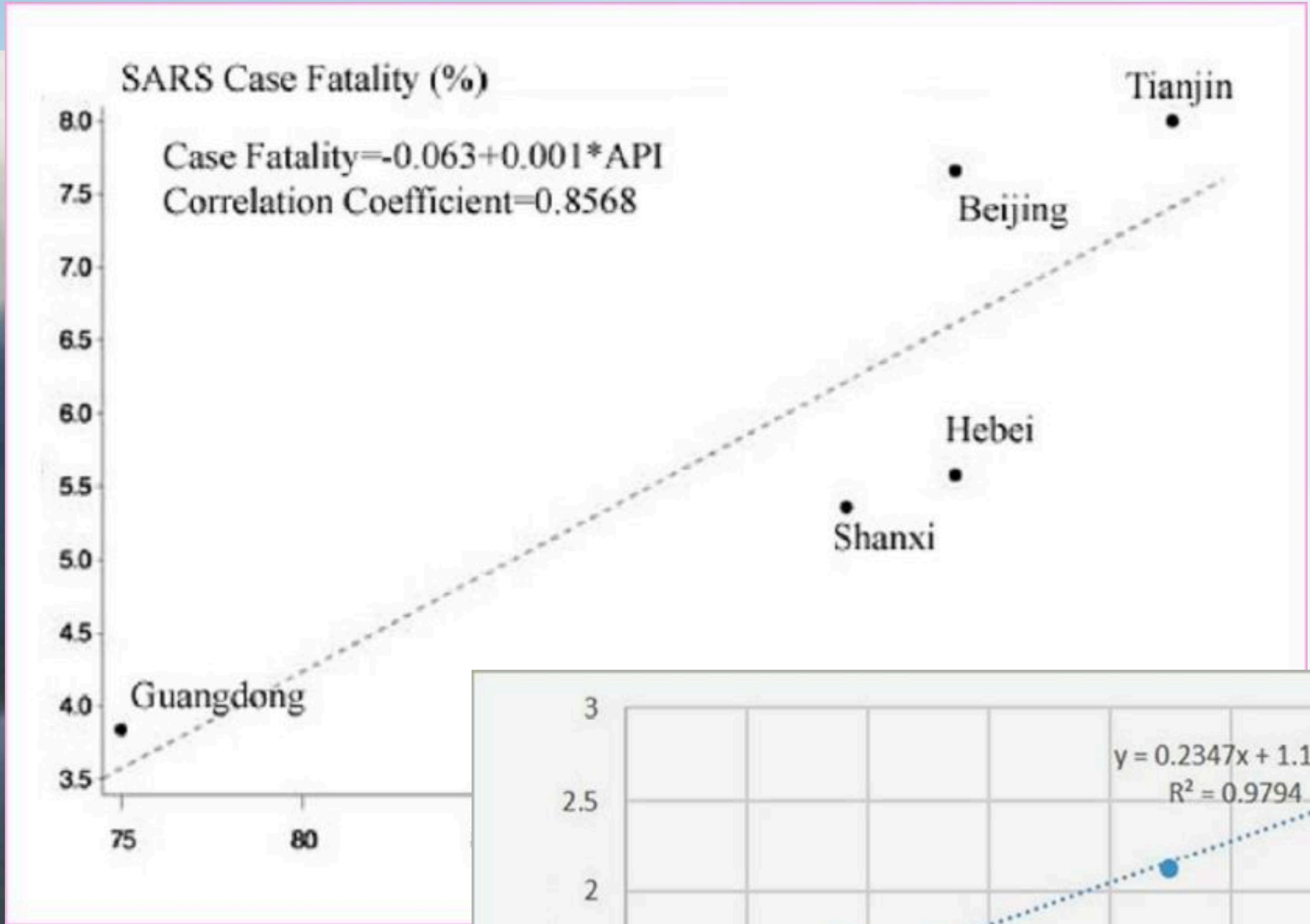
# Ventilate! Don't recirculate! (*Blind advice*)

100% Outdoor ventilation assumes a building's ability to meet additional heating and cooling loads. Below is a cold weather scenario, with 100% outdoor air delivery.





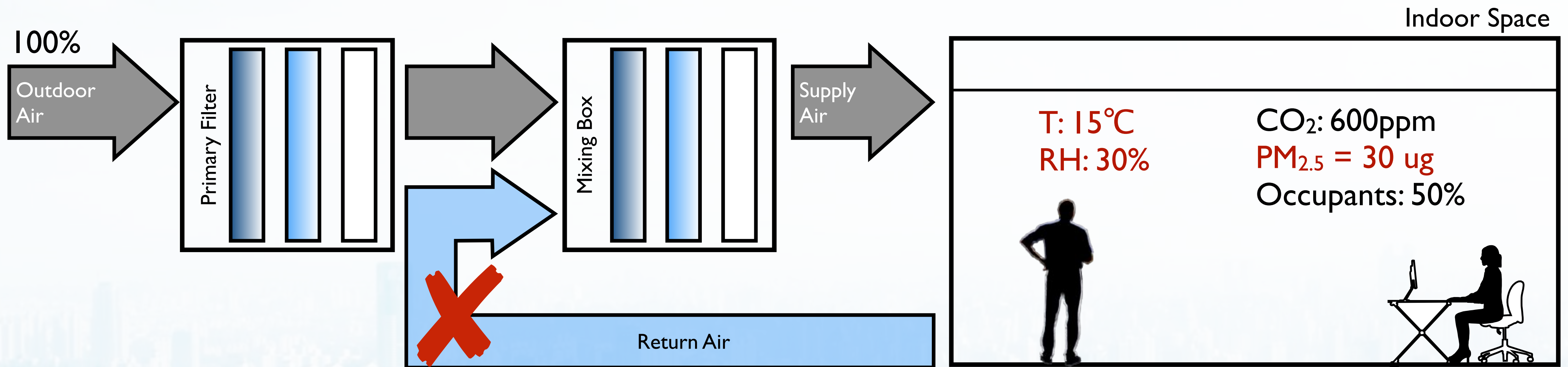
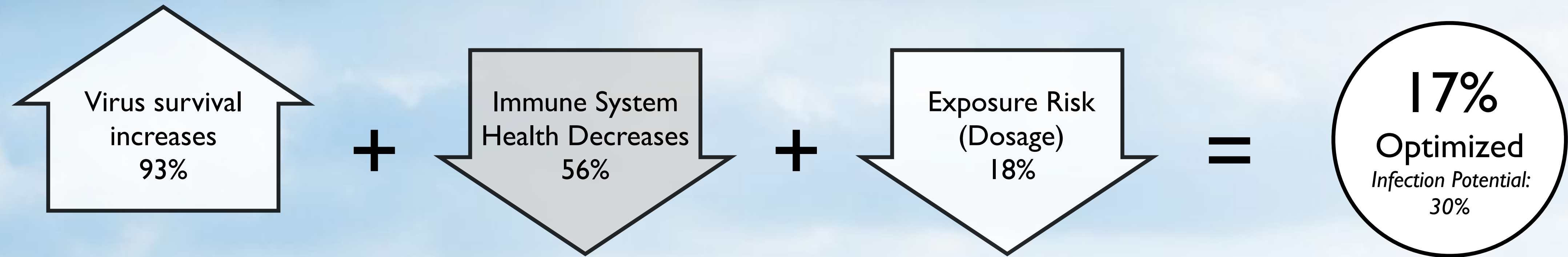
# And now... back to particulate matter





# Ventilate! Don't recirculate! (*Blind advice*)

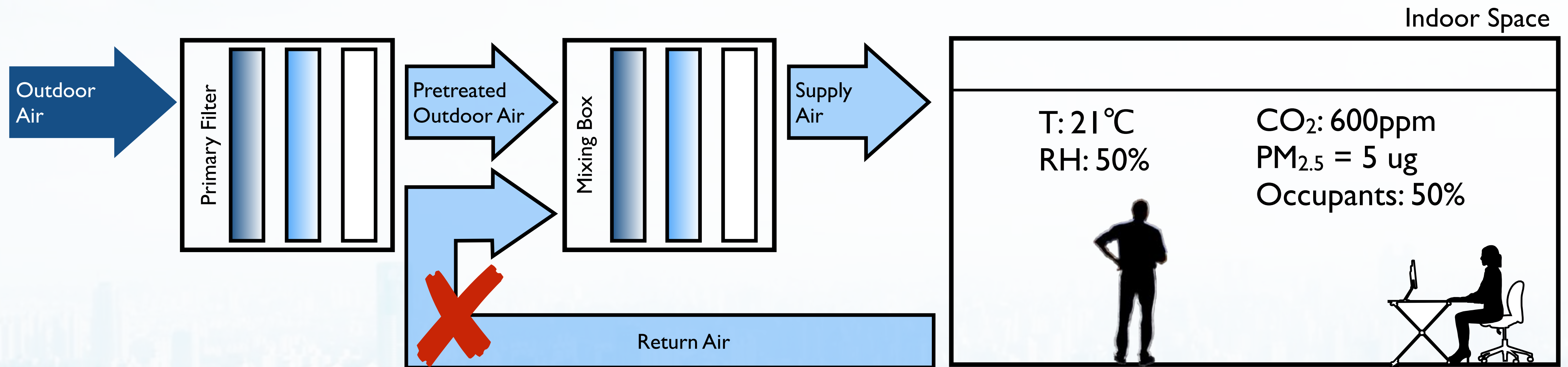
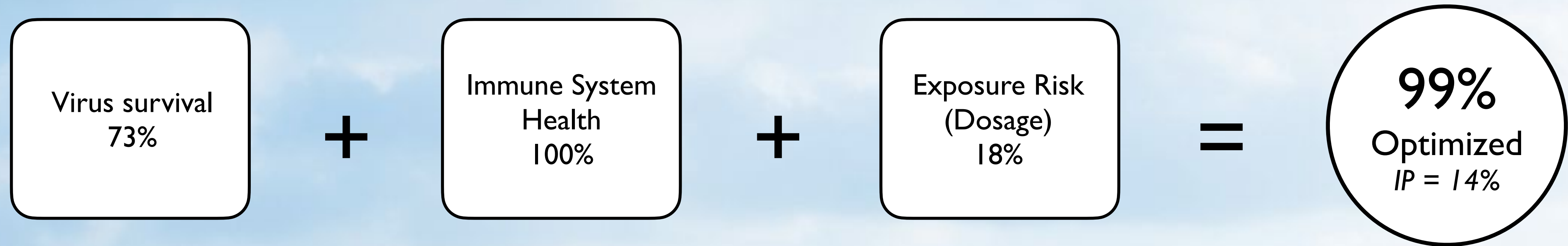
100% Outdoor ventilation also assumes a building's ability to meet additional filtration loads. Factoring in the impact of outdoor pollution further increases the infection rate potential.





# Ventilate! Don't recirculate! (*Blind advice*)

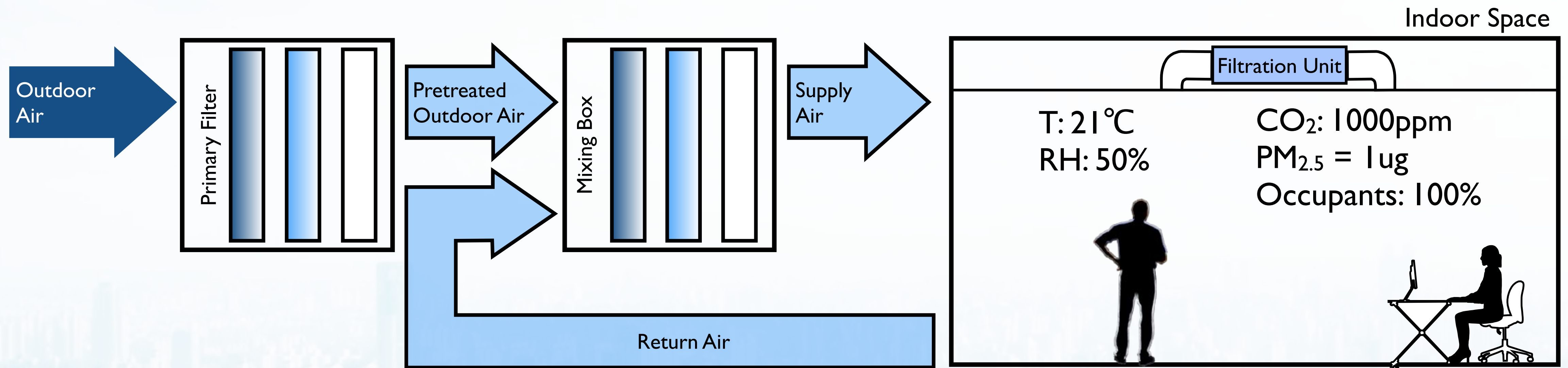
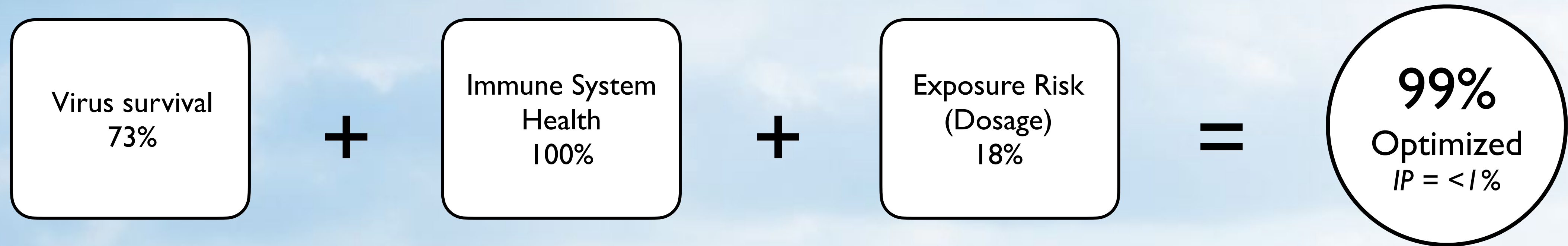
Assumes a building's ability to meet additional heating and cooling loads without recirculation.  
Taking for example a cold weather scenario, with 100% outdoor air delivery.





# Ventilate! Don't recirculate! (*Blind advice*)

Assumes a building's ability to meet additional heating and cooling loads without recirculation. Taking for example a cold weather scenario, with 100% outdoor air delivery.





Why are we managing our spaces without data?

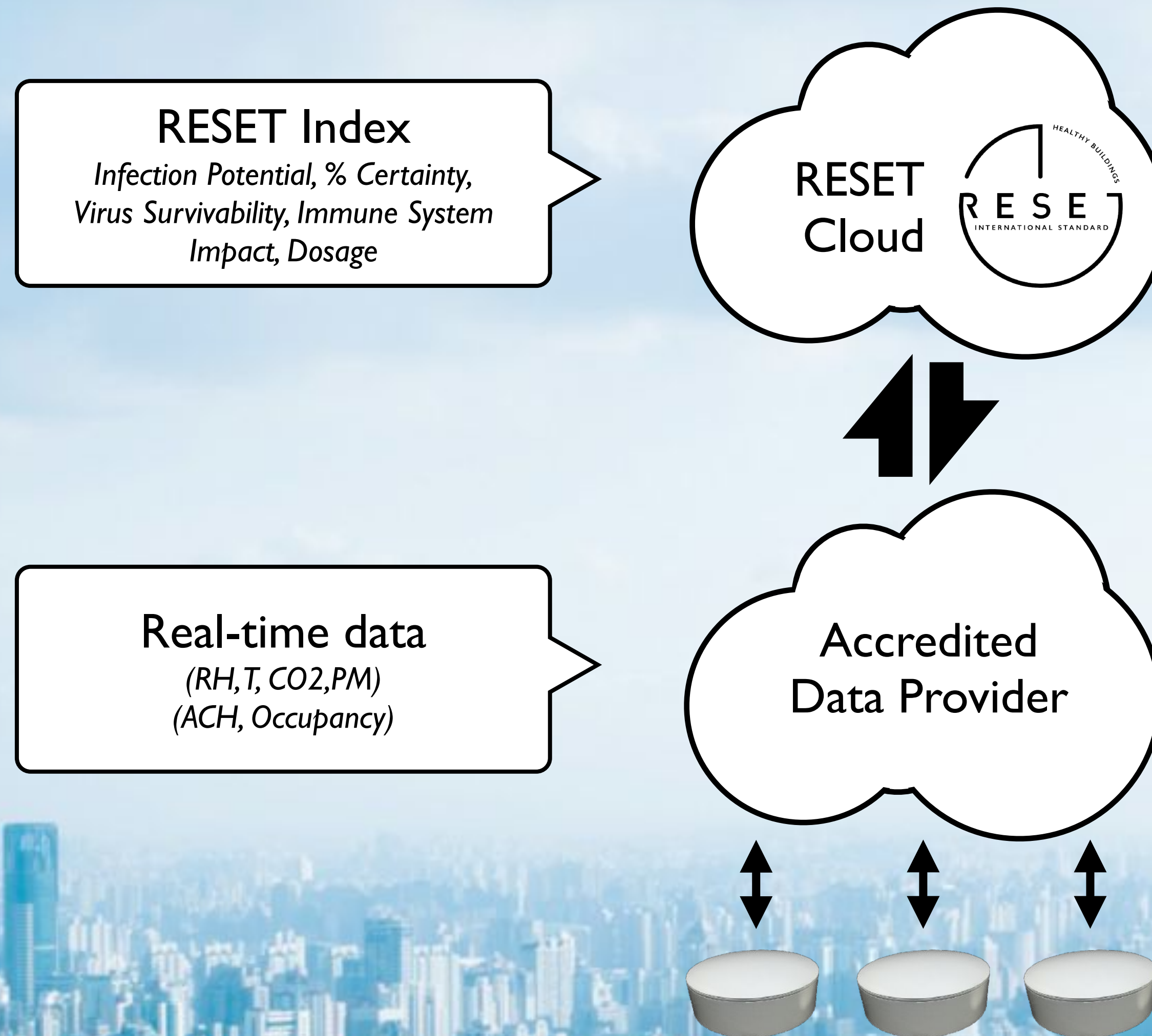
Why are we running blind?





# Analytics & Data Exchange

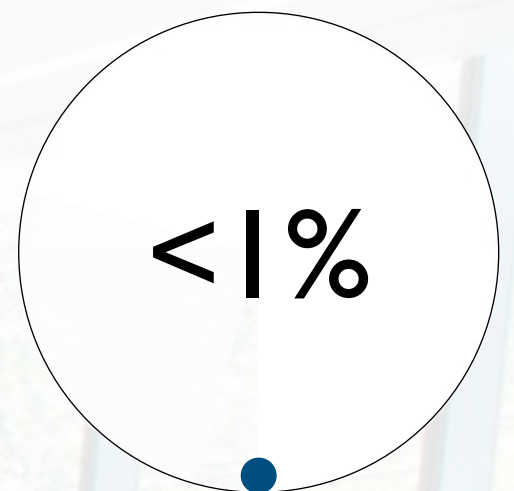
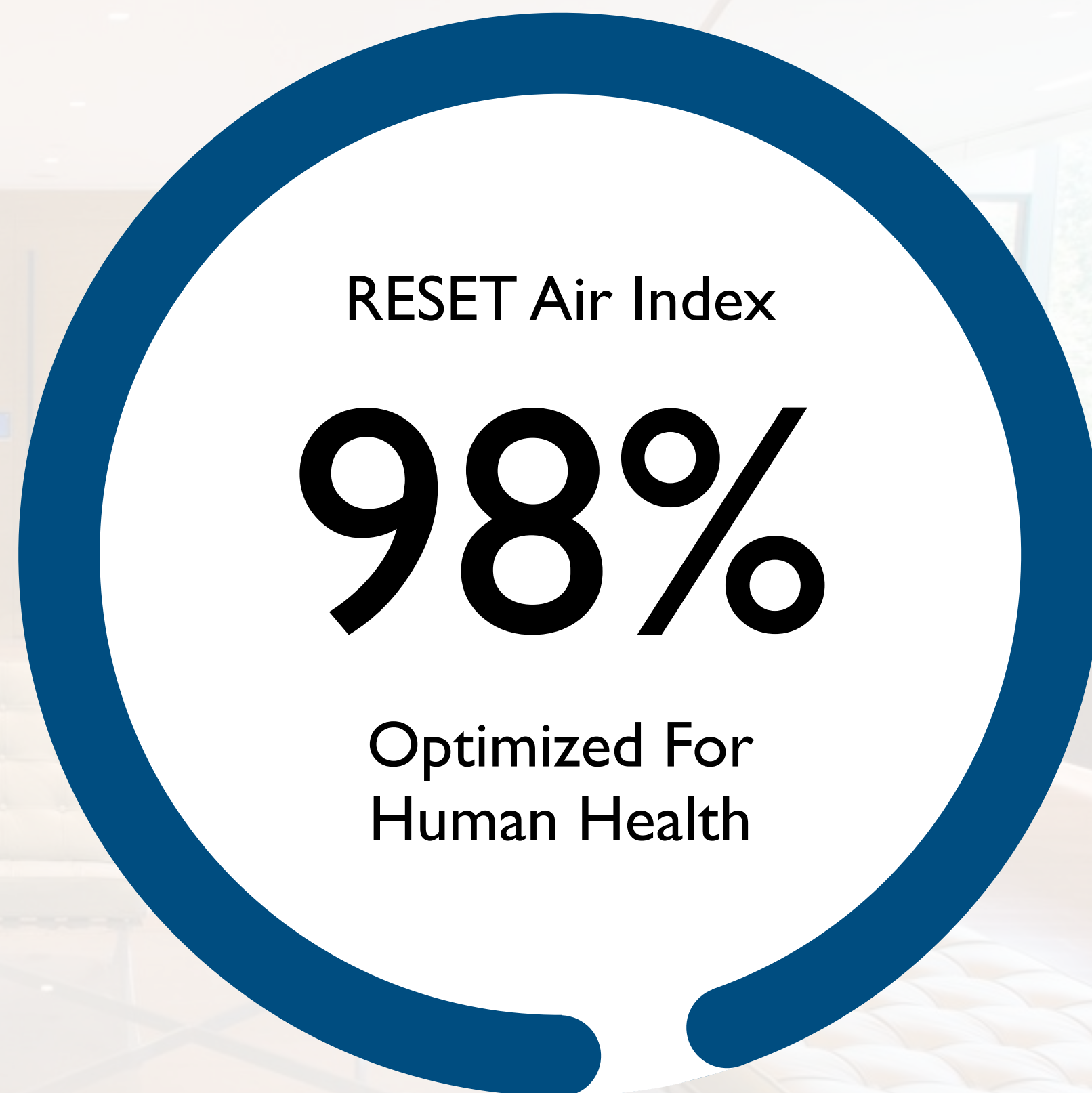
The RESET Index and its component parts will be computed within the RESET Cloud, with results sent back to Accredited Data Providers for actionability. There is no additional cost for the RESET Index.



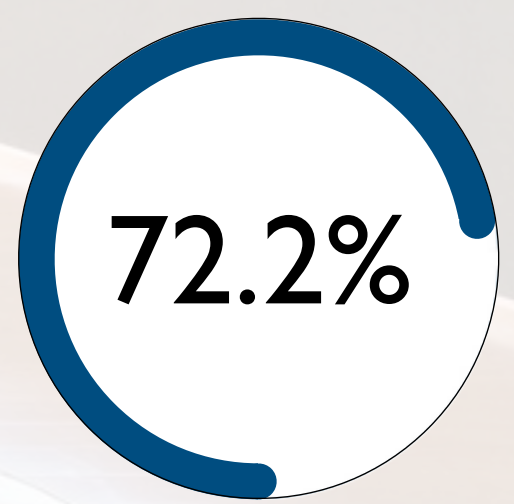


# Current Stage: Global Pilots

Owners & Operators  
Tenants  
Academics  
Building Management Systems



Aerosol Infection Potential: SARS-CoV-2\*



Certainty

\*Communicates optimization of air quality management by building systems, as measured by sensors. Not an expression of total infection potential.





The results are only as good as the data coming in.





NEW YORK

Updated: 30 min

AIR OPTIMIZATION (SARS-CoV-2)

EXCELLENT 96%

PM<sub>2.5</sub> GOOD 6  $\mu\text{g}/\text{m}^3$

OUTDOOR PM<sub>2.5</sub> 15  $\mu\text{g}/\text{m}^3$

FILTRATION LEVEL GOOD 2.5 x

PM<sub>0.3</sub> GOOD 32  $\mu\text{g}/\text{m}^3$

CO<sub>2</sub> GOOD 405 ppm

AIR CHANGES GOOD 18 min

TEMPERATURE 21 °C

HUMIDITY 46 %RH

AIR STERILIZATION ACTIVE





# RESET® Air - A Standard for Data Quality

RESET® tracks the pulse of buildings primarily via monitors and sets standards for their performance, installation, calibration and data reporting.

NEW YORK Updated: 30 min

---

INFECTION PREVENTION **EXCELLENT 96%**

---

PM<sub>2.5</sub> **GOOD 6** µg/m<sup>3</sup>

OUTDOOR PM<sub>2.5</sub> **15** µg/m<sup>3</sup>

FILTRATION LEVEL **GOOD 2.5** x

---

PM<sub>0.3</sub> **GOOD 32** µg/m<sup>3</sup>

---

CO<sub>2</sub> **GOOD 405** ppm

---

AIR CHANGES **GOOD 18** min

---

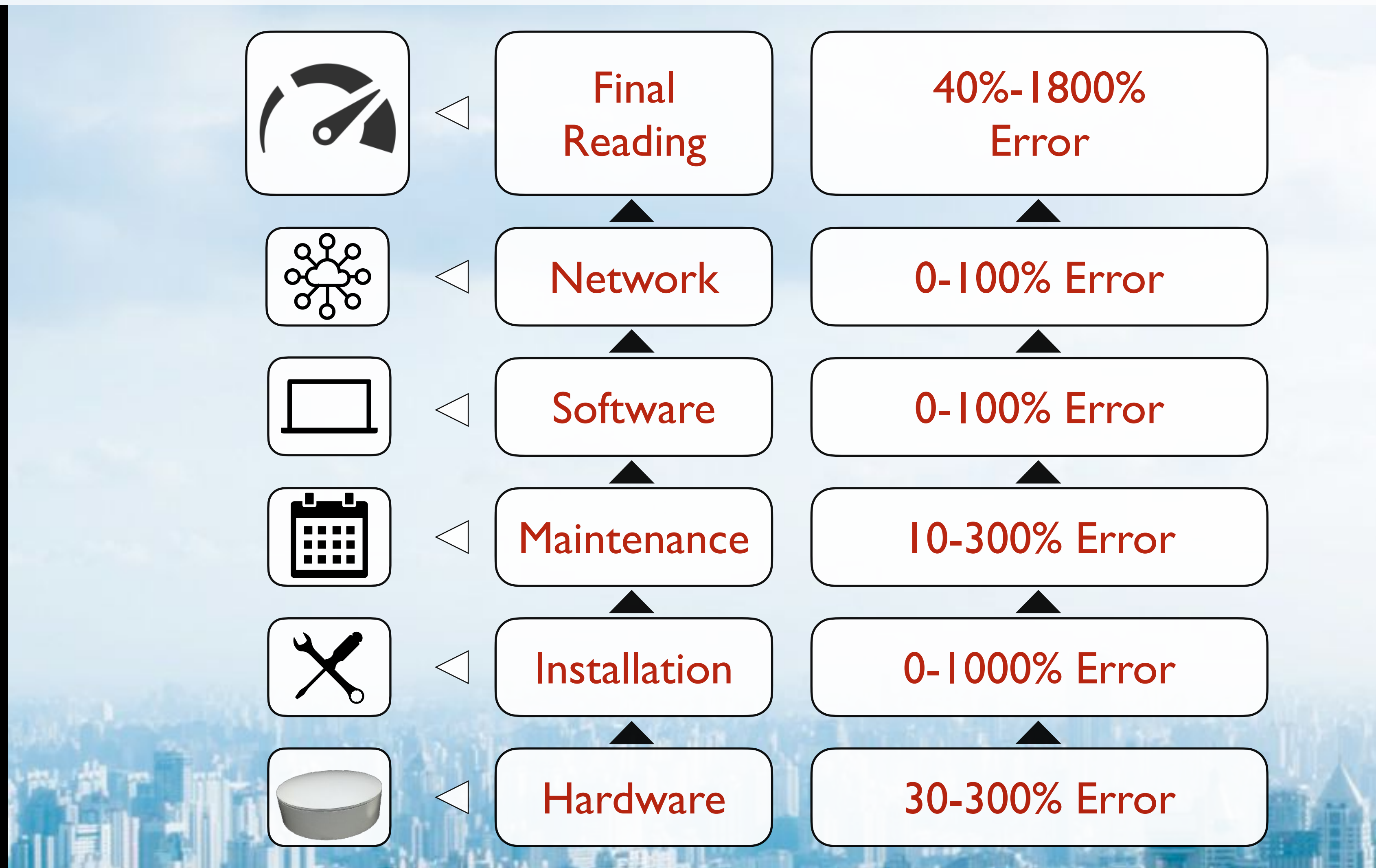
TEMPERATURE **21** °C

---

HUMIDITY **46** %RH

---

AIR STERILIZATION **ACTIVE**





# RESET® Air - Understanding Error: Hardware

RESET® tracks the pulse of buildings primarily via monitors and sets standards for their performance, installation, calibration and data reporting.

## Hardware Error: Two key tests

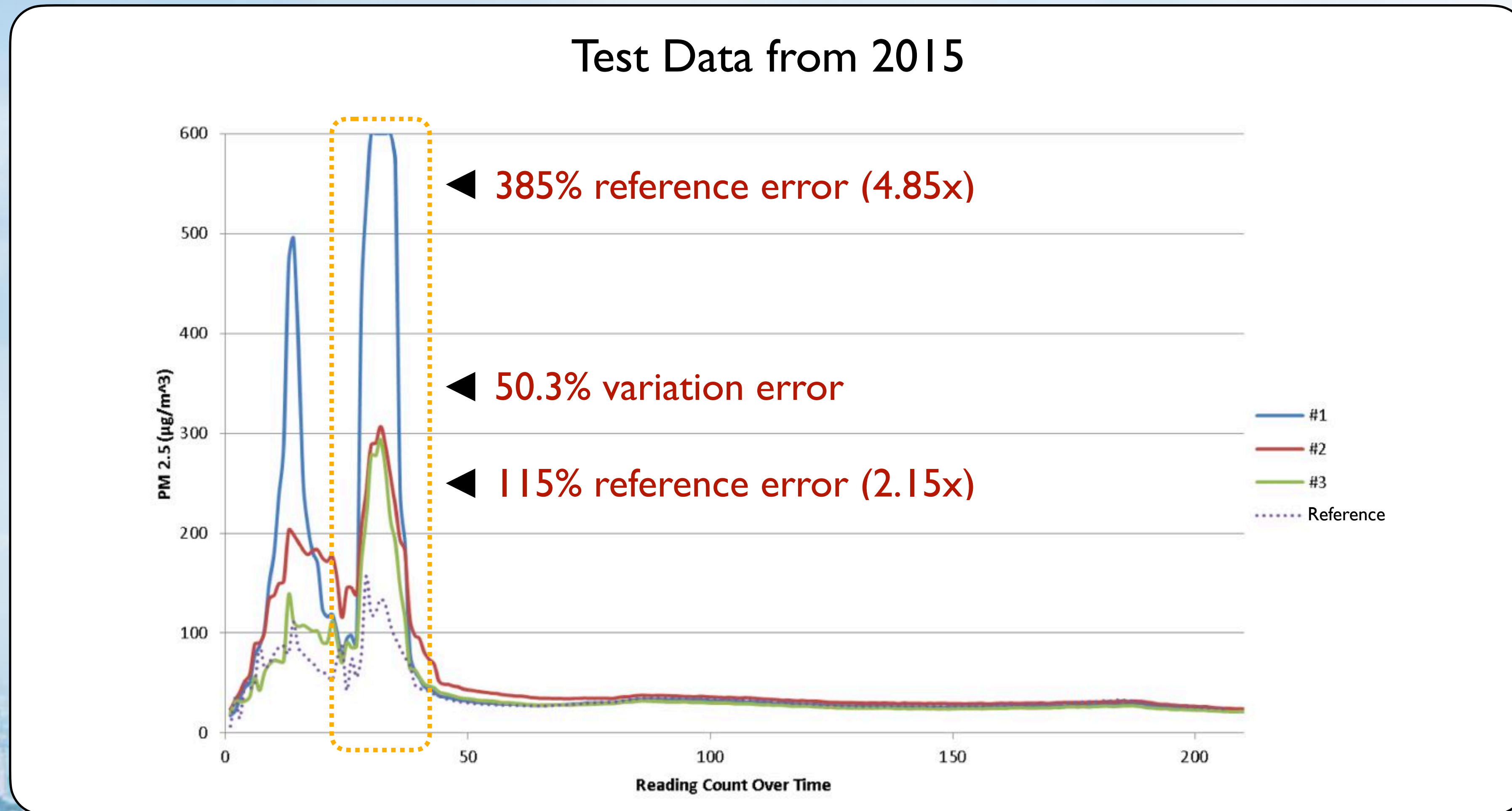
- 1) How IAQ monitors compare to a reference device.
- 2) How IAQ monitors compare to one another.





# RESET® Air - Understanding Error: Hardware

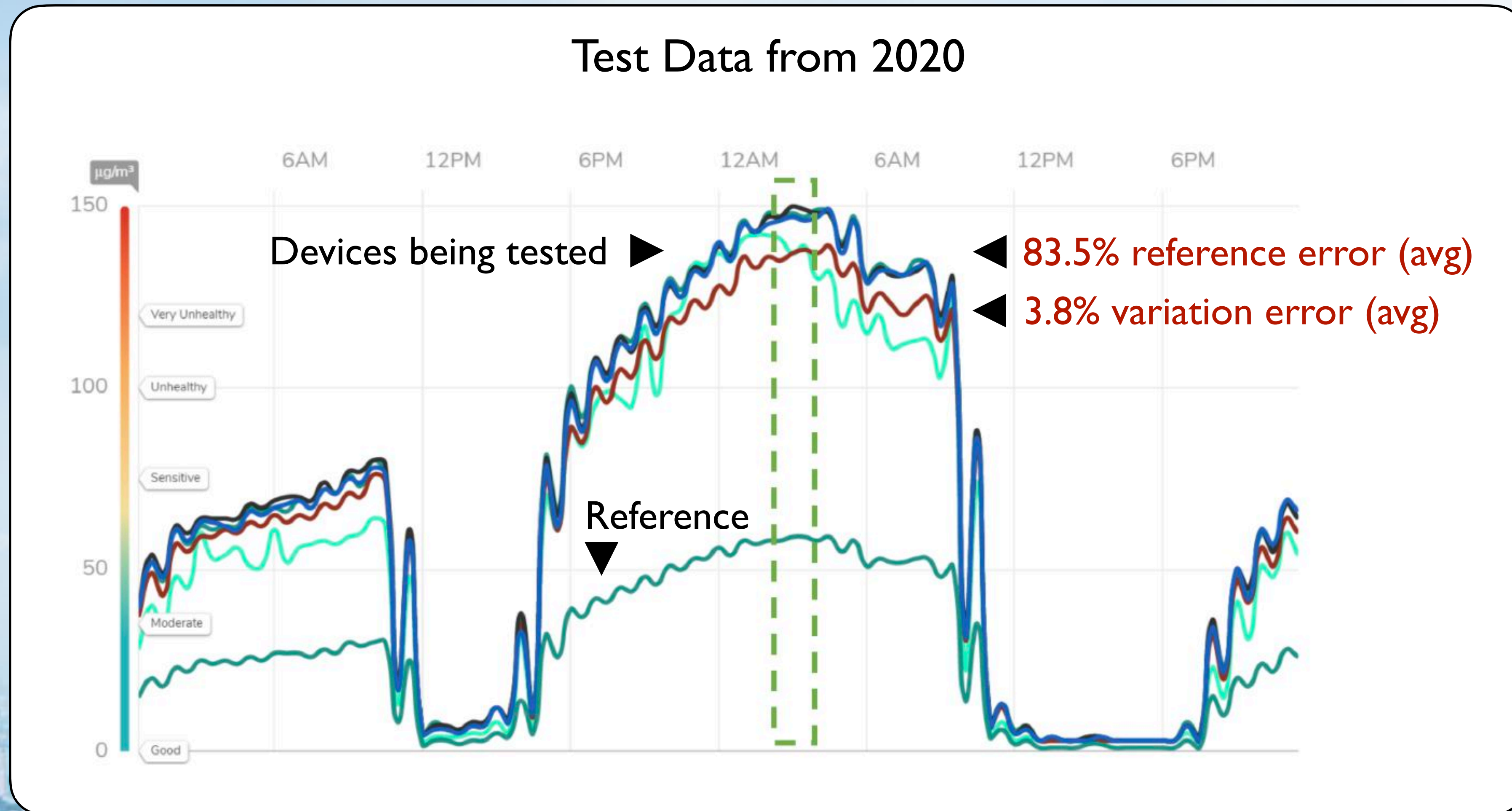
RESET® tracks the pulse of buildings primarily via monitors and sets standards for their performance, installation, calibration and data reporting.





# RESET® Air - Understanding Error: Hardware

RESET® tracks the pulse of buildings primarily via monitors and sets standards for their performance, installation, calibration and data reporting.



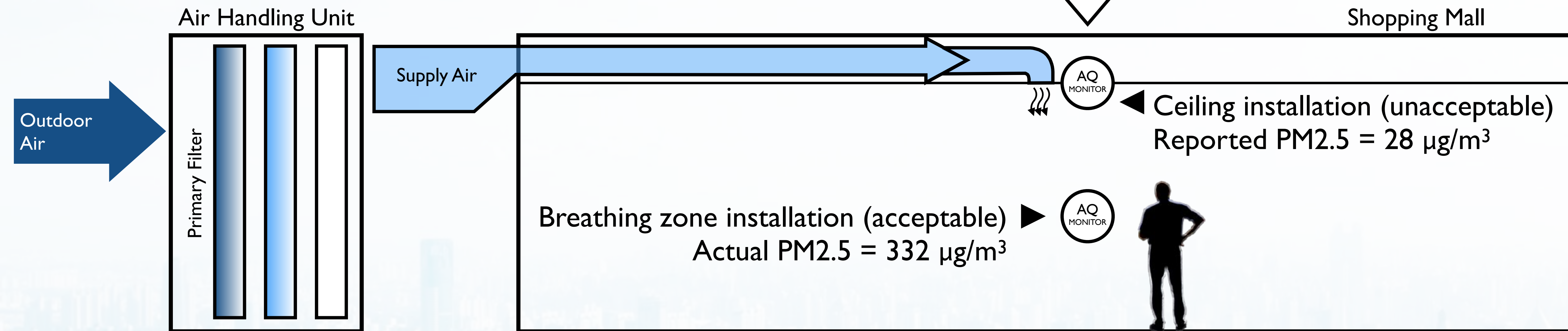
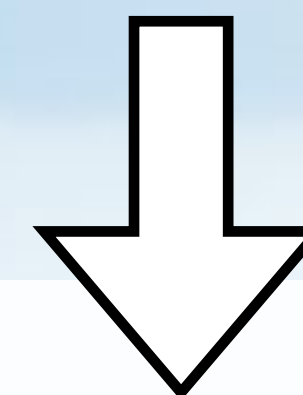


# RESET® Air - Understanding Error: Installation

Case Study: Shopping mall, whereby IAQ monitors were installed on the ceiling, next to a supply duct (non-compliant with RESET Standard), resulting in a reporting inaccuracy of 1085%.

\* Note that results lower by one order of magnitude ( $2.8 \mu\text{g}/\text{m}^3$  and  $33.2 \mu\text{g}/\text{m}^3$ ) in areas with cleaner outdoor air would also yield a reporting inaccuracy of 1085%.

1085% reporting error / inaccuracy





# RESET® Air - A Standard for Data Quality

RESET® tracks the pulse of buildings primarily via monitors and sets standards for their performance, installation, calibration and data reporting.

NEW YORK Updated: 30 min

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PM<sub>2.5</sub> **GOOD** 6 µg/m<sup>3</sup>

OUTDOOR PM<sub>2.5</sub> 15 µg/m<sup>3</sup>

FILTRATION LEVEL **GOOD** 2.5 x

---

PM<sub>0.3</sub> **GOOD** 32 µg/m<sup>3</sup>

---

CO<sub>2</sub> **GOOD** 405 ppm

---

AIR CHANGES **GOOD** 18 min

---

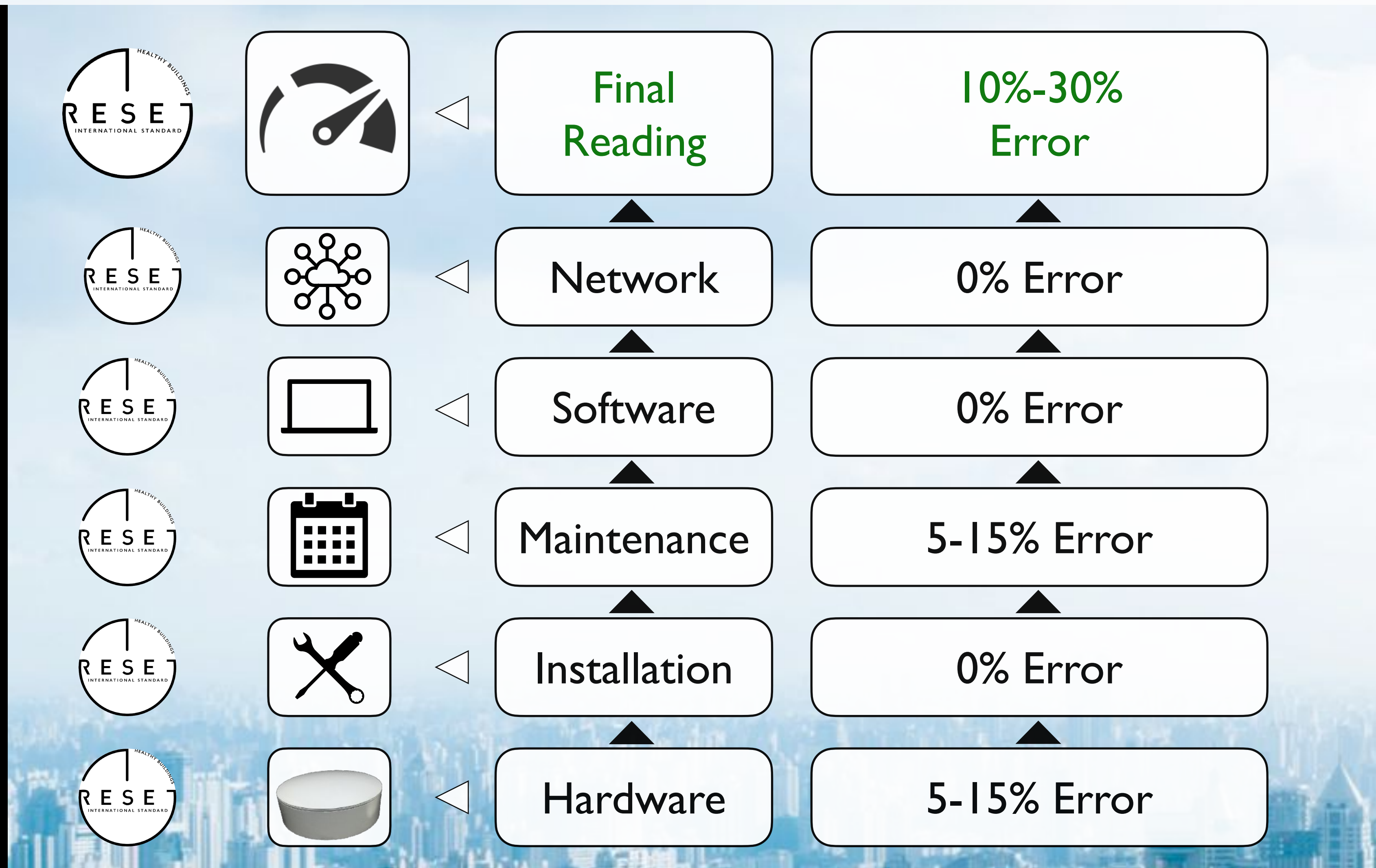
TEMPERATURE 21 °C

---

HUMIDITY 46 %RH

---

AIR STERILIZATION ACTIVE

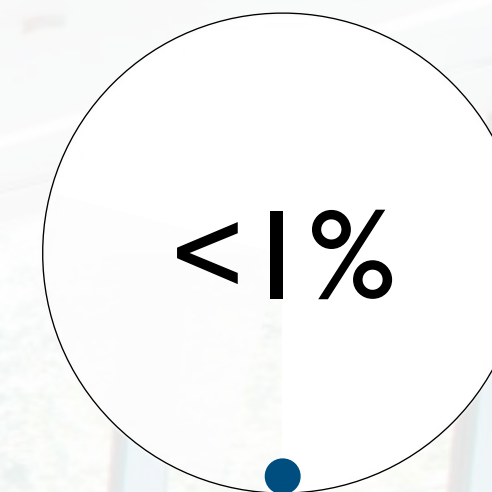
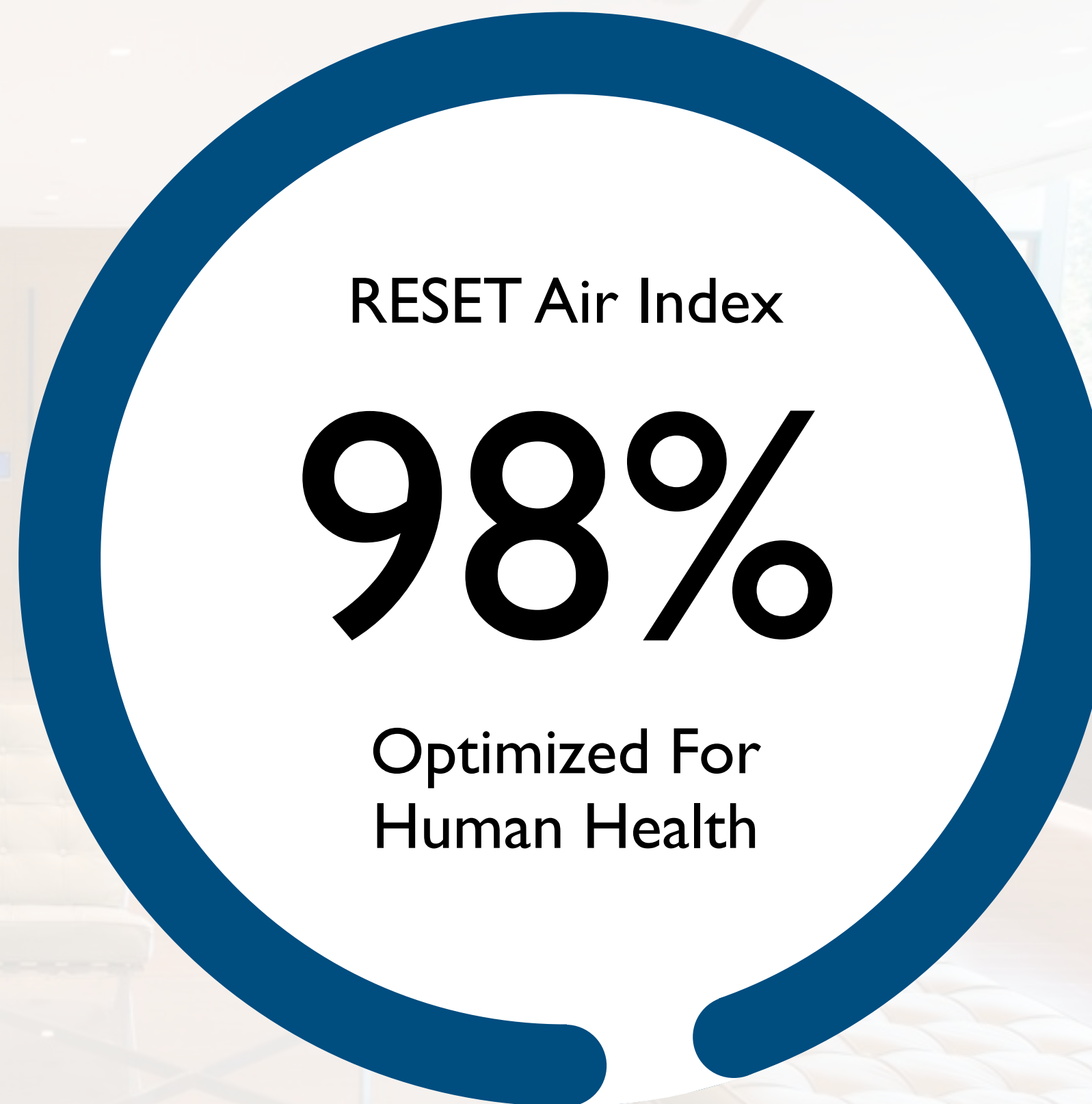




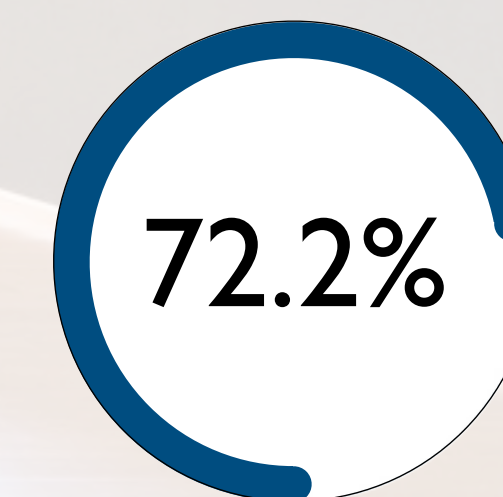
As an industry, we are doing remarkably little **air quality monitoring** for an **airborne pathogen** whose infectivity is influenced by controlling **air** in buildings.

Let's change that.

\*Communicates optimization of air quality management by building systems, as measured by sensors. Not an expression of total infection potential.



Aerosol Infection Potential: SARS-CoV-2\*



Certainty

