



Measuring air quality in Matei Bals

A case study in an infection hospital in Romania

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[Integrated Hospital Design Alliance | Better Healthcare with Nordic Hospital Design \(ihda.fi\)](#)



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Objectives

- Can the risk of airborne infection in a naturally ventilated building be lowered using air purification units?
- Studying existing indoor air quality and ventilation status in the hospital
- Installing air purification units in the studied spaces
- Measuring the effect of this intervention on air quality
- Also: gathering supporting data for simulations and risk models
 - Verifying simulation results experimentally



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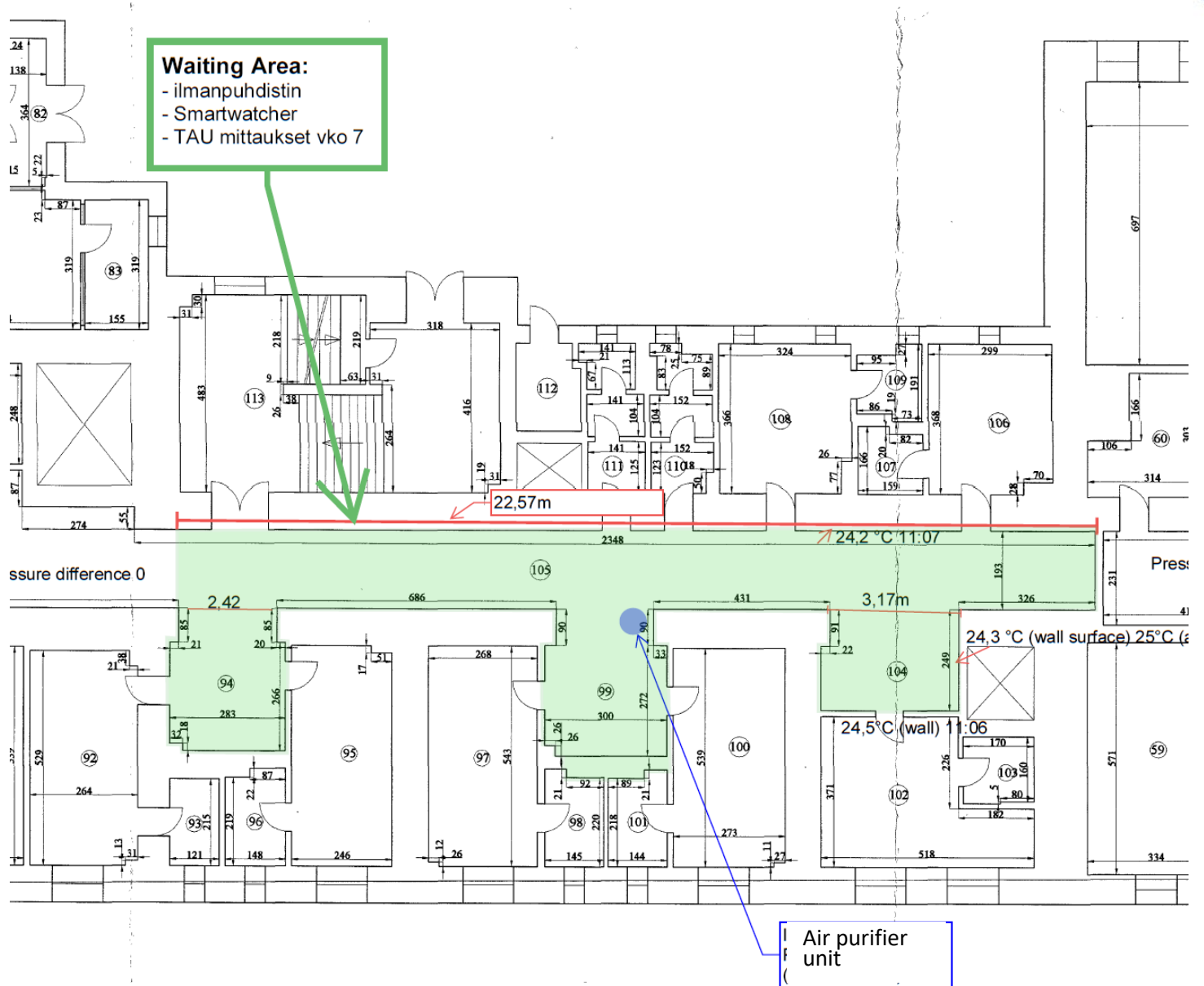
Risky spaces for airborne infections investigated in Matei Bals



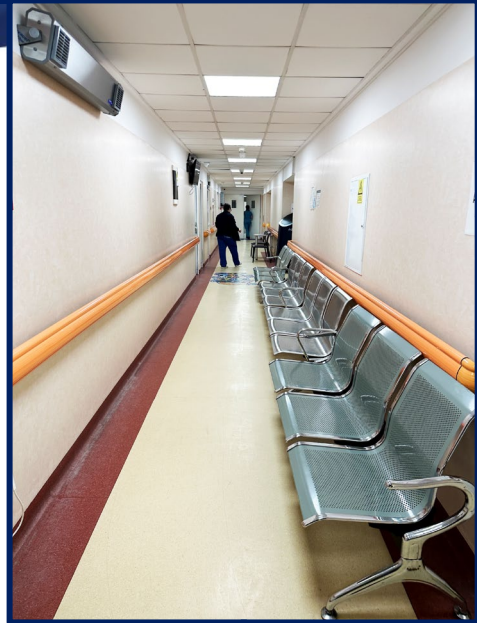
- Waiting area
- ICU room
- Covid room

Waiting area

- Located in the main hospital building on the first floor



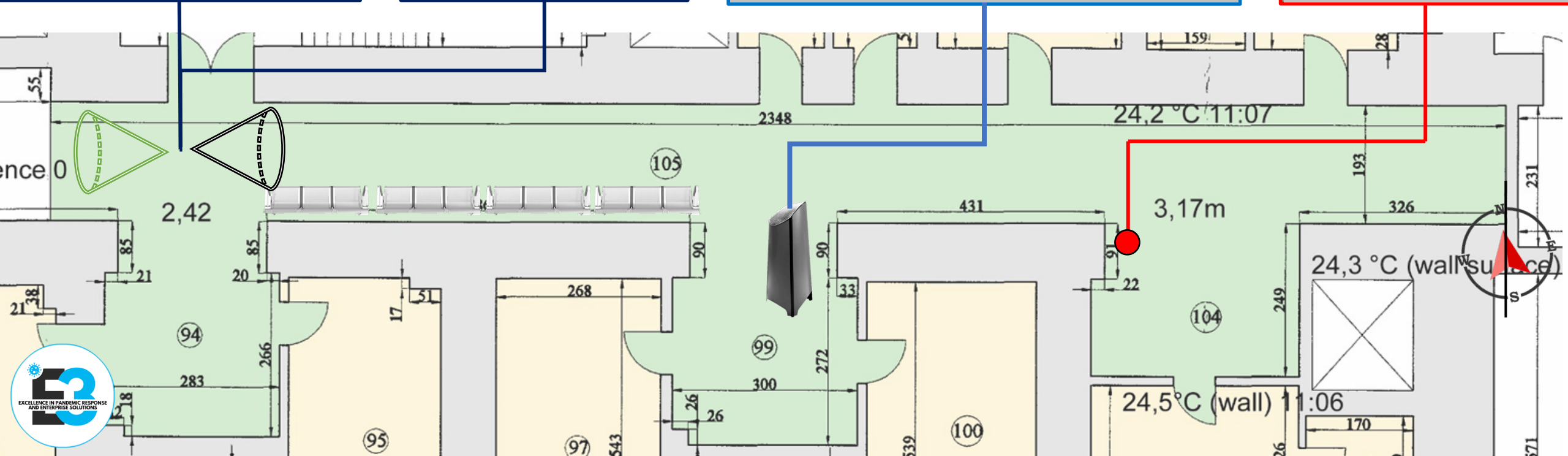
Air purifier and measuring tools placement



Air purifier unit

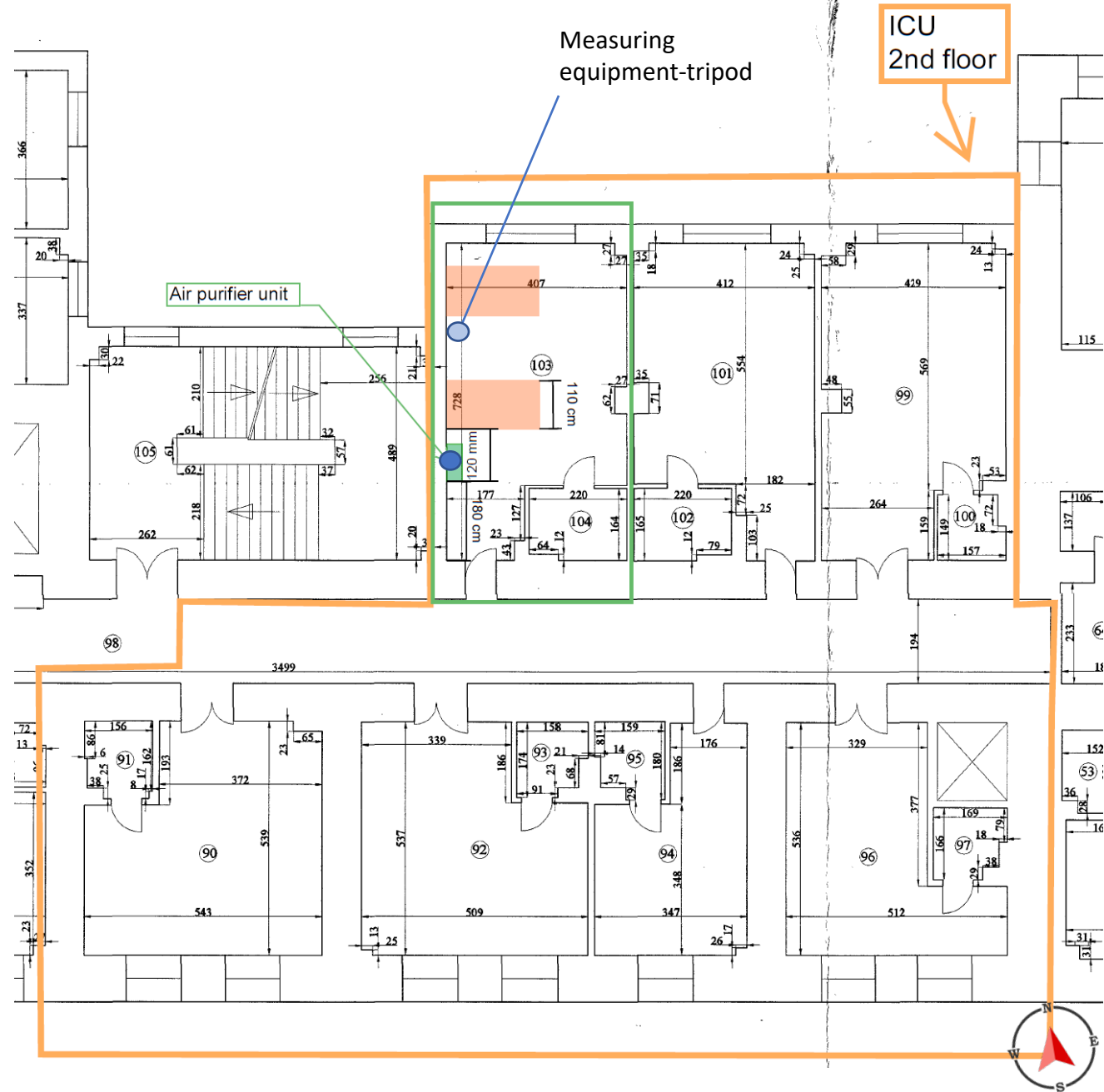


Measurement instrument

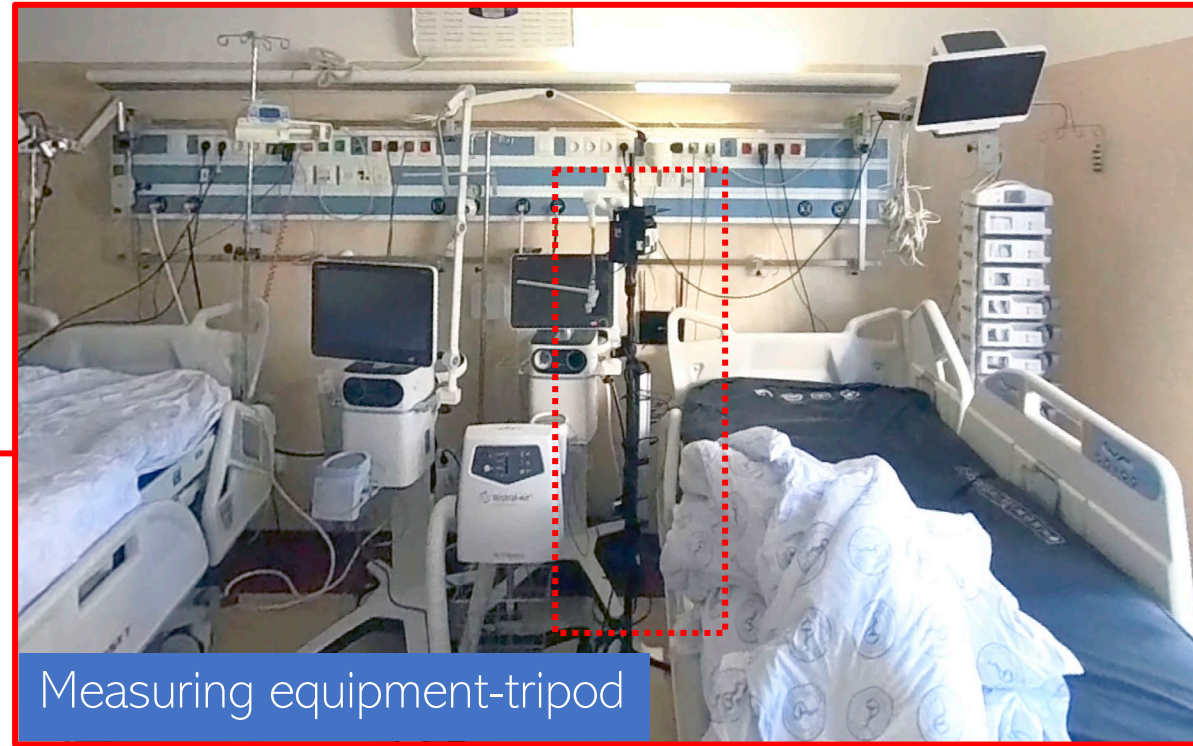
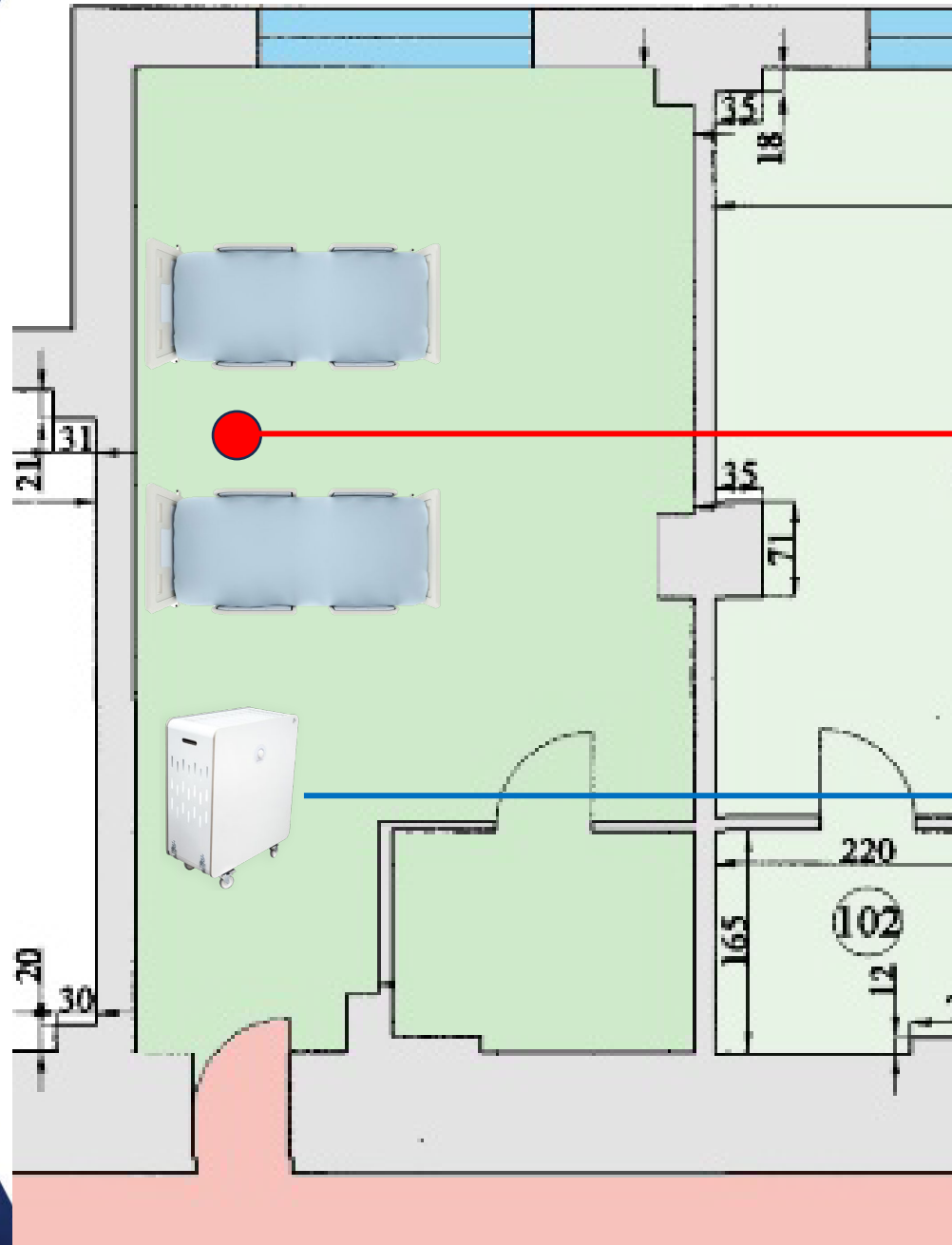


ICU unit

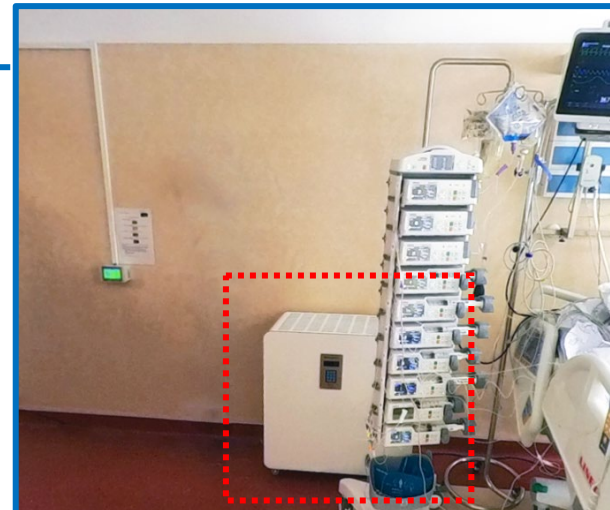
- Located in the main hospital building on the Second Floor



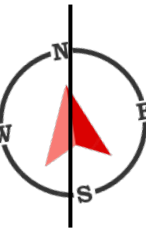
ICU room-Air purifier and measuring tools placement



Measuring equipment-tripod



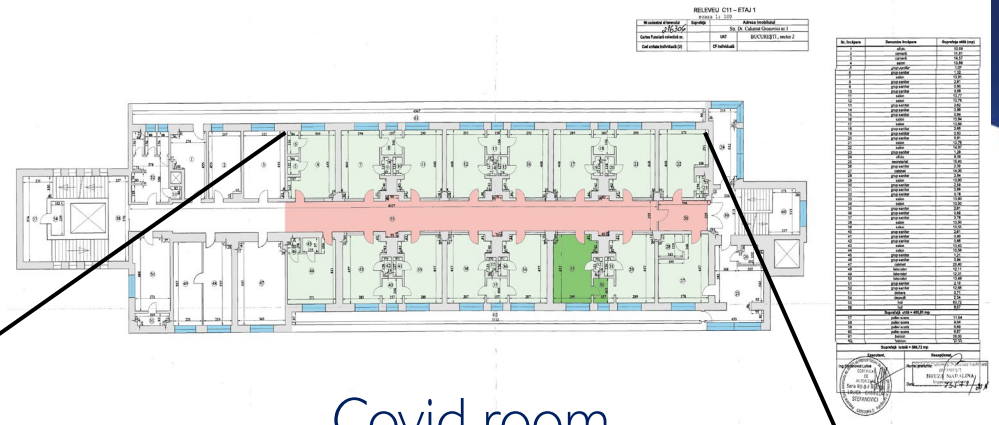
Air purifier unit



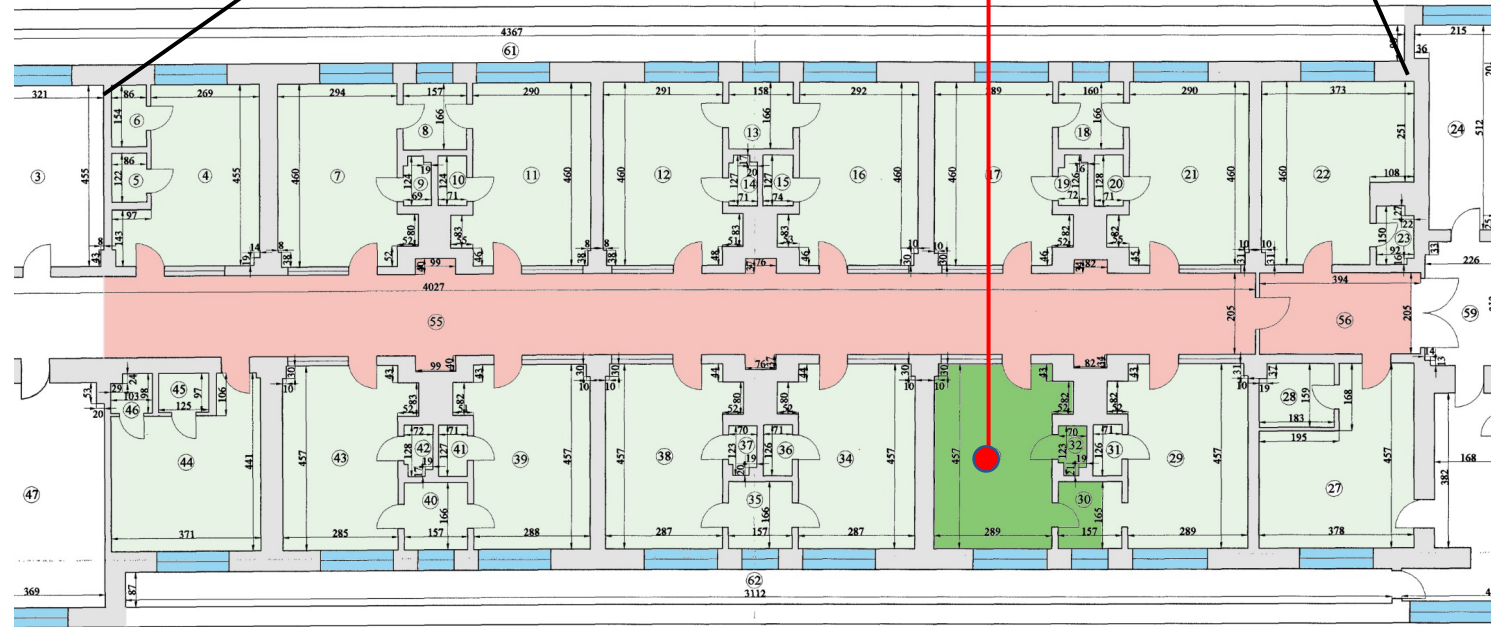


Covid Ward (Feb 2023)

- Located in the Covid ward building on the Second Floor



Covid room

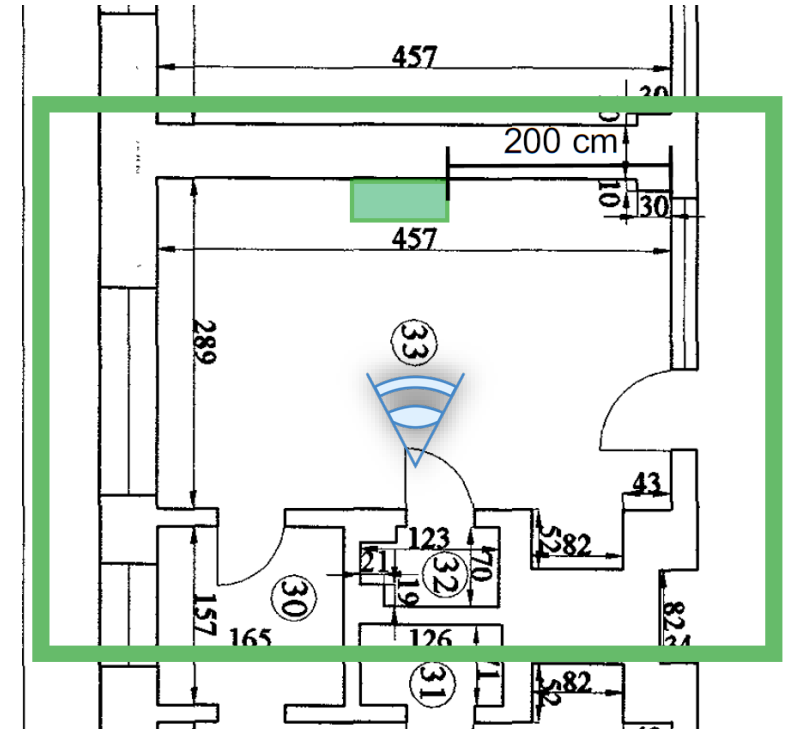


Covid Ward



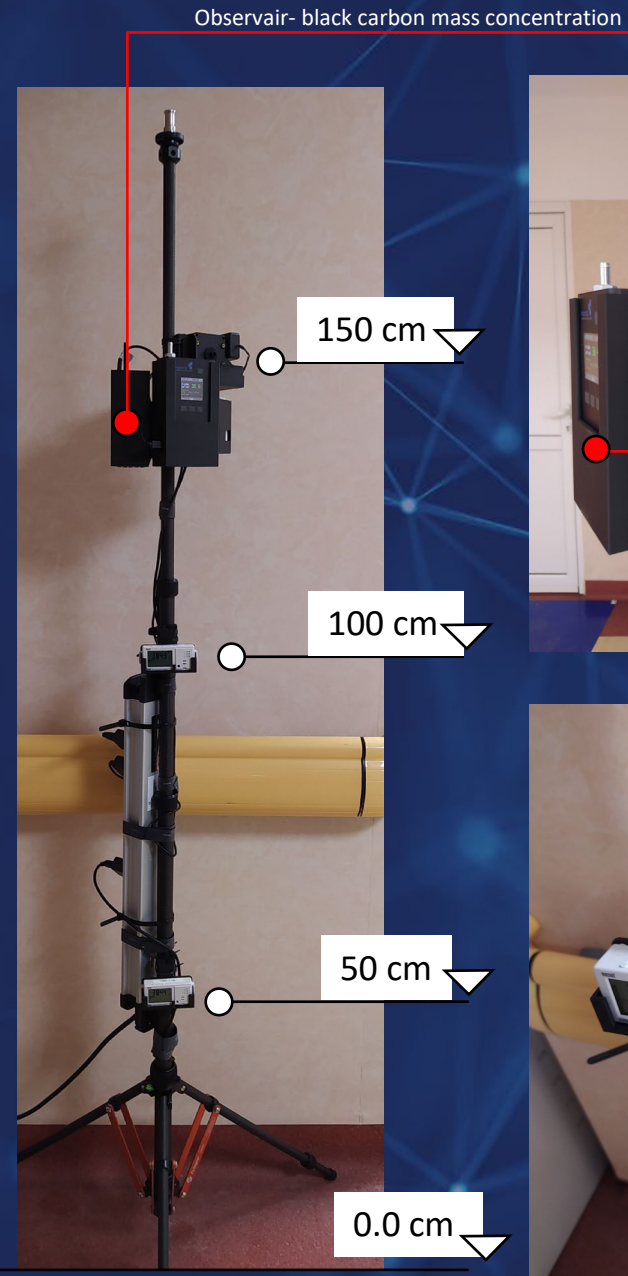
● Measurement instrument

● Air purifier unit

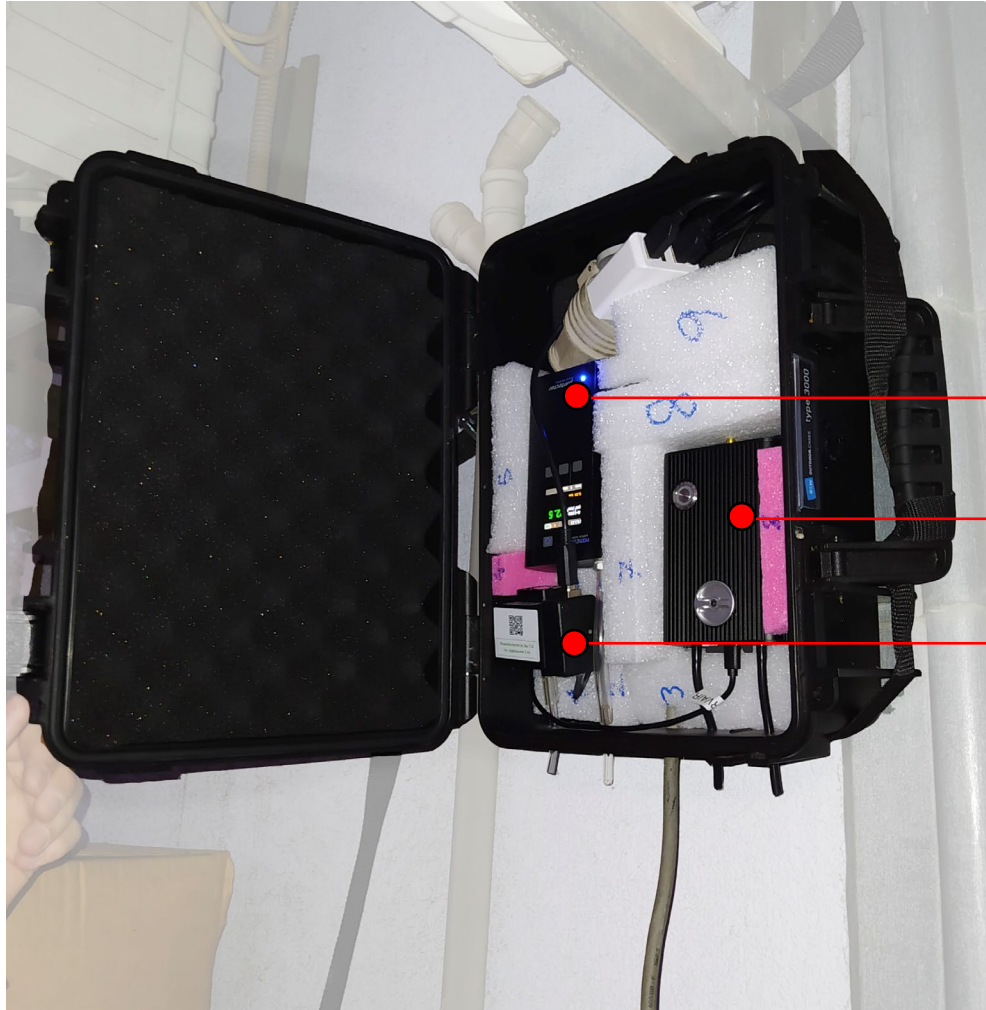


Parameters investigated

- Temperature (T) – (indoor and outdoor)
- Relative Humidity (RH) – (indoor and outdoor)
- Carbon Dioxide (CO₂).
- Particulate Matter (PM₁₀, PM_{2.5}, PM_{1.0}) – (indoor and outdoor)
- Total Volatile Organic Compounds (TVOC).
- Lung deposited surface area (LDSA) – (Indoor and outdoor)
- Black carbon (BC) pollution – (indoor and outdoor)
- Microbiological sampling.
- Airflow rates.
- Air and surface temperature.



Parameters investigated outdoors



Partector - (particle LDSA)

Observair- black carbon

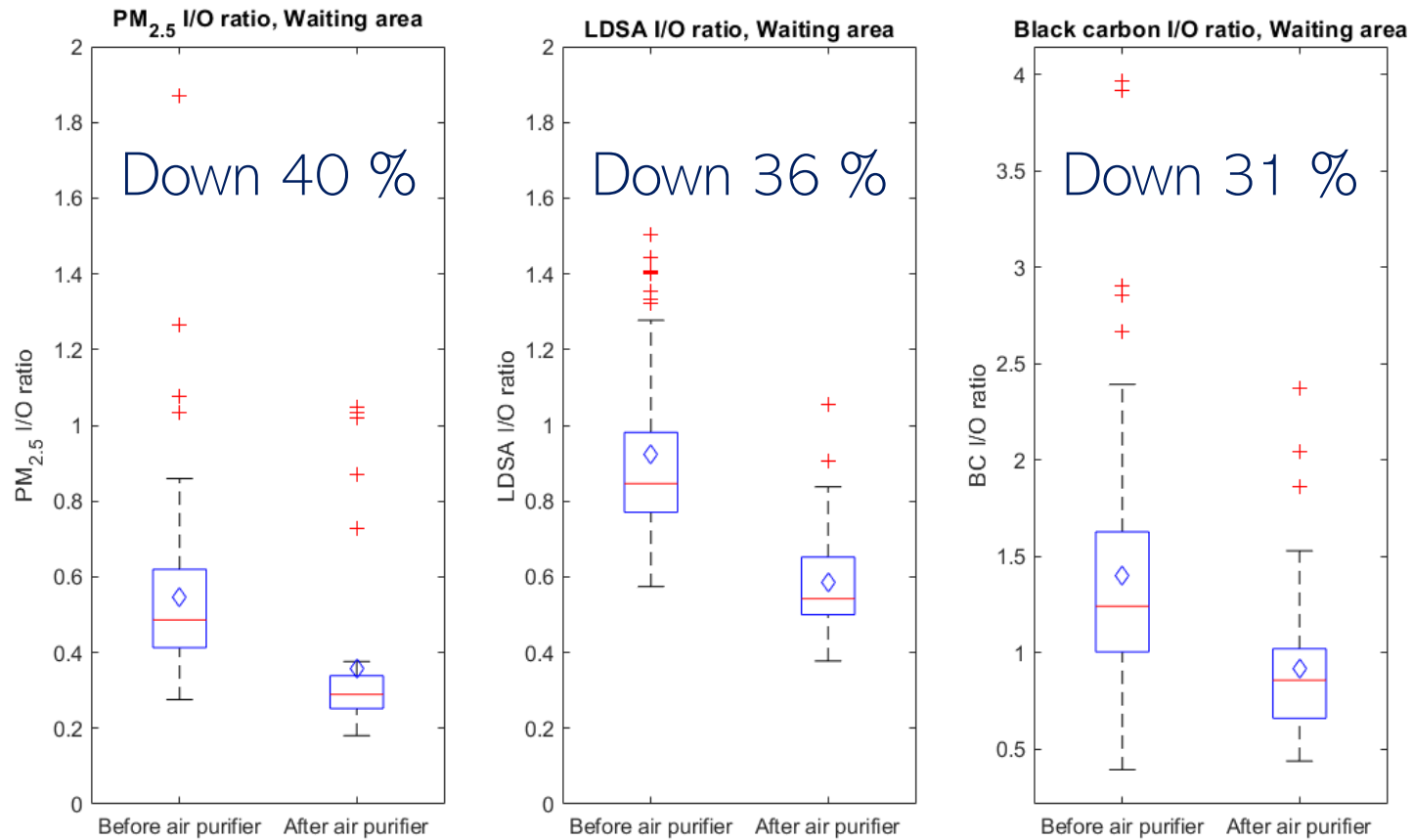
Alphasense - PM1, PM2.5 and PM10

Outdoor HOBO sensor for Temp. and RH



Mounted to a wall in the balcony – 2nd floor – covid section

Waiting area indoor/outdoor particle ratio

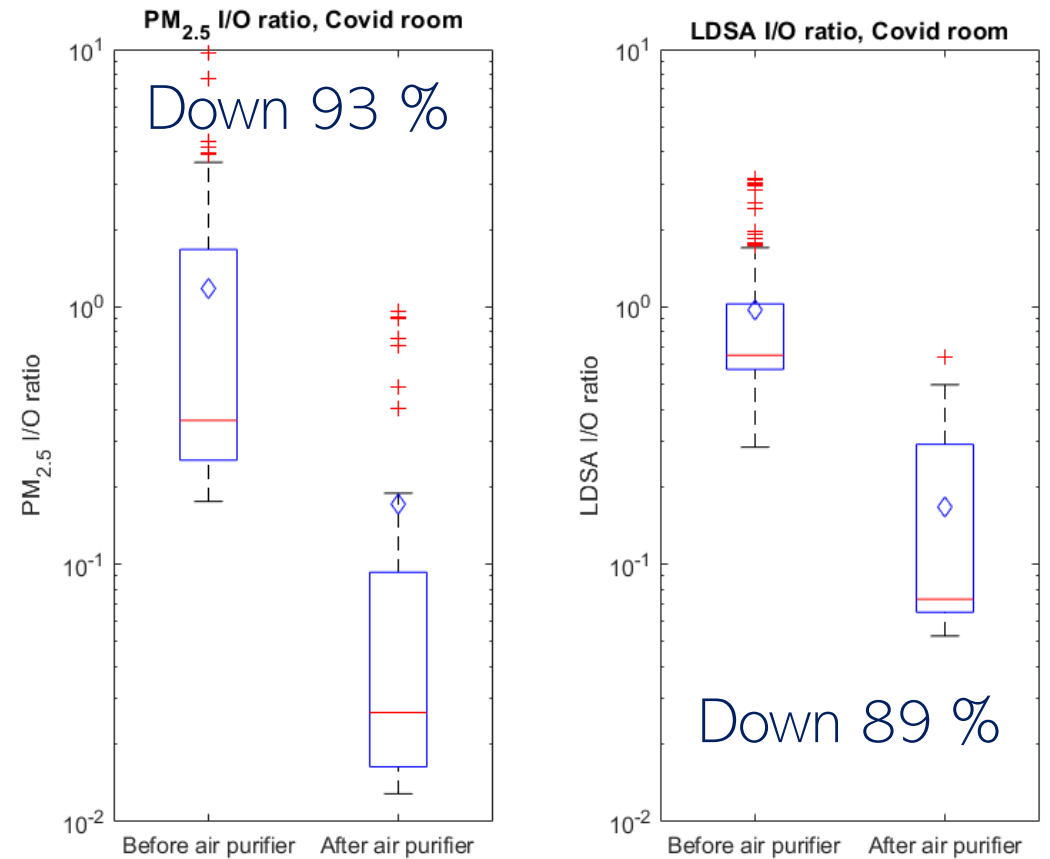
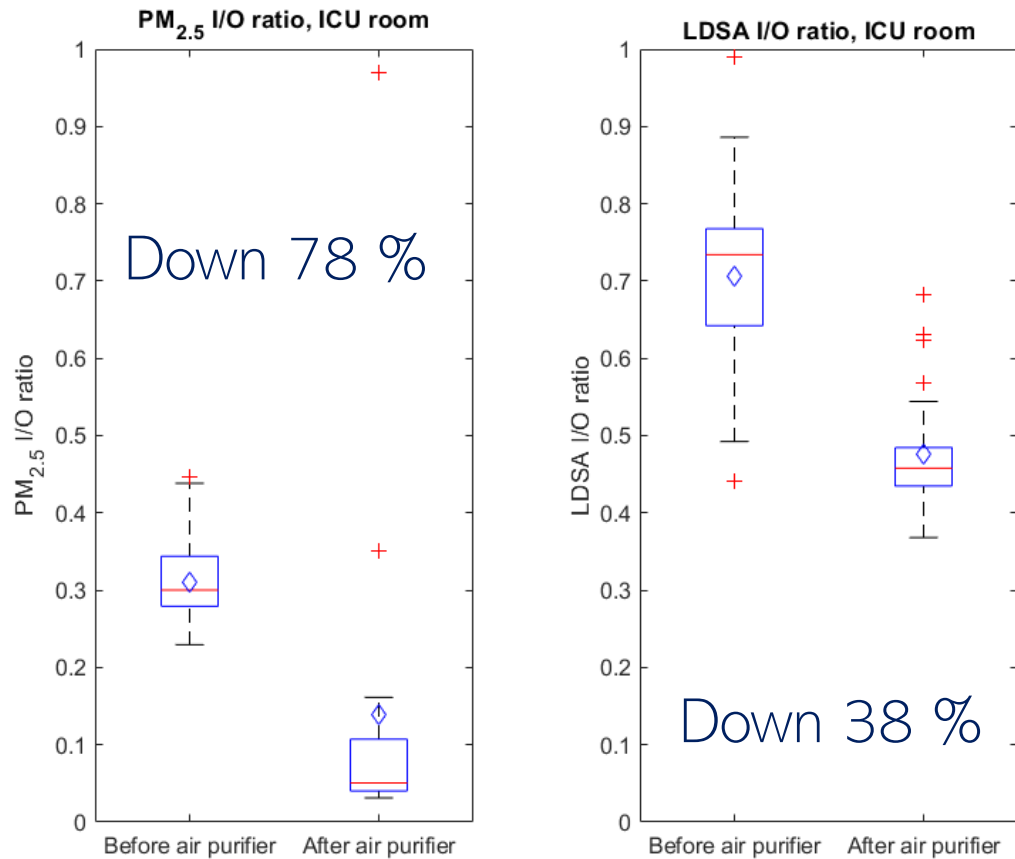


I/O-ratio in the waiting area before and after installing the air purifier.



ICU room indoor/outdoor particle ratio

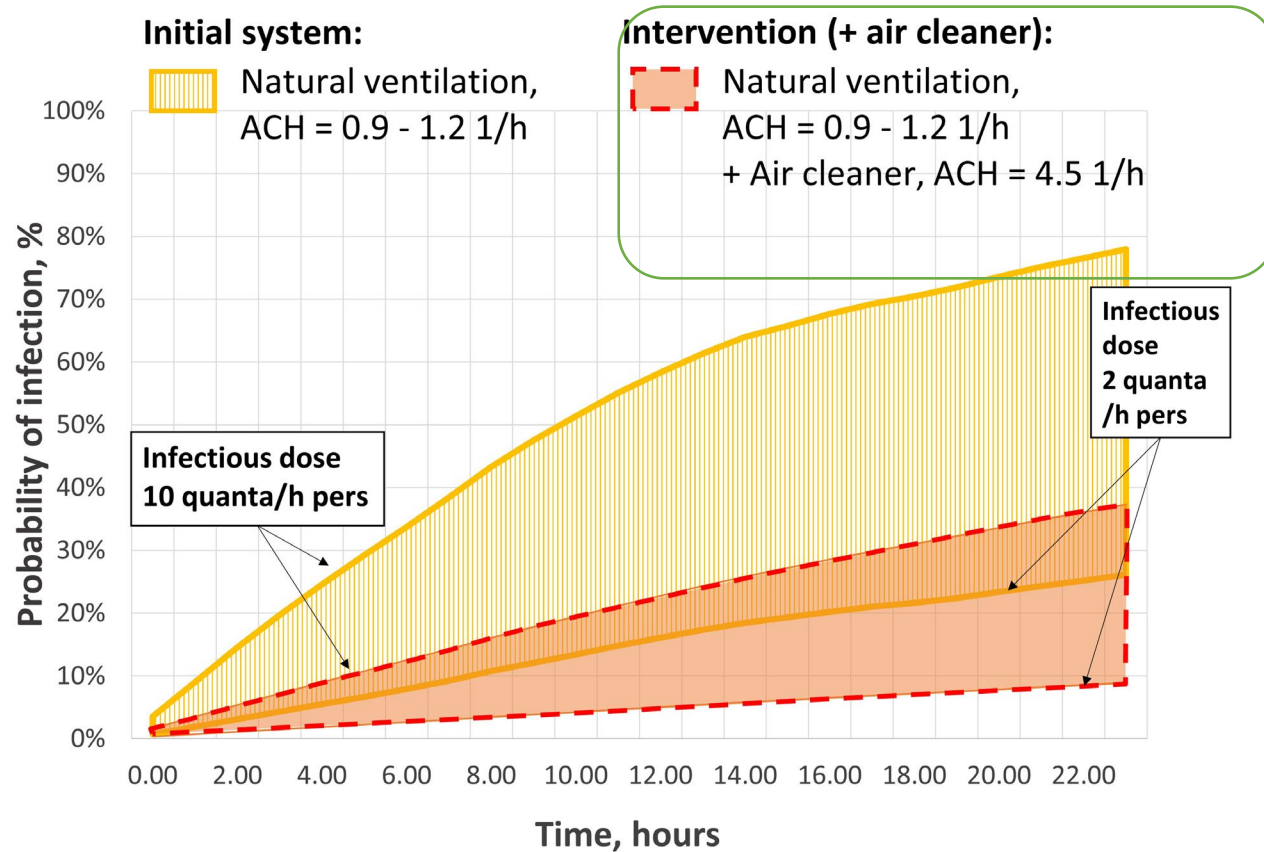
Covid room indoor/outdoor particle ratio



I/O-ratio in the ICU room before and after installing the air purifier.

I/O-ratio in the Covid room before and after installing the air purifier.

Calculated probability of airborne infection in covid room



Initial data

- One patient has covid infection
- One patient has no infection
- The infection risk is calculated with Wells-Riley model



Air change per hour in isolation room

Case studies	Ventilation type	Air exchange per hour ACH, 1/h				
		Initial situation		Intervention	Design requirements for isolation rooms, total ACH	
		Design outdoor ACH	Measured outdoor ACH	Total ACH with air purifier	The Lancet COVID-19 Commission (2022)	R3 Nordic Guideline for Hospital Ventilation (2023)
Matei Bals ICU Romania	Natural ventilation	N/A	1.0	5.5	12 – 20	12 – 24
Hospital 1 (Built 1976) Finland	Mechanical ventilation + air lock	4.2	1.7	10.8		
Hospital 2 (Built 2014) Finland	Modern mechanical ventilation +air lock	9.3	N/A	N/A		

* Simulated ACH with Ida-Ice program

Conclusions

- Air purifiers were efficient in reducing airborne particulate matter in the naturally ventilated hospital
- Measurements are in a key role when we search for methods to tackle pandemics
 - Learning to know the aerosol means we can develop ways to identify certain parts of it
- Air purifiers minimise spread of the pathogens from patient room to the corridors.
- In the waiting area air purifiers protect patient and personnel of airborne infections