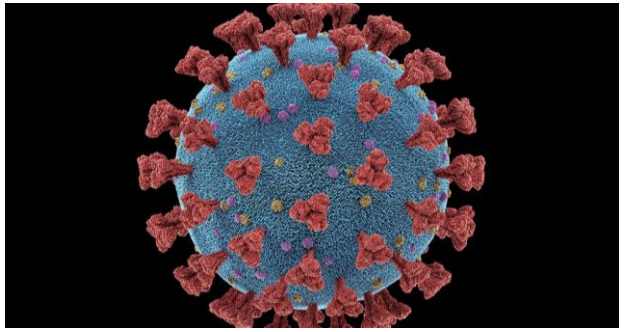
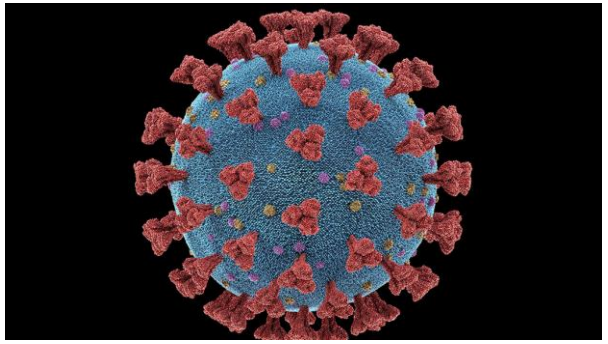
Title:Update on the transmission and clinical Ventilation -Droplet and airborne

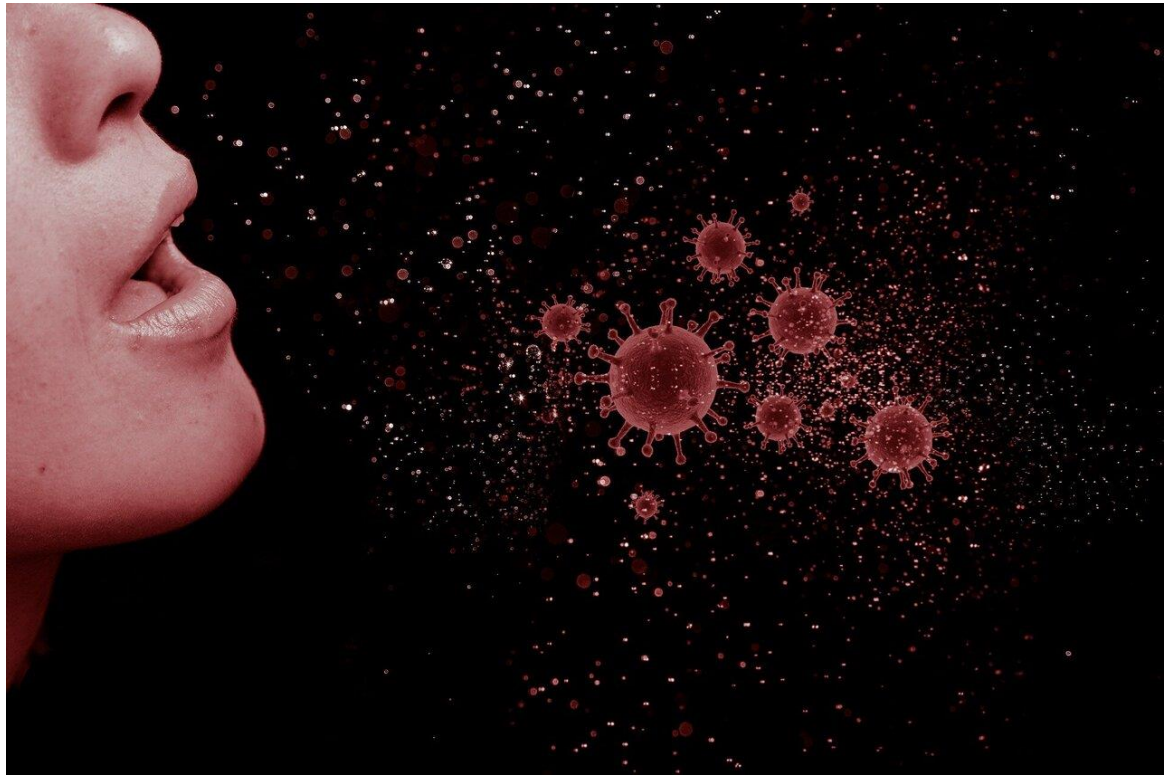
By: Prof S Mehtar

Preventing and controlling transmission of COVID 19 infection





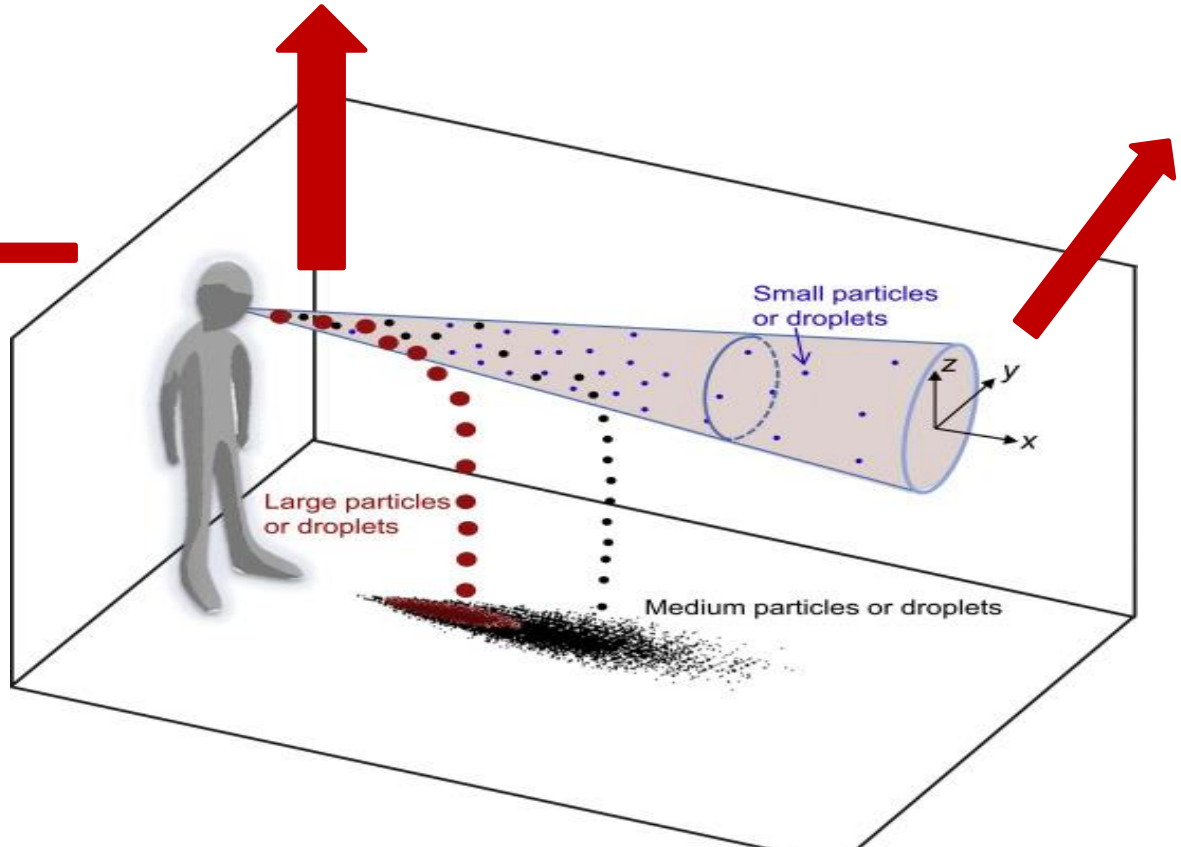
Ventilation



Prof Shaheen Mehtar

ICAN

Cough, droplets and aerosols

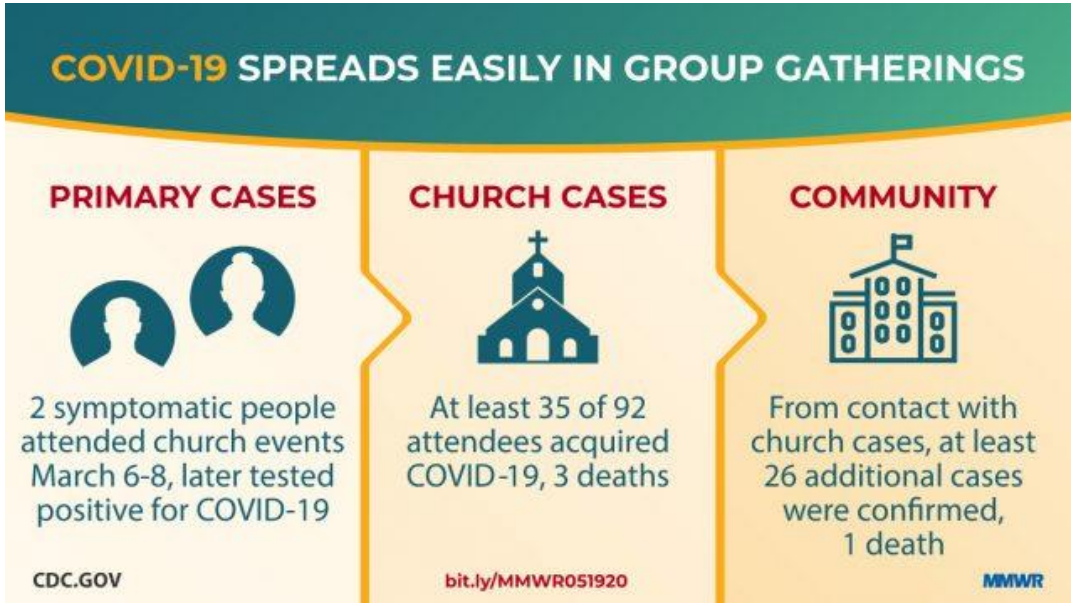


Transmission via aerosols

- **Small droplets**, (0.01- 10 µm diameter), during speech and coughing, contain viral particles, which can remain viable and infectious in aerosols for 3 h.
- The droplets can be transmitted either directly by entering the airway through the air (aerosols), or indirectly by contact transfer via contaminated hands.

- **Dose–response relationship of SARS-CoV-2 infection is still unclear, especially with respect to aerosol transmission of the virus.**

- **Aerosols** containing a small concentration of virus in **poorly ventilated spaces,** combined with low humidity and high temperature, might result in an infectious dose over time.
  - **Ventilated room, after 30 s the number of droplets had halved,**
  - **In a poorly ventilated room, the number of droplets was halved in 4 min.**
  - **Non ventilation this took about 5 – 9 min**



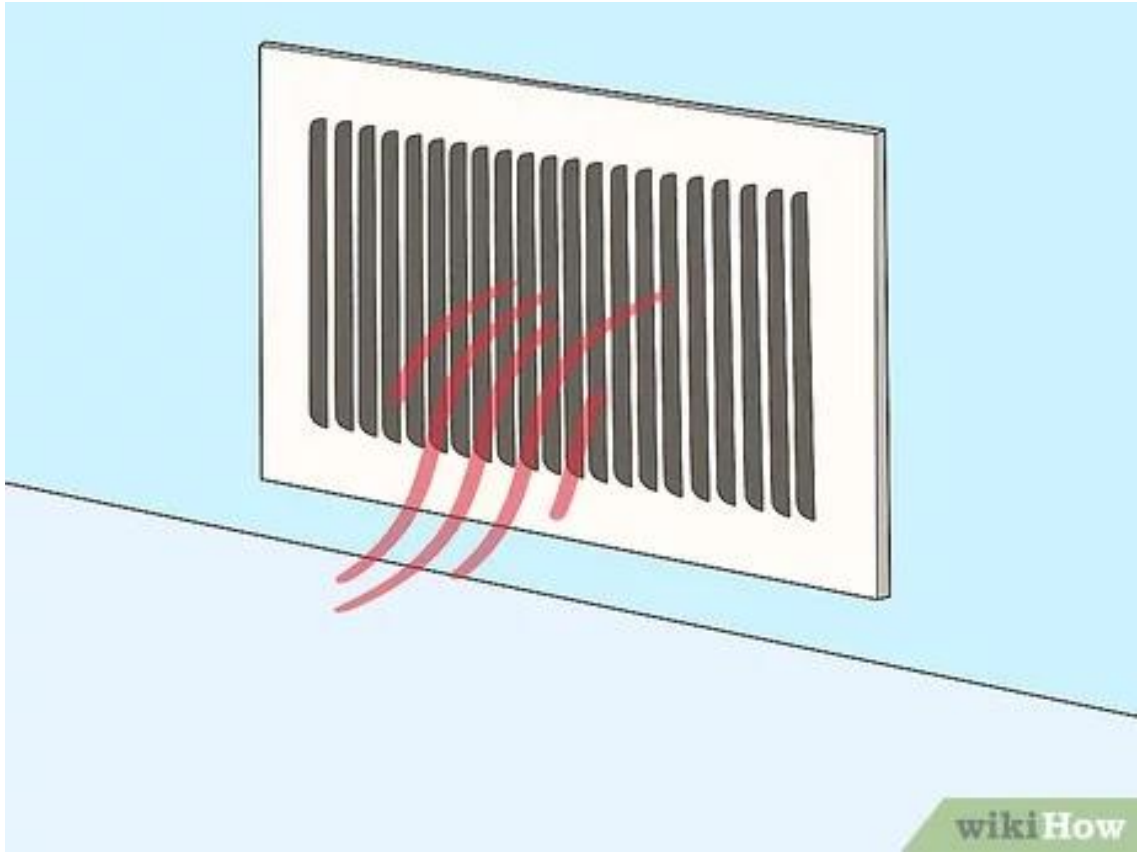
Ventilation – why?

Comfort “fresh air”; removal of heat (machine or solar gain), other temperature control

Removal of excess humidity (eg hydrotherapy pools)

Removal/dilution of: smells, toxic/flammable/explosive gases

Control & dilute airborne pathogens

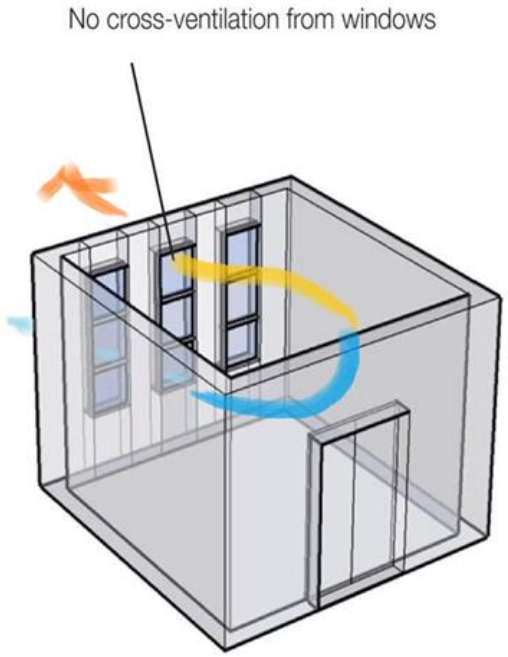


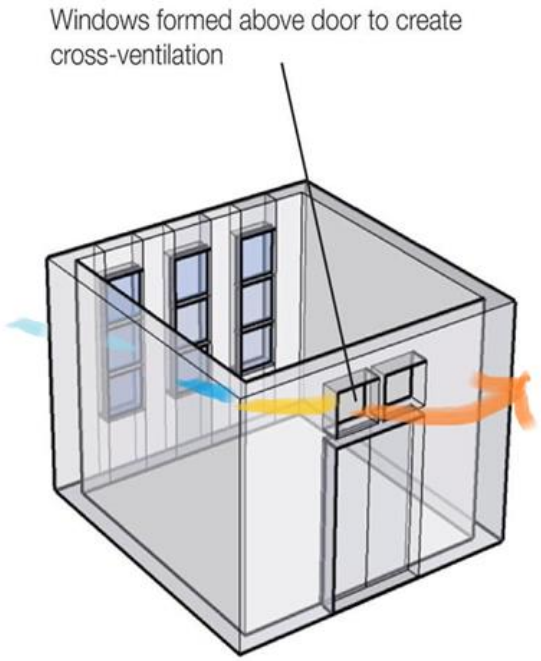
“Fresh air”

- Air from outside the building.
- It is put into a room in a building and displaces air in that room which may contain a variety of pollutants (microbial, chemical, odour etc.).
- Fresh air is not necessarily free from equivalent pollutants.

What is “bad” or stale air?

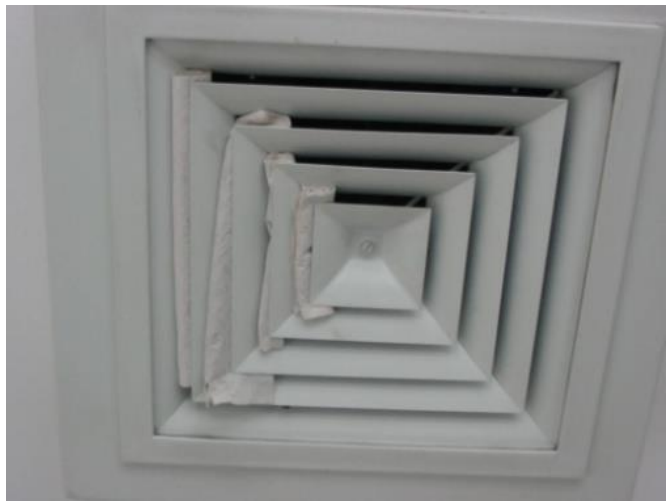
- In the absence of fresh air coming entering a space
- Air in a closed space which contains CO_2 , odours and particles including microbes (viruses) remain suspended in the air.
- These remain if not removed and replaced by fresh air from outside the building.
- The room or space smells stale.
- It is detrimental to health both in healthcare facilities and in homes.





IPC principles- ventilation

- Avoid dark and still areas without natural air movement
- Windows which can be opened
- Ventilation: air flow from patient areas to the outside atmosphere preferably NOT towards the corridors.
- Natural air circulation where possible
- Self closing doors with baffle plates to maintain airflow
- The air conditioning should be quiet and unobtrusive.



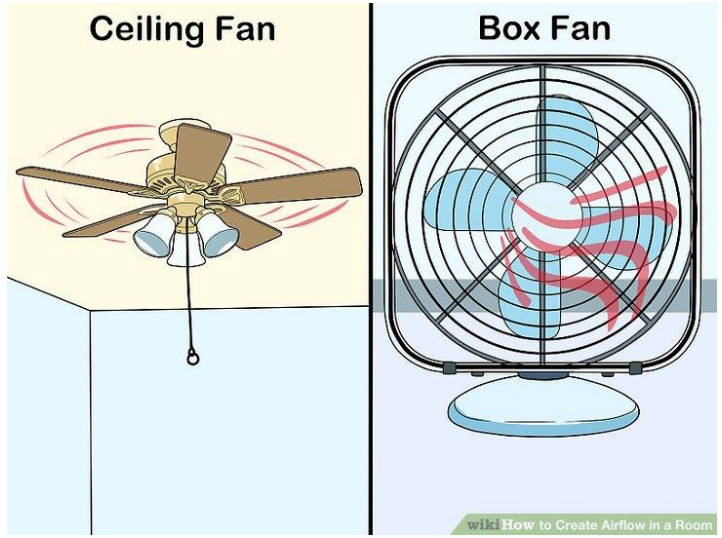
Types of ventilation

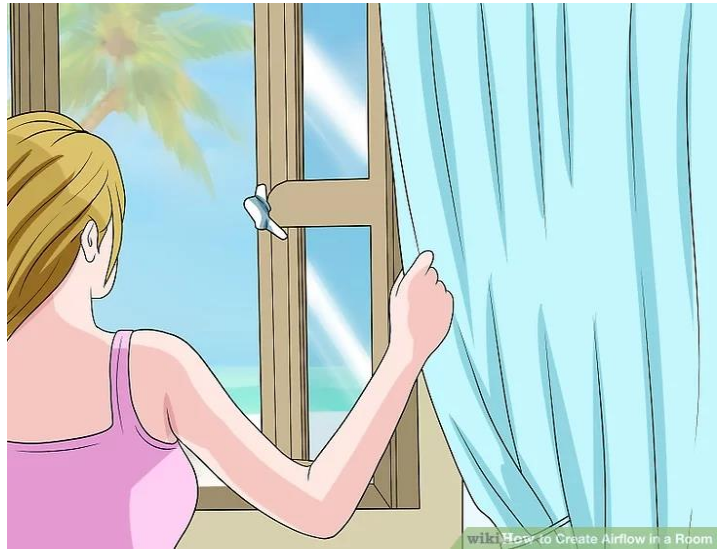
	Mechanical	Natural	mixed
Advantage	Suitable for all climates & weather Can be controlled	Suitable for mild & moderate climates Low costs & maintenance Capable of high ventilation rates Controllable by occupants	Suitable for all climates & weather Energy saving Flexible
Disadvantage	Expensive to install & maintain especially negative pressure vent	Effected by climate Difficult to design Reduces comfort level if hot, humid or cold Inability to provide negative pressure in isolation areas	Expensive Difficult to design

Natural ventilation, WHO 2009

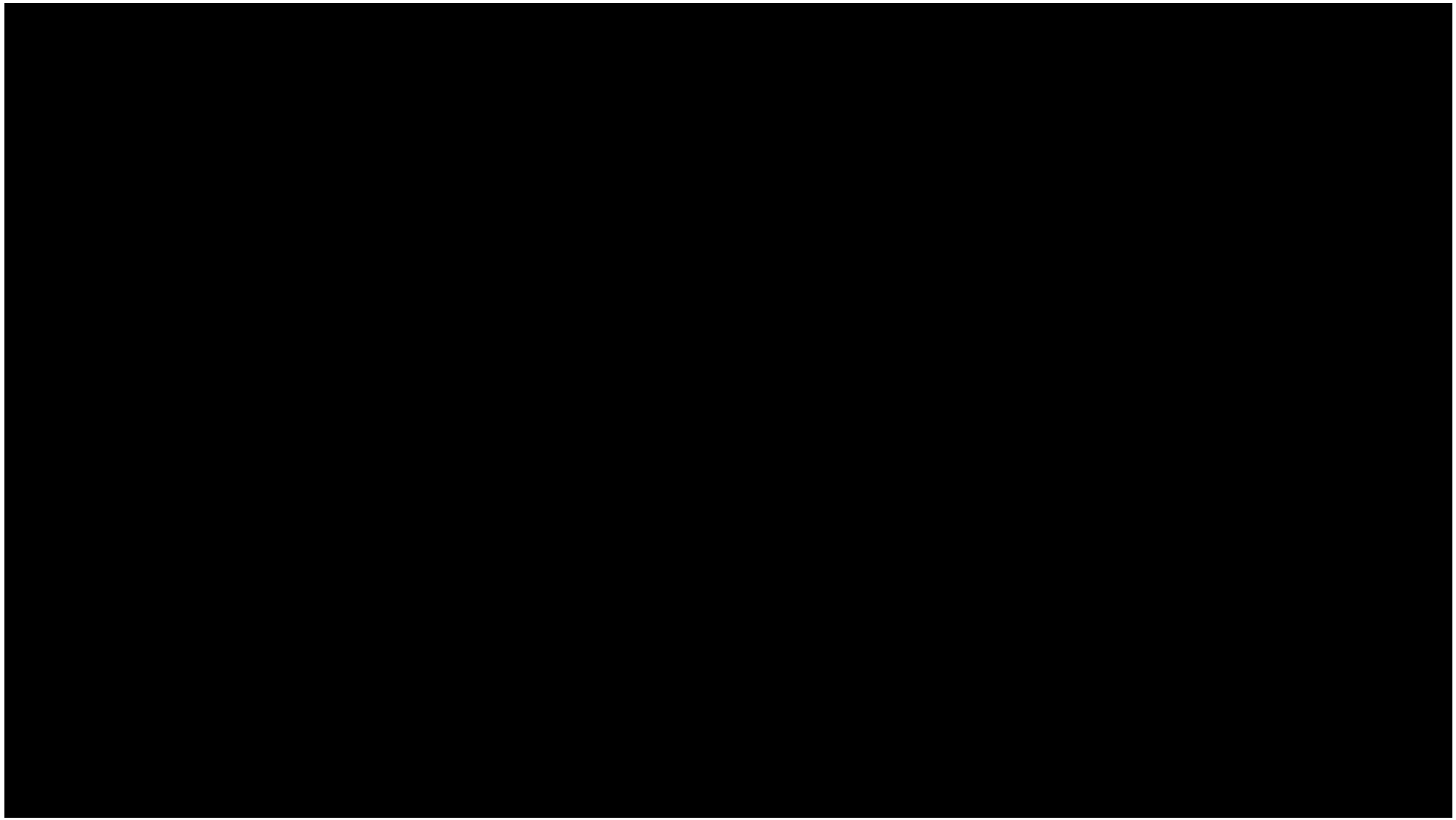
What are we looking for during COVID-19?

- **Fresh air** delivered at
  - 60 l/s/person in general areas of the healthcare facility
  - 160 l/sec/ person (or patient) in aerosol generating areas
    - ICU
    - COVID-19 wards
    - Operating theatres
- Do not need expensive systems
- In general areas open windows work well

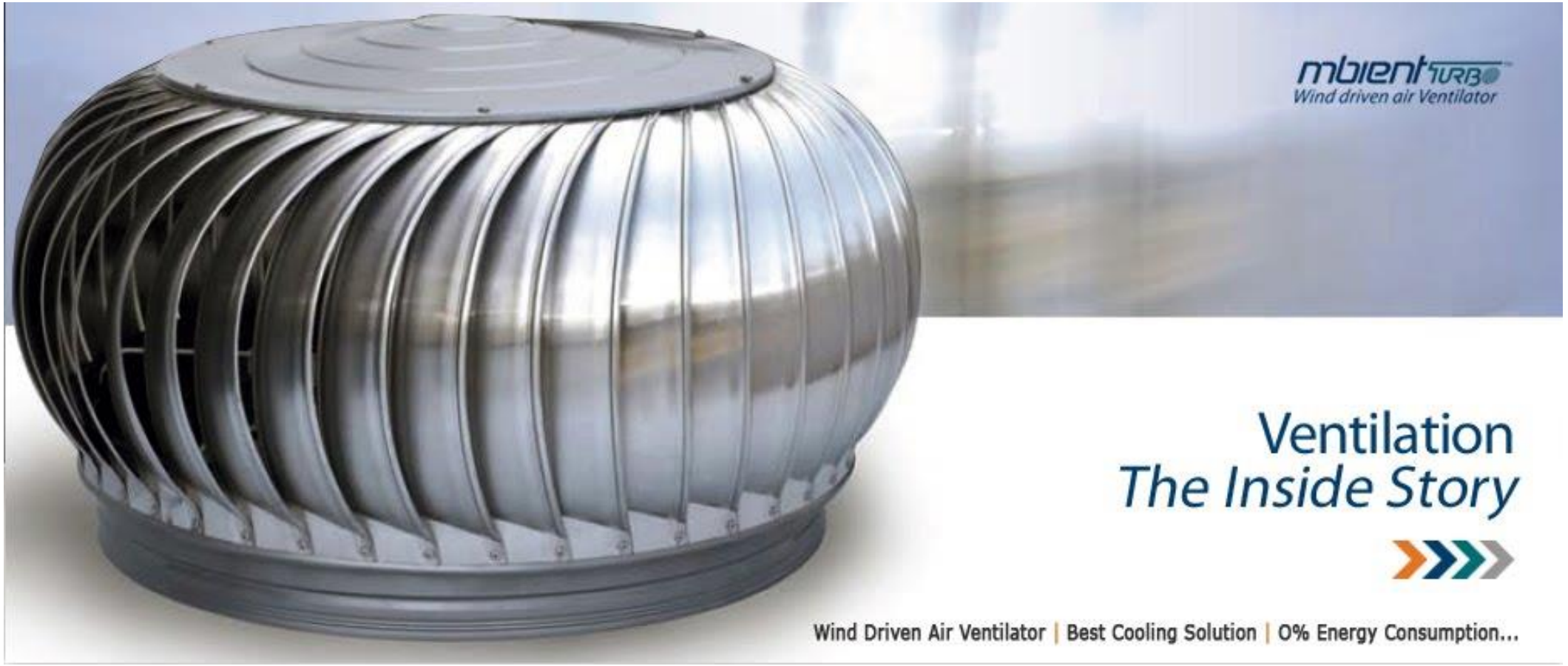




Natural ventilation principles



Improves air extraction (NPV)



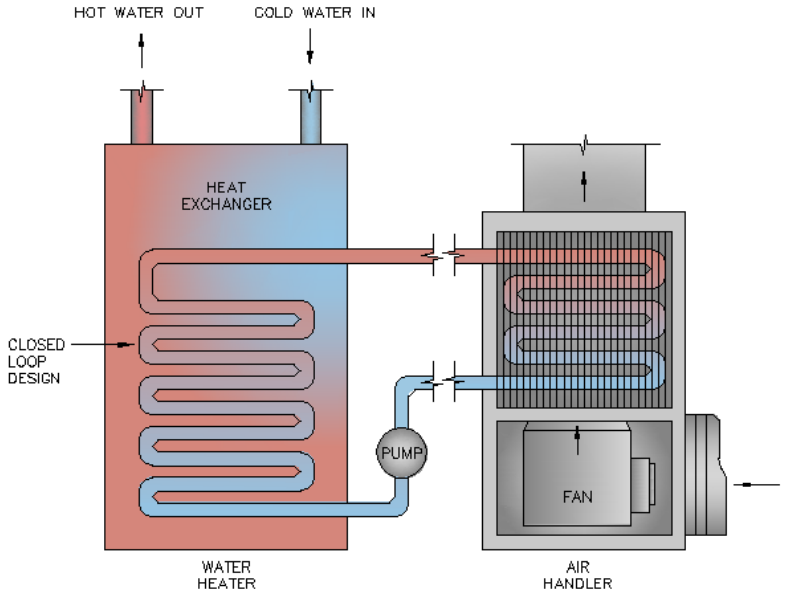
Floor standing air conditioners

- Cool the air and re-circulate it
- No filtering of particulate matter
- High contamination by dispersing skin scales and dust from floor
- **Not suitable for healthcare facilities**

Wall mounted Air conditioners

- Introduce air from the outside.
- Coarse particulate filter for dust
- Inappropriate for sterile areas such as the OT
- Allow temperature regulation in ordinary areas such as offices
- **Not appropriate for clinical areas**

Air handling unit with heat



Controlled mechanical ventilation

Dilution of pathogens

Rates of dilution by air changes are known; rates of generation of pathogen are not.

A rate of 6-10 ACH (or 60 l/s/ person) provides reasonable dilution and patient comfort.

Respiratory protection, in addition, by staff and visitors can be used.

- Does not need to be filtered (for TB)

If it is filtered - care with changes of HEPA and pre-filters. These will concentrate infectious particles

- Cannot be recirculated (even if filtered)
- Point of emission must not be near intakes or windows

AIR FILTERS - position

***If clean air is important*, the filters on air supply must be after the fan**.

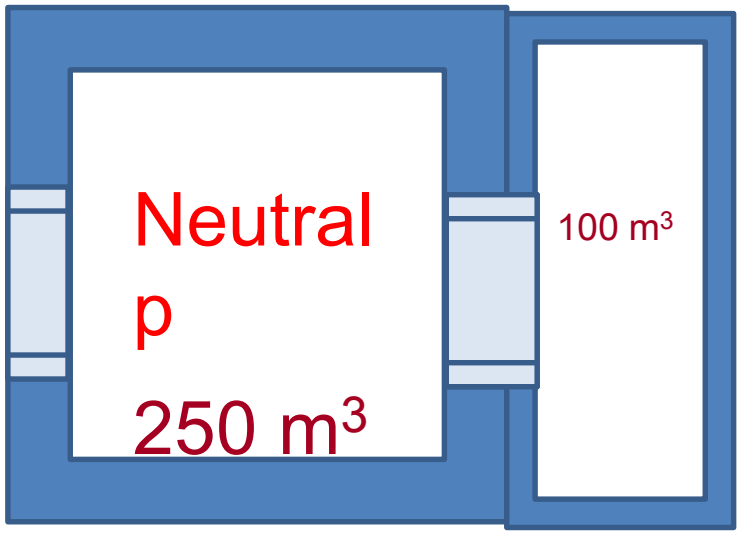
After the fan, the ductwork is under positive pressure; the system will tend to leak outwards.

If the filter is before the fan, there will be strong ingress through any holes between filter and fan.

Negative pressure ventilation

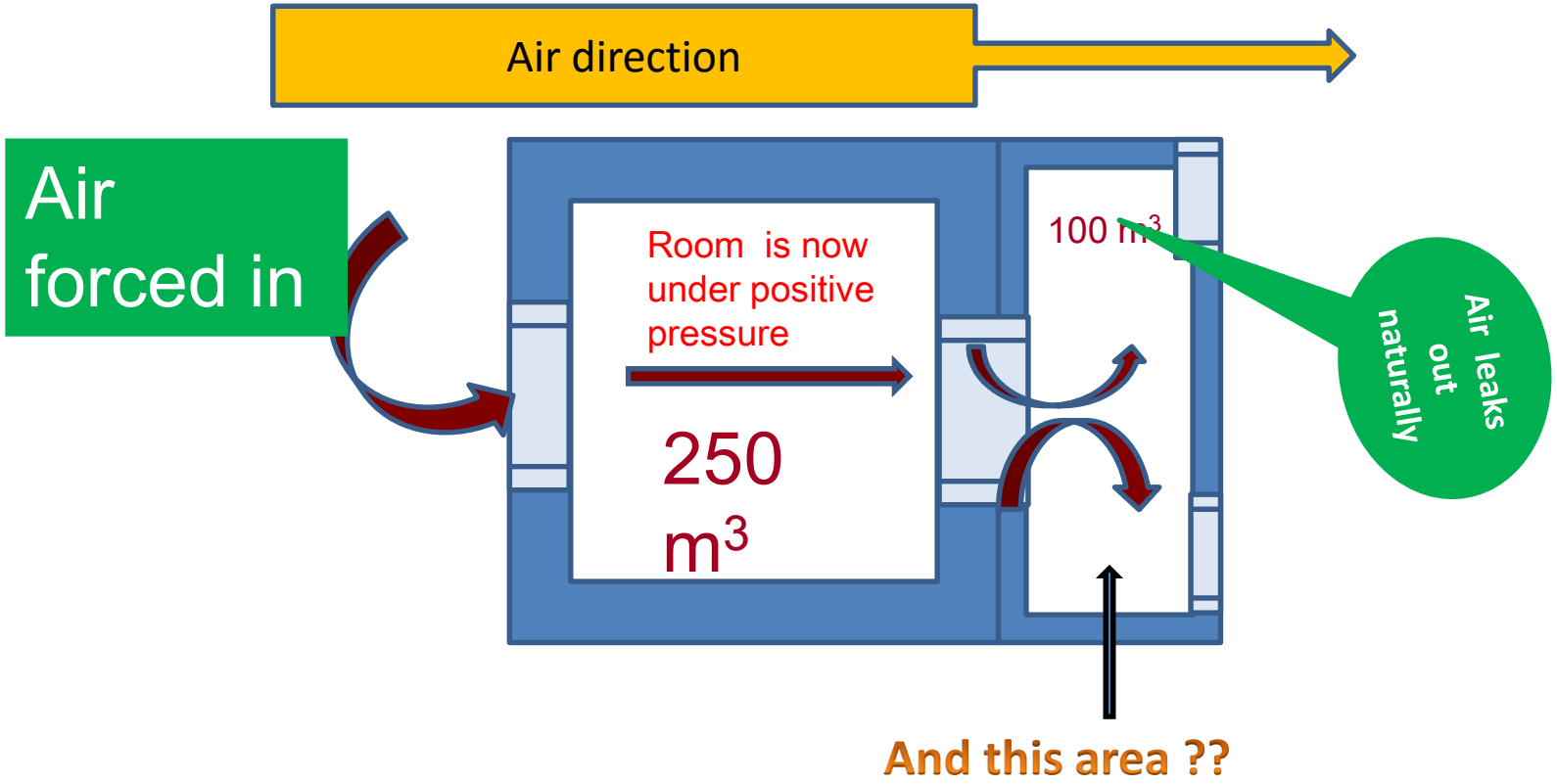
What is negative and positive pressure?

- A room has a fixed volume of air



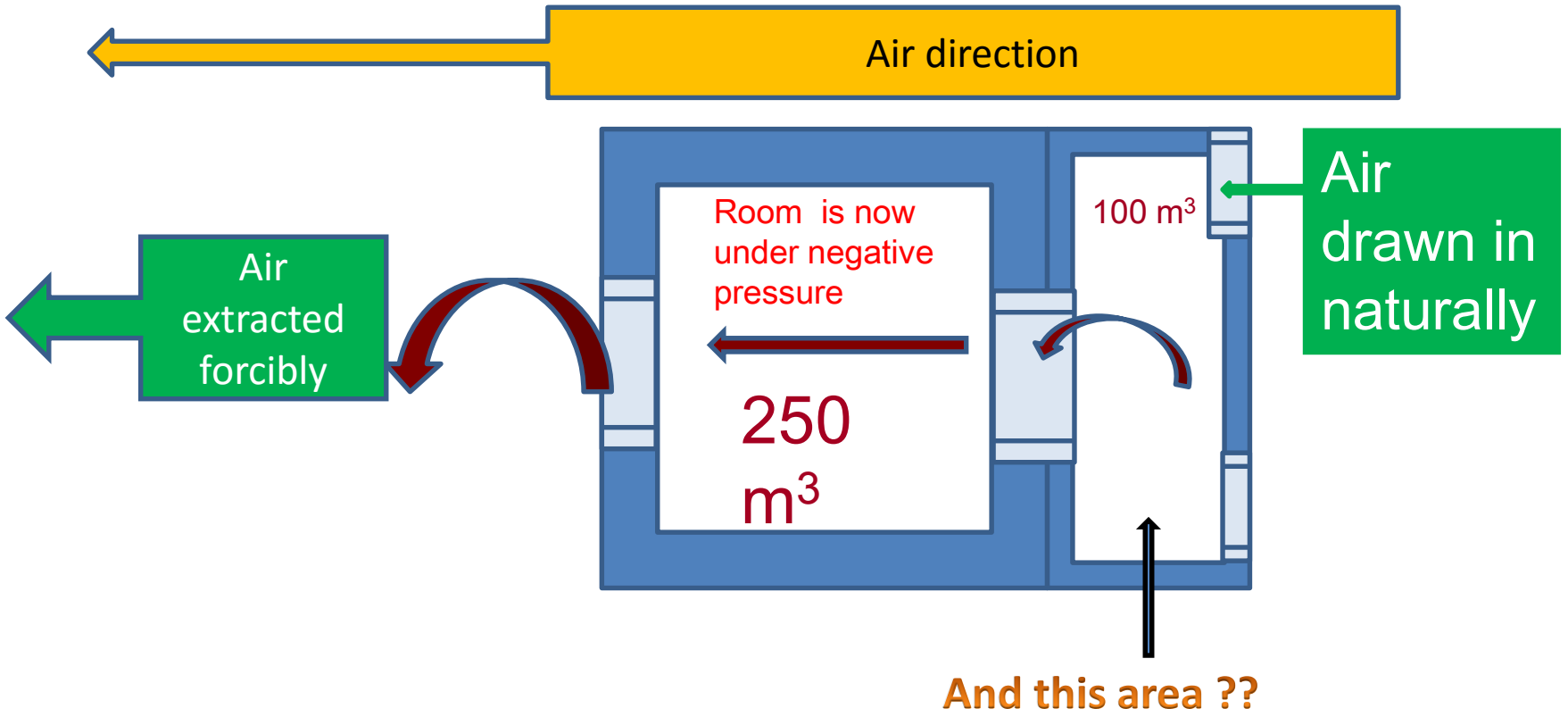
- Air moves naturally (in and out) based on a pressure gradient

Effect of mechanical ventilation



The small room is under negative pressure in relation to the larger room because air will not be able to leak backwards into the large room

Effect of mechanical ventilation



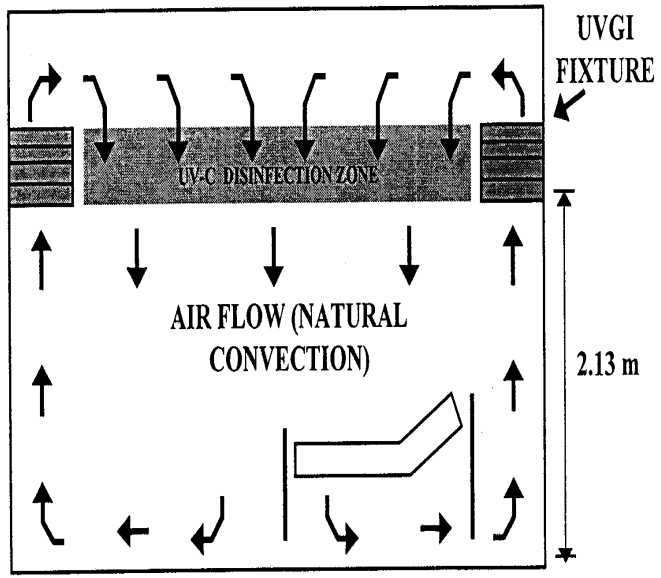
The small room is under positive pressure in relation to the larger room because air will leak outward into the larger room

Negative pressure rooms: other features

- Supply cuts out if extract fails (room fails static rather than at positive pressure)
- Non-opening windows
- Bathroom/toilet integral
- Anteroom useful but not essential

Ultraviolet germicidal irradiation

- It is a specific type of UVc light (253.7 nm wave length) which kills tiny microbes found in airborne nuclie.
- It does not affect larger respiratory droplets which is spread by contact
- It does not disinfect surfaces or objects
- Does not prevent direct person to person contact/ spread
- Not necessary for containment of COVID-19



Terminal cleaning and ventilation

- Once a patient with COVID-19 has been discharged the IPC team will organise terminal cleaning
- Turn on ventilation in the room or open the windows
- Wear PPE
- Clean the room and disinfect
- Admit after 2 hours once room is ready

Well designed Healthcare Facility- Worcester Hosp

- Wide open spaces
- Good natural ventilation
- Using the outside to improve ventilation

Summary- thank you!

- Spend money on what works rather than what might work!
- If the following are in place
  - Good simple yet effective policies to manage the patients
  - Spacing between beds
  - PPE
  - Adequate, preferably natural ventilation.
  - Good decontamination of respiratory equipment

Spread will be minimised in a cost effective manner!