IAQ

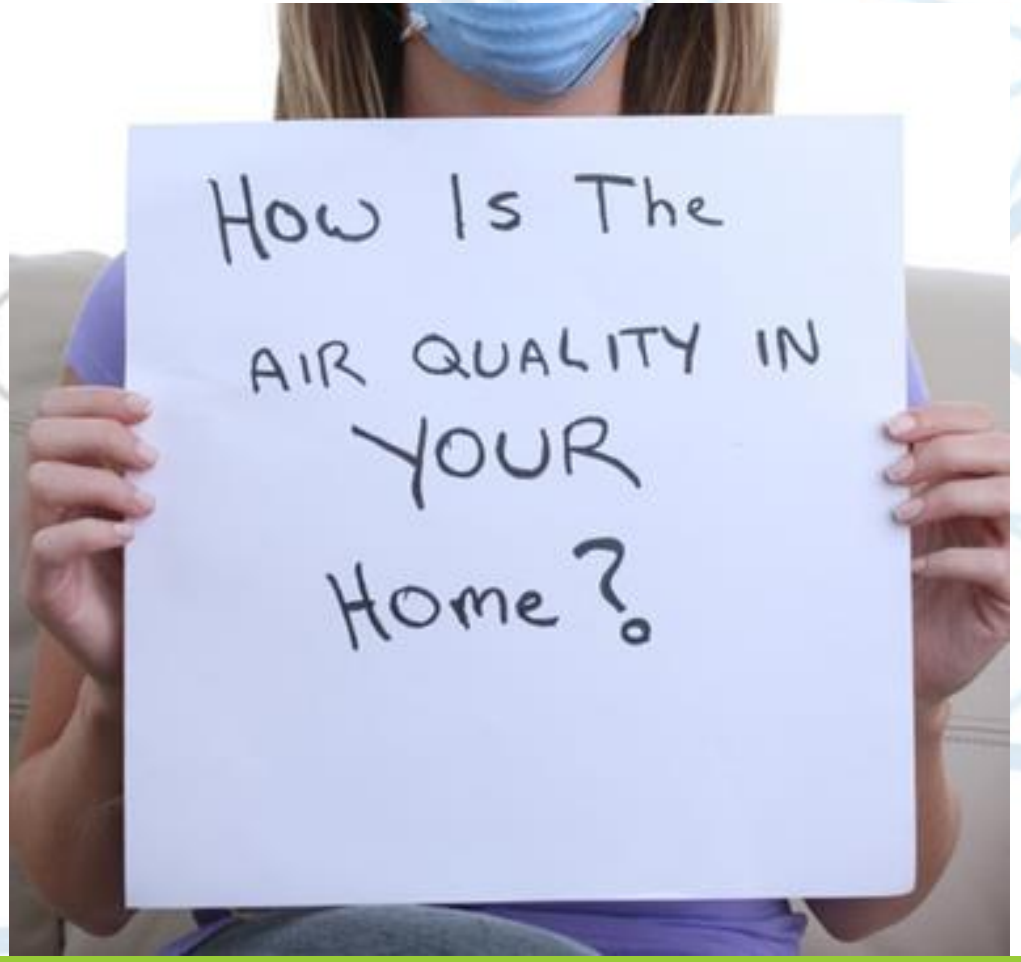
INDOOR AIR QUALITY IN HOSPITALS

HEALTHY ENVIRONMENT FOR HEALTHY PRACTICES

WHAT IS IAQ?

- Indoor Air Quality refers to the nature of conditioned (Heat/Cool) air that circulates throughout the space/area where we work and live

- **i.e. the air we breathe during most of our lives.**



Hospital IAQ?

- IAQ, refers not only to comfort, which is affected by temperature, humidity and odours but also to harmful **biological and non biological contaminants** present in the conditioned space.

PHARMACEUTICAL Clean room AQ

"**Federal Standard 209E"** defines a clean room as a room in which the concentration of airborne particles is controlled to specified limits.

WHO Guidelines for Classification Of Clean Room

Grade	Maximum number of particle permitted per m^3		Maximum number of viable micro-organism per m^3
	0.5 – 5 µm	> 5 µm	
A (Laminar airflow workstation)	3 500	None	Less than 1
B	3 500	None	5
C	350 000	2 000	100
D	3 500 000	20 000	500

Table 1. Air classification system for manufacture of sterile products

USFDA Guidelines for Classification Of Clean Room

Air Classifications by USFDA guideline on Sterile Drug Products

Clean Area Classification	<0.5 µm Particles/ft3	<0.5 µm Particles/mt3	Microbiological Limit	
			cfu/ft3	cfu/m3
100	100	3,500	<1	<3
1000	1000	35,000	<2	<7
10000	10000	350,000	<3	<18
100000	100000	3,500,000	<25	<88

ISO Standard for Classification Of Clean Room

Table 2 Selected ISO 14644-1 airborne particulate cleanliness classes for cleanrooms and clean zones

ISO Classification number	Maximum concentration limits (particles/m^3 of air) for particles equal to and larger than the considered sizes shown below					
	≥0.1µm	≥0.2µm	≥0.3µm	≥0.5µm	≥1µm	≥5.0µm
ISO Class 1	10	2				
ISO Class 2	100	24	10	4		
ISO Class 3	1 000	237	102	35	8	
ISO Class 4	10 000	2 370	1 020	352	83	
ISO Class 5	100 000	23 700	10 200	3 520	832	29
ISO Class 6	1 000 000	237 000	102 000	35 200	8 320	293
ISO Class 7				352 000	83 200	2 930
ISO Class 8				3 520 000	832 000	29 300
ISO Class 9				35 200 000	8 320 000	293 000

Factors affecting IAQ

The indoor environment in any building is a result of the interaction between the

- site
- climate
- construction techniques
- Ventilation system
- contaminant sources
- Pressurization and Airflow
- building occupants

(USEPA and NIOSH, 1993).

Main causes of poor indoor air quality

- **Pollutant sources** (indoor or outdoor)
- **Air-conditioning and ventilation systems** (contamination and malfunction)
- **Unplanned building design and usage.**

Types of Air Contaminants

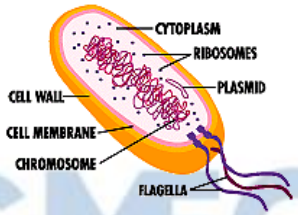
- Particulate
  Dust, skin, hair, makeup…

- Chemical
  Oil, grease, metal ions, perfume

Types of Air Contaminants

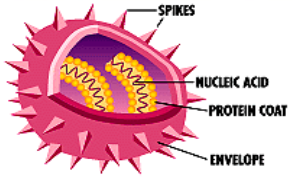
- Microbial

Bacteria



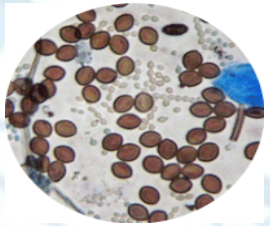
- E.g., MRSA, E. Coli, Staph, Strep…..

Viruses



- E.g., SARS, Avian Flu….

Fungi

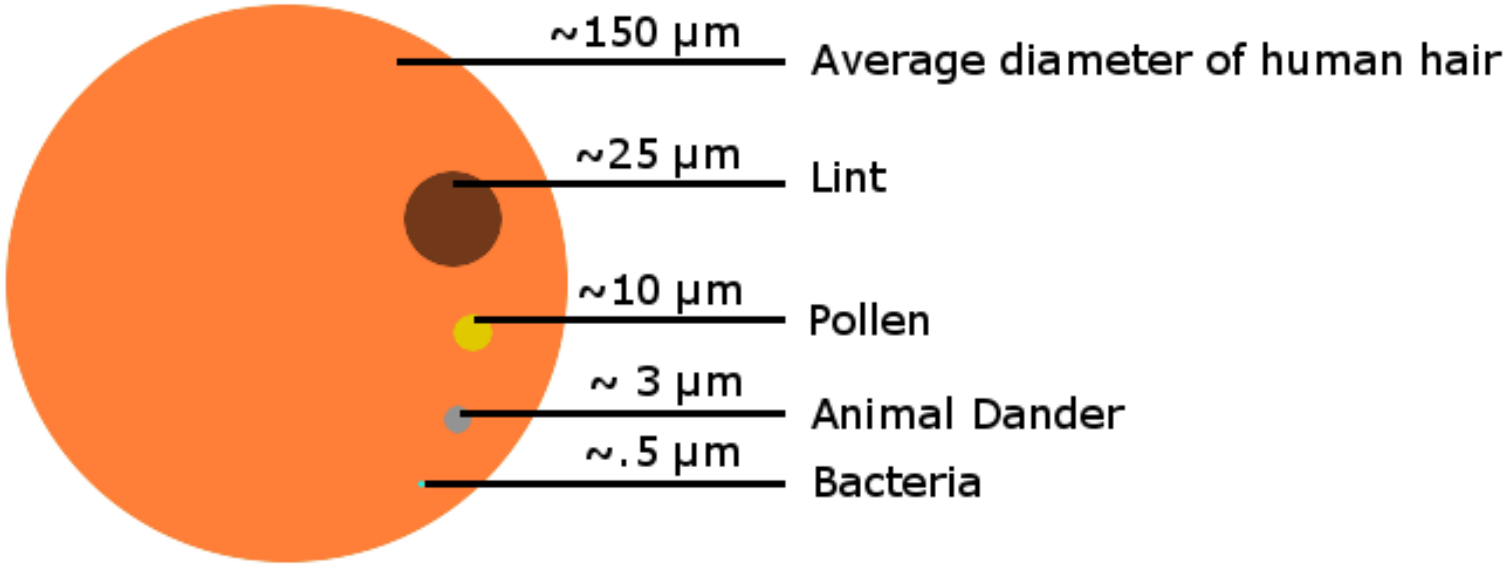


- E.g., Aspergillus

Sizes of airborne Contaminates

Common materials and their relative size in microns (one millionths of a meter):

- **Human Hair: 50-150 µm**
- **Dust : 0.01-100 µm**
- **Pet dander: 0.1-10 µm**
- **Pollen: 10-110 µm**
- **Tobacco Smoke: 0.01-1 µm**
- **fungal spores: 2.0-5.0 µm**
- **Bacterial cells: 0.3–10 µm**
- **Viruses: 0.02-0.30 µm**



1.HEPA Company glossary of terms
2.Originally 'High Efficiency Particulate Arrestment - see thefreedictionary.com
3.American Society of Mechanical Engineers, ASME AG-1a–2004, "Addenda to ASME AG-1–2003 Code on Nuclear Air and Gas Treatment", 2004
4.. [a] [b] *Gantz, Carroll (2012-09-21). The Vacuum Cleaner: A History. McFarland. p. 128. ISBN 9780786493210.*

How to Reduce air borne contaminants

Reducing airborne pathogens

There are four methods used to reduce the concentrations of airborne infectious agents:

1. DILUTION
2. PRESSURIZATION
3. FILTRATION (HEPA)
4. ULTRAVIOLET GERMICIDAL IRRADIATION (UVGI)

Dilution (Total Fresh Air)

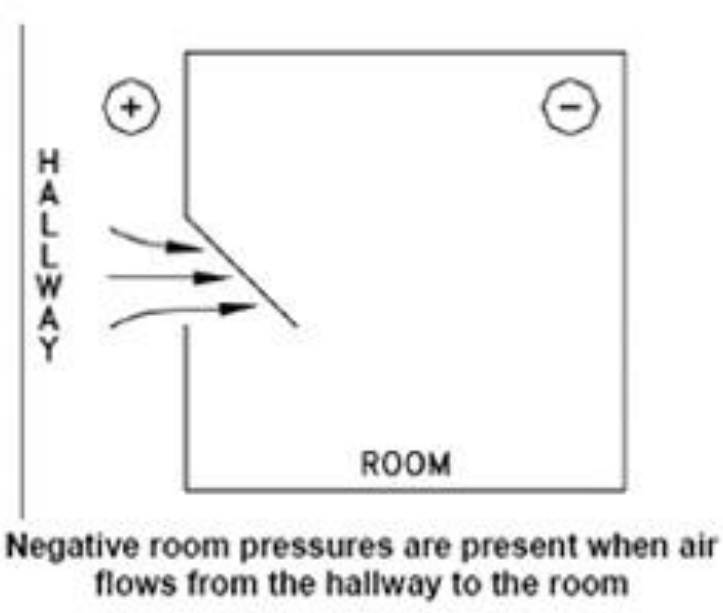
Dilution ventilation helps to control infectious particles by introducing outdoor air, usually **2 to 5 air changes/hour (ACH),** to dilute space air and then exhausting that amount as contaminated air.

Conditioning that amount of outdoor air would be very costly

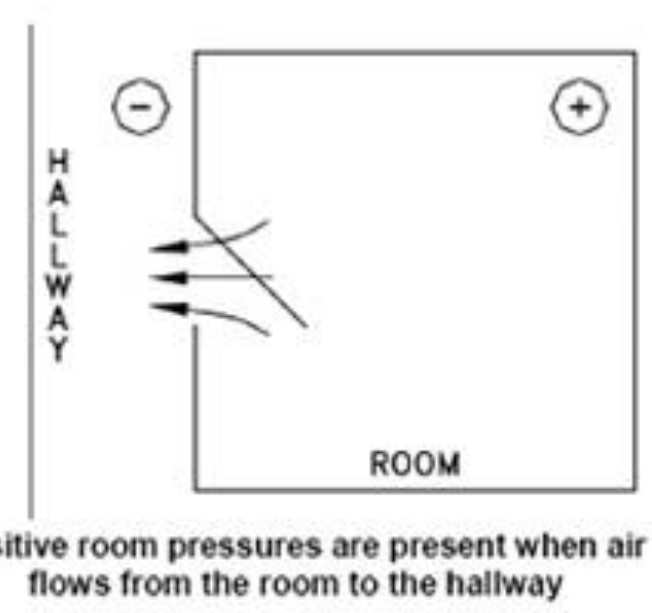
Fresh air may be carry airborne pathogens

Pressurization

Pressurization protects against cross contamination from the infiltration of air from one space to another in one direction. (+ve & -ve Pressure)



Negative room pressures are present when air flows from the hallway to the room

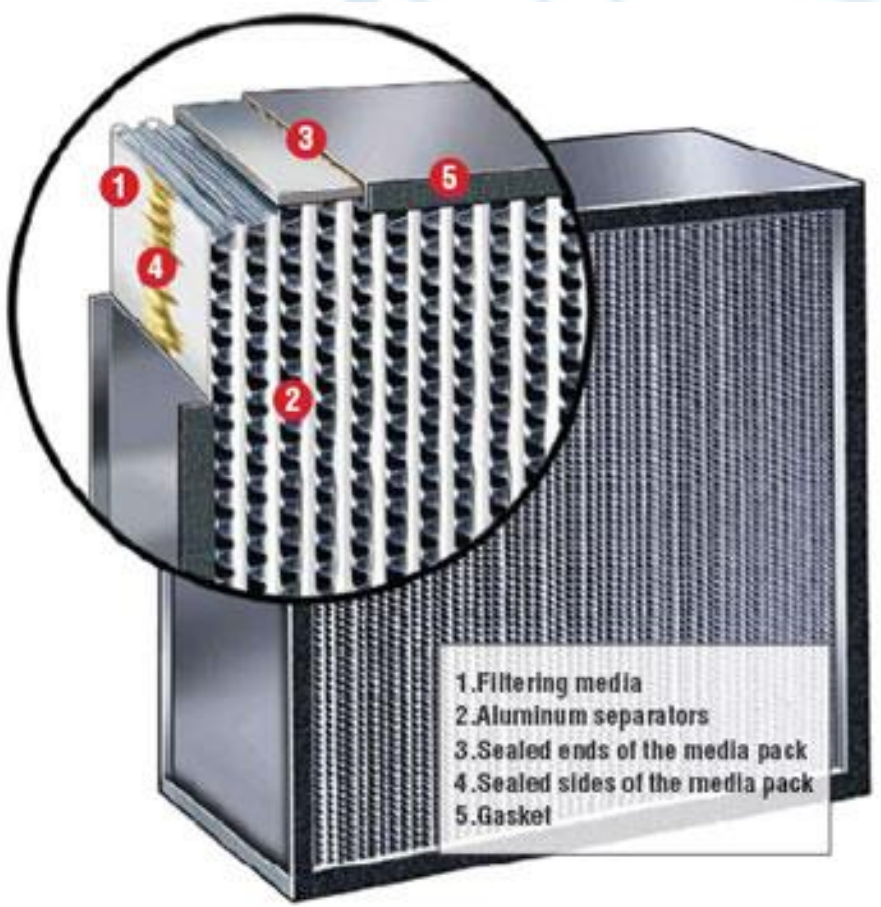


Positive room pressures are present when air flows from the room to the hallway

This is of great importance in healthcare settings, but it is very difficult to control.

(HEPA) (High-efficiency particulate arrest)

According to NIOSH (The US National Institute for Occupational Safety and Health), a true HEPA filter is one that can trap **99.97 %** of particles that are 0.3 microns in diameter or more



Have good effect on fungi and molds and some bacteria and virtually

NONE ON VIRUSES

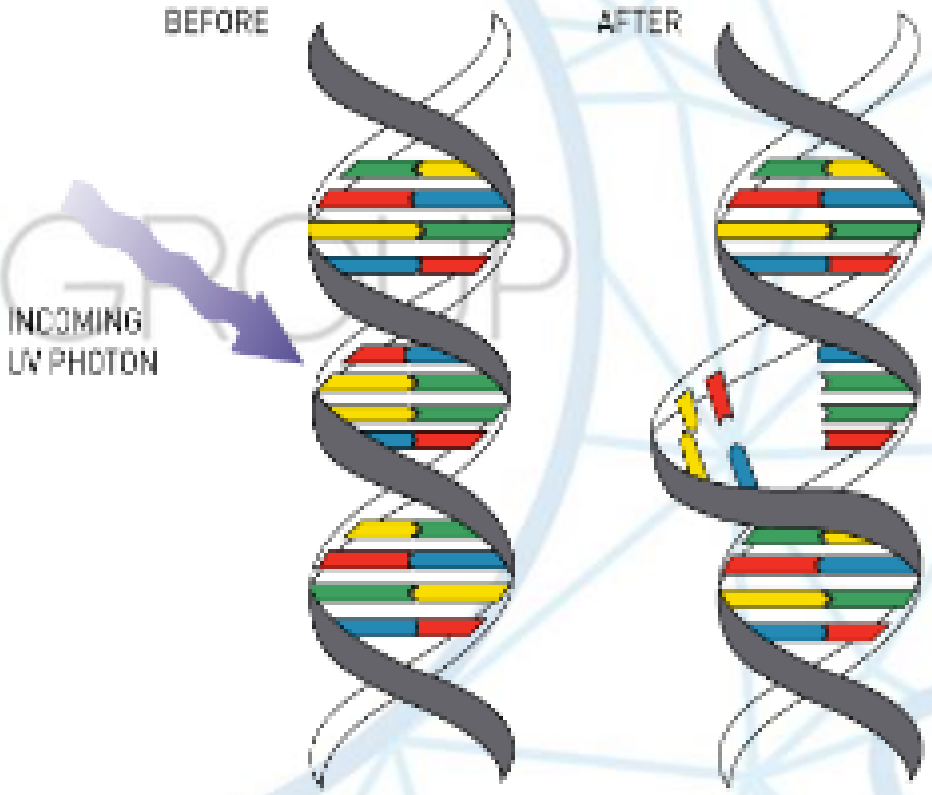
Considered as source of infection during replacing process

ULTRAVIOLET GERMICIDAL IRRADIATION (UVGI)

UV light inactivates microorganisms by damaging nucleic acids (DNA or RNA) thereby interfering with replication of the microorganisms and therefore incapable of infecting a host

Different microorganisms have different degree of susceptibility to UV radiation to be killed

Prolonged human exposure to UV radiation may result in acute and chronic health effects on the skin, eye and immune system.



(UVGI dose) in µWs/cm Needed for killing different types of germs (According to WHO standard)

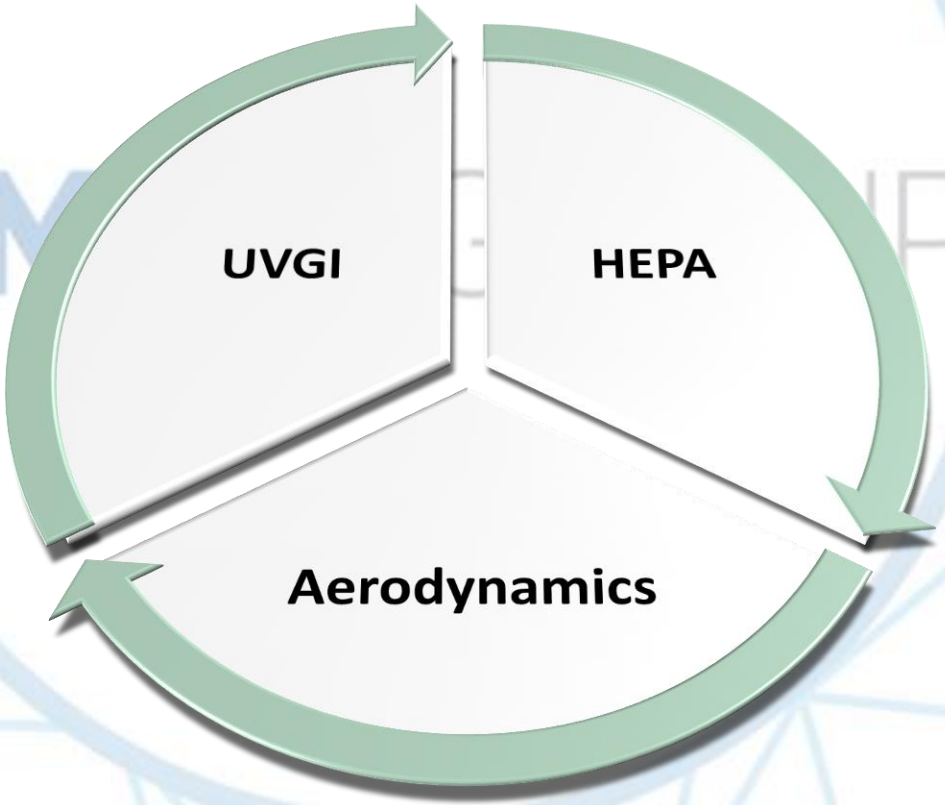
Microorganism	Disease	90% disinfection µWs/cm2	99.9% disinfection µWs/cm2
Bactria			
Bacillus anthracis	Anthrax	4500	12700
Salmonella entritides	Intestinal tract infections	4000	12000
Corynebacterium diphtheriae	Diptheria	3400	10000
Legionella pneumophila	Pneumonia	920	2760
Pseudomonuas aeruginosa	Wound infections	5500	16500
Salmonella typhimurium	Typhoid fever	8000	24000
Staphylococcus aureus	Wound infections	2200-4900	6600 - 14800
Streptococcus heamolyteicus	Scarlet fever	2200	6600
viruses			
Poliovirus	Polio	3200	9600
Influanza viruses	Influanza	3400	10200
hepatites viruses	Hepatites	5800	17400
Fungai			
Aspragilus niger	Allergy & resp. symptoms	132000	396000
Penicillium sp.	Allergy	50000	150000

To Enhance **Environmental Quality**

Requires integration of

- Well-maintained and clean HVAC
- Air-pressure-control
- Dedicated infection-control system
- Minimizing unplanned airflows
- HEPA
- Pre filters
- Application of (UVGI).

EIC Integrated Technology for Air Sterilization Solutions



Thank you

AHMED MEKKAWY

SALES MANAGER

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Comparison of Quality Requirements for Sterile Product Manufacture as Per Indian GMP and USFDA ;Yogita P, N Vishal Gupta, Natasha NS, Ashwini Nageen L, R Sudeendra Bhat; Research Journal of Pharmaceutical, Biological and Chemical Sciences; Jan 2012 volume 3(1): 225-236.

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