

# SciCan: Your Infection Control Specialist

- 
- **Canadian company**
  - Founded in 1957
  - **60 years of experience** in the healthcare market
  - Present in over 100 countries around the world
  - **2 specific business areas:**
    - SciCan **Dental**
    - SciCan **Medical**

Contamination control  
Healthcare safety



# Air Treatment Systems in Healthcare Settings

Thibaud BOISTON  
Kelsey MAH



# airinspace® worldwide cover



<b>FRANCE</b>	<b>Paris Assistance Publique Hospitals</b> : Saint Antoine, Necker, Saint-Louis, Louis Mourier, <b>University Hospitals</b> : Marseille, Montpellier, Bordeaux, Lille, Strasbourg, Nantes, Brest, Dijon, Lyon, St-Etienne...
<b>GERMANY</b>	Leipzig, Dresden, Munich, Berlin, Lubeck, Munchen, Bonn...
<b>CHINA</b>	Rui Jin Shangai, Pekin Hôpital 301 ( military), Suhzou, Wuhan, Canton...
<b>JAPAN</b>	Tokyo, Osaka...
<b>TURKEY</b>	Ankara, Antalya, Izmir
<b>SAUDI ARABIA</b>	Ryhad
<b>UNITED ARAB EMIRATES</b>	Dubaï, Abu Dabi, Fujairah
<b>ALGERIA</b>	Alger University hospital, Beni Messous, Batna, Pierre et Marie Curie, Blida...
<b>MAROCCO</b>	Casablanca, Marrakech...

# Our mission

**Improve air quality in hospitals' high risk areas.**

- **Reduce** airborne infections and related costs
- **Comply** with international and/or local standards
- **Improve** patient and staff safety



# Part I

## Air quality – general principles

# Contaminants that affect air quality

## Different types of contaminants :

- Inert particles (mineral or organic)
- Airborne biocontamination
- Gaseous pollution

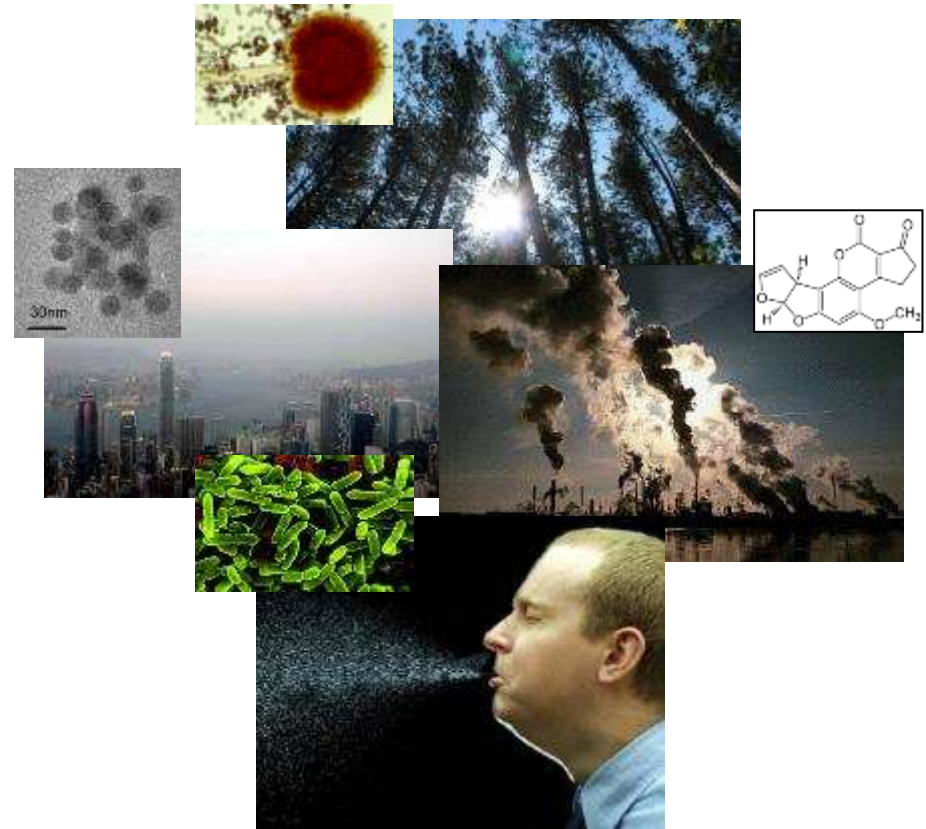
## Different sources of emission :

- Natural
- Human
- Industrial

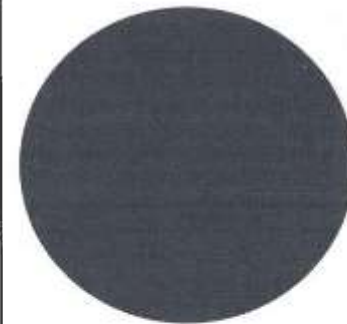
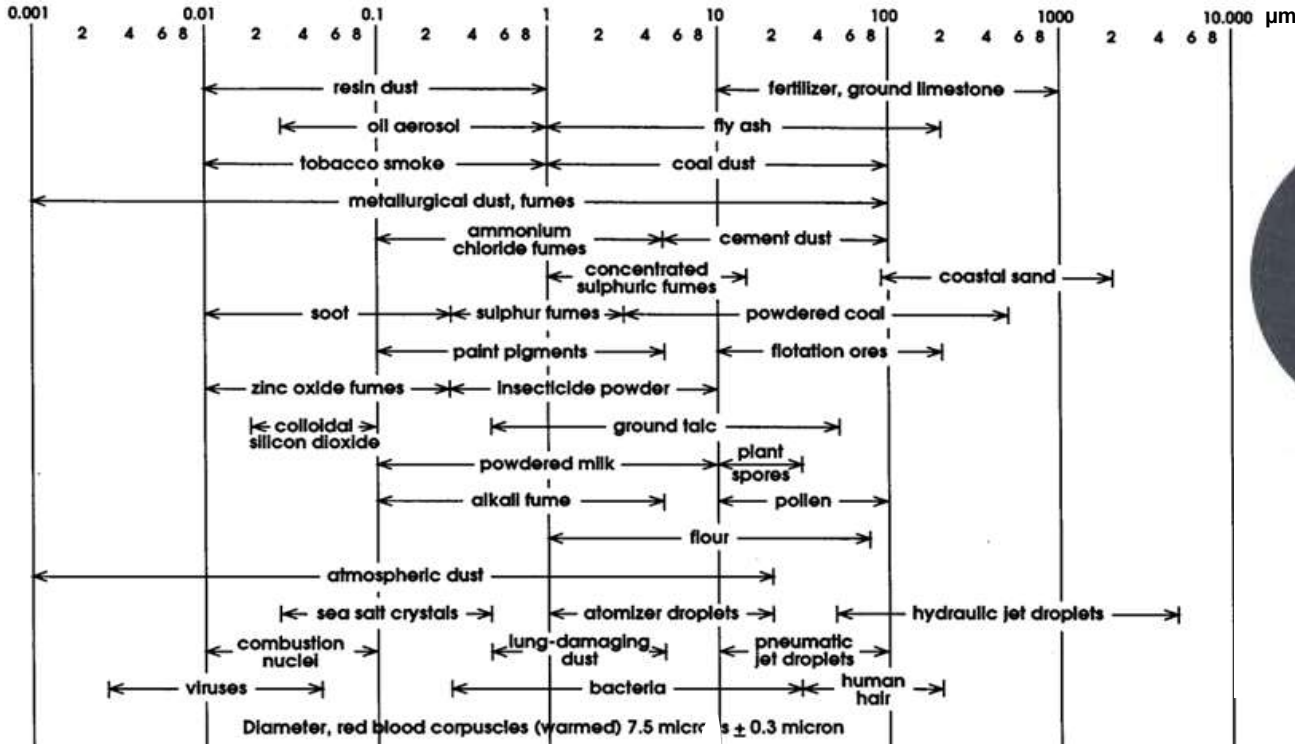
## Various intrinsic parameters :

- Liquid, solid or gas form
- Concentration, size, mass, morphology
- **Toxicity, pathogenicity, virulence**

➤ **Specific risk assessment is required for adequate air treatment**



# Relative size of airborne particles



Human hair  
 $\text{Ø } 100 \mu\text{m}$

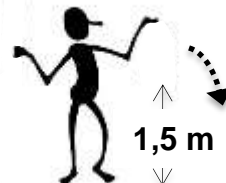


Visible particle  
 $\text{Ø } 50 \mu\text{m}$



Particle of  
 $\text{Ø } 0,5 \mu\text{m}$

Natural settlement speed  
 (without interference)



0,5 $\mu\text{m}$	1 $\mu\text{m}$	3 $\mu\text{m}$	10 $\mu\text{m}$
41 h	12 h	1.5 h	8 min

# CDC Guidelines / List of pathogenic agents with airborne transmission risk

Evidence for airborne transmission	Fungi	Bacteria	Viruses
Numerous reports in healthcare facilities	<i>Aspergillus spp</i> <i>Mucorales (Rhizopus spp.)</i>	<i>Mycobacterium tuberculosis</i>	Measles (Rubeola) virus Varicella-Zoster virus
Occasional reports in healthcare facilities (atypical)	<i>Acremomium spp.</i> <i>Fusarium spp.</i> <i>Pseudoallescheria Boydii</i> <i>Scedosporium spp.</i> <i>Sporothrix cyanescens</i>	<i>Acinetobacter spp</i> <i>Bacillus spp</i> <i>Brucella spp</i> <i>Staphylococcus aureus</i> Group A <i>Streptococcus</i>	Smallpox virus (Variola) Influenza virus Respiratory syncytial virus Adenoviruses Norwalk-like virus
No reports in healthcare facilities ; known to be airborne outside	<i>Coccidioides immitis</i> <i>Cryptococcus spp.</i> <i>Histoplasma capsulatum</i>	<i>Coxiella Burnetii (Q fever)</i>	Hantaviruses Lassa virus Marburg virus Ebola virus Crimean-Congo virus
Under investigation	<i>Pneumocystis carinii</i>	N/A	N/A



## Part II

# Air treatment in healthcare settings

# Air treatment must be considered supplemental to standard infection control practices (<20% HAI)

- MD sterility
- Prophylaxis (antibiotic / antifungal)
- Pre-operative shower
- Hands hygiene
- Biocleaning of surfaces / equipments
- Single-use PPE : Gloves/Gown/Hat/Shoe-covers
- Sealed windows, doors kept close
- End-point filtration of water point at risk
- clean / soiled circuits or « one way flow »
- Houseplants, flowers, cardboards forbidden
- (...)



# Two strategies depending on risk nature : Protection or Isolation

## ➤ PROTECTION (Protective Environment – PE)

- Immune-suppressed / Immune-compromised patients
- Exposed patients (wounds, invasive MD)

- Sterile process : Compounding / MD sterilization / ...

## ➤ ISOLATION (Airborne Isolation – AI)

- Septic patients

- Bio-safety laboratories
- Cytotoxic drugs
- Dangerous chemicals handling

PATIENTS

PROCESS

# Main medical applications concerned



## Protection of immune-suppressed patients

- BMT unit (Hematology ICU)
- Hematology (AML / ALL / Medullar Aplasia)
- Organ transplants (post-surgery hosting in ICU)

## Protection of exposed or immune-compromised patients

- CCU / ICU (depending on patients)
- Infectious diseases (AIDS patients)
- Burnt units (heavily burnt)
- Operating rooms or interventional radiology



## Protection of sensible products or process

- Drug preparation (GMP scope)
- Central Sterilization
- Cell culture (biological contamination)
- IVF laboratories (biological and chemical contamination)



## Airborne isolation of infectious patients or process at risk

- Infectious Diseases (TB wards, Airborne transmitted pathogens)
- CCU / ICU (Contagious patients at risk of env. dissemination)
- Bio-Safety Laboratories
- Cytotoxic drugs preparation
- Anatomico-pathology labs (chemical exposure)
- Endoscope disinfection facilities (chemical exposure)

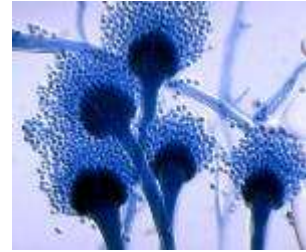


## Part III

# Focus on fungal infection risk

# Fungal infections transmission routes

- Fungi create very small spores  
(~ 3  $\mu\text{m}$  pour *Aspergillus* spp)
- Fungal spores are naturally present in the air  
(morphology adapted for airborne transport)
- Spores are also present on surfaces
- Additional risk factors
  - Construction works
  - Renovation activities



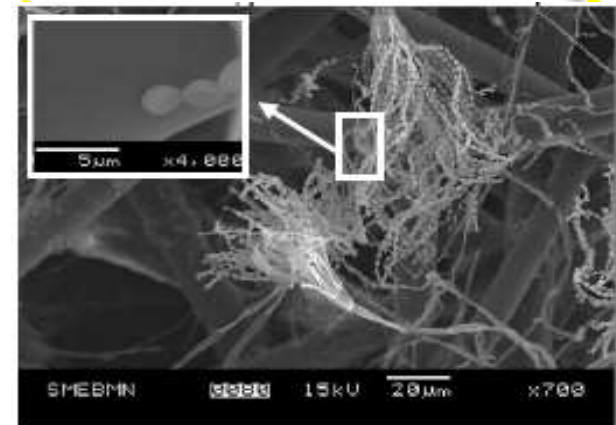
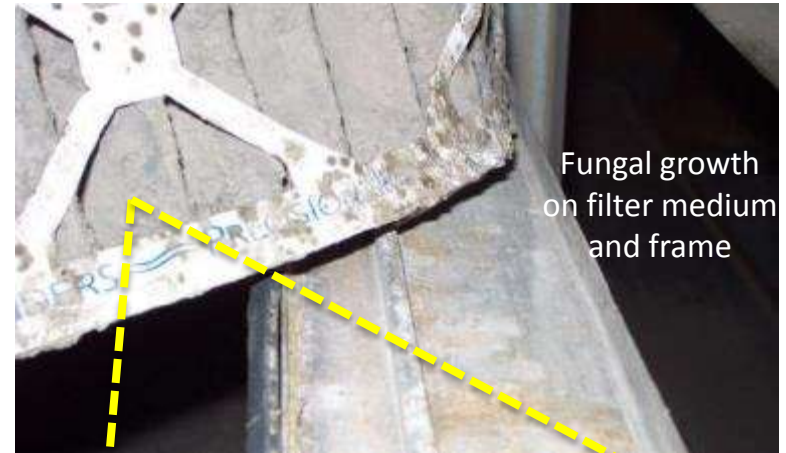
# Traditional mechanical filters are exposed to secondary contamination risks

## Risk : Microbial growth

Described in numerous scientific studies :  
Bonnevie-Perrier et al. "Microbial Growth onto Filter Media Used in Air Treatment devices",  
IJCRE, Vol 6 A9, 2008.

## Result : Microorganisms release

- ➔ Numerous HCAI caused by poorly maintained air treatment systems.
- ➔ Filters replacement is a high risk operation for technical staff.



# Patients at risk of fungal infection

## Patient typology

- Recipients of solid organ transplant
- Hematopoietic stem cell transplants
- Patients with hematologic malignancies
- Patients receiving immunosuppressive therapy
- Patients with severe aplasia
  - **Polynuclear neutrophils (PNN) < 500/mm<sup>3</sup>**
  - Platelets < 20 000/mm<sup>3</sup>
  - Reticulocytes < 20 000/mm<sup>3</sup>

## Why more and more patients ?

- Increase treatment proportion of patients with critical illnesses, previously considered lethal, due to rapid advances in medicine
- Development of more intensive chemotherapy
- Growing number of transplants
- Widespread of immunosuppressive therapies to treat autoimmune diseases

*Salam et al., AJIC 2010*



# Part IV

## Regulations, standards and guidelines

# CDC environmental guidelines / « Air » section

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- **List of airborne infectious diseases of concern**
- **HVAC systems conception (OT – PE – AI – CCU room)**
- **Construction work management**
- **Environmental monitoring (particles only with no target)**

International air quality standard

## ISO 14644-1(2015) : Cleanrooms and associated controlled environments - Part 1: Classification of air cleanliness by particle concentration / ISO classes definition

ISO class number (N)	Maximum permitted number of particles per m <sup>3</sup> of size ≥ to					
	0,1 μm	0,2 μm	0,3 μm	0,5 μm	1 μm	5 μm
1	10 <sup>b</sup>	d	d	d	d	e
2	100	24 <sup>b</sup>	10 <sup>b</sup>	d	d	e
3	1 000	237	102	35 <sup>b</sup>	d	e
4	10 000	2 370	1 020	352	83 <sup>b</sup>	e
5	100 000	23 700	10 200	3 520	832	d, e, f
6	1 000 000	237 000	102 000	35 200	8 320	293
7	c	c	c	352 000	83 200	2 930
8	c	c	c	3 520 000	832 000	29 300
9g	c	c	c	35 200 000	8 320 000	293 000

Extract from ISO 14644-1 French edition, 2016

International air quality standard

## ISO 14698-1(2003) : Cleanrooms and associated controlled environments - Biocontamination control - Part 1: General principles and methods

### ➤ **No targets – Methodology standard to establish biocontamination monitoring procedures**

#### ➤ **Air Sampling recommendations :**

- Number of sampling points : 1 min (2 advised)
- Iterations of samples : 1 min (2-3 advised)
- Height of sampling : ~ 1000 mm
- Volume sampled per point : 1 m<sup>3</sup> / 1000 L (500 L suitable for suspected high contamination)
- Advised culture media :
  - Bacterias (Total Mesophilic Flora) : Plate Count Agar (PCA) or Trypticase Soya Agar (TSA)
  - Fungi (Total Fungal Flora) : Sabouraud Agar or Malt Agar (+Gentamycine / Chloramphenicol possible)
- Advised Incubation :
  - Total Mesophilic Flora : +37°C – counted 24h / verified 48h
  - Total Fungal Flora : +24 - 30°C – verified 24h / counted 72h / verified 1 week

French standards

# NF S 90 351:2013

## Performance targets for air contamination control

Risk class	Particulate cleanliness class	Microbiological cleanliness class	1log Particulate elimination time	Diff. Pressure (+ or -)	Airflow pattern	ACH
4	ISO 5	< 1 CFU/m <sup>3</sup>	< 5 min	15 Pa ± 5 Pa	Unidirectionnal	6 ACH of fresh air +adequ. Air speeds for flow
3	ISO 7	< 10 CFU/m <sup>3</sup>	< 10 min	15 Pa ± 5 Pa	Unidirectionnal OR Turbulent	>15 ACH
2	ISO 8	< 100 CFU/m <sup>3</sup>	< 20 min	15 Pa ± 5 Pa	Turbulent	>10 ACH


# CDC Guidelines / Application-specific guidelines

Specifications	All room (bronchoscopy included)	PE room	Critical care room §	Isolation anteroom	Operating room
<b>Air pressure ¶</b>	Negative	Positive	Positive, négative or neutral	Positive or negative	Positive
<b>Room air changes</b>	≥6 TRH (for existing rooms) ≥12 TRH (for renovation or new construction)	≥12 ACH	≥6 ACH	≥10 ACH	≥15 ACH
<b>Sealed **</b>	Yes	Yes	No	Yes	Yes
<b>Filtration supply</b>	90% (ASHRAE 52.1.1992)	99.97% (filtration of fungal spores at point of use (HEPA at 99,97% for 0.3 µm particles))	> 90%	> 90%	90%
<b>Recirculation</b>	No (Recirculation possible if exhaust air first processed through HEPA filter)	Yes	Yes	No	Yes

§ Positive filter and HEPA filters may be preferred in some rooms in intensive care units (ICUs) caring for large numbers of immunocompromised patients

¶ Clean to dirty : negative to an infectious patient, positive away from an immunocompromised patient

\*\* Minimized infiltration for ventilation control : pertains to windows, closed doors, and surface joints



**Contamination control**  
Healthcare safety

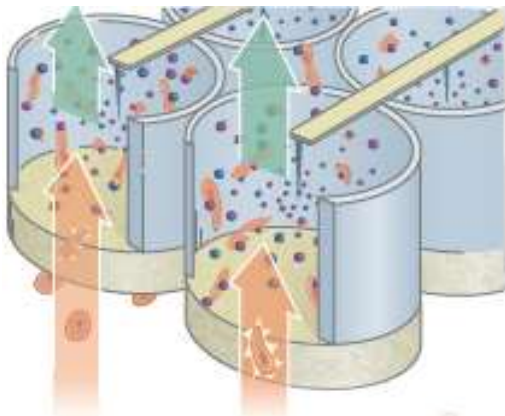
# PLASMAIR™

The reference in hematology and high risk areas

# HEPA-MD™ technology

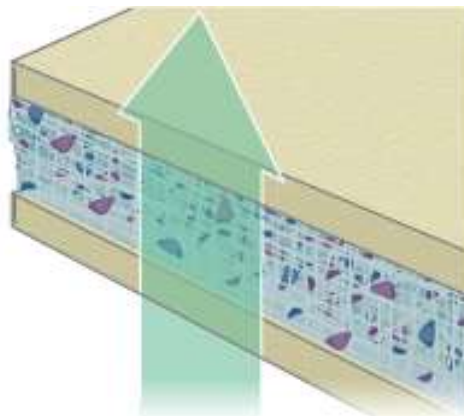
- **Broad-spectrum efficacy : particles, microorganisms and molecular pollution**
- **The risk of microbial growth is eliminated**
- **Low pressure drop profile : low noise emission, low energy consumption**

## 1. Microbial Destruction



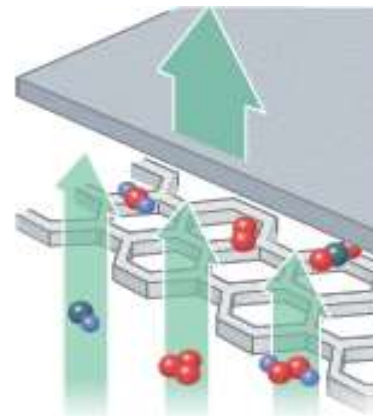
Destruction of airborne microorganisms by exposure to strong electric fields and to oxidative species in unique non-thermal plasma chambers

## 2. Biological decontamination and High Efficiency Particulate Arrestance



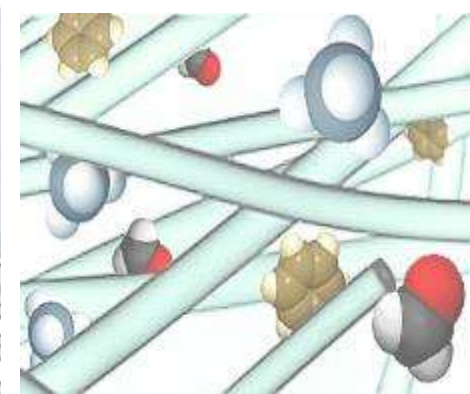
Charged materials exiting stage 1 are captured by an electrically active media where organic materials are continuously exposed to the plasma ions

## 3. Catalytic Conversion



Oxidant chemical species are removed by a catalytic monolith (notably ozone and NOx)









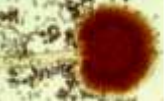










## 4. Molecular Trapping



Organic and mineral volatile molecular pollutants are adsorbed onto an activated carbon medium



# HEPA-MD™ Technology evaluated by leading international Labs

Species	Description	SPBR <sup>1</sup> Rate	Test Laboratories
Bacillus Subtilis (Gram+ bacteria / spore)	 Very resistant bacteria. Model for Anthrax which is a bioterrorism threat	>99.93%	 HARVARD School of Public Health  
BCG Mycobacterium Bovis (bacteria)	 Vaccine against tuberculosis	>99.99%	 CIRTS <small>Approved for National</small>
Staphylococcus Aureus (Gram+ bacteria)	 Most common cause of staph infections that cause skin infections, pneumonia, meningitis and endocarditis	>99.84%	 HARVARD School of Public Health
Aspergillus niger (Fungal / spore)	 Pathogen filamentous fungi that cause aspergillosis in immuno-compromised patients	>99.99%	 HARVARD School of Public Health
Serratia Marcescens (Gram- bacteria)	 Human pathogen involved in numerous HAIs, particularly urinary tract and wound infections	>99.99%	 HARVARD School of Public Health 
H5N2 (Virus)	 Avian influenza virus which can be lethal to human	>99.999%	 CIRTS <small>Approved for National</small>
Vaccinia (Virus)	 Very resistant airborne virus. Model for Smallpox which is a bioterrorism threat	>99.2%	
MS2 Bacteriophage (Virus)	 One of the smallest known viruses (~20 nm in diameter)	>99.999%	

<sup>1</sup> Single-Pass Biological Reduction: highest SPBR rate achieved using AirInSpace HEPA-MD™ device in one of the above listed test laboratories.

# A broad range products



**PLASMAIR™**

Guardian

High capacity air decontamination unit



**PLASMAIR™**

Sentinel

Light mobile air decontamination unit



**PLASMAIR™**

C2010

Ceiling-mounted air decontamination unit

PLASMAIR™ range include HEPA-MD™ technology

# The reference in high risk area

**PLASMAIR™**  
Guardian



- Very fast particle and microorganism reduction kinetic
- High flow rate (2500 m<sup>3</sup>/h)
- Fungi < 1 CFU/m<sup>3</sup>
- Reduce from ISO 9 to ISO 7/ISO 6 in a few minutes
- Very quiet
- 2 preset ventilation regimes (day/night) with automatic programmable change
- Continuous recording of in-use parameters with large data storage
- Large touch screen 4,3"

  
airinspace®

# Compact and easy solution for securing high infectious risk areas (ISO7/ISO8) up to 50m<sup>3</sup>



- Fully mobile
- Easy to use
- Small footprint
- Low noise level
- Low energy consumption

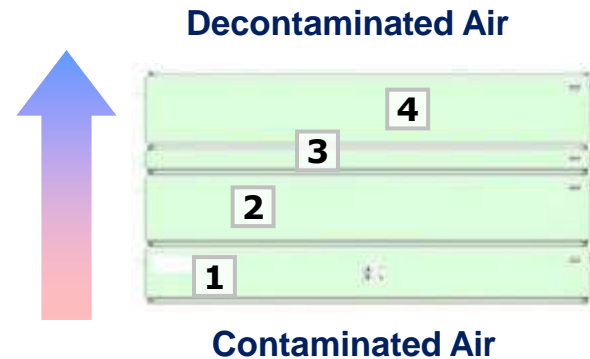


Performance range (for rooms up to 50 m <sup>3</sup> )	
Airborne Bacteriological class	<100/<10 CFU/m <sup>3</sup>
ISO Particulate cleanliness class	ISO8/ISO7
90% Decontamination kinetics	Within 20/10 minutes
Dimensions and weight	
Height	150 cm
Width	70 cm
Depth	45 cm
Weight	100 kg
Technical specifications	
Airflow range	400-600-850 m <sup>3</sup> /h
Max power consumption.	130 VA
Sound levels at 1m	400 m <sup>3</sup> /h – 37 dB(A) 600 m <sup>3</sup> /h – 41 dB(A) 850 m <sup>3</sup> /h – 47 dB(A)
Frequency and voltage	~ 100 V/230 V – 50 Hz/60 Hz



# HEPA-MD™ technology

1. Removable outlet grill
2. Reactor module
3. Electrical control Panel
4. Pre-filter



- 1 : Microbial Destruction
- 2 : Biological and particulate arrestance
- 3 : Catalytic conversion
- 4 : Molecular trapping


# The reference in high risk area

**PLASMAIR™**  
Guardian



# Large & intuitive touch screen



Icons	Information
	This icon indicates that the device is working correctly
	This icon indicates a warning
	This icon indicates an alarm
	This icon indicates the ventilation speed: DAY/NIGHT
	These icons indicate the actual air flow and the programmed room volume
	Access key to the Setup Menu
	Signal that automatic night-time programmer is activated
	Signal that manual mode is activated

# How to choose an efficient mobile filtration unit ?

- Lowest noise
- Technology adapted to the nature of the contaminations
- No release of toxic substances
- Capability to decontaminate the entire room volume
- High flow rate adaptable to room volume and standard
- Intuitive controls
- Really mobile
- Easy to maintain
- Performances validated by independent laboratories and published studies



# Examples of applications



Operating Room low surgery – 60 m<sup>3</sup>

PA-S blowing at 355 m<sup>3</sup>/h

ISO9=> ISO7 in less than 7 min

Positive pressure of 21 Pa



Operating Room. Ophthalmology 78 m<sup>3</sup>

PLASMAIR T2006NG – 1400 m<sup>3</sup>

ISO9 => ISO7 in less than 10 min

# Example of applications



Hematology – Autologous BMT Patient room 55 m<sup>3</sup>  
PA-T2006NG – 1,000 m<sup>3</sup>/h  
ISO9=> ISO7 in less than 10 min



Hematology – Allogenic BMT Patient room  
IMMUNAIR w/T2006NG– 1100 m<sup>3</sup>/h  
ISO9 => ISO5 in less than 6 min



**Contamination control**  
Healthcare safety

# Protective environment





**Contamination control**  
Healthcare safety

# BIOCAIR™

Modular isolation room or protective environment

# INNOVATION 2016

## BIOCAIR™ description

- Modular equipment to create a pressure controlled area
- Different configurations and dimensions are available
- Several options :
  - Flat screen TV
  - Decorated ceiling

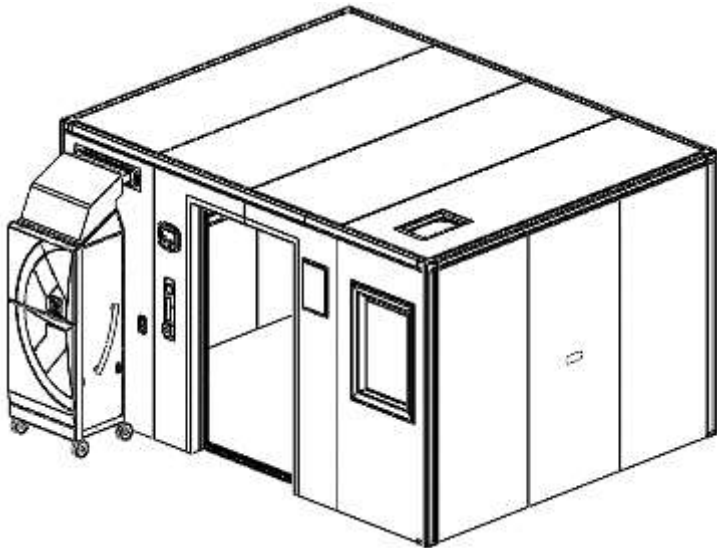


# BIOCAIR™ description

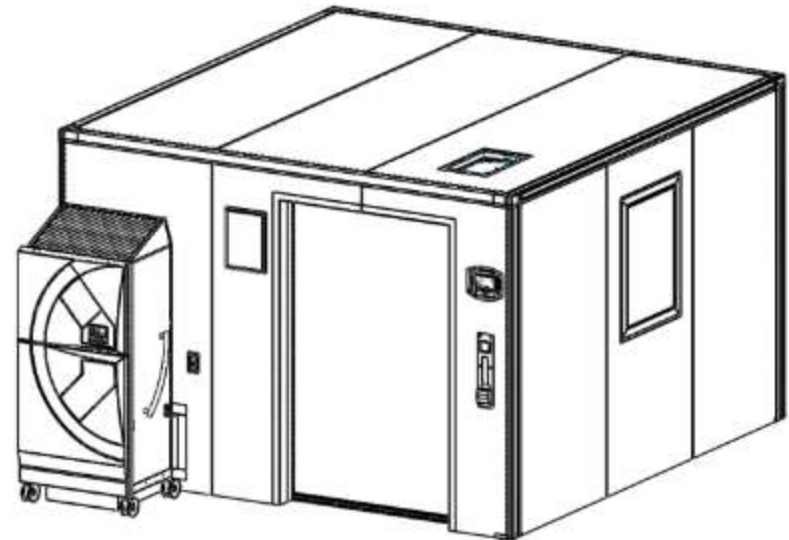


# 2 different approaches

**BIOCAIR™ Positive pressure**  
ISO5 to protect patients at risk

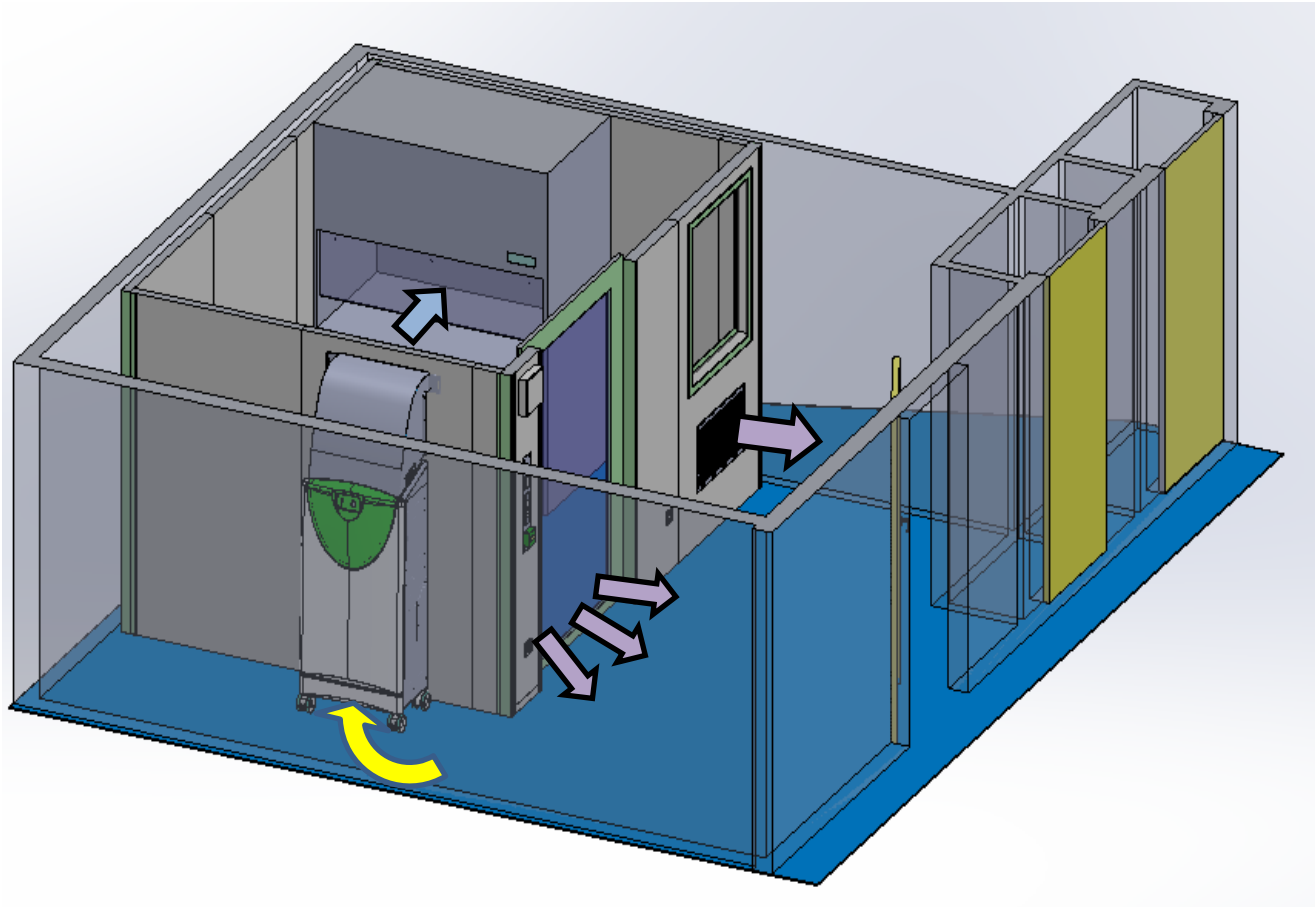


**BIOCAIR™ Negative pressure**  
to avoid contamination spread out



# Aeraulic simulation

## BIOCAIR™ with positive pressure

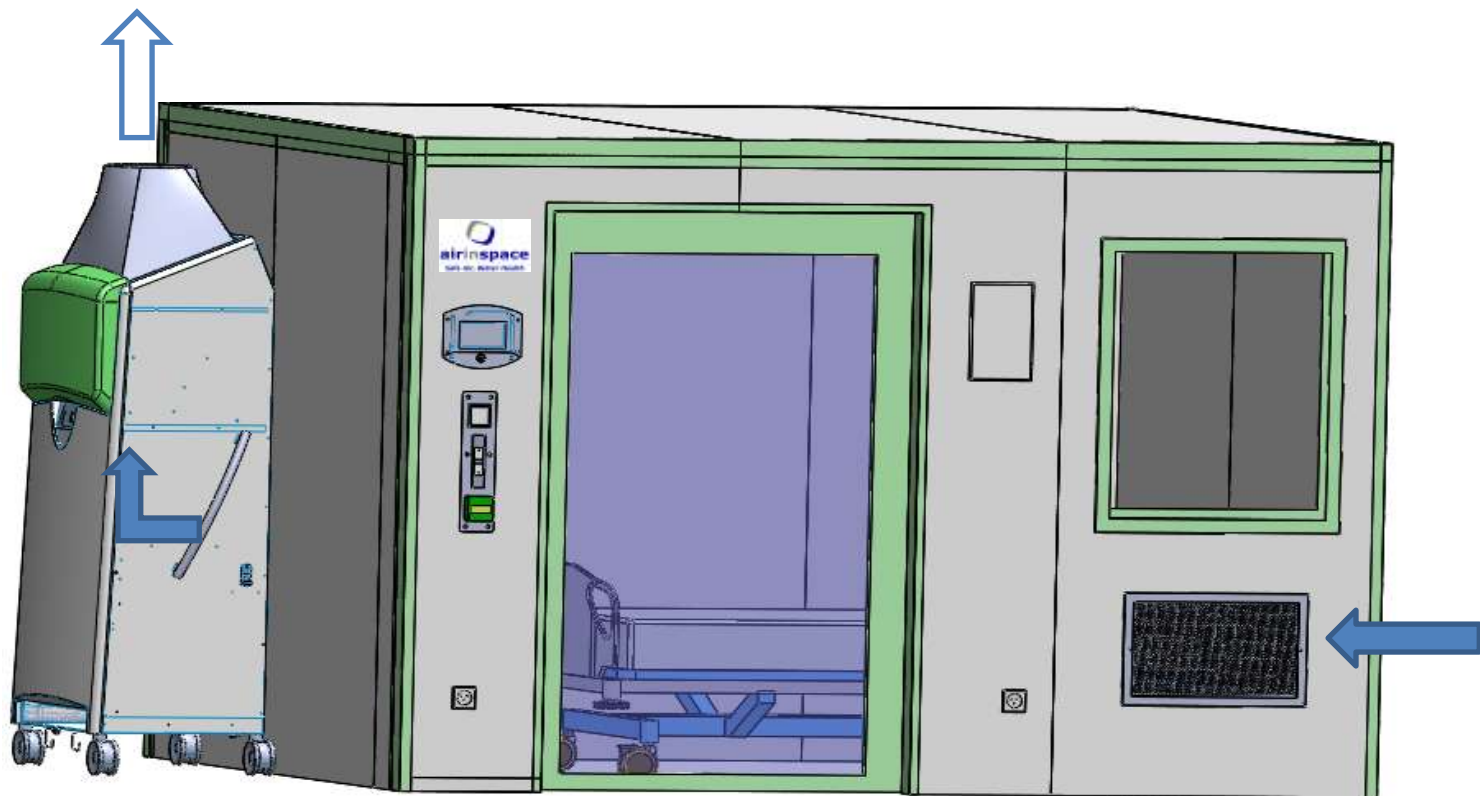




BIOCAIR™ with negative pressure

Infectious Risk Management

Plasmair outlet connected to Hospital Air Exhaust



# BIOCAIR™ Control panel

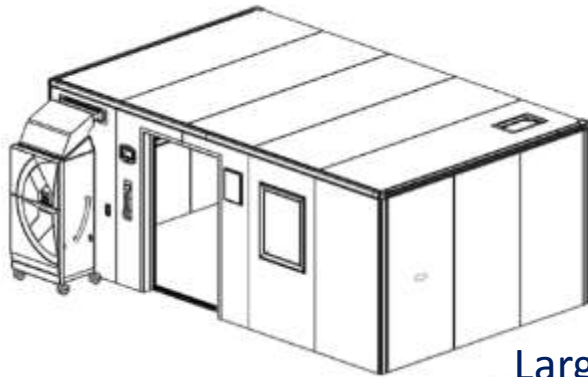


- 7-inch color touch screen control panel on the front outside to visualize in real time:
  - The differential pressure
  - The indoor temperature
  - Indoor relative humidity
  - The settable alarms
  - The blowing rate of the PLASMAIR unit
  - The adjustment parameters (pressure set etc ...)
  - Records (alarm log and warnings)
- 
- Control panel also integrates a USB port to retrieve the data stored in text format (.txt / .csv)

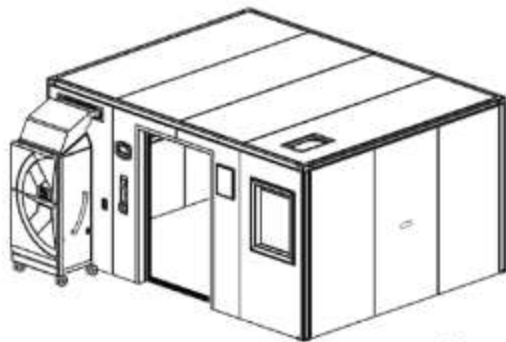
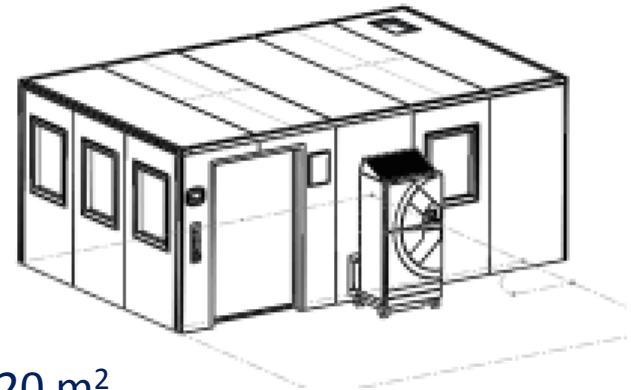
A connection ModBus series is also available to connect the hospital network and system Building Management System



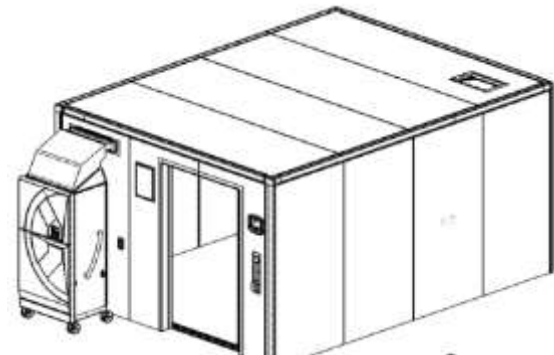
# Examples of configurations



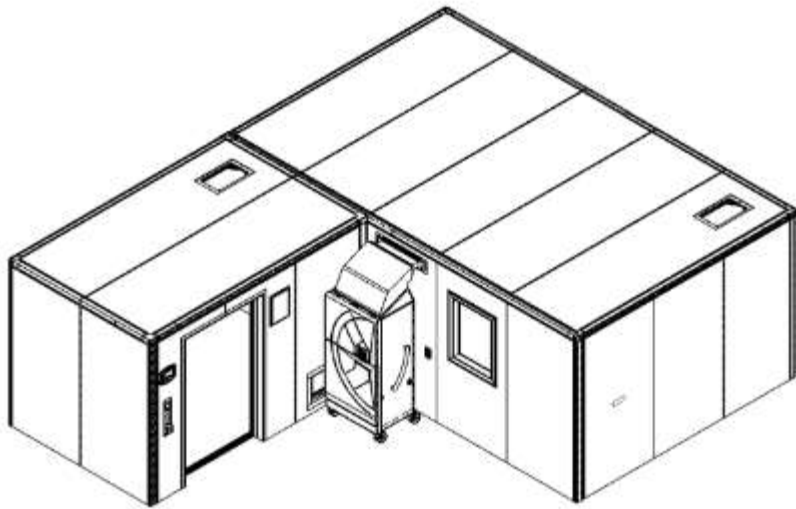
Large BIOCAIR™ 20 m<sup>2</sup>



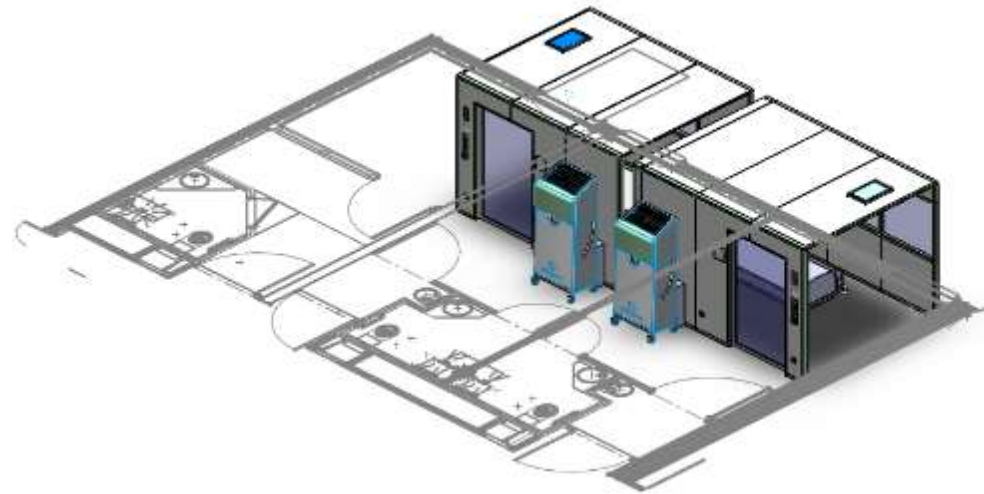
Medium BIOCAIR™ 16 m<sup>2</sup>



# Possibility of combinaisons



Large 20 m<sup>2</sup> (+30Pa) +  
Anteroom 8 m<sup>2</sup> (+15Pa)




Two isolation rooms 12 m<sup>2</sup>

# airinspace®'s laboratory : Assembling & Testing = 3 days



# airinspace<sup>®</sup> mobile air treatment benefits

- **PLASMAIR™** Destroys microorganisms (unlike conventional mechanical filters)
- Reduced operational costs (low pressure drop profile / point of use air treatment)
- Robust and efficient (scientifically tested and validated thoroughly)
- Ease of set-up and use (plug-and-play designs)



**Contamination control**  
Healthcare safety

**THANK YOU !**