Quantitative assessment of the environmental fungal risk and implementation of management precautions

Focus on construction works

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AGENDA

Environmental fungal risk

I. Defining the risks

II. Analysis of the relationship between the environmental fungal pollution and the risk of fungal infection

III. Quantitative assessment of the environmental fungal risk

Implementation of management precautions : focus on construction and renovation works in hospitals

IV. Risk characterization

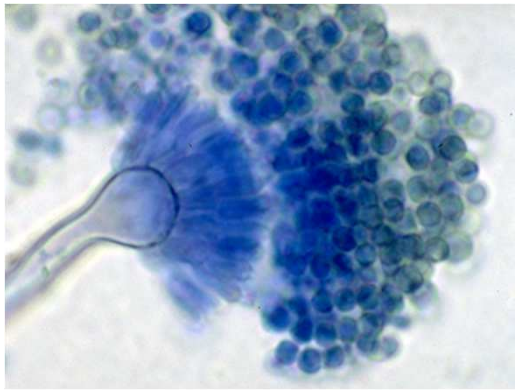
V. Implementation of management precautions

VI. Proposed indicators for the determination of the impact of management precautions on the risk of fungal infection

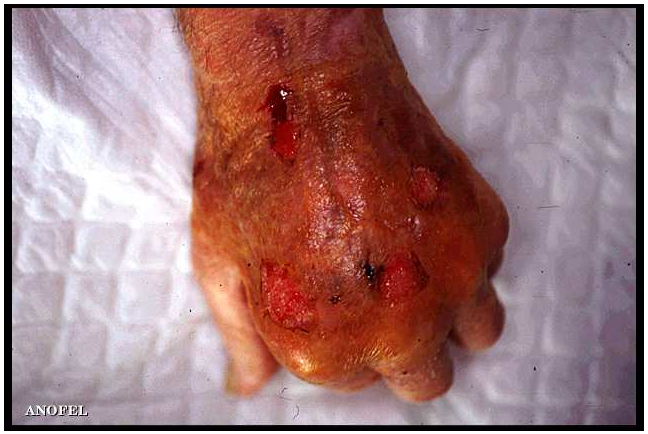
I. Defining the risks

- **The environmental fungal risk** : the identified and quantified presence and persistence of potentially harmful filamentous fungi, likely to be transferred to a patient during treatment

= biocontamination or pollution



Aspergillus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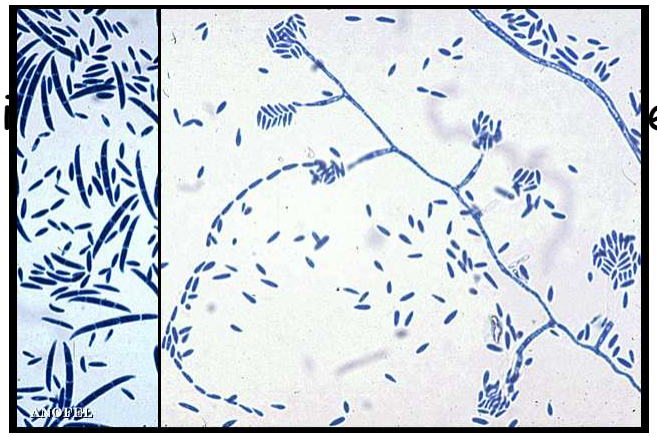
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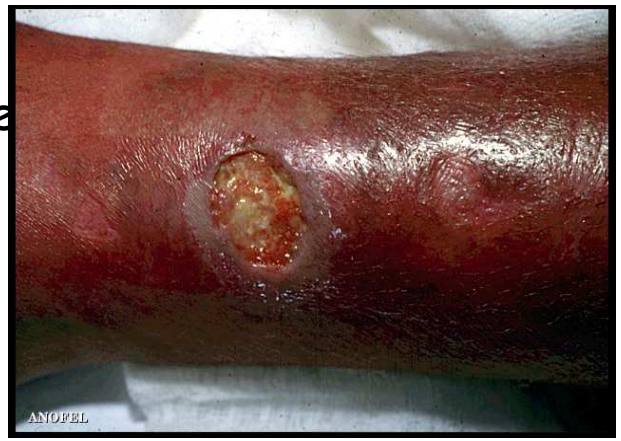
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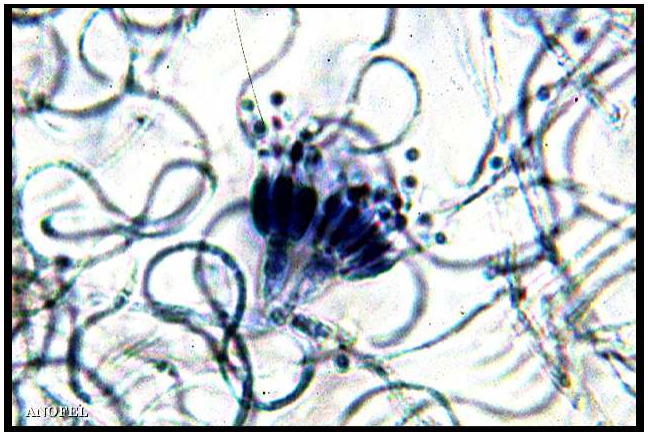
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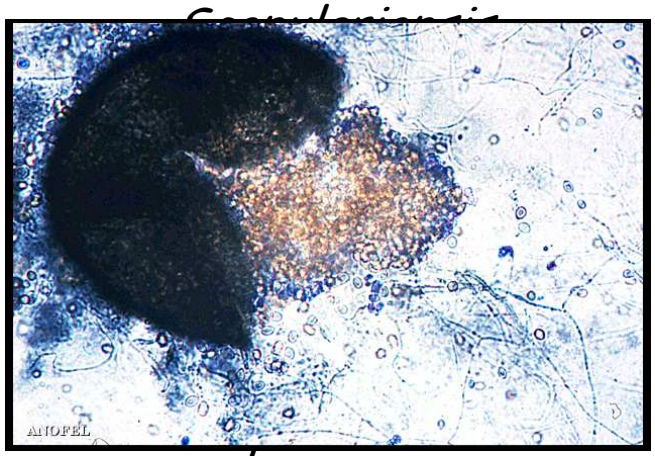
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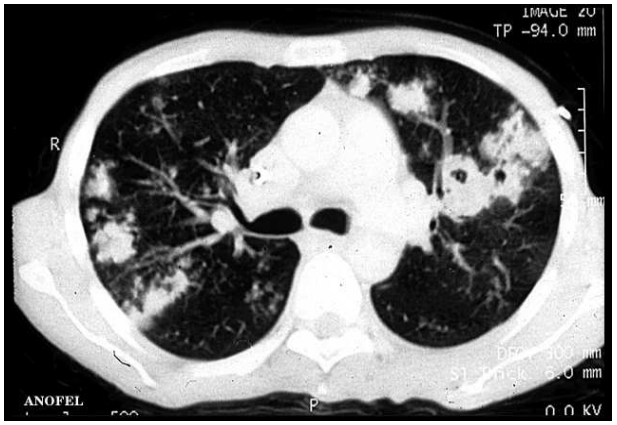
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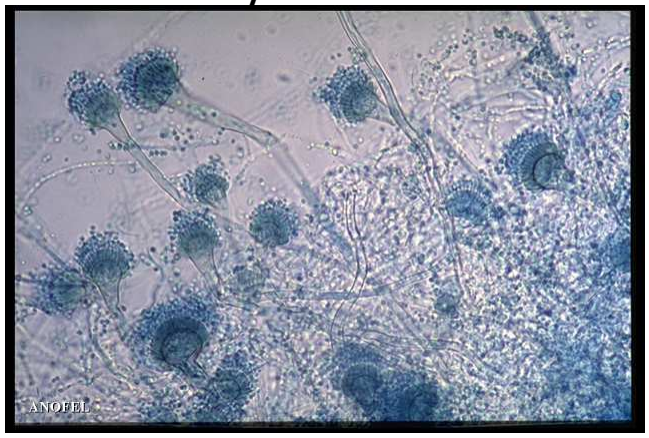
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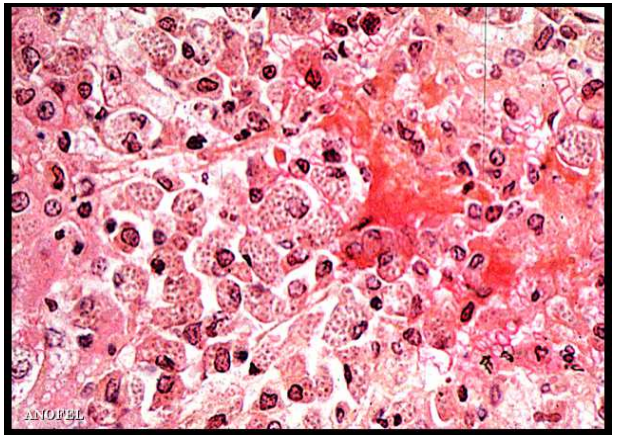
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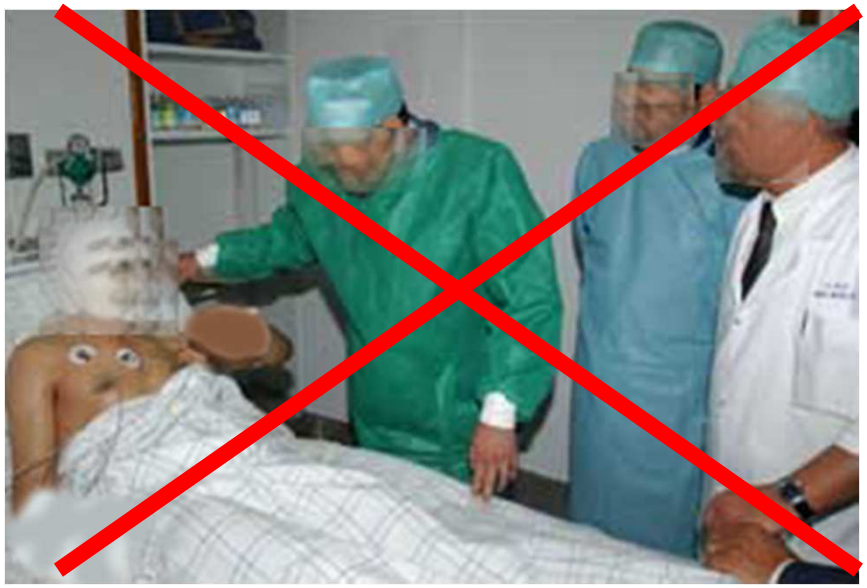
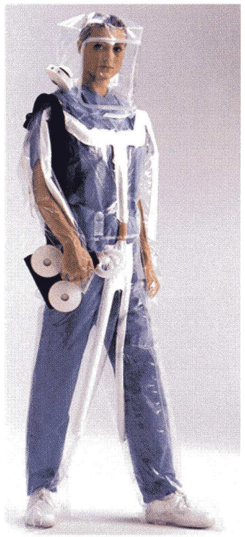
How to avoid biocontamination or pollution ?



I. Defining the risks

- **The risk of infection** : results from exposure of the host to a microorganism. It can be defined as the likelihood of infection following exposure to a potentially pathogenic microorganism



Risk of infection = Inoculum x microorganism's virulence
host's resistance

- **Risk of nosocomial fungal infection** associated with fungi during hospitalisation

II. Analysis of the relationship between the environmental fungal pollution and the risk of fungal infection

The relationship between *Aspergillus* exposure and the risk of infection is well established,

- qualitatively
- and descriptively

⇒ **However, it is difficult to establish it in quantifiable terms**

- highly fluctuating nature of fungal contamination
- influence of measurement uncertainties
- statistical demonstration (low incidence/rare events of invasive aspergillosis)
- etc…

Risk threshold : a hard question ?

II. Analysis of the relationship between the environmental fungal pollution and the risk of fungal infection

=> 3 approaches could help characterize this relationship and attempt to define a level of contamination above which the risk of aspergillosis would be increased

1. COMPREHENSIVE STUDY OF EPIDEMICS

2. STUDY OF THE IMPACT OF AIR TREATMENT MEASURES

3. A PROSPECTIVE APPROACH

1. COMPREHENSIVE STUDY OF EPIDEMICS

Both clinical and mycological data obtained on a continuous basis are needed

- 24 outbreaks
- during which measurements were made of airborne contamination

=> measured values varied significantly **0 -> 235 CFU/m^3** depending on the outbreak and the sampled sites

[VONBERG 2006]

1. COMPREHENSIVE STUDY OF EPIDEMICS

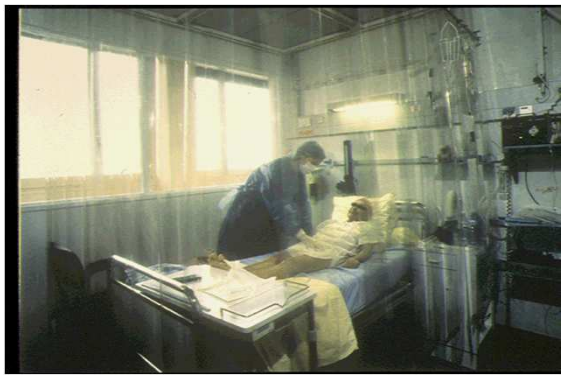
ARNOW et al. [JID 1991]
⇒ a six-year clinical and mycological follow-up
⇒ during which one aspergillosis outbreak occurred during the epidemic outbreak

Airborne concentration of *Aspergillus*	
Pre- and post-epidemic periods	Epidemic outbreak
< 0.2 CFU/m³	**1.1 to 2.2 CFU/m³**

Risk threshold : 1-2 CFU/m³ ?

2. STUDY OF THE IMPACT OF AIR TREATMENT MEASURES

Nb IFI/Nb high risk patients	Before laminar air flow	After laminar air flow
RHAME 1984	12/67	9/167
SHERERTZ 1987	14/73	0/40
BARNES 1989	6/19	0/19
ARAUJO 2008	6/198	0/205



3. A PROSPECTIVE APPROACH

Summary of protocols for the study of the relationship between environmental fungal contamination and the rate of invasive aspergillosis

Authors	Follow-up duration (months)	Clinical department	Measurement of airborne contamination	Number of invasive aspergillosis cases	Correlation between contamination rate and IA*	Comments
HOSPENTHAL 1998	13	Oncology	Yes	6	No	
MAHIEU 2000	11	Neonatal (3 departments)	Yes	0 cases of IA Measurement of pharyngeal carriage	No	Efficacy of HEPA air purifier
ALBERTI 2011	48	Hematology (3 depart	Yes air and 9800 from surfaces)	64	Yes	Correlation between IA risk and use of conventional rooms
LAI 2001	6	Hematology	Yes	6	No	Efficacy of HEPA air filtration
FALVEY 2007	120	Hospital	Yes 1523 air samples	1	No	
PINI 2008	14	Hematology	Yes twice/month i.e. 270 samples			
	7	Yes During construction	3 cases of IA during construction / High rate of *Aspergillus*			
RUPP 2008	84	Hematology	Yes 972 air samples	45	No	

Risk threshold : 2 CFU/m^3

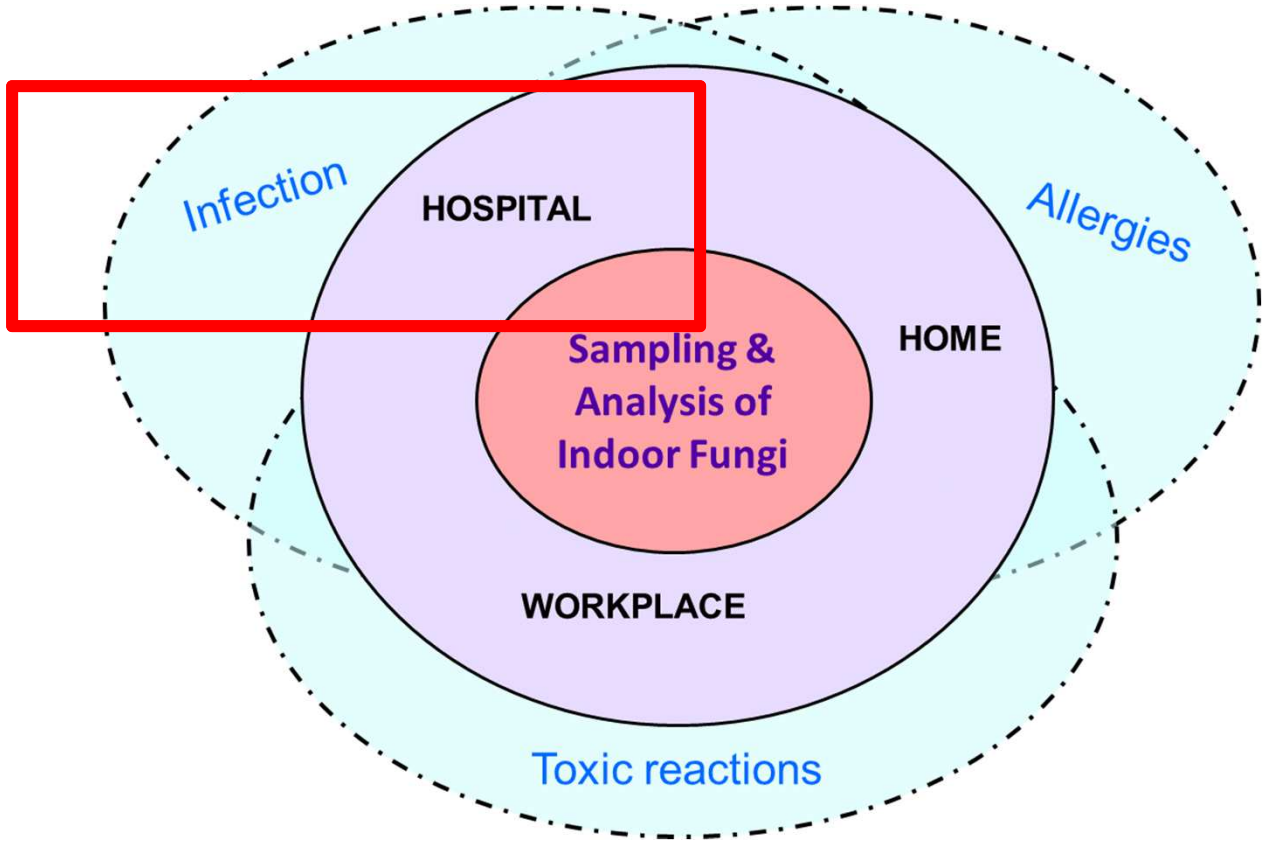
III. Monitoring of environmental fungal contamination in hospitals

Critical Reviews in Microbiology

REVIEW ARTICLE

Indoor fungal contamination: Health risks and measurement methods in hospitals, homes and workplaces

Delphine Méheust[1,2], Pierre Le Cann[1,2], Gabriel Reboux[3], Laurence Millon[3], and Jean-Pierre Gangneux[1,4]



1. Why monitoring the environmental fungal contamination in hospitals?

2. When/where ?

3. How ?

1. Why monitoring the environmental fungal contamination in hospitals?

- to detect increases in conidia density
- to assess air filtration efficiency

2. When/where ?

- in hospital units which benefit from air control measures
- in case of *Aspergillus* infection
- In case of construction and renovation works

3. How ?

- Air and surface sampling

Comparison of biocollectors for air sampling

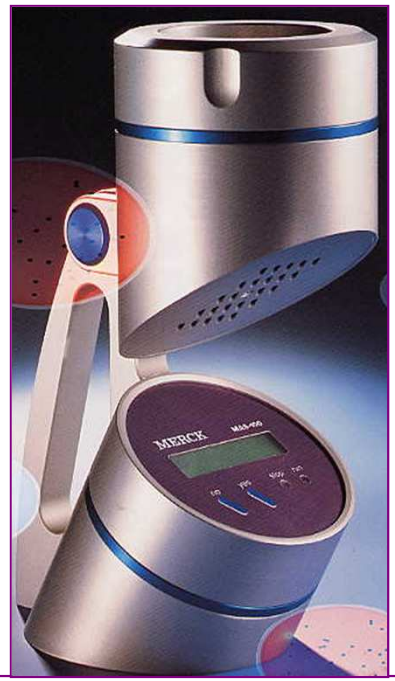
Methods : impaction, filtration, centrifugation
Reference impactor : Andersen device

Nesa, JHI 2001

New generation impactors : > Andersen / other methods

Air Ideal
(BioMérieux)

Sampl 'air MK2
(AES Laboratories)



Air Sampler Mas 100
(Merck)

Gangneux, ICHE 2006

Sampl'Air (AES Chemunex)

Air Ideal (bioMérieux)

BACTair - Airport MD8 (Sartorius)

100 L/min

125 L/min

Classical Petri dish(90 mm)

Special BACTair™ dish and sieve(110 mm)

Méheust et al., J Occup Environ Hyg. 2013;10(8):455-9

Culture vs. cytometry for fungal quantification in hospitals

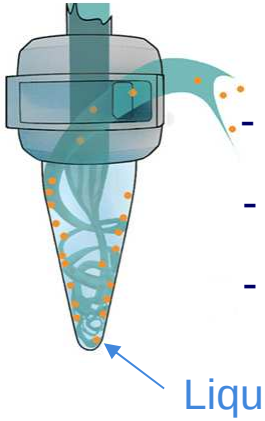
Combination of two technologies

Coriolis (Bertin Technologies)

+

ChemScan system (AES Chemunex)

Liquid cyclone high-volume air sampler



- Air flow rate: 100 to 300L/min
- Sampling time: 1 to 10 min
- Particle size: > 0.5µm

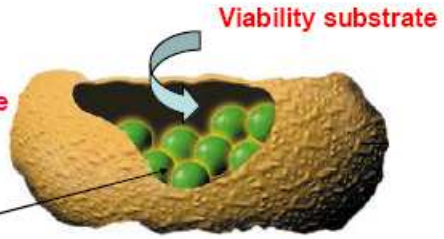
Liquid sample

Solid-phase cytometry

Enzymatic 'viability' staining procedure

A double discrimination key :

viability and cell membrane integrity



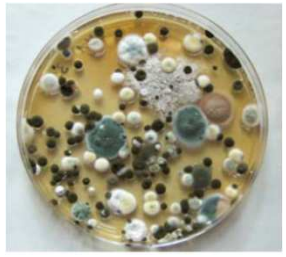
Comparison of 2 samplers

Coriolis (Bertin Technologies)

1

Sampl'Air (AES)

Cultural analysis



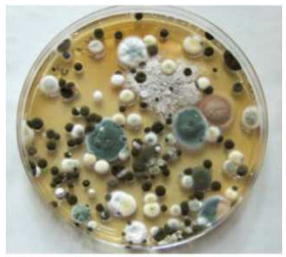
Comparison of 2 analytical methods

Coriolis (Bertin Technologies)

2

Solid-phase cytometry

Cultural analysis



Cultural analyses

- Sampl'Air: incubation of MEA plates at 25° C

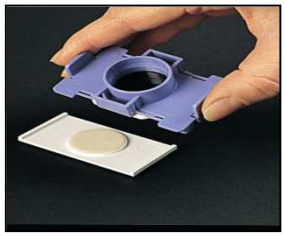
- Coriolis: 1/3 liquid volume (~ 1m3 air)
spread plate method on MEA dishes at 25° C

Fungal enumeration at days 3 and 5

Solid-phase cytometry

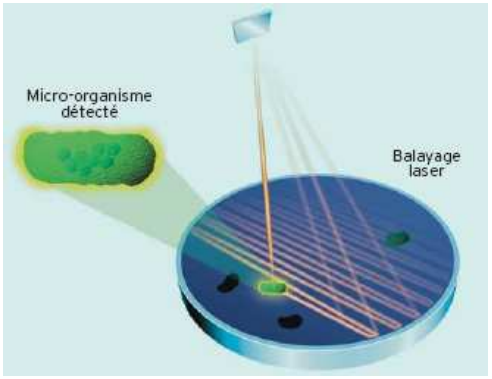
- Coriolis: 1/3 liquid volume (~ 1m3 air)

1. Filtration



2. Pre-Labeling (3h)

3. Labeling (1h)



3. ChemScan analysis

4. Microscopic validation

Air sampling protocol in the Teaching Hospital of Rennes (France)

Presumed level of fungal contamination	Site sampled (hospital)	No. of samples per sampler	
		Coriolis	Sampl'Air
High	Office	10	20
Medium	Conventional room	10	20
Low	Corridor in hematology unit	10	20
Negative	Room with laminar air flow[a]	10	20

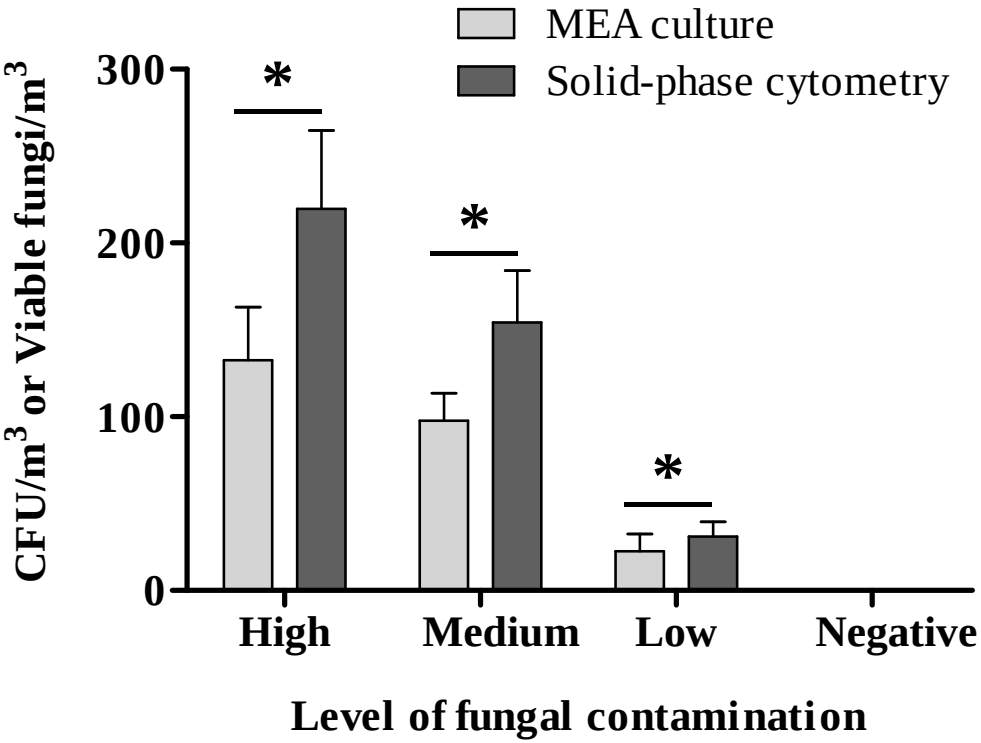
[a] Provided with high efficiency particulate air filtration

Air sampling conditions

Sampl'Air: 2 * 500L on Malt Extract Agar plates – 100L/min → 10min

Coriolis: 3m^3 in 15mL liquid sample – 300L/min → 10min

Quantification of viable fungi



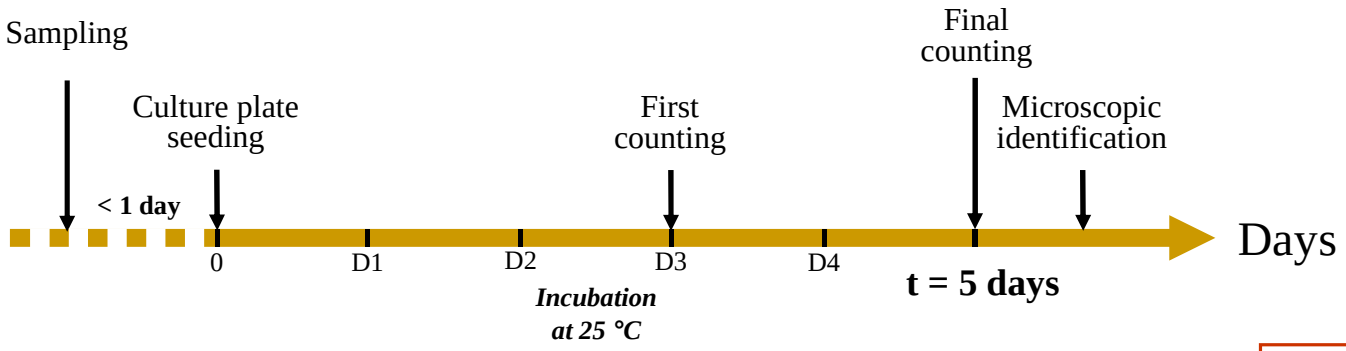
$$\frac{[\text{Viable fungi}]}{[\text{Culturable fungi}]} \approx 1.5$$

One-way ANOVA on the fungal concentrations obtained after air samplings with Coriolis

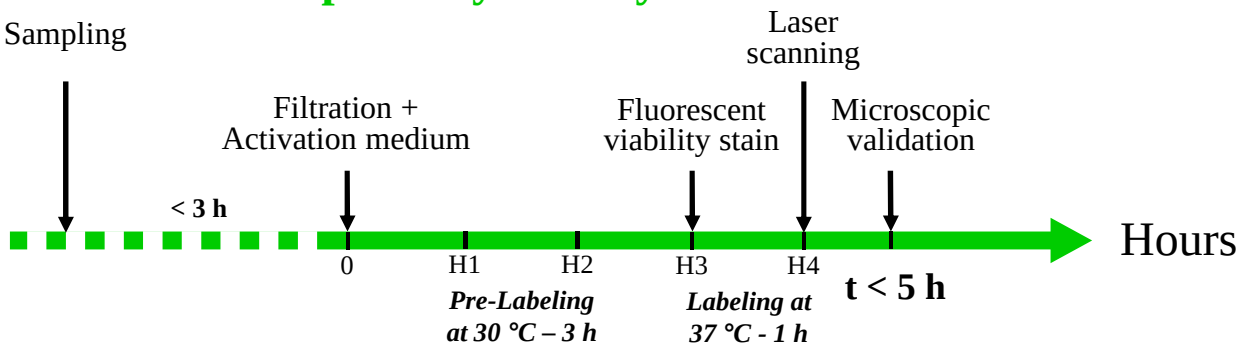
bar heights represent mean of 10 samples ± 1 standard deviation. * indicates a statistically significant difference between the measurements by the two analytical methods (p <0.05).

A rapid quantification of viable fungi…

Culture-based method



Solid-phase cytometry

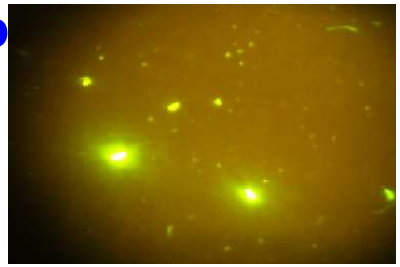


Action Decision

- Cleaning measures
- Reopening of high risk areas
- Patients' return to their room

… but requiring complementary methods for identificatio

Culture-based methods : a non-costly and easy identification of the cultivable fungal diversity



Méheust et al., J Hosp Infect. 2013 Feb;83(2):122-6

Surface sampling

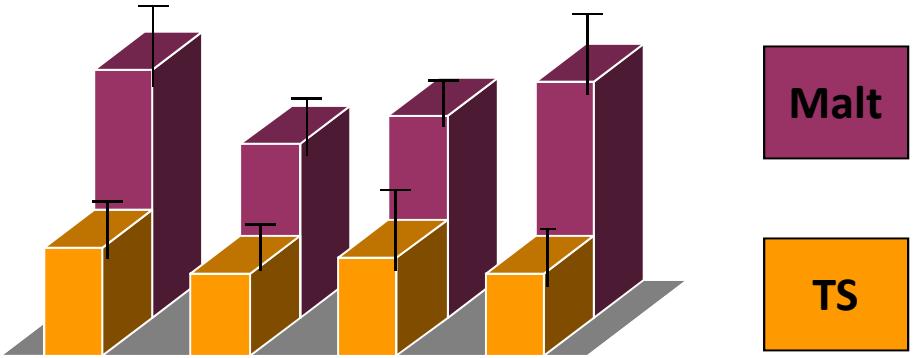
Contact Petri dishes

Humidified and non-humidified swabs

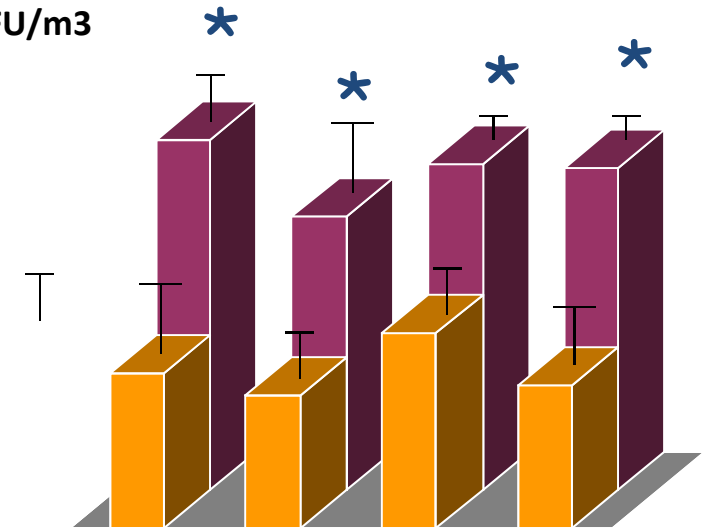
Culture medium

Fungal counts on Malt and Tryptic Soy Agar
(mean ± sd of 12 measures)

CFU/m3



CFU/m3



Conventional room
(200 L)

(P > 0,05)

Archive room
(100 L)

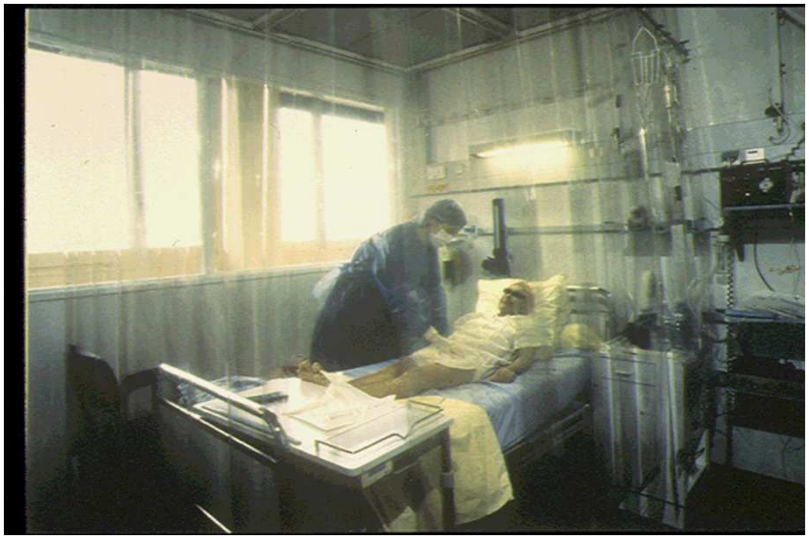
*** TS < Malt (P < 0,05)**

Gangneux, ICHE 2006,

Rythm of the surveillance (French study Group, *Presse Med 2002*)

- **Rooms equipped with LAF system :1X/trimestre**
- **Shared rooms of the ward / corridors : 1X/month**

1-2 air samples + 5-10 surface samples



Under the air flow

-1 air sample

-Surface samples : bedside table, telephone, television, technical block…

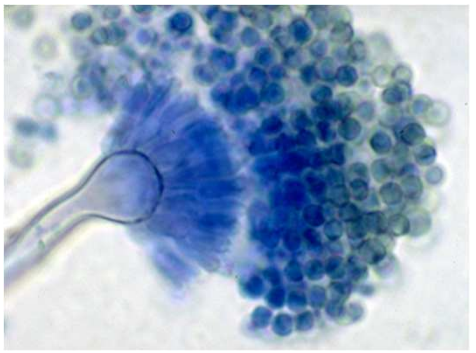
Outside the air flow

-1 air sample

-Surface samples : floor, extraction grid, window sill…

Mycological analysis

- ***Aspergillus* sp.**



- **Total fungal flora ++**

⇒ marker of risk for the presence of *Aspergillus* sp.

Alberti, J Hosp Infect 2000

- **Phenotyping and genotyping of human/environmental isolates ?**

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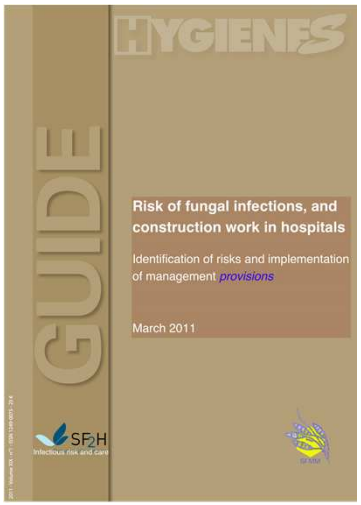


Risk of fungal infections, and construction work in hospitals

Identification of risks and implementation of management precautions

Practical approach to the development of an impact study in the hospital sector .

Putting the construction site into context

Partners: Nosocomial Infection Control Committee - Infection Control Team - aspergillus task force – clinicians – mycologists - construction manager or his/her representative...

Description of the project

- Location
- Description of technique
- Consequences for:
  - the air: particulate and fungal contamination
  - hot and cold water networks
- Start / Duration of the construction work

Description of the receiving environment

- Determining the zone at risk
- Description of the relevant components
- Consequences for:
  - patients at risk
  - services at risk
  - working areas (operating room …) at risk

Analysis of the project's impacts

- Impact determination and quantification, according to the type of construction work
  - Air: evaluation of particulate and fungal contamination
- Impact determination and quantification within the hospital
- Global quantification of risk

Propose preventative measures

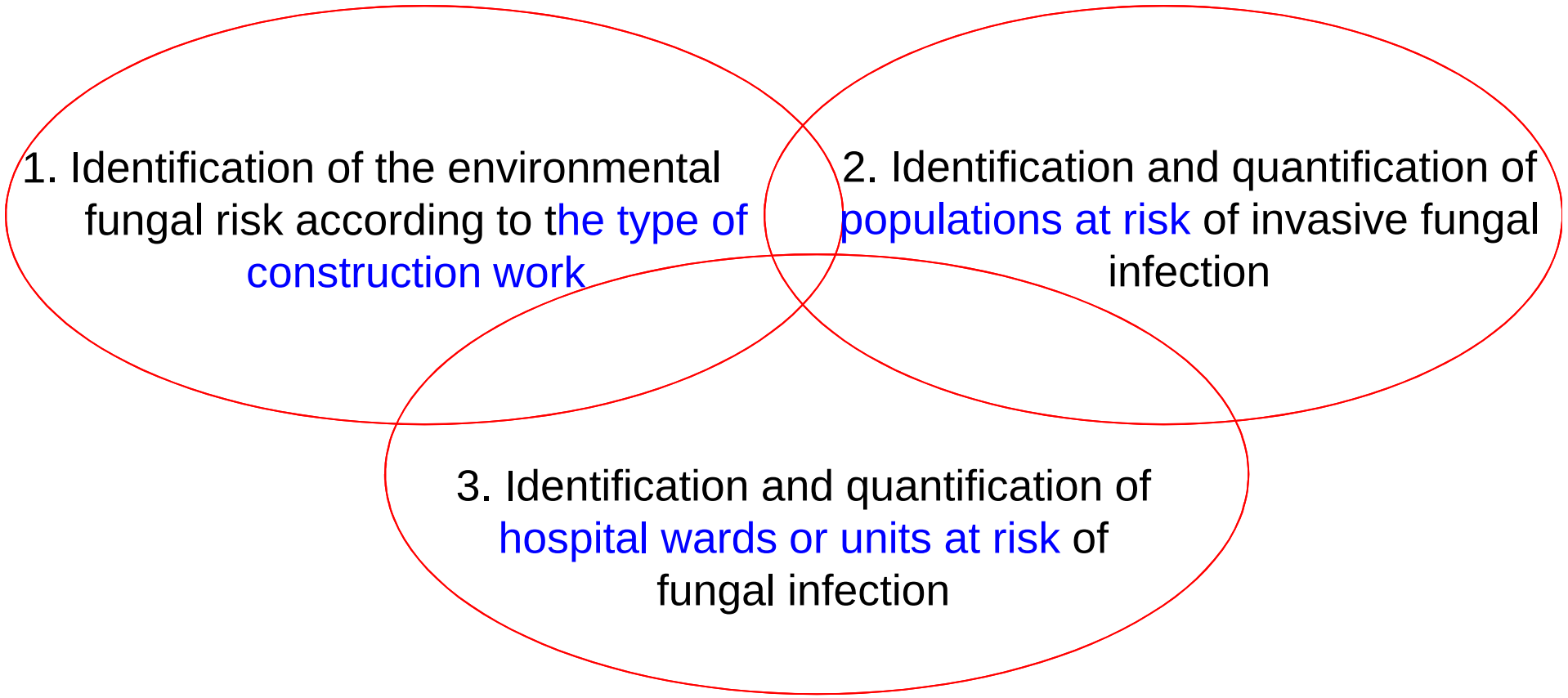
- Recommendations to intervening firms and/or the technical maintenance service
- Recommendations to the relevant healthcare services

Monitoring and follow-up

- Planning a follow-up of the recommended precautions
- Proposal for the surveillance:

IV. Risk characterization during construction and renovation works

⇒ Combination of 3 risk analysis



1.Classification of construction works according to the volume of dust they produce

Types of construction work	
Type A	**Non-invasive control work / internal work with minimum production of dust.** *Non exhaustive list* • Removal of suspended ceiling panels for inspection, limited to 1 plate/m², • painting without sanding, • paperhanging, • minor electrical work, • minor plumbing with water cutoff in the room lasting <15 minutes, • other inspection work requiring neither recesses in the walls, nor more extensive interventions on suspended ceilings.
Type B	**Short-duration, minor construction work producing small quantities of dust** *Non-exhaustive list* • Wire recesses in the walls or ceilings, with controlled production of dust for minor electrical installations or repairs on ventilation components, telephone or computer cabling, • removal of floor covering (limited area) • minor construction work on suspended ceilings, • sanding/grinding of the walls for paint removal or wallpapering involving the repair of only a small area, • plumbing work with water cutoff affecting ≥ 2 rooms for less than 30 minutes, • any construction work that can be performed by a single building trade.
Type C	**Any construction work producing moderate to high levels of dust, or requiring the demolition or removal of any fixed item (e.g. sinks, boards...)** *Non-exhaustive list* • Sand blasting / sanding of walls for painting or wallpapering; any construction work with plaster elements, • minor demolition, • removal of floor coverings and suspended ceilings, • construction of new walls; installation of new partitions, • minor construction, • minor piping or electrical wiring work in the ceilings, • minor excavation, • major wiring activities, • any activity that requires several building trades, • any plumbing work with water cutoff affecting > 2 rooms for > 30 minutes, but <1 hour.
Type D	**Major demolition, renovation, construction work / Major external construction work with significant dust production** *Non-exhaustive list* • demolition or renovation of an entire wiring system, • new construction involving several building trades, • plumbing with water cutoff affecting > two rooms, for > 1 hour, • major excavations.

2. Identification and quantification of populations at risk of invasive fungal infection

Very high-risk populations	High-risk populations	Lower-risk populations
- Allograft of hematopoietic stem cells, especially in the case of old age, disease relapse, second allograft, pheno-versus geno-identical graft, HLA incompatibility, total body irradiation (TBI) during conditioning, according to the type of graft (placental blood versus other cellular sources, T-depleted graft), presence of a graft versus host disease, of a cytomegalovirus (CMV) disease, of iron overload; - autografting of hematopoietic medullary stem cells; - severe combined immunodeficiencies; - post-chemotherapy neutropenia (with neutrophil counts [ANC] of < 500/mm^3 > 14 d or < 100/mm^3 regardless of duration; - Severe bone marrow failure	- High-dose corticosteroid therapy in the treatment of acute lymphoblastic leukemia; - post-chemotherapy neutropenia (with an ANC of < 500/mm^3) lasting less than fourteen days; - solid organ transplant: pulmonary, liver kidney, heart, pancreas, intestine; - chronic pulmonary diseases treated with corticosteroids or other immunosuppressants: obstructive pulmonary disease, emphysema, bronchiectasis, uncontrolled asthma, cystic fibrosis; - chronic granulomatous septic disease ; - newborns in neonatal resuscitation; relapsed or refractory acute myeloblastic leukemia	- Repeated and/or prolonged high-dose corticosteroid therapy; - HIV positive patients with AIDS, with CD4 T lymphocytes + of <50/mm3; - patients on mechanical ventilation; - patients on dialysis; - patients on chemotherapy; - diabetic ketoacidosis; - burned persons (> 50% body surface area); - systemic disease.

3. Classification of hospital wards or units with a risk of fungal infection

Groups of wards	Wards or departments concerned	
	[Anonymous Canada 2001, Ministry of health 2004b]	[APIC 2005, HAIDUVEN 2009]
Area 1 **Small RFI**	• Offices • Unoccupied rooms • Public areas	
Area 2 **Medium RFI**	• All other healthcare departments (unless they are in groups 3 and 4) • Outpatient clinics (except for oncology and surgery) • Admission units	• Cardiology • Echocardiology • Nuclear Medicine • Endoscopy • Radiology/NMR • Pneumology • Functional rehabilitation
Area 3 **High RFI**	• Emergency rooms • Conventional radiology • Recovery rooms (PACU) • Labor and delivery rooms (except the operating room) • Nurseries • Ambulatory surgery • Nuclear medicine • Spa pools or physiotherapy facilities • Echocardiology • Laboratories • General medicine and surgery rooms (unless they are in group 4) • Pediatrics • Geriatrics • Extended or long-term care	• Emergency room • Labor and delivery rooms (except operating room) • Nurseries • Laboratories • Ambulatory surgery • Pediatrics • Pharmacy • Recovery rooms (PACU) • Surgical departments
Area 4 **Very high RFI**	• Intensive care units • Operating rooms • Anesthesia facilities • Oncology units and outpatient consultation services for cancer patients • Transplant and outpatient units for patients having received a hematopoietic stem cell or solid organ transplant • Rooms and outpatient consultation services for patients with AIDS or any other immune deficiency • Dialysis • Neonatology • All cardiac catheterization and angiography facilities • Cardiovascular/ Cardiology departments • Endoscopy facilities • Drugs preparation facilities • Sterile preparation rooms • Central treatment (sterilization, endoscopes)	• Intensive care units • Operating rooms • Positive pressure isolation rooms • Medical departments • Oncology units and outpatient consultation services for cancer patients • Transplant and outpatient consultation units for patients having received a hematopoietic stem cell or solid organ transplant • ***Burn patients*** unit • Central sterilization

V. Implementation of management precautions

⇒ 4 steps

1. Implementation of an impact study

2. Identification of risk management precautions

3. Indicators for the determination of the impact of management precautions on the risk of fungal infection

4. Areas of responsibility for the fungal risk management

Phases* of fungal infectious risk evaluation to be managed according to the organizational resources of the establishment

Evaluation of the particulate contamination risk

Qualitative: High, Moderate, Low,

(see table III)

or

Quantitative: score/81

(see table IV)

Evaluation of the risks related to the patients and to the construction site location

Qualitative: +++, ++, +

(see table V)

or

Quantitative: from 0 to 10

(see table V)

Global risk quantification

Qualitative: High
Moderate
Low

(see table VI)

or

Quantitative: High (index > 100)
Moderate (index between 25 and 100)
Low (index < 25)

(see table VII)

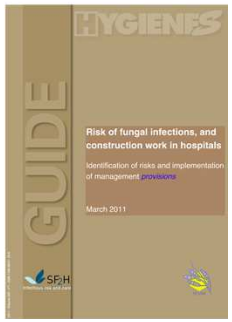
Deciding on preventative measures

Commitment from the relevant stakeholders

Monitoring of measures put into place

Qualitative tool for the evaluation of risks, according to the type of construction work [AP-HP Guide 1994, Anonyme Canada 2001, South-West CCLIN, 2006].

Contamination	Typology of construction work
High	Demolition Sandblasting of walls Ventilation system interventions Plastering (plasterboard, insulation ducts) Heavy work on roads, utilities and miscellaneous Plumbing
Moderate	Timber frame Suspended ceiling (+/- dismantling of existing ceiling) Interventions on roller blind casings Flooring (resilient, tiles or resin-based) Indoor joinery Ventilation - Air conditioning
Low	Light work on roads, utilities and miscellaneous (buried networks, earthwork) Structural masonry Landscaping Roofing (with or without tiles) Outdoor joinery (facade, outer cladding, coating) Metal frame, fitting Electricity Wall covering



Quantitative risk evaluation tool according to the nature of the construction work [South-West CCLIN, 2006]

Type of work	Score
Demolition	/10
Roads, utilities & miscellaneous (heavy)	/10
Roads, utilities & miscellaneous (light)	/3
Foundations	/2
Structural masonry	/3
Timber frame	/5
Covering (with or without tiles)	/1
Outdoor joinery (façade, outer cladding, coating)	/1
Metal frame / locks	/1
Electricity / heating, ventilation and air conditioning (+/- reconnection to existing ducts)	/1
Suspended ceiling ***(+/- dismantling of the existing)***	/5
Intervention on the ventilation system	/10
Intervention on the ducts for the rolling blinds	/5
Wall covering ***(+/- dismantling of the existing)***	/1
Floor covering (resilient, tiles or resin-based floor covering)	/5
Plastering (plasterboards, insulating ducts)	/10
Indoor joinery (timber, PVC, aluminum, glass)	/5
Landscaping	/3
Total	**/81**

Measures to be implemented for the containment of bioaerosols on the construction site, and to avoid their scattering towards areas in which RFI patients are housed.

Measure	Indication	Feasibility	Level of evidence	Importance and/or usefulness	Comments	Relevant literature
Close the ward in which RFI patients are housed	• Protect RFI patients • **Implement in the case of a high level of risk**	4	II	A	• Transfer RFI patients to another sector or hospital in which the level of environmental pollution is guaranteed and controlled. As this is not always possible, planning and/or phasing of the construction work should be envisaged	[Bocquet 1993, Anonymous Canada 2001, Anonymous Ireland 2001, APIC 2005, South-West CCLIN 2006, Haiduven 2009]
Place the area under construction under lower air pressure than the adjacent sectors	• Avoid the scattering of bioaerosols towards adjacent sectors • **Implement in the case of an average level of risk**	3	II	B	• Use efficient air extractors equipped with a highly efficient filtration system	
Erect rigid, waterproof barriers or dust-proof screens, from floor to ceiling, between the area of activity and that under construction	• Isolate the construction site • **Implement in the case of an average or high level of risk**	2	II	A	• Use materials which do not release dust which could be contaminated by filamentary fungal spores	
Minimize the re-suspension of bioaerosols in the area under construction	• Implement containment of construction site bioaerosols • **Implement in the case of a low, average or high level of risk**	2	II	A	• Ensure that the environment remains damp, in order to avoid the re-suspension of dust • Clean access roads on a regular basis • Empty waste from closed containers and/or tarpaulin covered bins • Work with closed doors • Reduce dust produced during drilling, through the use of machines and equipment fitted with a very high efficiency vacuum filtering system	
Practical application	• Isolation of the construction site using plasterboard panels screwed onto metal structures (advantages: rapidly put into place and panels can be cut with a Stanley knife), together with a doorset for access to the construction site • Installation of a 120 micron polyane film on the outside of the partition, to ensure its air-tightness • Use of 3-cm orange or gray duct tape (to be visually checked every day). To be supplemented around fluid				• Installation of one or several construction site air extractors, in accordance with its surface area, if it is possible to have an external casement • During the dust-removal phase, install a high efficiency air purifier (permanently, or for the duration of construction work in the case of a limited construction area). Foresee	

VI. Proposed indicators for the determination of the impact of management precautions on the risk of fungal infection

1. Visual checks

- doors tightly sealed (using adhesive tape for example)
- windows closed
- ground dust collection mat checked and replaced (at least daily, and whenever it is clearly saturated)
- obvious presence of dust (clouds, footprints, dusty surfaces ...)

Proposal for a Quick Audit Sheet, according to [Carter 1997]

Quick Audit Sheet

Ongoing construction work: .....
Department ..... **Date** .....

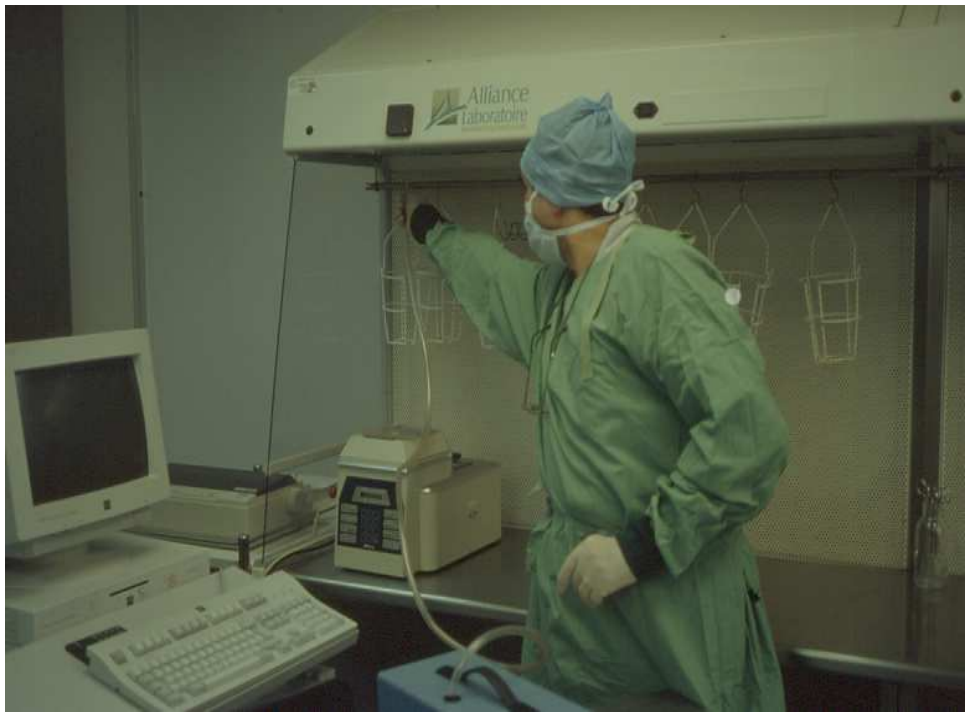
Barriers put in place						
Signs displayed?	Yes	☐	No	☐	NA	☐
Doors	Yes	☐	No	☐	NA	☐
Common premises: properly closed	Yes	☐	No	☐	NA	☐
Rooms: properly closed	Yes	☐	No	☐	NA	☐
Clean floor surface, no conspicuous dust	Yes	☐	No	☐	NA	☐
Air conditioning						
Windows shut in the construction area	Yes	☐	No	☐	NA	☐
Negative pressure functional	Yes	☐	No	☐	NA	☐
Construction area						
Rubble removed in covered containers	Yes	☐	No	☐	NA	☐
Cleaning of construction site	Yes	☐	No	☐	NA	☐
Movement						
Restricted to workers	Yes	☐	No	☐	NA	☐
Restricted to required care staff	Yes	☐	No	☐	NA	☐
Waste disposal duly performed	Yes	☐	No	☐	NA	☐
Persons outside the department (visitors…) are informed of precautions to be observed	Yes	☐	No	☐	NA	☐
Clothing						
Compliant with regulations in areas providing access to the construction site (e.g. operating rooms, high-risk units…)	Yes	☐	No	☐	NA	☐

If not compliant, by whom: care staff ☐, technical staff ☐, other ☐
Specify: .....

NA: Not Adapted to the situation

2. Checking the negative pressure in the construction zone

3. Particulate checks



4. Fungal biocontamination checks of the air and surfaces

• in protected areas where immunosuppressed patients reside for prolonged periods
• in other areas under construction, at least at the end of the construction work, following bio-cleaning of the premises




Proposed interpretation of the results of fungus-oriented environmental monitoring

Area	Local	Air sampling	Surface Sampling
Protected (with air conditioning)	Patient's room	No fungal spores	• Under laminar flow: no fungal spores • Other areas: tolerance for very rare Colony Forming Units (CFUs) of fungal spores per sample with no *Aspergillus**
	Common areas	Tolerance for very rare CFUs per sample with no *Aspergillus***	Tolerance for very rare CFUs per sample with no *Aspergillus****
Other areas	Patient's room and common areas	Expected results difficult to define in a non-protected environment. Only changes in biocontamination over time, occurring during construction work, or changes in comparison with baseline levels measured before the construction began, will be interpreted.	Expected results are difficult to define consistently and unequivocally. Only changes in bio-contamination over time, with respect to a baseline level, will be considered to be associated with the risk management effort.

By way of indication, in a normal situation in the absence of construction work,
*A tolerance of 2 CFUs/sample is accepted for a 25 cm^2 surface sample,
** A tolerance of 2 CFUs/sample is accepted for a one m^3 air sample,
*** A tolerance of 5 CFUs/sample is accepted for a 25 cm^2 surface sample.

Gangneux et al., J Mycol Med. 2012 ;22(1):64-71

Monitoring and areas of responsability

Proposed frequency of environmental monitoring to be implemented, and responsibilities.

Overall quantification of risk	Monitoring Frequency and persons in charge				
	Visual Healthcare Unit	Pressure Technical Staff	Particulates ICT	Airborne contamination ICT/Laboratories	Surfaces ICT/Laboratories
High "Protected" area	Once daily	Once daily	End of construction	Once weekly and at the end of construction work	Once weekly and end of construction work
High Other areas	Once daily	Once daily	—	Period to be defined by the CLIN** and end of construction work	End of construction work
Average	Once daily	—	—	—	End of construction work
Low	Once weekly	—	—	—	—

ICT: Infection Control Team (or internal or external sampler)

*Technical Department or Biomedical Department (Work Supervisor)

**For information and according to the duration of construction work, once or twice monthly.

Gangneux et al., J Mycol Med. 2012 ;22(1):64-71

5. Epidemiological surveillance of invasive fungal infections

a/ Creation of a local structure for epidemiological surveillance

b/ The investigation of clusters of cases or epidemics

$\Rightarrow$ The final indicator for the beneficial effects of preventive measures

$\Rightarrow$ a tool for the detection of grouped cases and/or epidemics, allowing corrective measures to be considered

Comparison of Epidemiological, Clinical, and Biological Features of Invasive Aspergillosis in Neutropenic and Nonneutropenic Patients: A 6-Year Survey

A. Cornillet,[1] C. Camus,[2] S. Nimubona,[3] V. Gandemer,[4] P. Tattevin,[2] C. Belleguic,[5] S. Chevrier,[1] C. Meunier,[6] C. Lebert,[7] M. Aupée,[8] S. Caulet-Maugendre,[9] M. Faucheux,[10] B. Lelong,[11] E. Leray,[12] C. Guiguen,[1] and J.-P. Gangneux[1]

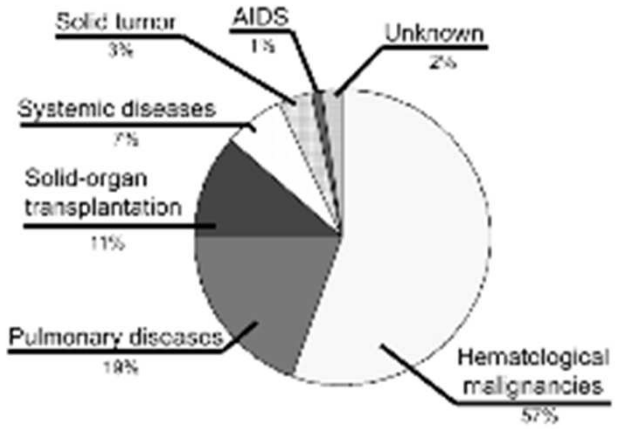


Figure 2. Underlying diseases and risk factors present in patients with invasive aspergillosis.

Table 2. Outcome of invasive aspergillosis (IA), according to the patient's underlying disease and case classification.

Primary disease/underlying condition and case classification	No. (%) of patients, by outcome		
	Death (n = 63)	Recovery (n = 19)	Unknown (n = 6)
Primary disease/underlying condition			
Hematological malignancy			
All (n = 49)	29 (59)	16 (33)	4 (8)
Acute leukemia (n = 19)	8 (42)	11 (58)	0 (0)
Other hemopathy (n = 30)	21 (70)	5 (17)	4 (13)
Solid-organ transplantation (n = 10)	9 (90)	1 (10)	0 (0)
Chronic pulmonary disease (n = 18)	16 (89)	1 (5.5)	1 (5.5)
Vasculitis disease (n = 5)	5 (100)	0 (0)	0 (0)
Solid tumor (n = 3)	2 (67)	0 (0)	1 (33)
AIDS (n = 1)	1 (100)	0 (0)	0 (0)
Unknown (n = 2)	1 (50)	1 (50)	0 (0)
Case classification			
Proven IA (n = 12)	10 (83)	2 (17)	0 (0)
Probable IA (n = 52)	37 (71)	10 (19)	5 (10)
Possible IA (n = 24)	16 (67)	7 (29)	1 (4)
All cases of IA (n = 88)	63 (71.5)	19 (21.5)	6 (7)

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Learned societies

Promotion: *Société française de mycologie médicale* (SFMM) and *Société française d'hygiène hospitalière* (SF2H)

Collaborations: *Société française d'hématologie* (SFH), *Société française de greffe de moelle et de thérapie cellulaire* (SFGM-TC), *Société de pathologie infectieuse de langue française* (SPILF), *Association française des infirmières de thérapie cellulaire* (AFITCH)

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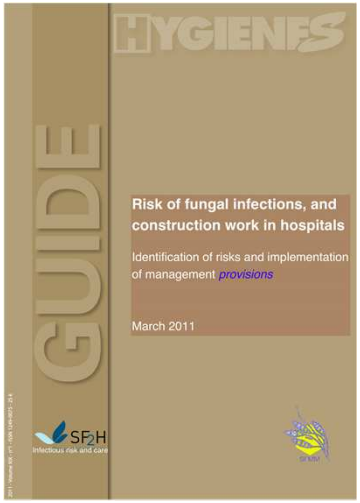
Philippe Blanchard, Frédéric Debels



Websites :
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Société Française d'Hygiène Hospitalière

Thank you four your attention

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CHU Rennes

IRSET Institut de Recherche en Santé, Environnement et Travail

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Inserm

EHESP École des hautes études en santé publique

Université des Antilles et de la Guyane