ACQUE SICURE NELLE STRUTTURE SANITARIE

Vieste-Pugnochiuso (FG)

27-28 maggio 2016

LE INFEZIONI FUNGINE CORRELATE ALLA RETE IDRICA:

QUALE RISCHIO PER I PAZIENTI?

Giuseppina Caggiano

Dipartimento di Scienze Biomediche e Oncologia Umana - Sezione Igiene
Università degli Studi di Bari "A. Moro"

... Infezioni Fungine ...

*….The morbidity and mortality associated with invasive fungal infections are substantial and it is clear that **fungal diseases** have emerged as important….*

…persistent public health problem!

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Lieviti

Organismi unicellulari

Muffe

Organismi pluricellulari

Eterotrofi

ubiquitari in tutte le matrici ambientali

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AMBIENTE

SUOLO

ARIA

ACQUA

Alcune specie vivono in ambienti *oligotrofi*

L'acqua veicola miceti…

…problema emergente in ospedale

Pericolo sanitario

soggetti immunocompromessi

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cause of gastrointestinal infections worldwide (Mara & Horan 2006). In the past, fungi were infrequently considered when discussing pathogenic microorganisms in water. A possible reason for this is that common for many of the pathogenic bacteria, viruses, and parasites their occurrence in drinking water often leads to relatively acute symptoms and disease in humans. As far as we know, the consumption of fungal

1960-1970

…analisi per sapore e odore o episodi di malessere correlati al consumo di acqua…

1980-1990

…in seguito ad episodi di allergia e irritazioni cutanea , si inizia ad approfondire la ricerca di miceti nell'acqua

(Hageskal, 2009)

Fungi in water have mostly been overlooked, but may be regarded as a chronic problem in drinking water distribution systems, and are possibly an underestimated problem. Fungi have received increased focus as drinking water contaminants in the last decades.

Hageskal, 2009

Fusariosis Associated with Pathogenic *Fusarium* Species Colonization of a Hospital Water System: A New Paradigm for the Epidemiology of Opportunistic Mold Infections

Elias J. Anaissie,[1] Robert T. Kuchar,[2] John H. Rex,[3] Andrea Francesconi,[4] Miki Kasai,[4] Frank-Michael C. Müller,[4] Mario Lozano-Chiu,[3] Richard C. Summerbell,[5] M. Cecilia Dignani,[1] Stephen J. Chanock,[4] and Thomas J. Walsh[4]

[1]Myeloma and Transplantation Research Center, Arkansas Cancer Research Center, University of Arkansas for Medical Sciences, Little Rock, Arkansas; [2] University of Texas School of Public Health, and [3]Center for Infectious Diseases, University of Texas Medical School, Houston, Texas; [4]Immunocompromised Host Section, Pediatric Oncology Branch, National Cancer Institute, Bethesda, Maryland; and [5]Centraalbureau voor Schimmelcultures, Utrecht, The Netherlands

Texas

We sought the reservoir of *Fusarium* species in a hospital with cases of known fusarial infections. Cultures of samples from patients and the environment were performed and evaluated for relatedness by use of molecular methods. *Fusarium* species was recovered from 162 (57%) of 283 water system samples. Of 92 sink drains tested, 72 (88%) yielded *Fusarium solani;* 12 (16%) of 71 sink faucet aerators and 2 (8%) of 26 shower heads yielded *Fusarium oxysporum*. *Fusarium solani* was isolated from the hospital water tank. Aerosolization of *Fusarium* species was documented after running the showers. Molecular biotyping revealed multiple distinct genotypes among the isolates from the environment and patients. Eight of 20 patients with *F. solani* infections had isolates with a molecular match with either an environmental isolate ($n = 2$) or another patient isolate ($n = 6$). The time interval between the 2 matched patient-environment isolates pairs was 5 and 11 months, and 2, 4, and 5.5 years for the 3 patient-patient isolate pairs. The water distribution system of a hospital was identified as a reservoir of *Fusarium* species.

Journal of Hospital Infection (2001) **47**: 143–148
doi:10.1053/jhin.2000.0876, available online at http://www.idealibrary.com on IDEAL®

Recovery of filamentous fungi from water in a paediatric bone marrow transplantation unit

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*Departments of *Microbiology and †Paediatrics, National Hospital University of Oslo, Norway, ‡Department of Medical Microbiology, University Medical Centre St Radbound, Nijmegen, The Netherlands*

Norvegia

The sampling was performed at the paediatric oncology ward at the National Hospital University of Oslo, Norway. This hospital consists of a complex of buildings built 50–100 years ago. The paediatric oncology department, containing two bone marrow transplantation (BMT) units, is situated in a relatively new wing of the paediatric clinic built in 1990. The paediatric oncology ward has a yearly admission rate of almost 900 patients and 10–12 allogeneic BMTs are performed annually. From 1992 to 2000, 25 proven invasive filamentous fungal infections were diagnosed, of which 15 (including two paediatric patients) occurred among BMT patients (incidence 5.3%).

Results

Water sampling

Filamentous fungi were recovered from 94% of water samples (Table I). Ninety-nine percent, 72.2% and 100% of samples taken from the taps, showers and main-pipe demonstrated growth of filamentous fungi, respectively. The mean colony forming units (cfu) were 2.8 per 500 mL of water from the taps and main pipe, and 2.5 per 500 mL of water from showers. *A. fumigatus* was recovered in 37.5% (mean 2.0 cfu/500 mL) of water samples and from 49% and 5.6% (mean 1.9 and 1.0 cfu/500 mL;

20-500 ufc/100 ml

POLONIA
Grabinska-Loniewska A et al., 2007

4-119 ufc/100 ml

EGITTO
Samah AM et al, 2014

33-97 ufc/100 ml

AUSTRALIA
Sammon NB et al, 2010

5-207 ufc/100 ml

BRASILE
Oliveira et al, 2016

Funghi filamentosi nell'acqua destinata al consumo umano sono comuni e possono essere isolati in elevate concentrazioni

Pathogenic *Aspergillus* Species Recovered from a Hospital Water System: A 3-Year Prospective Study

Elias J. Anaissie,[1] Shawna L. Stratton,[1] M. Cecilia Dignani,[1] Richa
Thomas P. Monson,[2] Trey Spencer,[1] Miki Kasai,[1] Andrea Frances
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University of Arkansas for Medical Sciences, Little Rock; [2]Centraal bureau voo
Diseases, University of Texas–Houston Medical School, Houston; and [3]Immuno
Institutes of Health, Bethesda, Maryland

Valutare l'eventuale presenza di *Aspergillus* nell'aria, acqua e superfici

Nosocomial aspergillosis, a life-threatening infection in immunocomp ised patients, is thought to be caused primarily by *Aspergillus* organisms in the air. A 3-year prospective stu r of the air, environmental surfaces, and water distribution system of a hospital in which there were known cases of aspergillosis was conducted to determine other possible sources of infection. *Aspergillus* species were found in the hospital water system. Significantly higher concentrations of airborne aspergillus propagules were found in bathrooms, where water use was highest (2.95 colony-forming units [cfu]/m^3) than in patient rooms (0.78 cfu/m^3; $P = .05$) and in hallways (0.61 cfu/m^3; $P = .03$). A correlation was found between the rank orders of *Aspergillus* species recovered from hospital water and air. Water from tanks yielded higher counts of colony-forming units than did municipal water. An isolate of *Aspergillus fumigatus* recovered from a patient with aspergillosis was genotypically identical to an isolate recovered from the shower wall in the patient's room. In addition to the air, hospital water systems may be a source of nosocomial aspergillosis.

Anaissie, CID 2002:34

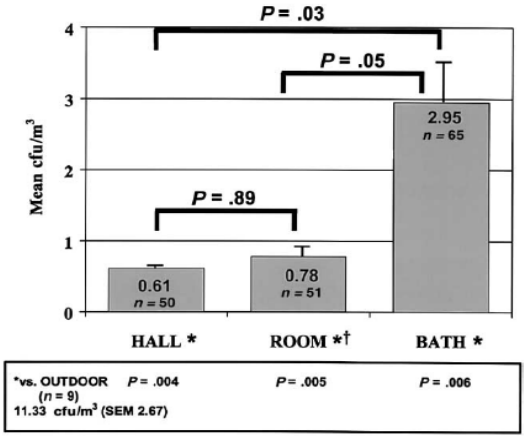


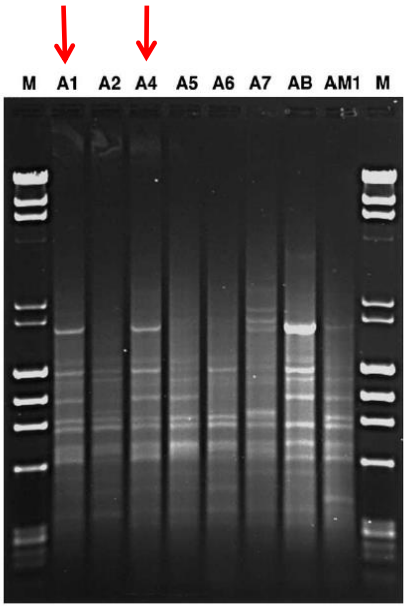
Figure 1. Bar graph comparing sites from which air samples containing *Aspergillus* species were recovered. Concentrations of *Aspergillus* were higher in air from bathrooms than in air from other indoor sites in the hospital. Error bars represent SEMs. HEPA, high-efficiency particulate air; LAF rooms, rooms equipped with laminar airflow systems.

Cariche **significativamente** più elevate di *Aspergillus spp* nei bagni 2,95 cfu/m^3 *vs* stanze dei pazienti 0,78 cfu/m^3, corridoio 0,61cfu/m^3 (P=0.03)

Anaissie , CID 2002

GENOTIPIZZAZIONE

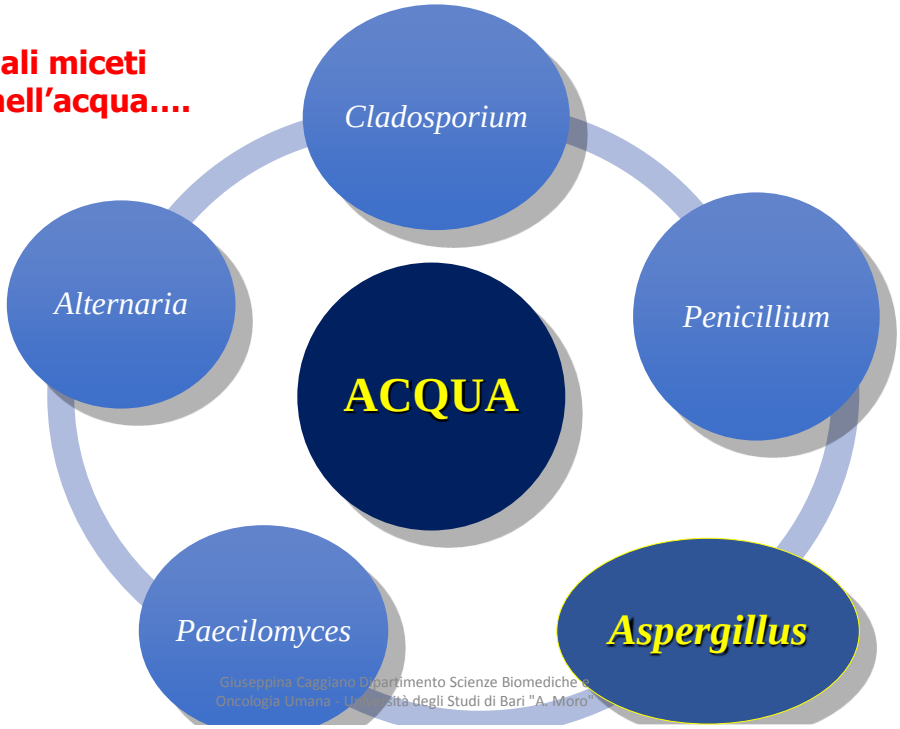
In this 3-year prospective surveillance study conducted in a hospital that has adequate precautions against contamination of the indoor air, we consistently showed that *Aspergillus* species can inhabit the water system of a hospital; that there is a difference in the concentration of airborne aspergilli between patient rooms and patient bathrooms (with the highest concentrations found in bathrooms with more water use); that there is a strong correlation between the rank orders of *Aspergillus* species isolated in water and air; and that hospital water storage tanks may serve as amplification sites for *Aspergillus* species. We also showed that the *A. fumigatus* strain recovered from the shower wall of 1 patient's room was of the same molecular genotype as the strain that caused aspergillosis in this patient. On the basis of the available data, however, we cannot rule out other sources for this strain, nor can we directly prove that it



Aspergillus fumigatus isolato da paziente con aspergillosi era geneticamente identico a quello isolato dalla parete della doccia nella stanza del paziente

Anaissie , CID 2002

Principali miceti ritrovati nell'acqua….



……

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CLINICAL OBSERVATIONS, INTERVENTIONS, AND THERAPEUTIC TRIALS

Pathogenic molds (including *Aspergillus* species) in hospital water distribution systems: a 3-year prospective study and clinical implications for patients with hematologic malignancies

Elias J. Anaissie, Shawna L. Stratton, M. Cecilia Dignani, Choon-kee Lee, Richard C. Summerbell, John H. Rex, Thomas F. Monson, and Thomas J. Walsh

The incidence of mold infections in patients with hematologic malignancies continues to increase despite the widespread use of air filtration systems, suggesting the presence of other hospital sources for these molds. Water sources are known to harbor pathogenic molds. We examined samples from water, water surfaces, air, and other environment sources from a bone marrow transplantation unit with optimal air precautions. Molds (*Aspergillus* species, others) were recovered in 70% of 398 water samples, in 22% of 1311 swabs from plumbing structures and environmental surfaces, and in 83% of 274 indoor air samples. Microscopic examination of the water plumbing lines revealed hyphal forms compatible with molds. Four findings suggest that indoor airborne molds were aerosolized from the water: (1) higher mean airborne concentrations of molds in bathrooms (16.1 colony-forming units [CFU]/m³) than in patient rooms (7 CFU/m³) and hallways (8.6 CFU/m³; $P = .00005$); (2) a strong type and rank correlation between molds isolated from hospital water and those recovered from indoor hospital; (3) lack of seasonal correlation between the airborne mold concentration in outdoor and indoor air; and (4) molecular relatedness between a clinical strain and a water-related strain (previously reported). Hospital water distribution systems may serve as a potential indoor reservoir of *Aspergillus* and other molds leading to aerosolization of fungal spores and potential exposure for patients. (Blood. 2002;101:2542-2546)

© 2003 by The American Society of Hematology

Introduction

Nosocomial opportunistic mold infections can be life-threatening in immunocompromised patients, particularly those with hematologic malignancies. These molds are thought to arise from contaminated outdoor air that infiltrates hospital ventilation systems.[1,2] Prevention of these infections is critical and has relied on air handling systems such as high-efficiency particulate air (HEPA) filters and laminar airflow (LAF). However, the incidence of mold infections continues to rise despite the widespread use of these air filtration systems,[3] suggesting that other hospital sources for molds may exist. We have previously shown that *Fusarium* species colonize the water system of a hospital and cause nosocomial fusariosis.[4] Water systems worldwide have also been shown to be colonized with pathogenic molds.[5-7] This 3-year prospective surveillance study of a hospital caring for immunocompromised patients demonstrates that opportunistic molds may colonize hospital water distribution systems and then lead to mold sporulation in patient care areas, and environmental sampling and molecular typing of isolates suggest that hospital water may be a potential indoor reservoir for *Aspergillus* and other molds causing nosocomial infections.

patient care tower (built in 1997), whereas the second unit (B) is in the old hospital building (built in 1955). Both units are equipped with central HEPA filtration. Unit A also has 3 LAF rooms. All HEPA and LAF filters are monitored and maintained per industry standards.

The hospital water is supplied by the Little Rock Municipal Water Works and meets water industry standards.[8] The municipal water enters the hospital from 2 separate substations. One serves the new patient care tower (unit A), and the other serves the old hospital (unit B). After entry into the new building, cold water is pumped immediately to all patient wards. Cold water is also distributed to 2 nonsanitarium water heaters and then sent to all floors. After entry into the old hospital building, cold water is pumped to 2 large water storage tanks housed on the hospital roof and then gravity-fed to unit B. Cold water is also sent to 4 large heating tanks and pumped to all floors of the old building.

Environmental sampling

Acqua, aria e superfici in BMTU muniti di filtri HEPA e stanze con LAF

Results

Water samples

Molds were recovered from the municipal water, hospital water storage tanks, and hospital water from patient care areas (total of 416 water samples; Table 1). The mean levels of free chlorine in municipal water, cold-water storage tanks, and cold tap water were within standard guidelines at 0.2, 0.1 to 0.2, and 0.05 ppm, respectively (data not shown).

A total of 109 water samples yielded *Aspergillus* species. The species of *Aspergillus* found were all recognized opportunistic pathogens, and included *A niger* (77%), *A fumigatus* (11%), *A terreus* (9%), and *A flavus* (3%). All the *Paecilomyces* species found in 44 water samples were *P lilacinus*. Three of 14 *Fusarium* species recovered from water samples were identified to species level. All 3 were *F solani* (known pathogens). The mean concentration ± SD of molds was 9-fold higher in the water tanks than in the municipal water: mean 11.4 ± 14.0 versus 1.3 ± 1.7 CFU/L, respectively ($P < .01$). With the exception of *Chaetomium* species, all molds recovered from municipal water were also present in the water tank. *Penicillium* species and *Aspergillus* species were the 2

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BLOOD, 1 APRIL 2003 VOLUME 101, NUMBER 7

Our study was carried out over a one-year period in a HSCT unit, where preventive measures to reduce patients' exposure to fungal nosocomial propagules have always been used, including the use of a HEPA air filtration system, positive pressure in the bedrooms and sealing off the windows. All patients use N-95 masks when they are outside their room. After a previous case of *Fusarium* infection, which prompted renovations including removal of the water reservoir in the toilets and this study, the only change in the patients care was restriction on showering [21].

Apart from *Mycelia sterilia*, we were able to identify eleven different genera of filamentous fungi in the following prevalence: *Cladosporium* spp. > *Penicillium* spp. > *Purpureocillium* spp. > *Aspergillus* spp. This finding is in accordance with other investigations that found a similar prevalence of fungal genera isolated from hospital water systems [3,4,22,23]. Despite all the positive cultures, none of them has caused any infection in the HSCT patients within the study period.

Considering all of the fungal propagules isolated from the nosocomial water system, we found differences in the fungal concentrations obtained from different compartments. *Fusarium solani* complex species exhibit high concentrations in tap water (216 CFU) when compared to the concentrations of these species present in water samples obtained from the tanks (40 CFU). Previous

Mesquita-Rocha *et al. BMC Infectious Diseases* 2013, **13**:289
http://www.biomedcentral.com/1471-2334/13/289

BMC Infectious Diseases

RESEARCH ARTICLE Open Access

The water supply system as a potential source of fungal infection in paediatric haematopoietic stem cell units

Sabrina Mesquita-Rocha[1], Patricio C Godoy-Martinez[2], Sarah S Gonçalves[1], Milton Daniel Urrutia[3], Fabianne Carlesse[4], Adriana Seber[4], Maria Aparecida Aguiar Silva[4], Antônio Sérgio Petrilli[4] and Arnaldo L Colombo[1*]

164 samples were collected from the water supply system of the HSCT

139 of the samples tested positive for filamentous fungi (84.8%), generating a total of 2,362 colonies.

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Article

Fungi from a Groundwater-Fed Drinking Water Supply System in Brazil

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2 Department of Chemical Sciences and Natural Resources, BIOREN-UFRO Scientific and Technological Bioresource Nucleus, Universidad de La Frontera, Temuco 4811-230, Chile; cledir.santos@ufrontera.cl
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Academic Editor: Panagiotis Karanis
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Abstract: Filamentous fungi in drinking water distribution systems are known to (a) block water pipes; (b) cause organoleptic biodeterioration; (c) act as pathogens or allergens and (d) cause mycotoxin contamination. Yeasts might also cause problems. This study describes the occurrence of several fungal species in a water distribution system supplied by groundwater in Recife—Pernambuco, Brazil. Water samples were collected from four sampling sites from which fungi were recovered by membrane filtration. The numbers in all sampling sites ranged from 5 to 207 colony forming units (CFU)/100 mL with a mean value of 53 CFU/100 mL. In total, 859 isolates were identified morphologically, with *Aspergillus* and *Penicillium* the most representative genera (37% and 25% respectively), followed by *Trichoderma* and *Fusarium* (9% each), *Curvularia* (5%) and finally the species *Pestalotiopsis karstenii* (2%). *Ramichloridium* and *Leptodontium* were isolated and are black yeasts, a group that include emergent pathogens. The drinking water system in Recife may play a role in fungal dissemination, including opportunistic pathogens.

***Aspergillus* 37%, *Penicillium* 25%**
Trichoderma e *Fusarium* 9%, *Curvularia* 5%

Int. J. Environ. Res. Public Health **2016**, *13*, 304,

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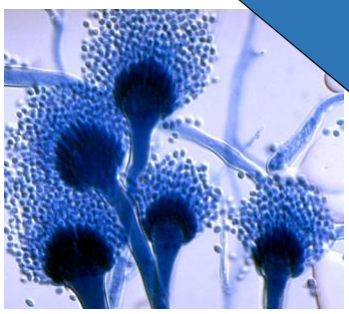
Aspergillus spp

2^ causa più frequente di infezione fungina nosocomiale

nei soggetti immunocompromessi



(Richardson, 2015)

Journal of Clinical Pharmacy and Therapeutics

Journal of Clinical Pharmacy and Therapeutics (2011) **36**, 152–160 doi:10.1111/j.1365-2710.2010.01166.x

ORIGINAL ARTICLE

Invasive fungal infections: epidemiology and analysis of antifungal prescriptions in onco-haematology

B. des Champs-Bro* Pharm D, A. Leroy-Cotteau* Pharm D, F. Mazingue† MD, F. Pasquier‡ MD, N. François§ BSc, S. Corm‡ MD, L. Lemaitre¶ MD, PhD, D. Poulain§ MD, PhD, I. Yakoub-Agha‡ MD, PhD, S. Alfandari** MD and B. Sendid§ Pharm D, PhD

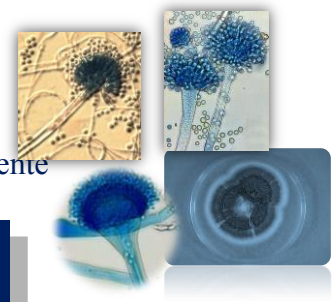
**Pharmacy Department, †Pediatric Oncology Department, ‡Haematology Department, §Mycological Laboratory, ¶Radiology Department and **Infectiology Department, Lille University Hospital, Tourcoing Hospital, France*

Mortalità per aspergillosi

- 49,3-77% in pazienti con leucemia o linfoma
- 86,7%-90% born-marrow

***Aspergillus* spp**

ubiquitario nell'ambiente



Circa 180 Specie identificate

Più frequenti
A.fumigatus, flavus, niger, terreus, nidulans

90% sostenute da *A.fumigatus*

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Trasmissione dell'infezione

- **Ingestione di acqua**
  - **Aspergillosi gastrica**
  - Aspergillosi intestinale
- per inalazione di conidi
  - **Aspergillosi polmonare**
- impianti accidentali tramite ferite

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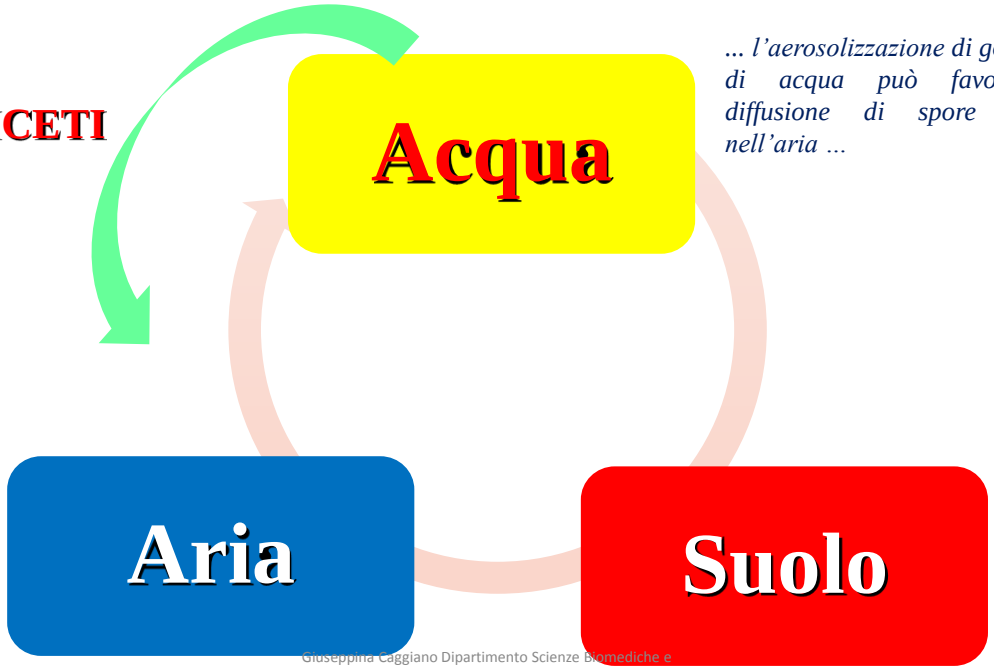
MICETI



... l'aerosolizzazione di goccioline di acqua può favorire la diffusione di spore fungine nell'aria ...

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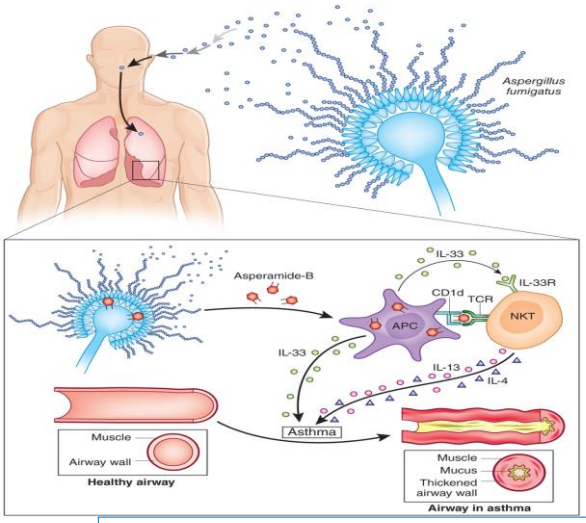

...inalazione dei conidi (Ø circa 2-5 µ) in soggetti immunocompromessi, in particolare affetti da patologie oncoematologiche con neutropenia prolungata e severa ...

Le spore sono inalate dopo aerosilazione dell'acqua quando passa dai rubinetti e docce

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Allergic bronchopulmonary aspergillosis (ABPA)

- exaggerated hypersensitivity reaction in cystic fibrosis and steroid-dependent asthma patients

Aspergilloma

- Lung cavities caused by tuberculosis
- emphysema
- bronchiectasis …

INVASIVE ASPERGILLOSIS

- Prolonged neutropenia, hematopoietic stem cell and solid organ transplant recipients, AIDS, premature newborns, chronic granulomatous disease

Medical Mycology May 2013, **51**, 361–370

informa healthcare

Global burden of allergic bronchopulmonary aspergillosis with asthma and its complication chronic pulmonary aspergillosis in adults

DAVID W. DENNING*, ALEX PLEUVRY† & DONALD C. COLE‡

**The University of Manchester, Manchester Academic Health Science Centre, The National Aspergillosis Centre, University Hospital of South Manchester, Manchester, †Oncalex, Whaley Bridge, High Peak, Derbyshire, UK, and ‡Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada*

Allergic bronchopulmonary aspergillosis (ABPA) complicates asthma and may lead to chronic pulmonary aspergillosis (CPA) yet global burdens of each have never been estimated. Antifungal therapy has a place in the management of ABPA and is the cornerstone of treatment in CPA, reducing morbidity and probably mortality. We used the country-specific prevalence of asthma from the Global Initiative for Asthma (GINA) report applied to population estimates to calculate adult asthma cases. From five re
New Zealand, Saudi Arabia and South Africa), we estimate
adults with asthma at 2.5% (range 0.72–3.5%) (scoping revi
pulmonary cavitation occurred in 10% (range 7–20%), allow
lence worldwide using a deterministic scenario-based mode
active asthma worldwide, we estimate that 4,837,000 patients
develop ABPA. By WHO region, the ABPA burden estimates are: Europe, 1,062,000; Americas, 1,461,000; Eastern Mediterranean, 351,000; Africa, 389,900; Western Pacific, 823,200; South East Asia, 720,400. We calculate a global case burden of CPA complicating ABPA of 411,100 (range 206,300–589,400) at a 10% rate with a 15% annual attrition. The global burden of ABPA potentially exceeds 4.8 million people and of CPA complicating ABPA ~ 400,000, which is more common than previously appreciated. Both conditions respond to antifungal therapy justifying improved case detection. Prospective population

Circa 4,8 milioni di persone nel mondo che hanno asma hanno anche aspergillosi broncopolmonare allergica e di questi 400,000 hanno anche aspergillosi polmonare

QUANTITÀ DI CONIDI NECESSARIA PER PROVOCARE INFEZIONE

i dati disponibili non sono sovrapponibili

Sheretz et al.
nessun caso con una concentrazione di conidi pari a 0,009 ufc/mc

Arnow et al.
significativa diminuzione di casi quando la concentrazione dei conidi nell'aria passava da 1-2 ufc/mc a 0,2 ufc/mc

Rhame et al.
valore soglia pari 0,9 ufc/mc;

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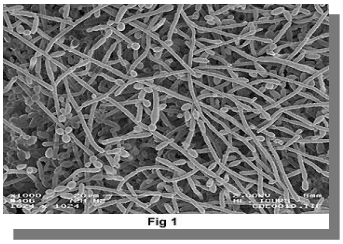
Aspergillus spp nelle acque dell'ospedale…



…biofilm supporto per la sua riproduzione di *Aspergillus* spp

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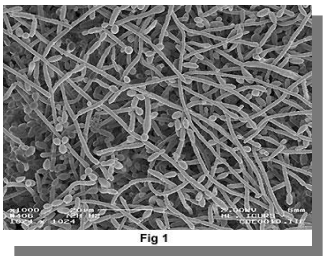
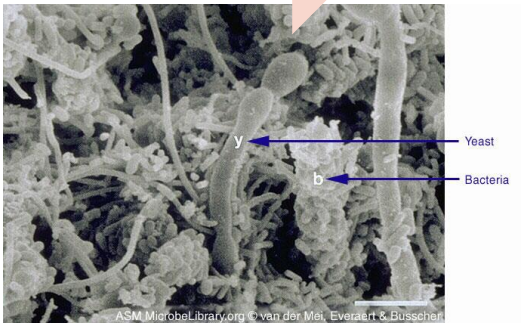
BIOFILM: Comunità microbica in una matrice di sostanze polimeriche extracellulare



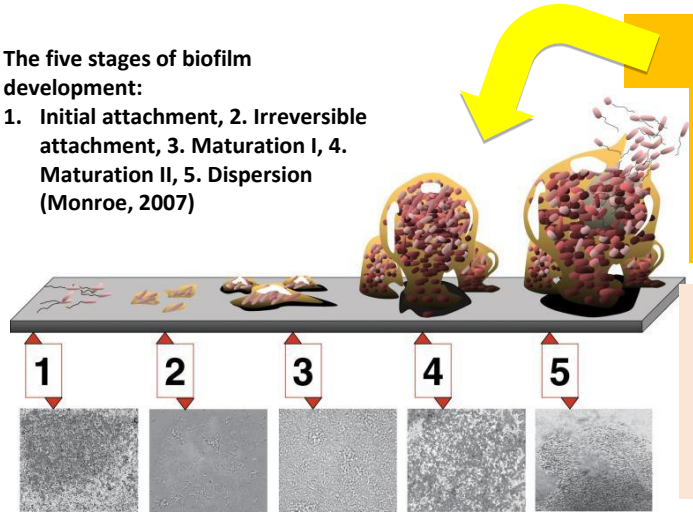


Il più importante carattere della crescita di biofilm è l'alta resistenza agli agenti antimicrobici che possono essere oltre 1000 volte più elevate delle cellule planctoniche

(Tobudic S, *et al.* Mycoses 2011)

The five stages of biofilm development:

1. **Initial attachment, 2. Irreversible attachment, 3. Maturation I, 4. Maturation II, 5. Dispersion (Monroe, 2007)**



I funghi che si stabiliscono nel biofilm sono meno sensibili ai trattamenti e alle procedure di disinfezione

Hageskal et al., 2009

Le ife fungine possono anche servire per consolidare l'intero biofilm e renderlo più difficile da rimuovere

Paramonova et al., 2009

- *L'efficacia dei trattamenti dipende dalle specie* (Kinsey et al., 2003).
- ***Le spore sono più resistenti delle forme vegetative*** (Kelley et al., 1997)
- *Una volta che i miceti si sono impiantati nel sistema è difficile impedire la colonizzazione e la formazione di biofilm* (Grabinska-Loniewska et al., 2007)

ACQUA

- *elemento fondamentale*

IGIENE OSPEDALIERA

il CDC fornisca misure di controllo e prevenzione per aria e superfici contaminate da Aspergillus in ambito sanitario, ancora non esistono Linee Guida specifiche per prevenire l'esposizione a funghi filamentosi e in particolare Aspergillus spp veicolato dall'acqua

Il trattamento dell'acqua riduce il numero di funghi senza rimuoverli

…ancora non esistono Linee Guida specifiche per prevenire l'esposizione ad *Aspergillus* spp veicolato dall'acqua…

Nel DLgs 2 febbraio 2002, quale integrazione al DLgs 31/2001 si considera tra i **parametri accessori** la ricerca generica di funghi, specificando un volume di riferimento pari a 100 ml

*Linee Guida della **Società Italiana di Nefrologia** introducono anche la ricerca di miceti tra i controlli microbiologici previsti per le acque di dialisi, facendo una distinzione tra lieviti e muffe e indicando valori di riferimento (<10 ufc/ml) e frequenza delle indagini (6 mesi)…*

Giornale Italiano di Nefrologia / Anno 22 n. 3, 2005 / pp. 246-273 **Ricerca di Risultato, Qualità, Epidemiologia e Statisti**

Linee Guida su acque e soluzioni per dialisi

Coordinamento Generale Linee Guida SIN: *G. Fuiano*

Coordinatore: *S. Alloatti*[1]

Estensori: *P. Bolasco*[2], *C. Canavese*[3], *G. Cappelli*[4], *L. Pedrini*[5], *F. Pizzarelli*[6], *G. Pontoriero*[7]

Centri di Nefrologia e Dialisi di [1]Aosta, [2]Cagliari-Territorio, [3]Novara, [4]Modena, [5]Seriate, [6]Firenze, [7]Lecco

In conclusione….

I miceti possono colonizzare i sistemi di distribuzione dell'acqua delle strutture ospedaliere

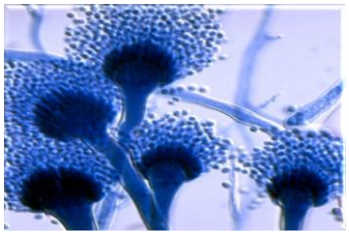
L'acqua può rappresentare una fonte di infezione fungina in gruppi di popolazione a rischio

impiego di mascherine facciali in grado di filtrare il 99% delle spore aerodiffuse.

…uso di acqua minerale e di bagni a secco è economico e importante..
(Mesquita-Rocha et al. BMC 2013)

…ridurre al minimo l'esposizione del paziente a pratiche che potrebbero far disperdere nell'aria spore fungine…

In conclusione….



Approfondire

le conoscenze sull'importanza dei funghi nell' acqua