EXPOSE
Establishing protocols to assess occupational exposure to bioburden in clinical environments

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1. Background

Occupational exposure to bioburden (fungi and bacteria) in the workplaces is a major concern with increased relevance in clinical environments.

(Cabo Verde et al. 2015; Kettleson et al. 2015; Nevalainen et al. 2015)

Clinical settings must provide a clean and safe environment to protect patients and staff from nosocomial infections and occupational diseases.

(Leung and Chan 2006)
Active and passive sampling methods have been used to characterize occupational exposure to viable bioburden.

(Reponen in Viegas et al. 2018)

Personal or stationary sampling of airborne bioburden can be performed to quantify exposure by inhalation, but may be influenced by environmental variables, such as seasonal variation and ventilation.

(Flannigan 1997).

Whereas passive-collection methods allow the collection of contamination over a longer period (days, weeks or several months), air samples can only reflect the load of a shorter period (mostly minutes) corresponding to the sampling duration.

(Badyda et al. 2016; Viegas et al. 2018b)
Passive and active methods used in parallel

More precise assessment of occupational exposure to bioburden

More accurate risk characterization

EXPOSE: Sampling protocol to access occupational exposure to bioburden in clinical facilities.
2. Materials and methods

Active sampling
- Air sampling by impaction

Passive sampling
- Surface swabs
- Electrostatic Dust Collectors (EDC)
- Settled dust
- HVAC Filters

10 PHCC in the Lisbon area

Waiting room, treatments room, vaccination room, back and front office, medical office, cleaning supplies room, oral hygiene office, sterilization, and canteen
Bioburden exposure assessment in 10 PHCC

**Bacteria**
- Inoculation in tryptic soy agar (TSA), incubation at 30°C for 7 days
- Inoculation in violet red bile agar (VRBA), incubation at 37°C for 7 days

**Fungi**
- Inoculation in 2% malt extract agar (MEA) with 0.05 g/L chloramphenicol media, incubation at 30°C for 5 to 7 days
- Inoculation in dichloran glycerol (DG18) agar-based media, incubation at 30°C for 5 to 7 days

Other performed assessments in the same matrices:
- Fungal biomass
- Toxigenic fungal strains detection
- MRSA prevalence (all passive methods)
- Azole resistance prevalence among the recovered mycobiota
- Mycotoxins
- Endotoxins
Bioburden exposure assessment in PHCC

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3. Results- Bacteria

Air samples showed that the total bacterial load surpassed the recommended guidelines (range from 50 to 150 CFU.m⁻³) in all areas.
3. Results - Fungi

- MEA: only the oral hygiene office is within the limit (150 CFU.m⁻³).

- DG18: only the treatment room and sterilization area (dirty) is complying with the limit.

- *Aspergillus* species among the most prevalent on surfaces and found in passive methods where was not possible to observe with active methods.

Fungal load on air samples in a) MEA and b) DG18 (The dashed line represents the recommended limit value of ACGIH for fungi (150 CFU.m⁻³), and surface contamination in c) MEA and d) DG18.
Aspergillus sections distribution on air samples collected by impaction method
a) MEA and b) DG18.
Aspergillus sections found in air, surface and HVAC filter samples
a) MEA and b) DG18.
Bioburden exposure assessment in PHCC

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![Image of bar chart showing fungi species identified](chart.png)

Number of different fungi species identified:
- Aspergillus section Versicolores
- Aspergillus section Flavus
- Stachybotrys chartarum
- Aspergillus section Fumigati
- Fusarium culmorum

Legend:
- Air sampling
- Surface sampling
- EDC sampling
- HVAC filters
- Settled dust
4. Main findings discussion

- Passive-collection methods enable the collection of contamination from a larger period of time (days, weeks or several months), whereas air samples can only reflect the load from a shorter period of time (mostly minutes). (Viegas et al. 2018)

- A multi-approach on sampling methods should be implemented to obtain not only the fungal load, but also the contamination.

This sampling protocol will allow an enriched occupational exposure assessment considering both approaches OE and IAQ.
Take home messages (with further results):

- The use of **more than one different media** for mycobiota assessment can also enrich data for the exposure assessment.

- A **multi-approach in the sampling methods and analyses** applied should be the trend.

More refined risk characterization

Suitable risk control measures to reduce workers health outcomes.
Once you stop learning, you start dying.

Albert Einstein

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