Beach sand as a source of faecal indicator organisms.

João Brandão

Dpt Environmental Health, National Institute of Health Dr. Ricardo Jorge

Portugal

joao.brandao@insa.min-saude.pt
FAQ: Can sunlight clean up?

No!

- **2009** Mika *et al.* showed that irradiation during day time doesn’t help reducing E. coli in the sand.

- **2012** Heaney *et al.* showed positive relationship between sand-contact activities and enteric illness.

- Fungi are very resilient, even in drier climates and bacteria lurk under the surface.

• “From a recreational viewpoint, sand beaches are sought after. Especially in higher latitudes, a significant percentage of time is spent on the beach itself rather than in the water.”

• “A number of genera and species that may be encountered through contact with sand are potential pathogens. Accordingly concern has been expressed that beach sand may act as reservoir of vectors of infection.”
There is no legislation or regulation in Europe or elsewhere in the world!

- The European Bathing water Directive contemplates surrounding areas to bathing waters because those may influence water quality but....

...Doesn’t specify sand-specific contaminants or sand as its own entity.
It’s a mess right now!
Different perspectives

SAND

- Sandboxes
- Beach
- Recreational parks

Viruses
Bacteria
Fungi
Parasites

FIB
Sub-standard recreational water quality (closes beach from public use)

Opportunists/Pathogens
Allergenic

Medical relevance
What’s missing?

1. A **consensus** in methods and parameters based on a wide review proposal of papers on sand contaminants

2. More epi studies to demonstrate the need to regulate

3. Regulation

4. Confirm efficiency of regulation
Scientific community is waking up

Publications on Sand Contaminants
Air and water currents of the world

https://i.stack.imgur.com/N3mFm.jpg
Temperature anomalies arranged by country 1900 – 2016

by Antti Lipponen
(Finnish Meteorological Institute) @ Kuopio - 2017
Climate change is generating changes in microbial communities... reports

- *Vibrio spp* in Europe
- *Vibrio vulnificus* infections in Florida
  ([http://www.floridahealth.gov/newsroom/2015/06/061215-fl-beaches.html](http://www.floridahealth.gov/newsroom/2015/06/061215-fl-beaches.html))
- *Cryptococcus gattii* is being found all over Europe
- Blackmould is becoming a major indoor contaminant in developed regions
- *Cladophialophora bantiana* is now a pathogen (BSL3)
- Canine cyano-intoxication reports increasing in the USA (see next slide)
Canine cyano-intoxication reports increasing in the USA
Effects of a Changing Earth on Predicting Microbial Dynamics and Human Health Risks in the Beach Water/Sand Continuum

Outline and Team leaders

• Introduction lead by Jody Harwood and Mike Sadowski
• Pathways to the Beach lead by Thomas Edge and Erin Symonds
• Moving Around lead by Clare Robinson and Laura Vogel
• Hangouts lead by João Brandão and Helena Solo-Gabriele
• Bummers lead by Gregory Kleinheinz and Meredith Nevers
• Putting It All Together (Modeling) lead by Ali Boehm and Mantha Phanikumar
• Effect of Climate Change on Microbial Fate and Transport (A changing world, e.g. temperature, precipitation, storm events, sea level rise, population increase, changing land use) lead by Christopher Heany and Tarja Pitkänen
• Discussion lead by Chelsea Weiskerger and Richard Whitman

20th of February 2010 - An active cold front combined with Atlantic low-pressure and temperature differences of the sea surface with unusually warm waters from West Africa, affected Portugal, Spain, Morocco and the Canary Islands, causing flooding, rain and strong winds. Madeira, has different types of beaches within a small coastline and severely affected. Between 6 a.m. and 11 a.m., 108 mm of rain were recorded at Funchal weather station and 165 mm at Pico do Areeiro (1818m of altitude).

The entire February’s month average rainfall in Funchal is 88.0 mm. The South of the island was severely affected by flashfloods, originating mudslides that tore down everything along the way. Devastation was high and costly, both in lives and economically. The areas affected the most were Funchal, Ribeira Brava, Câmara de Lobos and Santa Cruz.

The impact of this event in microbiological communities caused a notorious peak of Enterococcus spp., E. coli and sporulating fungi, both in sand and water until September of the same year. Bathing water and sand quality monitoring revealed that both water and sand profiles were profoundly altered for months to follow.
Microbial fluctuation of FIB and Fungi in sand and in coastal water

**Bacteria: A story of ups and downs**

Annual trends showed high values in 2010, and a gradual decrease throughout the years, with a small occurrence for bacteria in the following years (2).

**Fungi: A story of persistence**

After experiencing high values in 2010, yeasts and dermatophytes tend to decrease whilst potentially pathogenic fungi seem to be persistent during the course of time (2).

Beach water *E. coli* profiling of 2010 shows that Praia do Vigarão is one of the most affected areas (data from Madeira island only).

Beach water *Enterococci* profiling of 2010 shows that Praia do Vigarão is one of the most affected areas (data from Madeira island only).

Beach water *Enterococci* profiling of 2011 showing return to normality (data from Madeira island only).

Beach water *E. coli* profiling of 2011 showing return to normality (data from Madeira island only).

2010 shows higher maximum values, but variation is continuously high throughout the years.
Conclusions

• Bacteria suffer a higher fluctuation, but fungi populations such as yeasts and dermatophytes are also affected.

• The only sand-renourished beach took more time to recover from the event, especially concerning fungi.

• The chemical composition and granulometry of sand were not influencing factors in the microbial load and survival, following the extreme weather event.

• Surveillance and rapid public health response can restrict infectious diseases from spreading but, knowledge of microbiological profiles of exposed, and therefore susceptible, environments can also help predict the emergence of potential pathogens
Exploring fungal contamination in the sand and water around the Mediterranean Sea and other water bodies of Europe

- **Project Leader**: Prof. Esther Segal; segale@post.tau.ac.il; Tel Aviv University, Sackler School of Medicine, Dep. of Clinical Microbiology and Immunology.
- Co-lead by João Brandão
- Promoted by the European Confederation of Medical Mycology (ECMM)
- **Parameters**:  
  - Dermatophytes – indicators of human/animal dermal contamination (including the *Arthroderma insingulare* complex, formerly known as *Trichophyton terrestre*)  
  - *Candida albicans* – indicator of human fecal contamination,  
  - Allergenic fungi – *Aspergillus, Penicilium*
- **Geo parameters**: Target is all of Europe, sectioned by climates, geological characteristics and fresh water and seawater. A strong participation of the Mediterranean coast, where tourists tend to congregate the most during warm months, is highly desired.
- **Methodology**:  
  - Culture and quantification  
  - Molecular methodology
- **Duration**: one year (tests will be carried out during all 4 seasons). After that year, data will be analyzed and decision will be made as to generate more data or to end the project and publish the results
**Reference values for sand quality assessment based on national means**

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<tr>
<th>Mycology Parameters:</th>
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<tbody>
<tr>
<td>1. Yeasts</td>
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<tr>
<td>2. Potential pathogenic moulds (filamentous fungi)</td>
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<tr>
<td>3. Dermatophytes</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Bacteriology Parameters:</th>
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</thead>
<tbody>
<tr>
<td>1. Total coliforms</td>
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<tr>
<td>2. <em>E. coli</em></td>
</tr>
<tr>
<td>3. <em>Enterococci</em></td>
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Beach managers were instructed on how to control contaminant levels.

Result: Drastic reduction of contaminant levels from the first sampling (pre-bathing season) to the following two (during bathing season) after the first year of the project (2006)
Factors that positively influence the quality of beach sand

• **Garbage removal** - Frequent removal of litter and garbage from sand and neighbouring areas;

• **Garbage receptacles** - Number of garbage receptacles appropriate for the length of the beach;

• **Sand treatment** - based on experience of one region with weekly iodine spraying (this statement does not express the point of view of the authors);

• **Surroundings** - Identification and treatment of neighbouring contaminated areas
Factors that negatively influence the quality of beach sand

• Over-use of beach
• Admission of pets
• Accumulation of garbage
• Abandonment of remains from fishing
• Rodents and prowling animals
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Beach sand and the potential for infectious disease transmission: observations and recommendations

HELENA M. SOLO-GABRIELE1,2, VALERIE J. HARWOOD3, DAVID KAY4, ROGER S. FUJIOKA5, MICHAEL J. SADOWSKY6, RICHARD L. WHITMAN7, ANDREW WITHER8, MANUELA CANIÇA9,10, RITA CARVALHO DA FONSECA11, AIDA DUARTE12, THOMAS A. EDGE13, MARIA J. GARGATE14, NINA GUNDE-CIMERMAN15, FERRY HAGEN16, SANDRA L. MCELellan17, ALEXANDRA NOGUEIRA DA SILVA18, MONIKA NOVAK BABIĆ19, SUSANA PRADA19,20, RAQUEL RODRIGUES21, DANIELA ROMÃO22, RAQUEL SABINO14, ROBERT A. SAMSON22, ESTHER SEGAL23, CHRISTOPHER STALEY6, HUW D. TAYLOR24, CRISTINA VERÍSSIMO14, CARLA VIEGAS25, HELENA BARROSO26 AND JOÃO C. BRANDÃO14

1University of Miami Center for Oceans and Human Health, Key Biscayne, FL 33149, USA, 2Department of Civil, Architectural, Environmental Engineering, University of Miami, Coral Gables, FL 33146, USA, 3Department of Integrative Biology, University of South Florida, SCA 110, 4202 E. Fowler Ave., Tampa, FL 33620, USA, 4Centre for Research into Environment and Health, Inst of Geography and Earth Sciences, Aberystwyth University, Aberystwyth SY24 3DB, UK, 5Water Resources Research Center, University of Hawaii, Honolulu, HI 96822, USA, 6Department of Soil, Water, & Climate, and BioTechnology Institute, University of Minnesota, St Paul, MN 55108, USA, 7Former Chief, Lake Michigan Ecological Research Station, USGS, 1088 N 350 E., Chester IN 46304, USA, 8National Oceanography Centre, Liverpool L3 5DA, UK, 9National Reference Laboratory for Antibiotic Resistance – Department of Infectious Diseases, National Institute of Health Dr Ricardo Jorge, Av. Padre Cruz 1649-016 Lisbon, Portugal