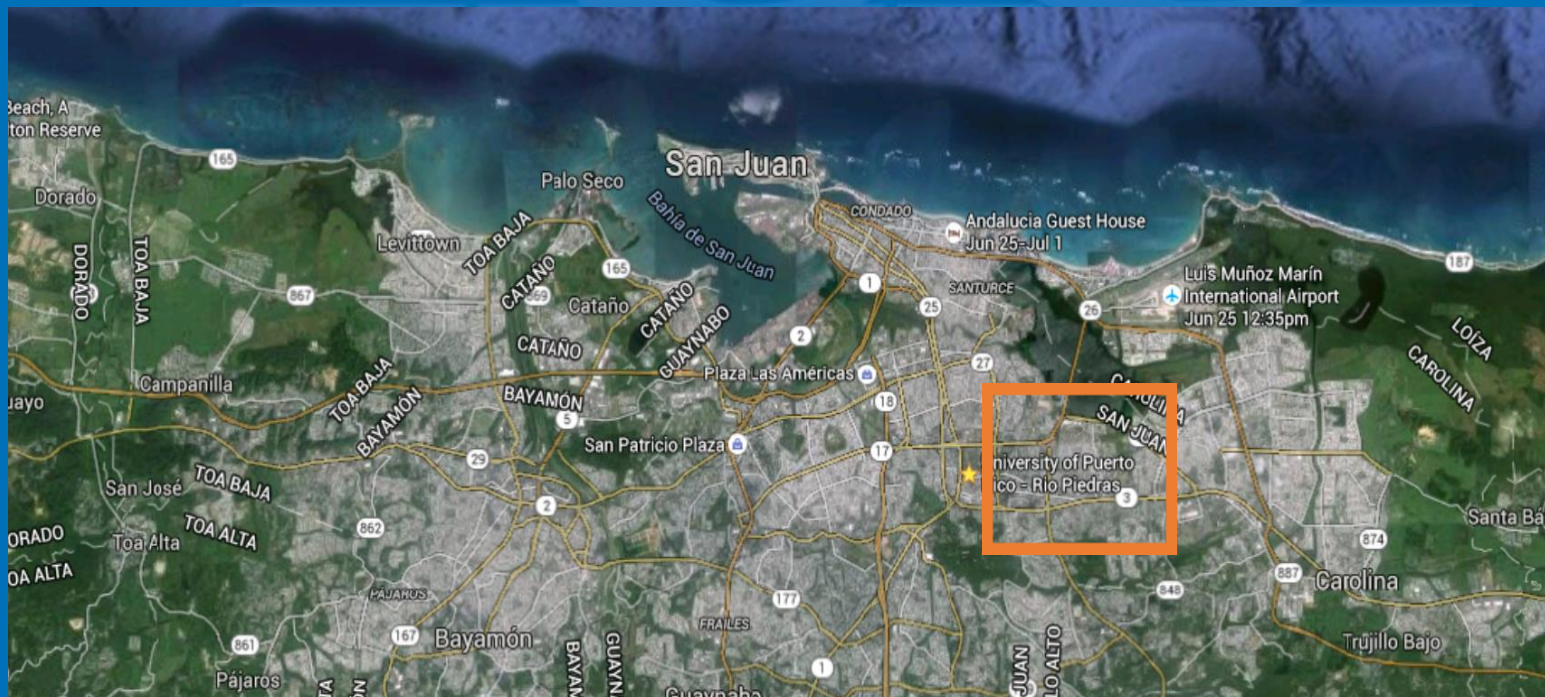


An EPA pilot study characterizing fungal and bacterial populations at homes after flooding events at the Martin Peña channel community – Puerto Rico



Doris Betancourt, NRMRL/APPCD/IEMB
Timothy Dean, NRMRL/APPCD/IEMB
Stephen Vesper, NERL/EMMD
Evelyn Huertas, CEPD/MPCB



Collaborators

- Dr. Benjamin Bolaños, University of Puerto Rico
- Dr. Filipa Godoy-Vitorino, Interamerican University, PR

Overview

- Background : Indoor Air Quality (IAQ) and Mold 101
- EPA ongoing study at Puerto Rico - Martin Peña Channel Community(MPC)
- Anticipated results and regional impacts
- Anticipated Products



Why indoor air quality is so important?



- **We spend aprox 90 % of our time indoor**
- **IAQ problems originate from the release of gases and particles into the air**
- **Expensive to society: estimated cost of 150 billion/yr due to sickness and lost productivity**



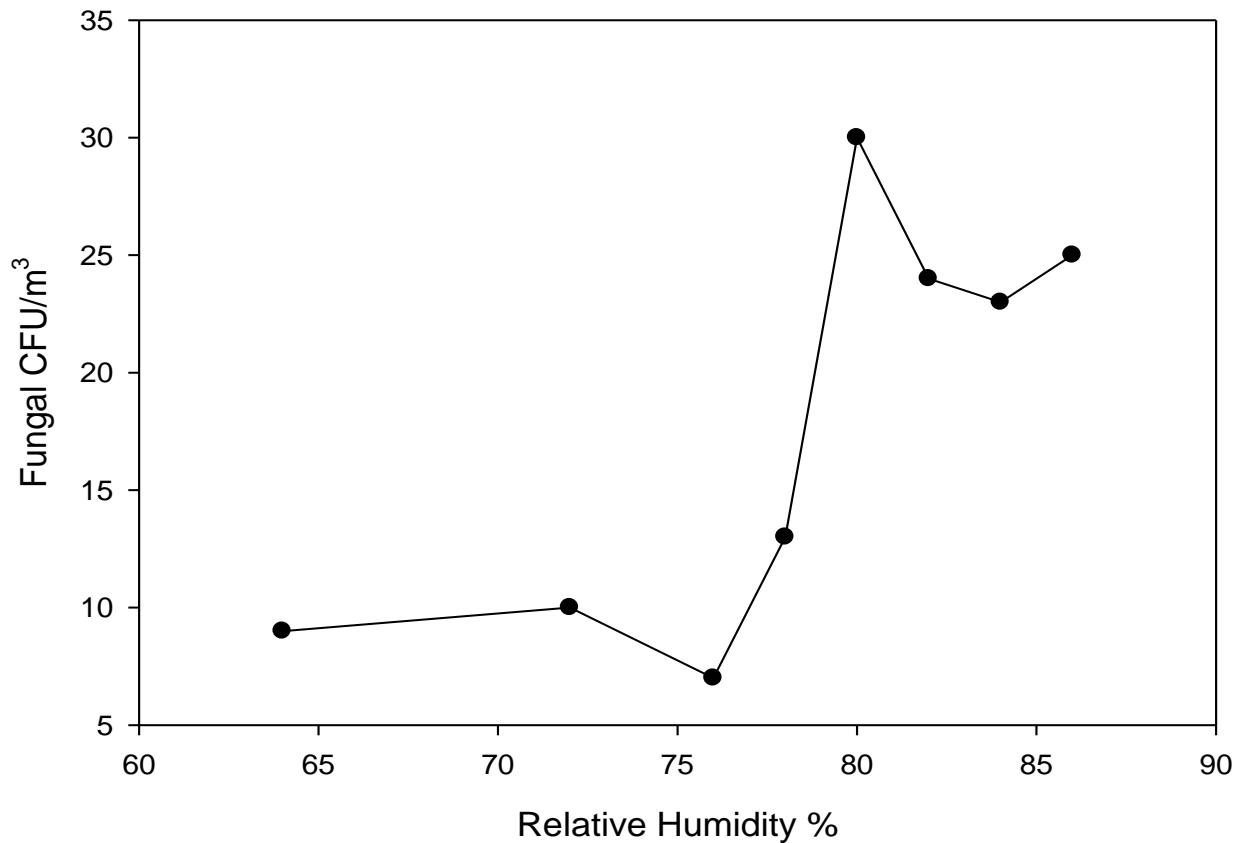
Typical Sources of Indoor Air Biocontaminants

Outside Sources	Building Equipment	Components/ Furnishings	Other Indoor Sources
<p>Polluted Outdoor Air Pollen, dust, fungal and bacterial spores</p>	<p>HVAC equipment Microbiological growth in drip pans, ductwork, coils, and humidifiers</p>	<p>Components Microbiological growth on soiled or water-damaged materials. Materials that produce particles (dust)</p> <p>Furnishings Microbiological growth on or in soiled or water damaged furnishings</p>	<p>Occupants with communicable diseases Food prep areas Smoking lounges</p>

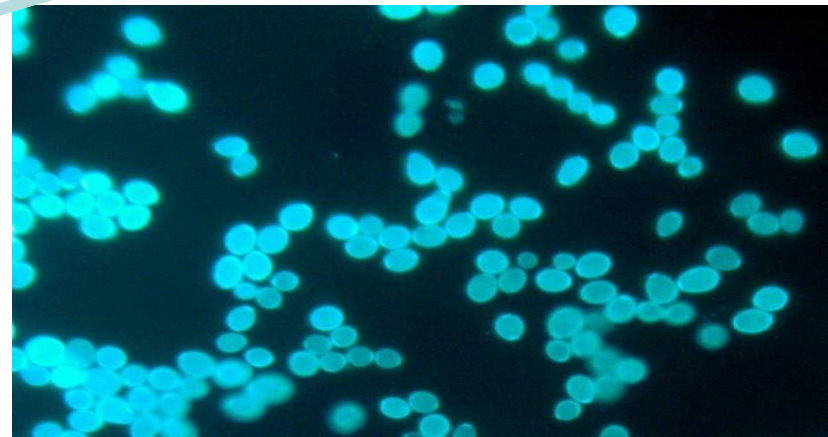
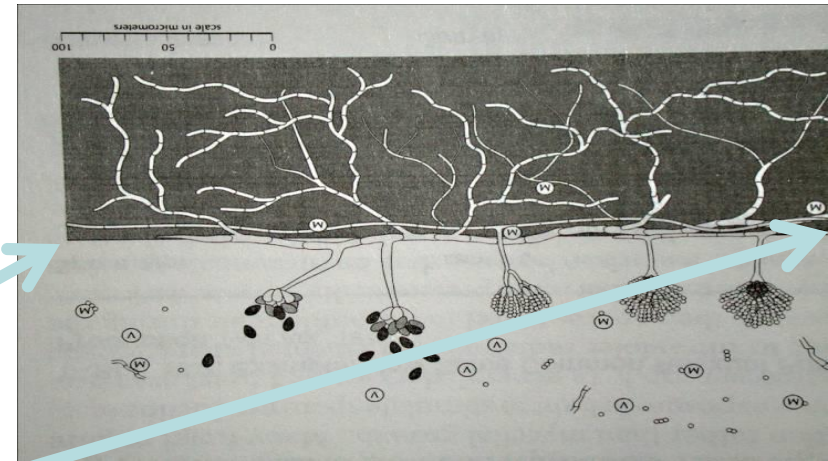


Relative Humidity > 70% Promotes Fungal Growth

Correlation of fungal Bioaerosols and Relative Humidity



Indoor molds: spore aerosols



Species	Production unit	Spore production
<i>Penicillium sp</i>	Colony 2.5 cm diam.	4×10^8 spores total

Mold



- Filamentous Fungi
- Eucaryotic
- Multicellular
- Cell wall
- Produce spores
- Grow at 25 °C and in humid environments

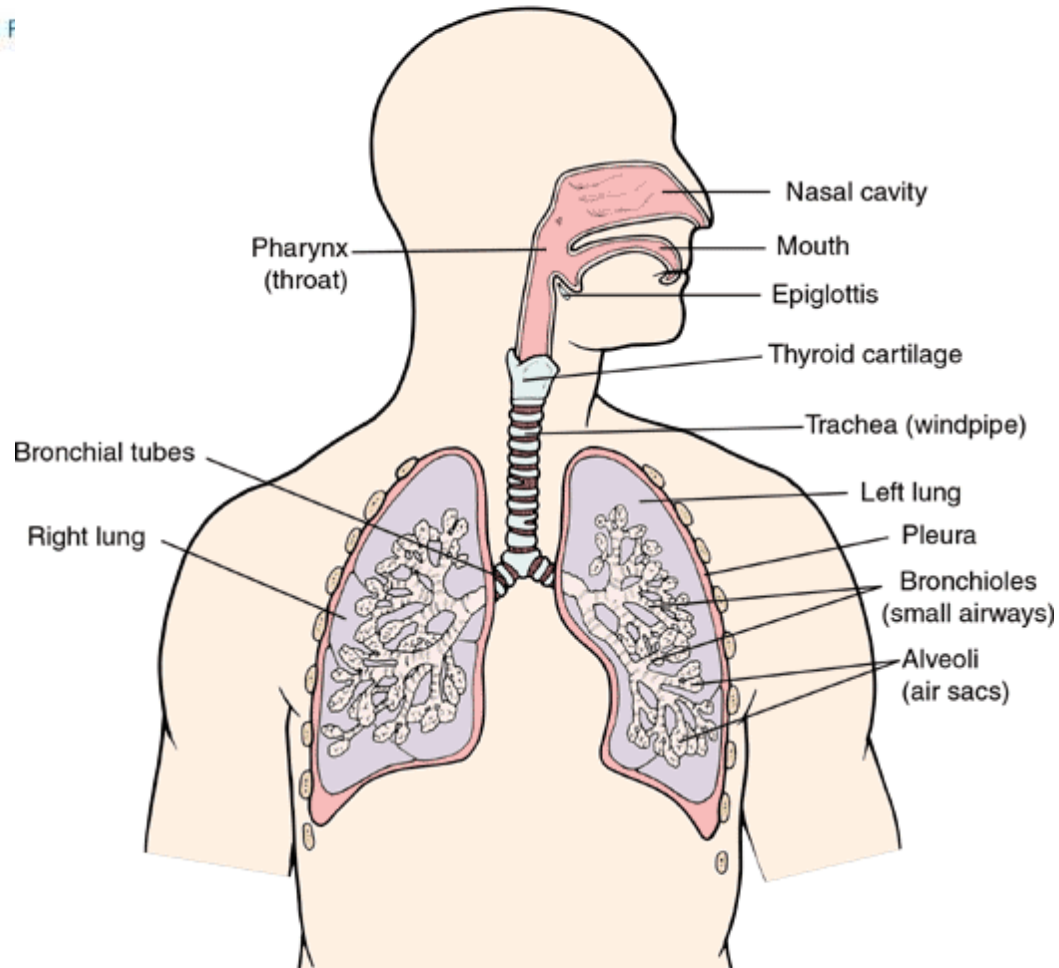
Mold



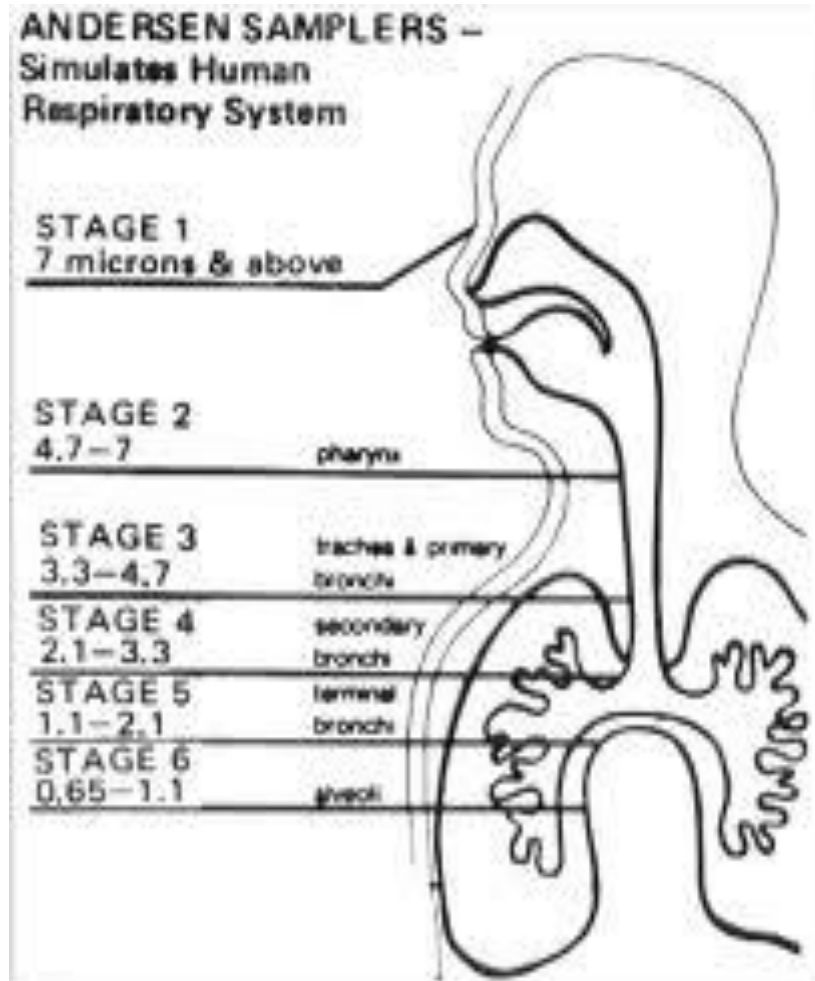
Mold Derivatives

- Proteins
- β -(1,3)-D-glucanes
- MVOC
- Mycotoxins

Respiratory System



Respiratory System



Mold and Disease

Inflammatory Illnesses

- Airways inflammation
- Chronic bronchitis
- Hypersensitivity pneumonitis
- Asthma
- Rhinitis
- Conjunctivitis

Generalized ailments

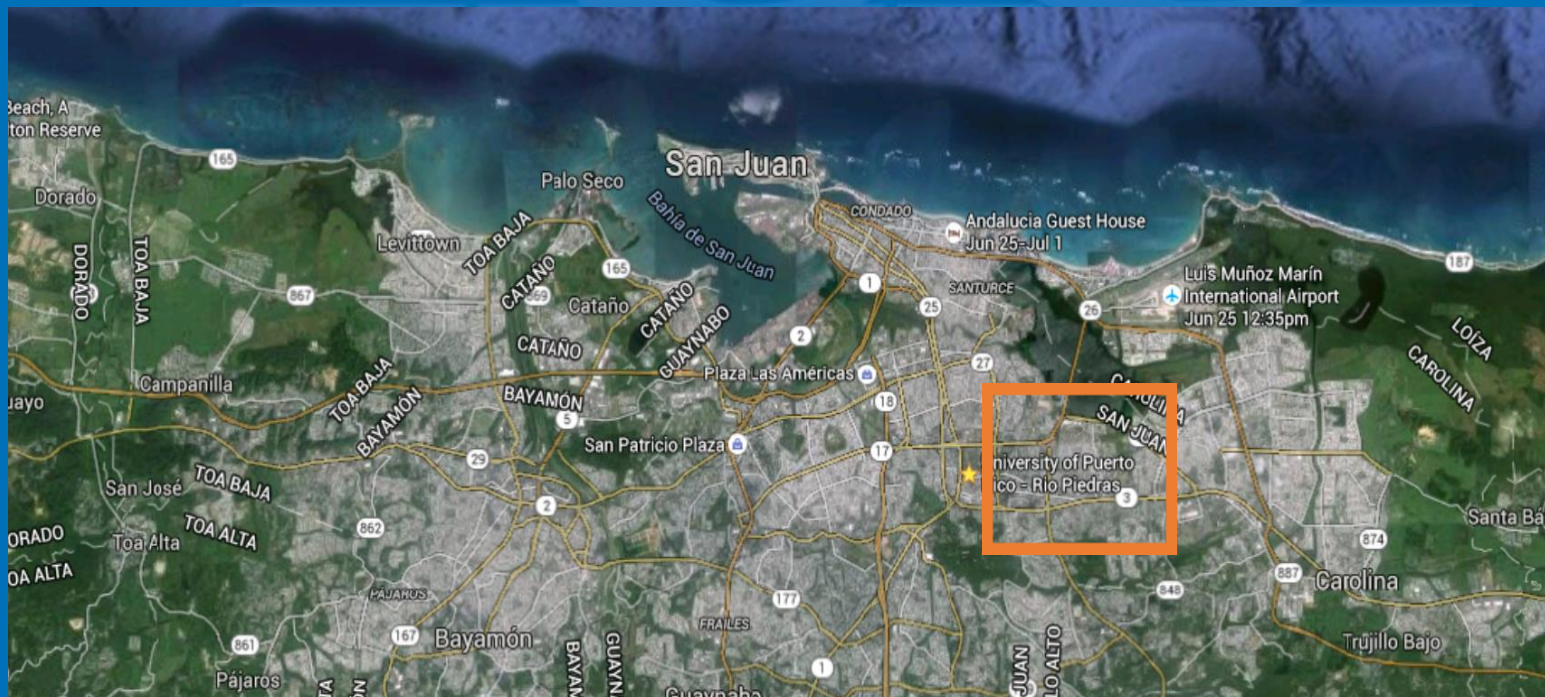
- Headache
- Fatigue
- Joint pain
- Neurological symptoms



Asthma and the Environment

- Research by EPA and others has shown that:
- Molds, dust mites, cockroaches, pet dander, and secondhand smoke trigger asthma attacks.
- Exposure to secondhand smoke can cause asthma in pre-school aged children.
- Exposure to dust mites can cause asthma.
- Ozone and particle pollution can cause asthma attacks.
 - When ozone levels are high, more people with asthma have attacks that require a doctor's attention.
 - Ozone makes people more sensitive to asthma triggers such as pet dander, pollen, dust mites, and mold.
- Learn more at <http://www.epa.gov/asthma>

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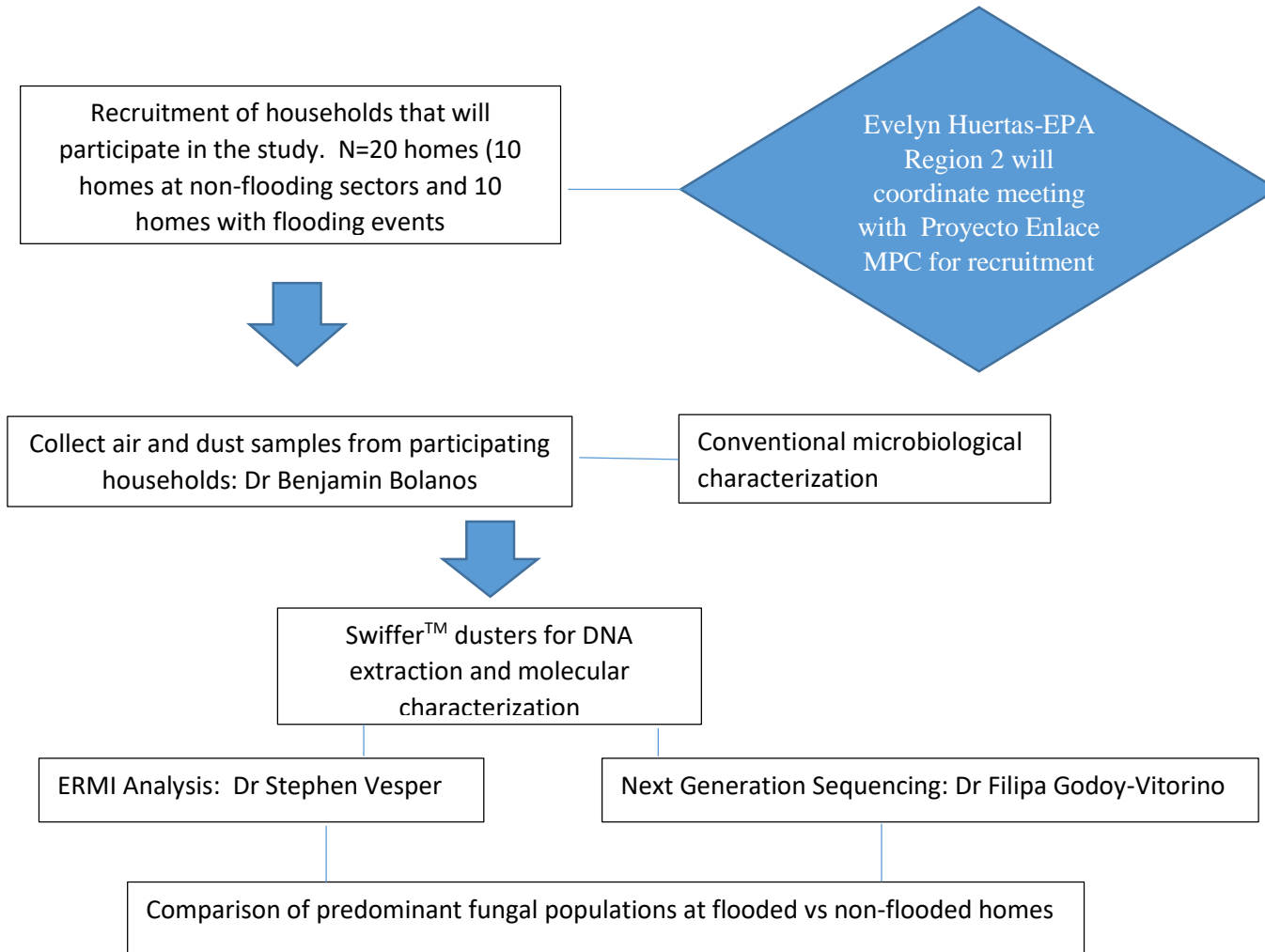
Abstract

- This research proposal aligns with RAP Sustainable and Healthy Communities- SHC 2.61
- The proposed study selected the Martin Peña channel community , San Juan, Puerto Rico
- The high incidence of asthma appear to be associated to deterioration of homes with flooding events and mold exposures

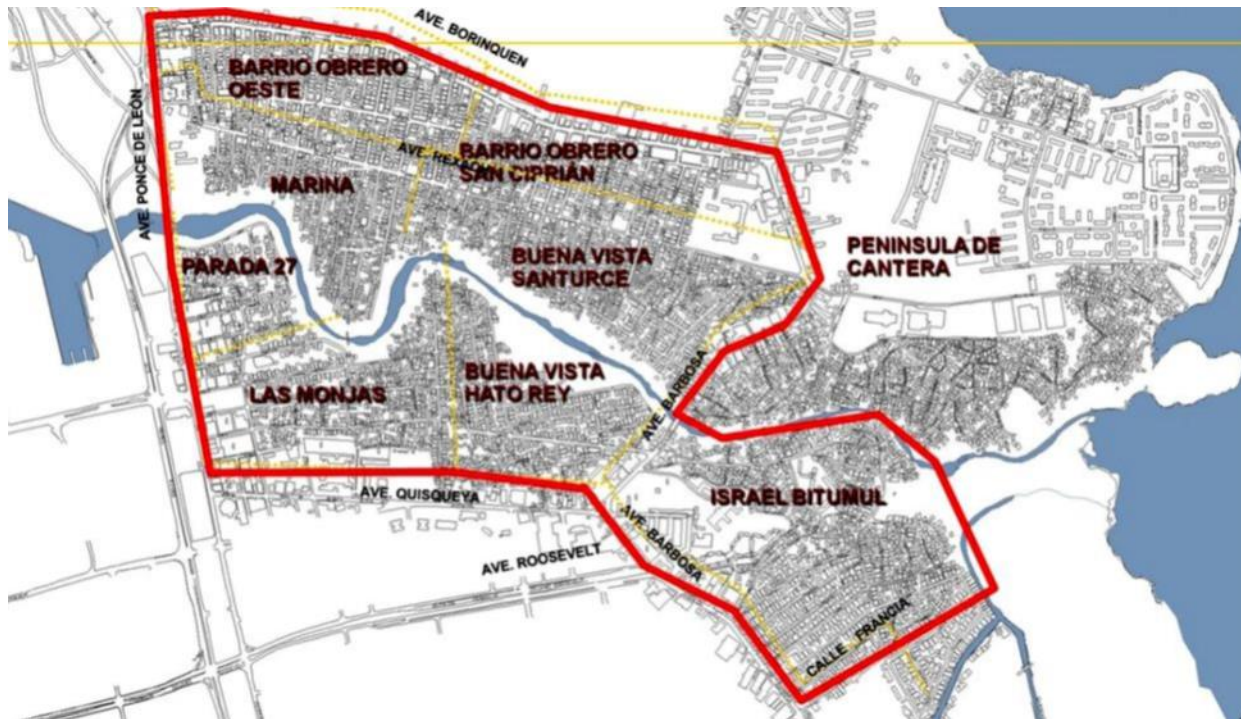
Research Objectives

- Generate a fungal and bacterial population profile comparing non-flooded residences vs residences with flooding events at Martin Peña Channel community
- The most abundant fungal and bacterial populations identified in flooded' residences will be selected for exposure studies of building materials most frequently used in the construction of PR residences and for antimicrobial efficacy tests
- Provide low-cost mitigation solutions for the improvement of the indoor environment in residences with flooding events

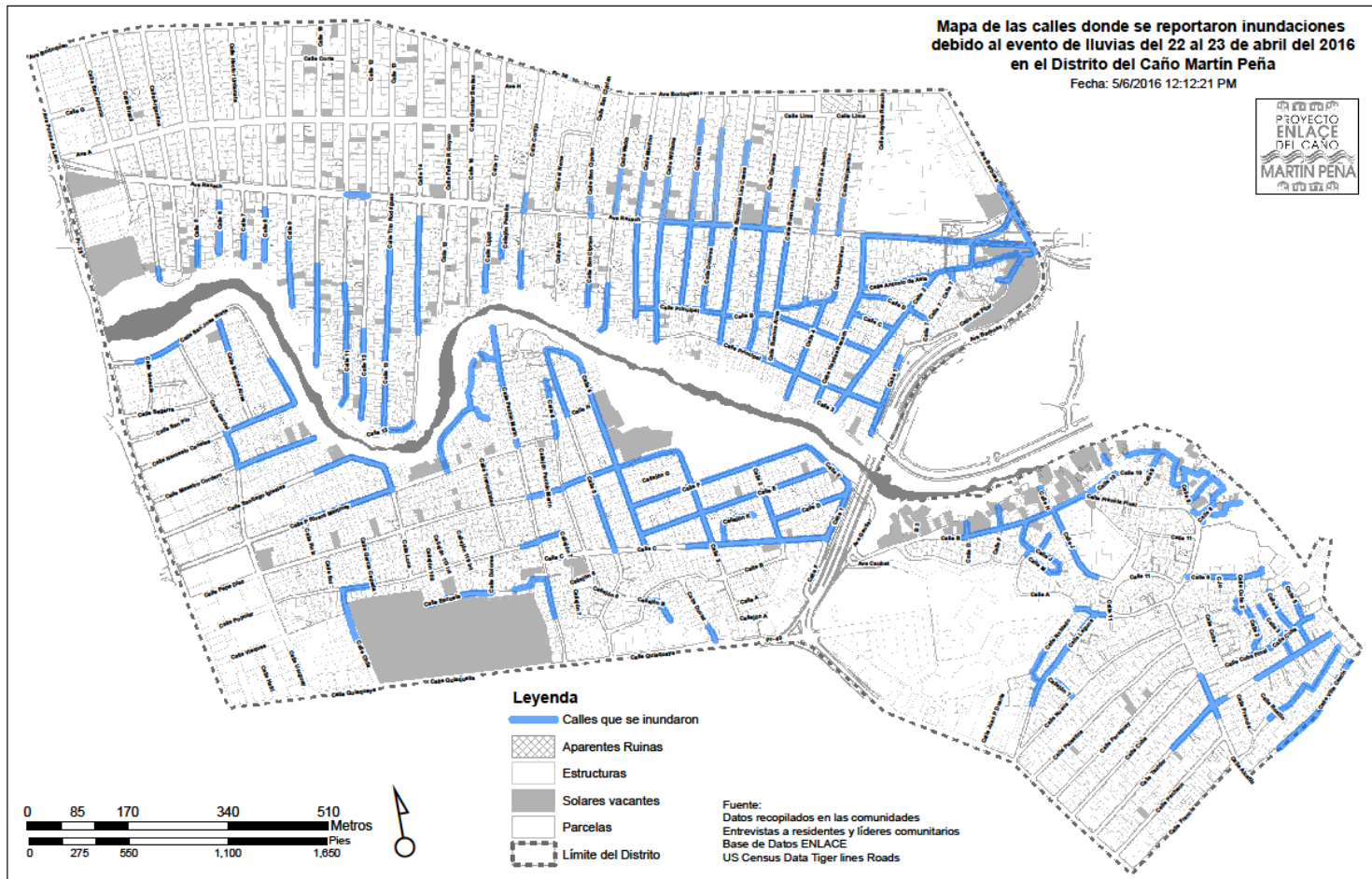
Figure 2: Flow chart of the research approach - Caño Martin Peña Study



Martin Peña Channel Communities

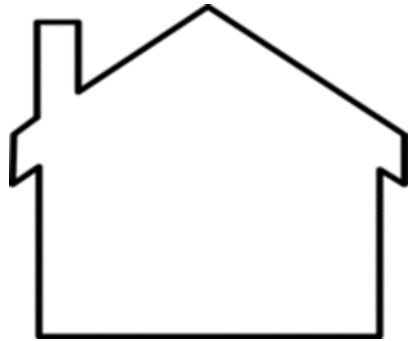


Flooded streets CMP 4/22-23/2016



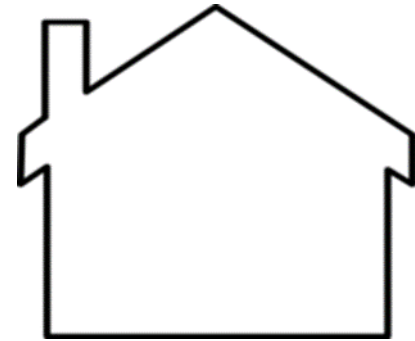
Research Approach

Phase 1



Homes at flooded
sectors

Collect air and dust samples
from houses with flooding
and non-flooding events



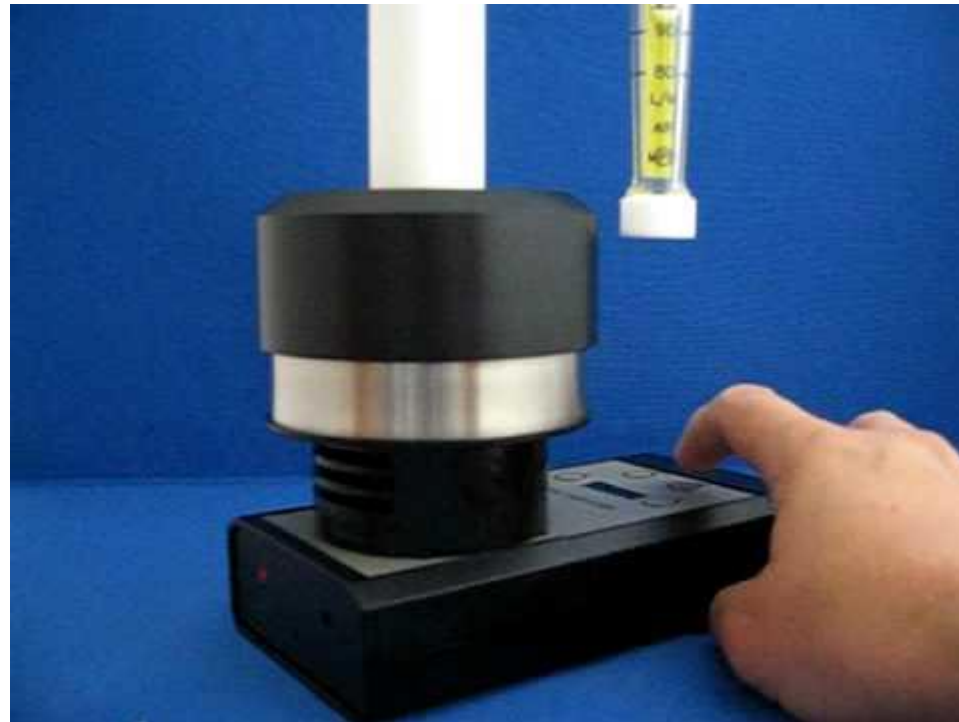
Homes at non-flooded
sectors

DNA extraction and analysis



Determination of predominant fungal and bacterial populations at homes in
flooded sectors

Phase 1: collection of air samples indoors and outdoor



MicroBio Air Sampler MB2

Phase 1: collection of indoor dust samples

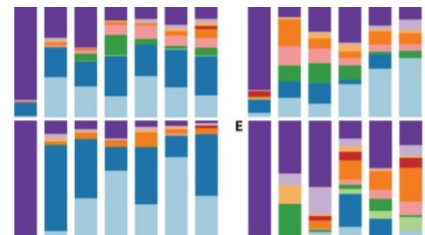


Phase 1: Identification and analysis of fungal and bacterial populations

Conventional Microbiological Methods



Molecular Methods





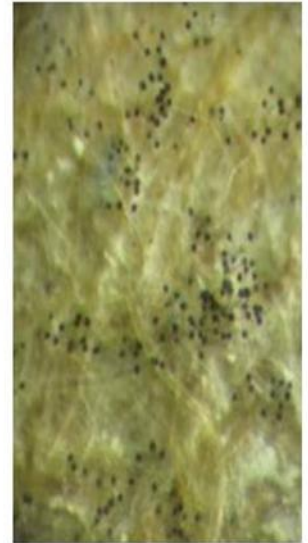
Environmental Relative Moldiness Index (ERMI)- metric or scale to quantify mold contamination

- **METHOD:** DNA-based analysis of 36 molds
- **RESULT:** The result is a single digit- the ERMI value for that home that describes mold contamination. The bigger the number the more mold present.

Research Approach

Phase 2

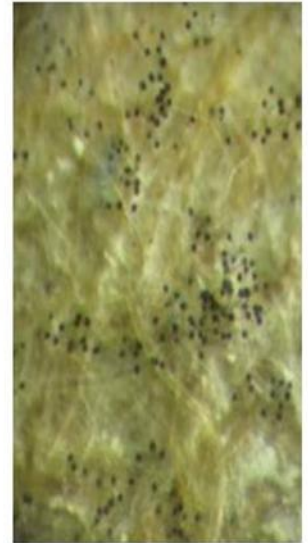
- Chamber studies: exposure of building materials commonly used in PR construction to predominant mold spores identified in the 1st phase



Research Approach

Phase 3

- Antimicrobial efficacy testing: building materials exposed to mold spores will be simultaneously exposed to antimicrobial cleaners to test their efficacy



Anticipated Results and Regional Impact

- Phase 1 : Better understanding of the fungal and bacterial populations in homes susceptible to flooding. Results will help in developing strategies to improve indoor air quality in homes at the MPC community
- Phase 2 & 3 : Provide low-cost mitigation solutions for the improvement of the indoor environment in homes with biocontamination.

Anticipated Results and Regional Impact

- The beneficiaries from this project:
 - ✓ Martin Peña channel communities
 - ✓ Local health centers
 - ✓ Local agencies
 - ✓ EPA Region 2

Anticipated Final Products

- EPA report that will be posted to the public through the EPA website
- Target audience: the Martin Peña channel communities and other PR communities with similar environmental issues



QUESTIONS ?????

