

IAQ

Mold Concerns

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What We'll Cover

Description of Mold

Health Effects

Water Intrusion

Mold Inspection

Sampling

Guidelines & References

Conclusions & Discussion



Key Message

1. It's a facility and maintenance issue
2. The BUILDING is not sick (Sick Building Syndrome)
3. Occupant illness or medical complaints are SYMPTOMS of the BUILDING'S problems
4. At your location, is Safety the point of entry for mold related issues?

Even though medical effects will be covered the key to mold IAQ is building design, maintenance and repair



Fungi (mold)

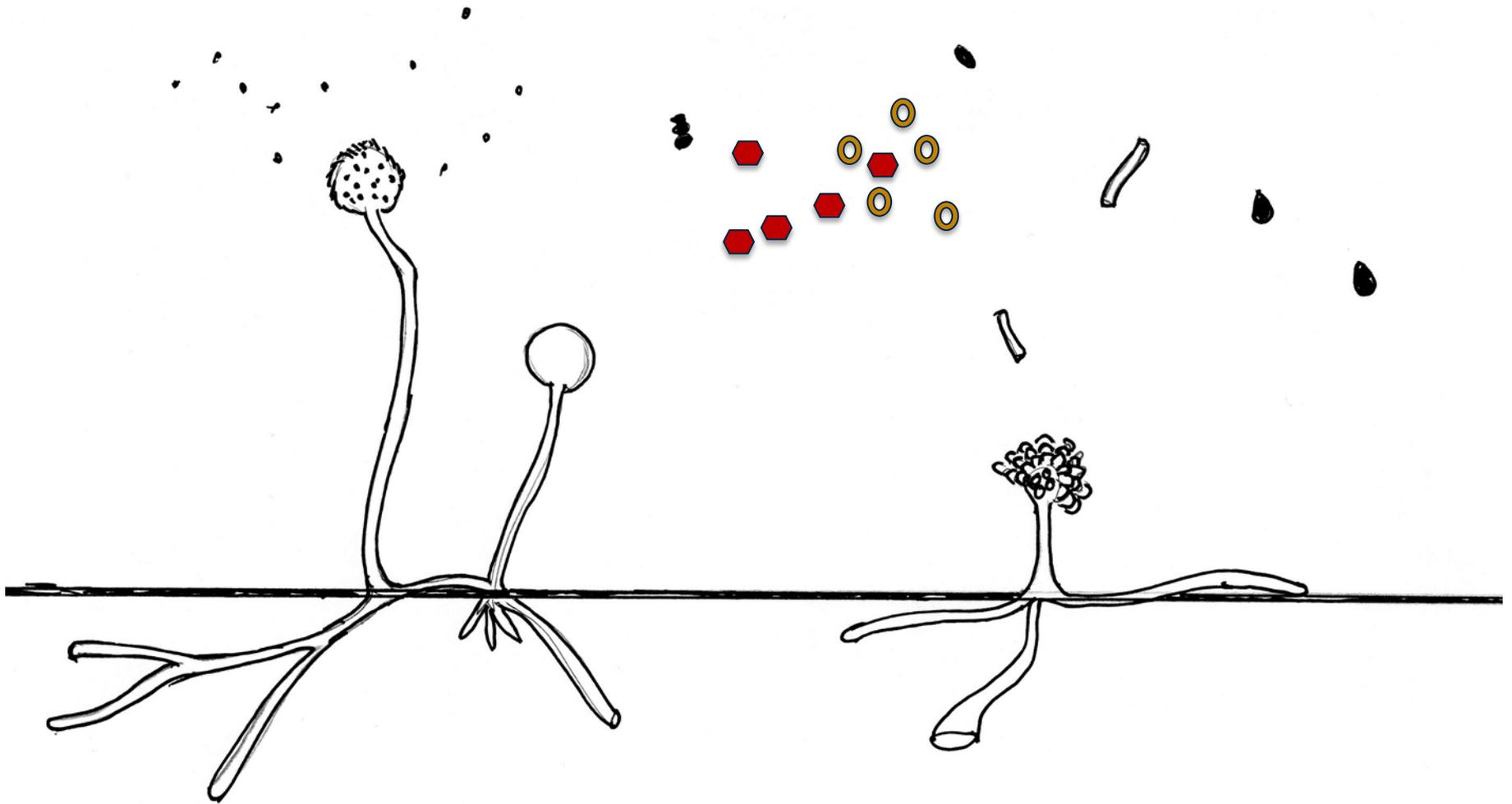
- Unicellular or multicellular organisms classified within eukaryote kingdom
- Perhaps up to a million species
- Naturally ubiquitous in the environment
- Fungal colonies (mycelium) may appear cottony, granular, white, green, gray, brown, black, yellow
- Fungal spores
 - 500 – 10,000 spores / m³ in outdoor air may be typical depending on geographic location, season and weather
 - Indoor air may mimic outdoor air
 - Watch for indoor amplification of species
 - Fungi and spores may be found in settled dust



ACGIH

- **Bioaerosols**: Airborne particles that are living or originate from living organisms (bacteria, virus, fungi, mites, etc)
 - Microorganisms (culturable and non-culturable)
 - Microorganism fragments
 - Associated toxins related to microorganisms
 - Metabolic products
- **Biologic Agent**: Substance of biologic origin capable of producing effect (irritant, inflammation, hypersensitivity)
 - Includes MVOC, mycotoxins, mold particulates





Medical Effects



- Hypersensitivity
 - Undesirable reaction produced by a normal immune system
 - 10% general population genetically sensitive to mold (atopic have IgE antibodies). Half of this population (5%) may demonstrate allergic symptoms.
 - Alternaria, Aspergillus, Cladosporium and Penicillium
 - Epidemiologic allergic rhinitis association in literature but confounded by multiple sensitivities. Causal relationship not demonstrated.
 - No credible conclusive reports documenting indoor air exposure to molds as a cause of nonatopic IgE-mediated disease.
 - Patients treated for symptomology
 - Common for individuals to have multiple sensitivities

Medical Effects

■ Asthma

- (IOM) Sufficient evidence of association of indoor air fungi exposure to asthma exacerbation in sensitive individuals
 - Evidence of causal relationship not demonstrated
- (IOM) Insufficient evidence of indoor air fungi exposure and asthma development in children
- Irritants vrs. allergens
 - Allergens are only problematic for asthmatics allergic to them
 - Irritants such as tobacco smoke may lead to asthma symptoms for any person with asthma



Medical Effects

- Microbial Volatile Organic Compounds (MVOC)
 - May be irritating to upper airway and nasal passageways
- Mycotoxins (not volatile)
 - Primary exposure route: dermal, ingestion (ie, usually contaminated food)
 - Large dose > 1 mg/Kg body weight exposure from food may be severe
 - Avoid toddler exposure during remediation
 - Requires route of exposure and sufficient dose for effect
 - Mucosal irritation, rash, nausea, possible immunosuppression
- Glucans (cell wall components)
 - Irritant effects



Stachybotrys

- Mid-1990's paper suggested link between *Stachybotrys chartarum* (atra) and infant idiopathic pulmonary hemorrhage.
- Current CDC: To date, a possible association between acute idiopathic pulmonary hemorrhage among infants and *Stachybotrys chartarum* (*Stachybotrys atra*) has not been proved. Further studies are needed to determine what causes acute idiopathic hemorrhage.
- It can grow on material with a high cellulose and low nitrogen content, such as fiberboard, gypsum board, paper, dust, and lint. Growth occurs when there is moisture from water damage, excessive humidity, water leaks, condensation, water infiltration, or flooding. Constant moisture is required for its growth.



Medical Effects

- At Risk Individuals
 - Immune System Suppressed / Compromised
 - Cystic Fibrosis
 - Chemotherapy Patients
 - AIDS
- Risk factors and associated reduction should be discussed between patient and provider
- Patient should have a good command POC to address IAQ concerns regarding air quality or exposure if they are at risk



Medical Effects from Extreme Exposure

- Occupationally related disease (alveolitis, pneumonitis) does occur in specific exposure scenarios
 - Typically requires heavy prolonged dust exposures containing fungi.
 - Farmer's lung (actinomycetes)
 - Maltworker's lung (*Aspergillus clavatus*)
 - Cheesewasher's lung (*Penicillium casei*)
 - Dog house disease (*Aspergillus versicolor*)
 - “fog of particulates”. Exposure range 10,000 – 100,000,000 spores / m³
 - **This is special case exposure and not traditional IAQ**



Indoor Air and allergens

- 50% of homes have at least 6 detectable allergens present (AAAI)
 - Cigarette smoke, dust mites, cockroaches, pet dander, pollens, chemicals
 - Pets bring in outdoor allergens
 - Carpets may act as reservoir for allergens
 - HVAC filters need to be monitored and replaced
 - HEPA vacuum furniture

- There are no threshold exposure standards (limit values) regarding mold spores, MVOC, etc.
 - Individual susceptibility
 - Uncontrollable in the environment
 - Difficult compliance
 - Sampling variability
 - Organism variability
 - Other contributing factors for individual allergic response
 - No scientific basis for a standard



Mold Growth within 24 – 48 Hours

Water

- Leaky pipe
- Leaky roof
- Seep holes
- Condensation (HVAC, windows)
- Cracked slabs
- Disconnected high moisture ventilation
- Showers, tubs
- Poor seals
- Humid areas

Nutrients

- Wood
- Paper
- Drywall
- Plastic
- Grout
- Skin

Temperature: 40 – 100° F
Relative Humidity: > 60%

Wet / dry cycles can make detection by workers
difficult



Mold Inspection

Snapshot in Time

- Visual walkthrough (preliminary and follow-up)
 - Document occupant concerns
 - Document active water intrusion
 - Document evidence of past water intrusion
 - Document active mold growth
 - Document professional judgment on previous mold growth
 - Estimate extent (inches, feet)
- Non-destructive testing
 - Tape samples, air samples
 - Moisture meters ($a_w > 0.7$, Equil RH $>70\%$), relative humidity meters
 - infrared
- Destructive testing (investigation damages material)
 - Examples: borescope, lift flooring, remove drywall, bulk samples, etc
- Could recommend or estimate scope of work
 - Agree to this prior to inspection



Sampling and Testing

- Tape sample and Accredited lab microscopy (48 hrs)
 - Determine types of mold present
 - Does not distinguish between viable or relic colonies
 - Not quantitative
 - Results: Numerous, moderate, low
 - Debris field may underestimate result
 - Hyphae may indicate past or present growth
 - Numerous spores may indicate past or present growth
 - Zero spore result is uncommon
 - Current mold growth, past mold growth, settled spores, HVAC or filter dirty? Put tape sample results in context of the visual inspection and other results

- Bulk sample and Accredited Lab (5 – 7 days)
 - Determine types of mold present
 - Can be used clinically to test patients for allergens
 - Sample can be archived
 - Follow lab guidance for sample packaging and shipping
 - Semi-quantitative
 - Results: CFU / gm or area , spores / gm or area



Sampling and Testing

- Air sampling for culturable fungi or total spore count
 - Types of samplers: impactors, slit, centrifugal, gravity, liquid impingers, filters, agar surface, spore trap
 - Compare indoor to outdoor concentrations
 - Preliminary results may lead to further investigation by species (amplification)
 - Rule of thumb is indoor 50% of outdoor - not etched in stone
 - May require multiple samples and/or logarithmic treatment of data
 - Affected by environmental conditions
 - Sample data can be quite variable
 - Single short term samples may difficult to assess
 - Efficiency consideration of sampling equipment
 - Inlet: entrain particles without bias
 - Removal: separate particles from airstream
 - Biologic recovery: assay without affecting viability or physical integrity of biologic agent
 - PCR or assay possible (collection method must line up with lab expectation)
 - Results: CFU / m³ , total spores / m³



Prevention and Mitigation

- Mold inspection results used for mitigation and repair – **are not** useful for medical outcomes or prediction
- Facility mitigation of mold will vary depending on extent of growth, length of time, degree of water damage, state law, other guidelines
- Proactive maintenance measures are crucial
 - Responsiveness
 - Eliminate intrusion or condensation rather than continually fixing the same problem
 - Policy and information to occupants
- Occupant or resident risk factor reduction can be considered
 - Housekeeping
 - Carpet removal
 - Pet considerations



Useful Documents and Guidelines

<http://www.nmcphc.med.navy.mil/>

- Industrial Hygiene and exposure
 - ACGIH
 - AIHA
 - EPA
 - Navy IH Field Operations Manual
 - OPNAVINST 5100.23 (IAQ)
- Medical
 - Centers for Disease Control
 - Institute of Medicine
 - American Academy of Allergy, Asthma and Immunology
 - American Academy of Occupational and Environmental Medicine



Other useful Documents or Resources

- Housing and Urban Development
- Institute of Inspection Cleaning Restoration Certification
S300, S500, S520 (the Cleantrust)
- National Air Duct Cleaners Association (NADCA)
- Standard 62.1-2010 -- Ventilation for Acceptable Indoor Air Quality
(ANSI Approved)



NAVFAC PPV

- NAVFAC contract with private companies to manage housing
 - 50 year contract
 - Oversight by NAVFAC with review of pertinent metrics
- Navy Medicine cannot provide direct service or consult to private companies
- Navy Medicine can provide advisement services to NAVFAC directly
 - NMCPHC look at whether language can be inserted into IHFOM
 - BUMED Guidance?



Summary and Conclusions

- Water intrusion issues need to be addressed by maintenance within 24 hours of notification
 - Obviously, flooding and extreme cases need to be addressed immediately
- Key to mold control is maintenance and elimination of water intrusion
- 5 states have regulations for mold inspection and remediation and may apply
- Mitigation of mold will vary depending on extent of growth, length of time, degree of water damage, state law
- Medical effects are allergic response for general population however there may be some at risk individuals



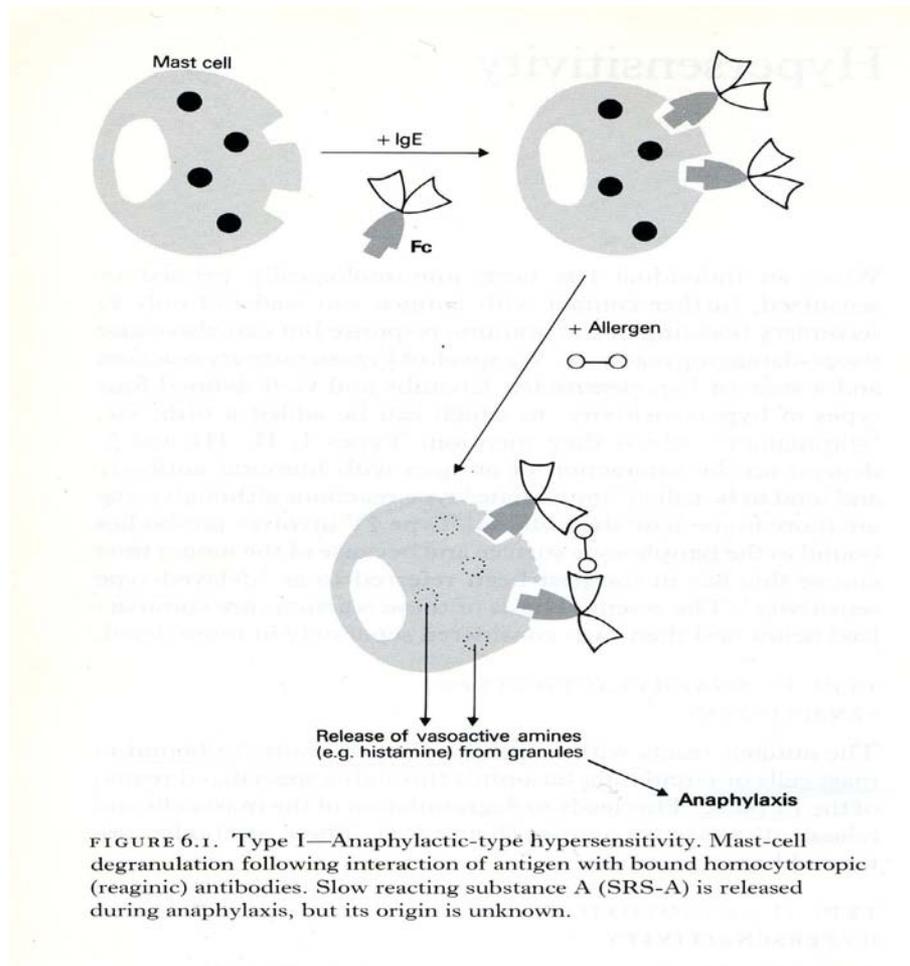
Extreme Case Post Flooding



BACKUPS



Type I IgE Mediated Hypersensitivity



EPA Relative Moldiness Index (ERMI)

- Requires mold specific Polymerase Chain Reaction (PCR) of a standard panel of species
- Will need to rely on large national database of homes throughout the U.S. (currently do not have)
 - Account for seasonal, geographic, neighborhood variance
- Requires log transformation for each spore count
- Compares typical and atypical homes
 - Group I (molds found in water damaged homes)
 - Group II (molds found in all homes)
- Can be used as a tool – but use caution

