Avoiding the Second Wave of Sandy - Indoor Mold Health Risk

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In collaboration with
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Wayne Gordon (MSMC, New York, USA)
Fungal Research Group Foundation, Albany, N.Y.
Mummy’s wrath…. And mold?
“Sandy Cough Plagues Homeowners Cleaning Up”

Remediation worker in Germany

“A living, lurking threat in Sandy-hit homes: mold”

“Superstorm Sandy Deaths, Damage And Magnitude: What We Know One Month Later”

Huffingtonpost 11/29/12

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Overview

• Medical Cases – Sentinel Investigations
• Pathology Synopsis
• Epidemiological Studies
• Review & “evidence” papers
• Critical Remarks
• Summary & Conclusion
• Outlook
Sentinel Case Investigation-1

• 30 y female museum worker/volunteer
  – Clean-up moldy cardboards / paper in basement for 3 days

• Acute Sx
  – Gastro-intestinal (? Gallbladder attack)
  – Fever/chills / cold-sweats
  – Myalgia (muscle aches)
  – Hand rash
  – Liver tenderness
  – Immune function problems
  – Anorexia
  – Neuro-cognitive problems
The New Museum Case Study – New York City
Eckardt Johannig · Ray Biagini · DeLon Hull
Philip Morey · Bruce Jarvis · Paul Landsbergis

Health and immunology study following exposure to toxigenic fungi
(*Stachybotrys chartarum*) in a water-damaged office environment

<table>
<thead>
<tr>
<th>Organ system affected</th>
<th>By external comparison:</th>
<th>By internal comparison, according to office location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Controls $(n = 21)$</td>
<td>Subjects $(n = 53)$ $P^a$</td>
</tr>
<tr>
<td>Upper airways</td>
<td>43</td>
<td>57</td>
</tr>
<tr>
<td>Lower airways</td>
<td>43</td>
<td>76**</td>
</tr>
<tr>
<td>Worse in past year</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Skin</td>
<td>19</td>
<td>47*</td>
</tr>
<tr>
<td>Central nervous system</td>
<td>52</td>
<td>70</td>
</tr>
<tr>
<td>Eyes</td>
<td>19</td>
<td>57**</td>
</tr>
<tr>
<td>Constitutional (feverish, adenopathy, flu-like)</td>
<td>5</td>
<td>28*</td>
</tr>
<tr>
<td>“Multiple chemical hypersensitivity”</td>
<td>33</td>
<td>43</td>
</tr>
<tr>
<td>Chronic fatigue symptoms</td>
<td>5</td>
<td>24*</td>
</tr>
<tr>
<td>Allergy history</td>
<td>48</td>
<td>60</td>
</tr>
<tr>
<td>Infection (within past year)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper respiratory infections</td>
<td>47</td>
<td>62</td>
</tr>
<tr>
<td>Yeast</td>
<td>14</td>
<td>26</td>
</tr>
<tr>
<td>Urinary tract infections</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Health worse since employment at problematic building</td>
<td>N/D</td>
<td>51</td>
</tr>
</tbody>
</table>

* $P < 0.05$
** $P < 0.01$

$P^a$ Difference between external controls and subjects (chi-square)

$P^b$ Difference between subjects (internal controls) by office location (chi-square)

$P^c$ Trend by Mantel-Haenszel test for linear association
On May 7, 1993, the New York City Department of Health (DOH), the New York City Human Resources Administration (HRA), and the Mt. Sinai Occupational Health Clinic convened an expert panel on *Stachybotrys atra* in Indoor Environments. The purpose of the panel was to develop policies for medical and environmental evaluation and intervention to address *Stachybotrys atra* (now known as *Stachybotrys chartarum* (SC)) contamination. The original guidelines were developed because of mold growth problems in several New York City buildings in the early 1990's. This document revises and expands the original guidelines to include all fungi (mold).

Sentinel Case - 2:

11 y hispanic with Genetic Disease & Worsening Asthma

The mother is right – the medical expert is wrong!....
Clinical Experience and Results of a Sentinel Health Investigation Related to Indoor Fungal Exposure

Eckardt Johanning,¹ Paul Landsbergis,² Manfred Gareis,³ Chin S. Yang,⁴ and Ed Olmsted⁵

¹Mount Sinai School of Medicine, New York, New York USA; Eastern New York Occupational and Environmental Health Center, Albany, New York USA; ²Cornell University Medical College, Mount Sinai School of Medicine, New York, New York USA; ³Federal Meat Research, Microbiology and Toxicology, Kulmbach, Germany; ⁴P&K Microbiology Services, Inc., Cherry Hill, New Jersey USA; ⁵Olmsted Environmental Services, Inc., Garrison, New York USA

Table 4. Sentinel case exposure assessment—bulk and air sampling results.a

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Quantity</th>
<th>Comments (predominant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fungiculture (CFU/m³) (viable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inside</td>
<td>1993 to &gt; 7067</td>
<td>Clado., Asp., PNC, Stachy.</td>
</tr>
<tr>
<td>Control</td>
<td>194 to 336</td>
<td>Clado., PNC</td>
</tr>
<tr>
<td>Fungal structure/m³ (nonviable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inside</td>
<td>180,000 to 658,000</td>
<td>ASP/PNC like, Clado., Stachy.</td>
</tr>
<tr>
<td>Control</td>
<td>3656 to 4700</td>
<td>Clado., Basidiospores</td>
</tr>
<tr>
<td>Bulk sample (CFU/g)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wallpaper (living room)</td>
<td>1.6–2 × 1,000,000</td>
<td>Stachy, (50–66%), A versicolor, PNC</td>
</tr>
<tr>
<td>Toxicity tests (MTT screening)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wallpaper (bedrooms, samples 1–3)</td>
<td>Toxic to highly toxic</td>
<td>Stachy, ++++, PNC+, ASP+</td>
</tr>
<tr>
<td>Kitchen (wallpaper)</td>
<td>Highly toxic</td>
<td>Stachy, ++ Fusarium+ Trichoderma+</td>
</tr>
<tr>
<td>Nonfungal tests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cockroach allergen (Bla g1)</td>
<td>18 to 36</td>
<td>Microgram per gram dust</td>
</tr>
<tr>
<td>Pesticides</td>
<td>0</td>
<td>None detected</td>
</tr>
</tbody>
</table>

Abbreviations: Clado, Cladosporium; Asp, Aspergillus; PNC, Penicillium; Stachy, Stachybotrys; CFU, colony-forming units; MTT, mycotoxin cytotoxicity screening tests. aVarious test protocols described in "Methods." *P* to +++ = low to high quantity.

Figure 1. Health survey: children vs. adults. For explanation of office workers and controls, see text.
Sentinel Case - 3: Holmdel N. J. – Storm damage repair by owner
Sentinel Case - 3: Holmdel N. J. – Storm damage repair by owner

• 40+y old male
  – Prior healthy
• Health complaints
  – Sinus
  – Light-headed/dizzy
  – Neuro-behavioural
  – Joint pains

<table>
<thead>
<tr>
<th>Sample</th>
<th>Stachybotrys</th>
<th>Cyto-tox</th>
<th>Satratoxin</th>
<th>Spirolactones/lactams</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>3</td>
<td>+++</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>4a</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>4b</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>+++</td>
</tr>
</tbody>
</table>
Fungal Exposure: Various agents and disease outcomes

**Agents:**
- Allergens
- Ergosterol
- (1-3)-β-D-glucan
- Mycotoxins
- microbial volatile organic compounds (MVOCs)
- ???

**Allergy + Non-allergic**
- Dermatitis,
- Urticaria
- Rhinitis, Sinusitis
- Asthma
- Extrinsic allergic alveolitis “humidifier fever”
- Organic dust toxic syndrome
- Toxic – irritant effects
Mycotoxins

• Secondary fungal metabolite
  – alkaloids, cyclopeptides, and coumarins
• 400+ mycotoxins discovered
• “toxic mold” – “black mold”:
  – Aspergillus versicolor, Penicillium, Fusarium, Trichoderma, Cephalosporium, Chaetomium, Stachybotrys
• Documented properties in animals/humans:
  – genotoxic, mutagenic, cytotoxic, carcinogenic, nephrotoxic, pseudo-estrogenic, immuno-suppressive, protein synthesis inhibitor or other toxic properties
Mycotoxins in the Recent Past

- During and after 2nd World War: Alimentary toxic aleukia in Russia by trichothecenes?
- 1961: “Turkey X disease”: Aflatoxicosis (C. C. Wannop, Avian Diseases, 5, 371-381)
- 1965: Ochratoxin A (Van der Merve et al., Nature 205, 1112-1113)
- 1946: Glutinosin (Verrucarin A & B) (Brian & McGowan, Nature 157, 334)
Early Years of Immunoassays for Mycotoxin Testing

1975 RIA Ochratoxin A
1976 RIA Aflatoxin B1
1977 EIA Aflatoxin B1
1979 RIA T-2 toxin
1983 RIA Zearalenone
1984 RIA Diacetoxyscirpenol
1988 EIA Deoxynivalenol
1988 EIA Roridin A
1992 EIA Fumonisins
Diagnostic problems

Exposure
Multiple Mixture
- dose

Non-specific symptoms
Multiple disease endpoints
Health effects of fungi

- Mycotoxicosis
- Hypersensitivity pneumonitis
- ODTs
- Bronchitis
- Allergic diseases
- Dermatitis; airway infections
- Irritative and non-specific symptoms

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**METHODS**

Indoor environments of 55 patients (1999 and 2005) with verified moisture related building damage and indoor fungal growth were studied. In total, 161 high-volume air samples were analyzed for trichothecene (Roridin A) content by the ELISA method and fungi in this comparison.
Air sampling (24 h)

**Inhalation Exposure - Logistics and Methodology**

Clinical data

Case

Bulk samples

Air sampling (24 h)

Mycology

with special attention to *Stachybotrys ch.*

Toxicity

Cytotoxicity screening of crude extracts (MTT-test)

Mycotoxin analysis

HPLC-DAD

GC-MS

EIA

Mycology

Toxicity

Mycotoxins

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paper in preparation
RESULTS

69.6% of the samples analyzed for RoA showed levels >2 ng/g, 8.7% were > 50 ng/g.
Detection of Airborne *Stachybotrys chartarum* Macrocyclic Trichothecene Mycotoxins in the Indoor Environment

T. L. Brasel, J. M. Martin, C. G. Carriker, S. C. Wilson, and D. C. Straus*

*Department of Microbiology and Immunology, Texas Tech University Health Sciences Center, Lubbock, Texas 79430*

Received 9 March 2005/Accepted 12 July 2005

Allergens Can f 1, Der p 1, and Fel d 1. For test buildings, the results showed that detectable toxin concentrations increased with the sampling time and short periods of air disturbance. Trichothecene values ranged from <10 to >1,300 pg/m³ of sampled air. The control environments demonstrated statistically significantly ($P < 0.001$) lower levels of airborne trichothecenes. ELISA specificity experiments demonstrated a high specificity for the trichothecene-producing strain of *S. chartarum*. Our data indicate that airborne macrocyclic trichothecenes can exist in *Stachybotrys*-contaminated buildings, and this should be taken into consideration in future indoor air quality investigations.
The current findings of cognitive impairment are consistent with those of Gordon et al. (1999) and Baldo et al. (2002). In addition, persons exposed to mycotoxins reported significantly more cognitive and physical symptoms than nondisabled individuals.
Neurocognitive Testing Results, WMS III, Toxicity, % Reduced functioning (≤ 16th percentile)

- 22 neurocognitive cases selected that included indoor air toxicity assessments
Conclusions.
Dampness and mold were associated with depression, independent of individual and housing characteristics. This association was independently mediated by perception of control over one’s home and by physical health. (Am J Public Health. 2007;97:1893–1899)
“High-dose and repeated low-dose SG elicited a 13% and 66% reduction in OSN volume density, and a 14-fold and 24 fold increase in apoptotic cells of the OE, respectively. This model provides new insight into the potential risk of nasal airway injury and neurotoxicity caused by exposure to water-damaged building.”

Nasal passages of the rhesus monkey nose.
Respiratory and Allergic Health Effects of Dampness, Mold, and Dampness-Related Agents: A Review of the Epidemiologic Evidence

Mark J. Mendell,¹ ² Anna G. Mirer,³ Kerry Cheung,⁴ My Tong,¹ and Jeroen Douwes⁴

Conclusions: Evident dampness or mold had consistent positive associations with multiple allergic and respiratory effects. Measured microbiologic agents in dust had limited suggestive associations, including both positive and negative associations for some agents. Thus, prevention and remediation of indoor dampness and mold are likely to reduce health risks, but current evidence does not support measuring specific indoor microbiologic factors to guide health-protective actions.

CONCLUSIONS:

- Our findings extend the 2004 conclusions of the Institute of Medicine by showing that mold levels in dust were associated with **new-onset asthma** in this damp indoor environment.
- Hydrophilic fungi and ergosterol as measures of fungal biomass may have promise as markers of risk of building-related respiratory diseases in damp indoor environments. 

Rhinosinusitis and mold as risk factors for asthma symptoms in occupants of a water-damaged building


- The BR-rhinosinusitis symptom group had higher odds for developing BR-asthma symptoms [odds ratio (OR) = 2.2; 95% confidence interval (CI) = 1.3–3.6] in any subsequent survey compared to those without BR-rhinosinusitis symptoms.

- The BR-rhinosinusitis symptom group with higher fungal exposure within the building had an OR of 7.4 (95% CI = 2.8–19.9) for developing BR-asthma symptoms, compared to the lower fungal exposure group without BR-rhinosinusitis symptoms.

- Our findings suggest that rhinosinusitis associated with occupancy of water-damaged buildings may be a sentinel for increased risk for asthma onset in such buildings.
Conclusions & Summary

• Allergy
• Non-allergic health effects
• Infections
• Trigger and aggravation effects
• New onset of symptoms and abnormalities in non-sensitized patients
“Knowing is not enough; we must apply.” – J. W. Goethe

- Bio-marker of exposure and disease
- Non-allergic health effects
  - Toxicology
  - Neuro-cognitive disorders
  - Cancer?
  - Reproductive hazards?
- Prevention and Control
  - Population at increased risk
Announcement:

Safe and Effective Flood and Mold Remediation - after Super Storm Sandy and other Natural Disasters.

March 13 to 15, 2013 — at the Seaview Hotel & Golf Club near Atlantic City, N.J.

- Flood and Mold Clean-Up after Natural Disasters, Flooding & Water damage
- Risk management and emergency response
- Medical problems and prevention of harmful bioaerosols
- Investigation technology and methods
- Safe remediation and restoration
- Restoration of art work, books, valuable etc.
- Legal issues
- Special item: Safety in Artwork, Documents, Furniture and Precious Item Cleaning & Restoration

www.bioaerosol.org or www.dampnessmold.com