My Workplace is Making Me Sick

A Practical Approach to Investigating and Managing Indoor Air Quality Problems in Hospitals, A Nursing Perspective

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Over Time—Windows
Closed
Objectives:

- Identify what constitutes air quality concerns in buildings, especially hospitals?
- Review a case study experience involving a sick building.
- Identify steps to gather data when first aware a problem may exist.
- Compile a team of experts to research and resolve the problem.
- Advocate for employees and employers.
Symptoms such as: headaches, fatigue, trouble concentrating, irritation of eyes, nose, throat and lungs.

The environment has been tied to diseases such as asthma from dampness and mold in indoor environments.

Serious illnesses are also attributed to asbestos, and radon and can lead to cancer years later.
Air Quality Is All About the Environment
Causes: Environmental

- Biologic:
Causes—ENVIRONMENTAL

Chemical:
  - Carcinogens—such as Radon (Rn) gas.
  - Building materials: including carpeting and plywood emit formaldehyde (H₂CO) gas.
  - Paint and solvents: give off volatile organic compounds (VOCs) as they dry.
  - Lead paint can degenerate into dust and be inhaled.
Air fresheners, incense, and other scented items.
Smoke particulates in the air, inside and out.
Pesticides and other chemical sprays indoors without proper ventilation.
Cleaners and reagents.
Gases present in the outdoor environment can be brought in by the HVAC system, such as: exhaust from air or ground transport; methane; combustion exhaust etc.
Air Quality—Departmental Processes
Air Quality

- Affected by:
  - Fragrances.
  - VOCs—Volatile Organic Compounds.
  - Processes within Departments—Radiation.
  - Construction or re-modeling.
Air Quality

- Problems affecting the quality of air
  - Formaldehyde spills
  - Dialysis cleaning agents spills
  - Mixing chemicals accidentally
- Air Flows
- Humidity
- Cleanliness
- Air pressures
Allergens

- Mold
- Pollen
- Latex
- Medications
- Animal Dander
In 2004, the Institute of Medicine (IOM) found there was sufficient evidence to link indoor exposure to mold with:

- upper respiratory tract symptoms,
- cough, and wheezing in otherwise healthy people.
- worsening of asthma symptoms in people who have asthma.
- Mold was also reported to be linked to hypersensitivity pneumonitis in individuals susceptible to this immunologic condition. This uncommon disease is similar to pneumonia and can develop in susceptible individuals after brief or prolonged exposure to mold.

2004, the Institute of Medicine (IOM)
Case Review
Hospital outside was finished, so let the party begin!

"Desperate times call for desperate politicians!"
Employees in Medical Records and Coding: Were NOT having fun.

skin rashes, sore throats, a funny taste in their mouth, dizziness and inability to focus. Headaches, loss of voice or laryngitis, asthma attacks and more.
Shortly thereafter, Emergency Department nurses, IT and Oncology physicians and nurses, all working in newly constructed areas.
Sick building syndrome (SBS) is used to describe situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified.
SBS symptoms will be relieved soon after the occupants leave the particular room or zone. However, there can be lingering effects of various neurotoxins, which may not clear up when the occupant leaves the building. In some cases—particularly in sensitive individuals—there can be long-term health effects.

How To Respond?

Run for the Hills
Initial Response

- Treat the employees–get them into fresh air–send them outside.

- Examine– R/O Infectious disease.

- Document.

- Communicate the problem to the building engineer and the principles of the organization.
Start Collecting Information

- **Occupational Health** takes the lead.
- List of environmental or respiratory complaints from employees.
- Air monitoring specific to affected areas.
- Air monitoring in entire building.
- Map of the building with spaces and process identified within the building, i.e. chemicals.
- Map of the HVAC system within affected areas; areas that share the air system.
- Work processes occurring within the space.
Information Continued....

- Maintenance records for the air supply; filter changes, air flow data etc.
- Cleaning process for affected spaces, schedules of frequency.
- Chemicals used in the cleaning process.
Walk through affected areas
Observe the processes occurring within the space.
Carpeting?
Investigate the air supply system or HVAC looking for system breakdowns.
Look for visible wet spots or sources of leaks
Steps taken to Investigate

- Pull together a team of experts, decision makers
- Communicate all reports to your experts.
- Set up meetings being flexible to include all.
- Discuss additional needs such as **testing or cleaning.**
- Include the Public Relations Officer to communicate, communicate & communicate.
- Extensive minutes written of every meeting that go to administration and to the affected employees—be transparent.
Decision Makers

- Occupational Health
- Safety Leaders
- Risk Management
- Affected employees
- Quality Improvement
- Administration
- Departmental Leaders
- Environmental Services
- Engineering and Industrial Hygiene
- Public Relations
Review of Processes–Team

Engineering and Industrial hygiene will review:

- Air system, filtration, air flows, air balancing, percentage of outside air.
- Maintenance records of the air handling & humidification system.
- Cleaning process, chemicals used and process for cleaning.
Needs to take the lead:

- He/she knows the employees S&S and can relate these to problems found. i.e. Headaches, irritated eyes, nose and throat can be chemicals used, or the lack of humidity. Asthma can be attributed to mold.
- Keep the team focused on the IAQ solution.
Occupational Health Nurses

- Review the work practices and make sure they are safe.
- Evaluate and implement engineering controls when needed.
- When all else fails, place individuals in personal protective gear/ relocate.
- Monitor continuously to insure safety.
Set up a system for balancing the air supply to affected areas, working with Industrial Hygiene to insure adequate air supply.

Check water sources such as ice machines for leaks and repair immediately.

Check equipment such as Lab or Anesthesia to make sure there functioning perfectly.

Monitor results and report the monitoring
Engineering Controls

- Filters should be functioning and changed as recommended.
- Air humidification is a process that needs to be monitored, too little is uncomfortable too much can create mold.
- Air flow is important in hospitals, negative pressure, positive pressure and doors must remain closed.
- Remove or replace spray cans with chemicals such as cleaning or polishing with less toxic products. Pour don’t spray.
Laboratory spills or accidental mixing of reagents.

- Isolate & secure the area of people
- Review SDS sheet on chemicals
- Spills call Clean Harbors
- Monitor air—people return once safe
Communication & Transparency = Trust

- All meeting minutes
- All investigative reports
- All employee suggestions
- Specialist recommendations
- Team findings
Steps to Resolve

- Clean! Clean! Clean!

- Resolution is dependent upon problems found.
Major Problems or Unable to Solve

Employees are still symptomatic

Call in the Professionals:
Environmental Companies such as:
EH&E
Indoor Air Quality
Just because you can’t find what is responsible for these Employee complaints—doesn’t mean there isn’t something there!
Employee Advocacy

- Listen
- Assess
- Document
- Validate your employees concerns.
- Advocate for employees with administration.
- Advocate for the employee as an Occupational Health Nurse by keeping them working if possible. Relocate, send work home with people.
- Be creative.
Advocate for Employees and Employers—Prevention

- Construction or remodels—be an active part of planning and prevention.
- Participate at Safety Committee & Infection Control Committees work towards prevention.
- Demonstrate how it is fiscally responsible to prevent problems rather than pay for them.
Formalin in construction materials caused our problem. We relocated the entire staff except the ED staff; extremely sensitive employees did other jobs elsewhere.

Hired an Environmental company to handle. Cleaning companies came in and washed with water ceilings, walls floors etc.

We hired a company to individually moist clean every medical record page by page. Medical records didn’t return for 2 years, the employees wanted administration to occupy the space and they did.
Regulatory Requirements

- DPH–Construction requirements
- OSHA–NIOSH–Standards
- EPA–Environmental standards
- ASHRAE. Ventilation for Acceptable Indoor Air Quality.
- 780 CMR 1209.0 Mechanical Ventilation. S
- State Board of Building Regulations and Standards, refers to BOCA
Thank You!

Questions?
Jordan Peccia—Yale researcher working on DNA testing. [http://seas.yale.edu/faculty-research/faculty-directory/jordan-peccia](http://seas.yale.edu/faculty-research/faculty-directory/jordan-peccia)

- Application of molecular biology to environmental science and engineering; bio aerosol detection and source tracking, microarrays and other high throughput measurements.
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- My Office is Killing Me. The Sick Building Survival Guide: Jeffrey C. May.
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Does Sampling for Mold Tell the Truth?

Jeffrey C. May
May Indoor Air Investigations LLC
Tyngsborough, MA
Since 1992, we have completed more than 4,000 building inspections, including more than 2,000 “sick building investigations” in homes, schools, businesses and offices.

We have taken and analyzed by microscopy over 35,000 air and dust samples.
How Do We Sample for Mold?

- Culturable Sampling:
  - Andersen N6 + petri dish for air
  - Swab sampling for surfaces

- Non-viable Sampling:
  - Burkard and Allergenco samplers for air
  - Air-o-Cell cassette for air

- Tape sampling for surfaces

- Vacuum dust sampling

- Polymerase chain reaction (PCR)
Andersen N-6
Culturable Sampling:

Tests only for living organisms..

..that can compete and grow on the culture medium.
Particles greater than 100 microns settle out within seconds.

One micron particles take hours to settle.
Aspergillus count went from 0 to 17,000/m3 after waving a notebook
Terry Brennan Study of Air:
Identical air samples were sent to nine different laboratories.
(one lab did two samples using different counting methodologies)
Bacteria cluster from carpet 1,200x

Skin scale

Labs do not note presence of bacteria
The tray of a furnace humidifier full of mineral clumps. Floating on the water surface is a large, white colony of actinomycetes, a mold-like growth that can cause hypersensitivity pneumonitis.
Actinomycetes in basement air 1,000x

Pen/Asp spore chain

Actinomycetes

skin scale

Labs do not note presence of actinomycetes
More Confusion

Nitrocellulose immunoblots of conidial extracts of *Cladosporium cladosporioides* showing the heterogeneous distribution of the allergens recognized by the sera of 6 different patients.

*The Fungal Spore*, p. 395 Cole and Hoch
“Surrogate Allergens”

• Corn starch granules in “donning powder” at the interior of gloves acquire latex proteins and the aerosolized granules become surrogate allergens.

• Pollen allergens on sub-micron soot particles

• Cat allergens on soot and kitty litter aerosol

• Mold enzymes on substrate dust such as drywall

• Bacterial allergens and endotoxin on rust
Condensate tray in winter

Moldy Air Conditioning Coil

Sub-micron particulates

Micron-sized rust

Surrogate allergens in dry “bioslime”

Condensate tray in winter
The Main Sources of Mold Allergens Indoors are:

- carpets
- HVAC systems
- below-grade spaces (excess humidity)
- building materials (wet from leaks, etc.)
The thick coating of dust on the A/C coil below is typical of most poorly filtered systems. Clean fins can be seen at the bottom where there has been low air flow.

Mold hyphae growing in the dust from the AC coil at the left.
Dirty *Cladosporium* spores from an air vent

Labs do not note if spores are “dirty”
Dirty hyphae from an air vent
Sampling caveats

The dark material on the coil is all mold.

The fiberglass liner is water-stained and moldy.
Sampling Caveats: Dead or Alive

Microscopy of tape samples from the moldy A/C coil: all mold!

Colony-Culture Results:
1 gram (+) cocci
3 basidiomycetes
2 Cladosporium cladosporioides
1 sterile fungi

Nearly all mold spores were dead!
Sampling caveats

• Spores naturally die off but allergens still last for years!

• “The school is OK as long as indoor concentration is about 1/3 outdoors.”

• Elevated *Penicillium* or *Aspergillus* is a problem.

• Microscopy **must** be used to see if chains present!!!!!
In an Andersen sampler, this would culture as one colony!
The Future

- Detecting the presence of microorganisms by DNA.
- Quantitative PCR for bacteria and fungi.
- No standards yet.
- For now, changes can be monitored.
Raw data: lists of species present and abundances, Bacteria

Source
- Soil
- Water
- Mouth
- Urine
- Gut
- Skin

Door in (n=8)
Door out (n=11)
Stall in (n=6)
Stall out (n=10)
Faucet handles (n=10)
Soap dispenser (n=10)
Toilet seat (n=11)
Toilet flush handle (n=10)
Toilet floor (n=12)
Sink floor (n=12)

Jordan Peccia © 2015
Conclusions:
We may not learn enough from sampling so....
Rely on microscopy
Believe the occupants
Pray for DNA
What you get from PCR:

- A list of fungi including relative abundances. Typically 2,000 to 10,000 identifications per sample;

- Species level identifications: list of allergens, list of pathogens;

- Quantitative comparisons from one location or time-point to another;

- Diversity—How many different species of fungi are present;

- Ability to track the sources of fungi.

Jordan Peccia
The Future

For Quantitative PCR

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Would be happy to talk anyone with samples they want sequenced.