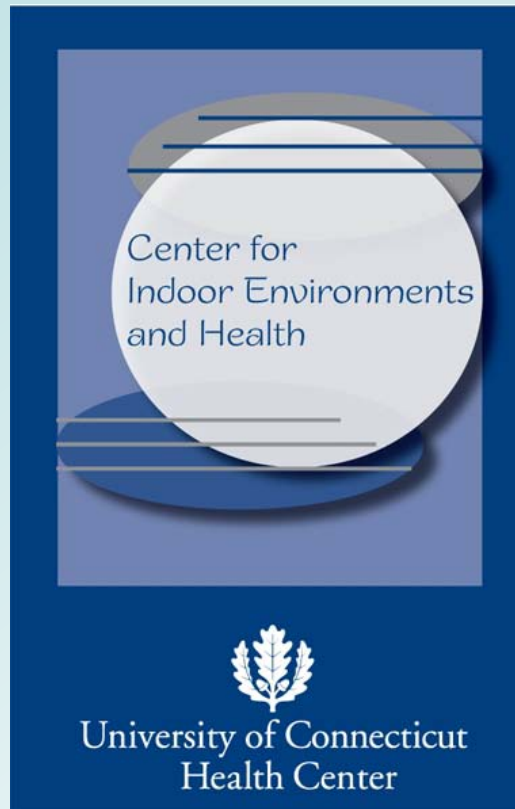


Promoting a Safe and Healthy Work  
Environment: What is a Healthy Workplace  
Part II: A Panel Discussion  
November 16, 2011  
Storrs, CT



## Indoor air quality and health

*Paula Schenck, MPH*

*Center for Indoor Environments and Health*

<http://www.oehc.uhc.edu/CIEH.asp>

**Section of Occupational and Environmental Medicine**

*University of Connecticut Health Center*

*The Exchange, Suite 262; 270 Farmington Avenue*

*Farmington, Connecticut 06032 860-679-2368*

[schenck@nso2.uhc.edu](mailto:schenck@nso2.uhc.edu)

*Guidance for Clinicians: Mold and Moisture*

<http://www.video.uhc.edu/MoldMoisture/>

IAQ, *“interpreted broadly, refers to the environmental characteristics inside buildings that may affect human health, comfort, or work performance.”*

<http://www.iaqscience.lbl.gov/overview.html>

## ***Today's plan***

- Health and quality of life
- Sources of indoor pollutants
- Unique concerns about bioaerosols
- Employee actions

# What about indoor environments?



- Exposure to substances that irritate, exacerbate and/or cause illness
  - on average, U.S. citizens spend about 90% of their time indoors
  - indoor levels of air pollutants may be 2-5x higher than outside (and occasionally much higher)
  - building conditions may contribute to production of air contaminants
- Inadequate ventilation
  - moisture; suitability for microbial reservoirs;
  - accumulation of materials including environmental tobacco smoke
  - pathways
- Maintenance
  - variable



# Health and quality of life

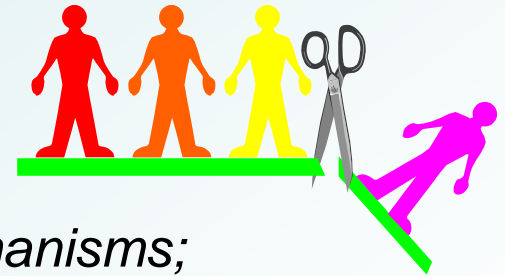
- Illness with building relationship

## Sick building syndrome (SBS)

*(non-specific symptoms develop from a build-up of irritants in the environment probably associated with poor ventilation; symptoms usually resolve without long term consequence)*

## Building-related disease

*(more severe condition, identified illness; allergic, infectious, toxic and irritant mechanisms; individual susceptibility)*



# Health and quality of life

- Productivity concerns  
*(absenteeism and poorer work/school performance)*
- Other economic impacts  
*(may be more costly to remediate problem buildings than to prevent IAQ problem, other potential liability)*
- Public and community relations



From- Leigh

*agcenter.ucdavis.edu/seminar/flyer/2009/Leigh\_Nov3\_2008.ppt*

## **Diseases and Costs, 2005, Preliminary Estimates**

<b>Disease</b>	<b>ICD-9 Codes</b>	<b>Percent Attributed To Jobs</b>	<b>Estimated Job-Related Deaths</b>	<b>Estimated Job Related Costs (Billions\$2005)</b>
1 Cancer	140-209	8%	44,445	\$16.3293
2 Circulatory disease (heart and stroke)	410-414, 430 438, 440	10%	7155	\$4.5070
3 Chronic obstructive pulmonary disease and asthma	490-496	10%	11,880	\$6.4660
4. Pneumoconioses	500- 505	100%	1136	\$0.1268
5. Nervous system disorders	323.7, 331, 332, 349.82, 356, 357.7, 359.4	2%	712	\$0.1985
6. Renal disease	580-589	2%	911	\$0.4586
7. Osteoarthritis	715	8%	0	\$14.4652
8. Non-fatal illnesses from BLS	N/A	100%	0	\$6.5752
<b>TOTAL</b>			<b>66,239</b>	<b>\$49.1266</b>

# Estimated Benefits – Indoor Work Environments and Health

Health Effect	Affected Indoor Workers	Potential Reduction in Health Effects	Potential Annual Economic Benefits
Sick building syndrome symptoms	35-60 million	20% to 50% (8 to 30 million workers protected)	\$4 to \$70 billion
Communicable Respiratory Illness	52 million	10% to 14% (5-7 million infections prevented)	\$3 to \$4 billion
Allergies and Asthma	18 million (allergy) 4.7 million (asthma)	6% to 15% (1 to 3 million exacerbations prevented)	\$0.2 to \$0.6 billion

# Home—Cost of poor environment

*Public health and economic impact of dampness and mold*  
D. Mudarri and W. J. Fisk; Indoor Air 2007

## Abstract

“attributable fraction to the updated national annual cost of asthma, the national annual cost of asthma that is attributable to dampness and mold exposure in the home is estimated to be \$3.5 billion (\$2.1–4.8 billion). Analysis indicates that exposure to dampness and mold in buildings poses significant public health and economic risks in the USA. These findings are compatible with public policies and programs that help control moisture and mold in buildings”



# Sick building syndrome

- itchy, dry eyes
- headache
- fatigue/sleepiness
- cough
- skin irritation

*rapid improvement upon going outside*

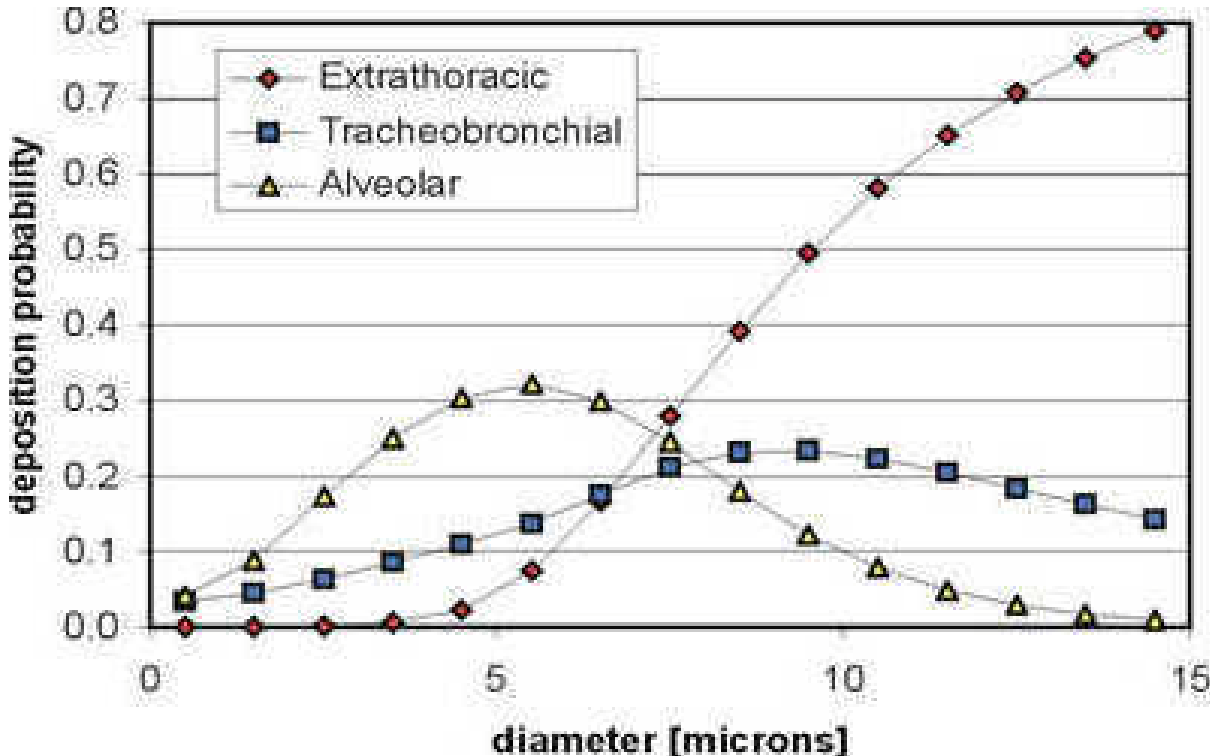
# Building-related illness

- asthma
- hypersensitivity pneumonitis
- laryngitis
- rhinitis/sinusitis
- sarcoidosis
- infectious diseases
- illness related to toxins- (lung cancer)
- non-specific symptoms and syndromes

# Mechanisms and example agents

- Infectious
  - Virus (colds, flu), bacteria (Legionnaires)
- Irritant
  - Cleaning agents/bleach
- Allergic/immunologic
  - Isocyanates, dust mites
- Toxic
  - Carbon Monoxide, radon

# Respiratory system- particle/droplet deposition



The probability that inhaled droplets of different diameters will deposit in the different regions of the respiratory tract as predicted by a two-way coupled hygroscopic model for a Ventolin® aerosol with mass median diameter of 4.0 micrometers (microns) and geometric standard deviation of 1.7 with 100,000 droplets/cc and room temperature ambient air of 50% RH is shown.

# Examples: specific indoor contaminants and building-related disease

- Asbestos - mesothelioma (cancer), lung cancer
- Bioaerosols - respiratory diseases
- Carbon monoxide - oxygen deprivation/tissue death
- Infectious agents, i.e. legionella and illness
- Lead exposure –developmental and CNS and organ effects
- Environmental tobacco smoke – asthma and other health effects
- Formaldehyde - respiratory irritant, suspect carcinogen
- Radon exposure - lung cancer
- VOCs including plasticizers (*isocyanates*), fragrances –respiratory disease and irritation

# How Can You Determine if an Illness is Work-related?

## Ask the worker-

- What kind of work do you do?
- Do you think your symptoms are work related?
- Are your symptoms worse at work?
- Have there been any changes at work ?
- Are your co-workers affected as well?  
(Sentinel effect, opportunity for prevention! )



# Workplace Safety & Health Topics

<http://www.cdc.gov/niosh/topics/SHEO/>

“An **Occupational Sentinel Health Event** is a disease, disability, or untimely death, which is occupationally related and whose occurrence may:

- 1 provide the impetus for epidemiologic or industrial hygiene studies; or
- 2 serve as a warning signal that materials substitution, engineering control, personal protection, or medical care may be required.

.. the Sentinel Health Event is a preventable disease, disability, or untimely death whose occurrence serves as a warning signal that the quality of preventive and/or therapeutic medical care may need to be improved. (Rutstein et al 1976)

# Indoor air quality assessment

What are the sources of indoor contaminants and what are the more concerning ones?

What are the occupants' exposures/ how do the contaminants move?

What are the measures to control risk?

And to whom and how should you communicate the risk and the remediation plan?



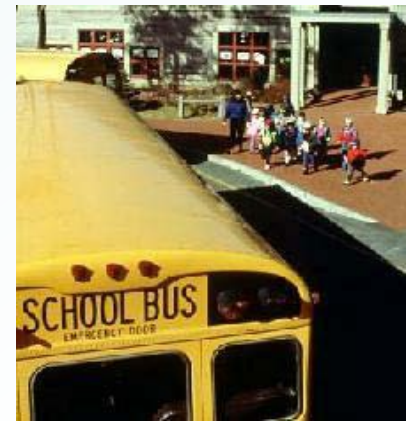
# Sources

- **chemical products** such as cleaning products, glues, personal care products, markers, adhesives, paint, pesticides
- **things** in the building, for example:
  - furnishings
  - copy machines
  - plants
- **building materials**



# Sources

- **emissions** from furnaces
- **building condition and moisture** that together provide food and water for growing microbes and material degradation
- **outdoor air** that penetrate buildings –pollutants, natural biological material-pollens, fungi
- **people, other living things and their activities**





# It's all about moisture/dampness!

## Mold indicates moisture

Mold actively growing indoors may:

degrade the surrounding materials,

weaken the structure, and

add unhealthy fungal products and bioaerosols to the indoor air

When mold is growing other agents are likely present:

bacteria and their products,

dust mites,

other animal proteins such as cockroach droppings and pet animal dander

# Concepts that drive assessment for mold and moisture

- Moisture in buildings is associated with illness- in particular respiratory illness (*IOM 2004 report; asthma burden -WJ Fisk et al., Indoor Air, 2007; WHO Guidelines for Indoor Air Quality – Dampness and Mould-July 2009*)(visible mold indicates moisture)
- Controlling moisture/dampness will control microbial growth
- Different fungal species grow at different levels of moisture
- Fungi species have characteristics that make measurements difficult
- Adequate ventilation is critical to health of the occupants; air movement provides pathways for biological materials
- Building systems fail if not maintained



Mushrooms produced on hardwood floor where there has been long-term water incursion.

(Unknown or anonymous author. Image courtesy of Dr. Chin S. Yang *Guidance for Clinicians on the Recognition and Management of Health Effects Related to Mold Exposure and Moisture Indoors*

Page 15)

# “Building Science”

A term to describe :

**the interrelationship** among  
environment ( site, climate, etc.);  
building design, construction, materials; and  
building systems (such as humidity control); and  
**how these factors determine the quality of the  
environment that affects the health and well  
being of the occupants.**

# Specifically when concerned about bioaerosols, a good “assessor” notes

- water damage (leaks, high humidity, musty or moldy odors)
- chronic condensation (typically cool surfaces- outside walls, windows) and any standing water (i.e., air conditioners, humidifiers)
- carpet condition (i.e., evidence of water damage and age)
- condition of other fabric materials such as upholstery, furniture, drapes (i.e., dampness and microbial growth, dirt)
- plants ( mold growth)

# Other helpful information

- The area of moisture damage
  - size and type of damage
- Relative humidity and temperature
  - may direct to locations supporting mold growth, minimizing destructive sampling



# Difficulties with Mold Measurements

- Sampling and laboratory variability and limitations
  - inherent in sampling and culture methods
  - microscopic identification
- Fungal characteristics
  - natural ecology
  - morphology
- Human activities

# Mold Sampling Programs

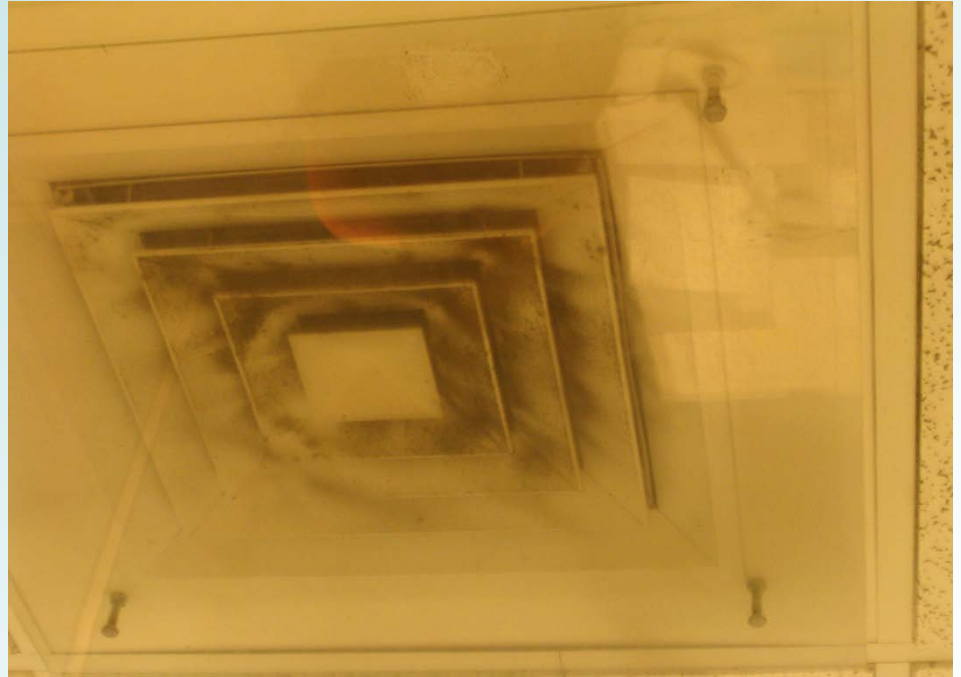
*Bulk, tape, dust, air*

- Research settings
- Focused problem solving
- Often not necessary and not the first step; then when?
  1. building-related illness is strongly suspected, AND
  2. mold exposure is thought to possibly contribute to concerned individuals' health symptoms, AND
  3. there is insufficient information to suggest where mold is growing/the qualitative inspection hasn't identified areas of concern, AND
  4. it would be helpful to have to plan appropriate intervention/remediation

***Environmental Relative Moldiness Index (ERMI)*** – dust sample, uses mold-specific quantitative polymerase chain reaction; ***utility in air quality investigations is not established***

# “Sleuthing”- Patient problem investigation

Plastic covering placed to remove a draft allowed water droplets to condense and provided an ideal microenvironment for bacteria and mold. A bulk sample was used to confirm that bacteria and fungi were growing.



# Interpretation of Air Sampling Data

- Without mold dispersing from indoor sources
  - the concentration and species types would reflect the outside and the movement of outside air into the indoors either through windows or failing filters.
  - dominant species profiled from the indoor sample would be similar to the outdoor profile.
- Low fungal concentrations from indoor samples do **not** document the absence of potential mold exposure.
- Indoor profiles with highly allergenic or toxigenic species from genera such as *Alternaria*, *Aspergillus*, *Fusarium*, *Stachybotrus*, call for more exploration for sources of moisture and biota amplification.
  - ***Remediation plans should not be based on the results of air monitoring alone.***

“There is an allure to establishing a fungal concentration standard for indoor air to guide decisions. However, threshold levels of fungal concentrations in the indoor air have not been established and with our current knowledge would not be helpful in understanding exposure risk to patients.”

*Guidance for Clinicians on the Recognition and Management of Health Effects Related to Mold Exposure and Moisture Indoors*

“When there is evidence of moisture damage, the causes of moisture intrusion should be fully investigated and fixed, mold present on nonporous, easily accessible materials cleaned, and other damaged materials discarded.”

# Environmental information: Site Visit Approach

- Identify environmental factors and potential exposures that may contribute to health risk
- Means - Walk-through assessment
  - ✓ outside and building exterior
  - ✓ ventilation
  - ✓ inside environments
- Sources and pathways
- Result -
  - Recommendations for:
    - 1) improvements to environment and materials use that will reduce risk
    - 2) further “specialized” assessment if indicated



# Intervention

- Remediate the environment
- Separate people from exposures
- Manage the illness
- Communicate risk effectively
- Prevention
  - Better understand the cause—research
  - Improve our indoor environments
  - Rigorous maintenance of building and of HVAC
  - Opportunity in “green buildings”

UConn Health Center  
Division of Occupational and Environmental  
Medicine

*Dr. Oluremi Aliyu*

*Dr. Martin Cherniack*

860-679-2893

occmedEHS@uchc.edu



# EPA Resources

## *A Brief Guide to Mold, Moisture, and Your Home*

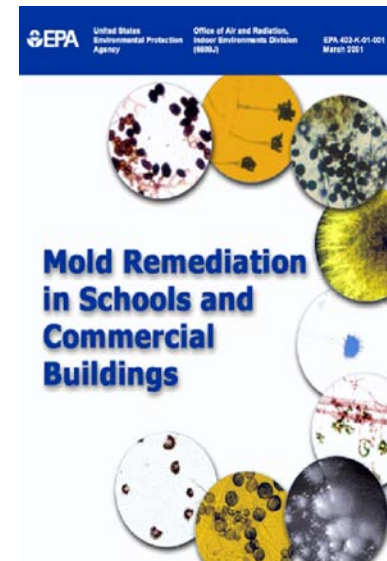
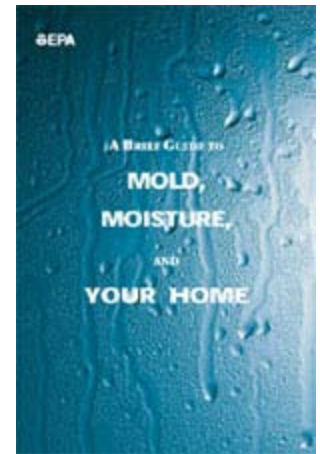
<http://www.epa.gov/mold/moldguide.html>

- English and Spanish pdf versions
- Audience: homeowners and renters
  - How to clean up residential mold
  - How to prevent mold growth

## *Mold Remediation in Schools & Commercial Buildings*

[http://www.epa.gov/mold/mold\\_remediation.html](http://www.epa.gov/mold/mold_remediation.html)

- Audience: building managers and those responsible for building maintenance
  - Reference for professional remediators
  - Anyone addressing mold problems in buildings





# Targeted education

- Capacity building- clinicians

- [www.video.uhc.edu/MoldMoisture](http://www.video.uhc.edu/MoldMoisture)

- Guidance for Clinicians: Mold and Moisture 2009

- **FREE** on line course
    - eligible for 6 continuing medical education units/CME

- *Guidance for Clinicians on the Recognition and Management of Health Effects Related to Mold Exposure and Moisture Indoors 2004*

- Eileen Storey, Kenneth H. Dangman,, Paula Schenck, Robert L. DeBernardo, Chin S. Yang, Anne Bracker, Michael J. Hodgson*

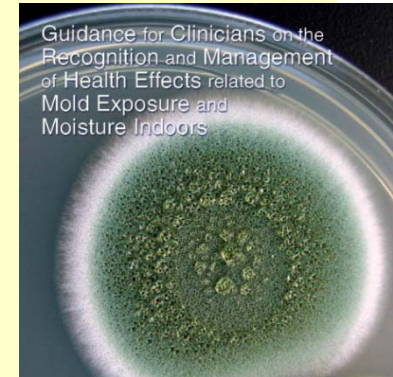
- paper copies available for clinicians
    - free download <http://oehc.uhc.edu/clinser/MOLD%20GUIDE.pdf>

- Capacity building- environmental and public health practitioners

- Center for Indoor Environments and Health

- <http://oehc.uhc.edu/CIEH.asp>

- Healthy home assessment checklists
    - “Tools for Techs” approach to assessing exposures in technical high schools



# Indoor Air Quality in Schools Research-to-Practice Dampness and Mold Pilot

## *Partners:*



National Institute for Occupational  
Safety and Health



Maine Indoor Air Quality Council



Center for Indoor Environments  
and Health

Thank you!

