



BUILDING A FRAMEWORK FOR HEALTHY HOUSING

2008 National Healthy Homes Conference

A National Survey of Professional Mold Remediation Practices

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Current Mold Remediation Practices - A National Survey

(HUDMOLHH0137-05)



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*2008 National Healthy Homes Conference*²

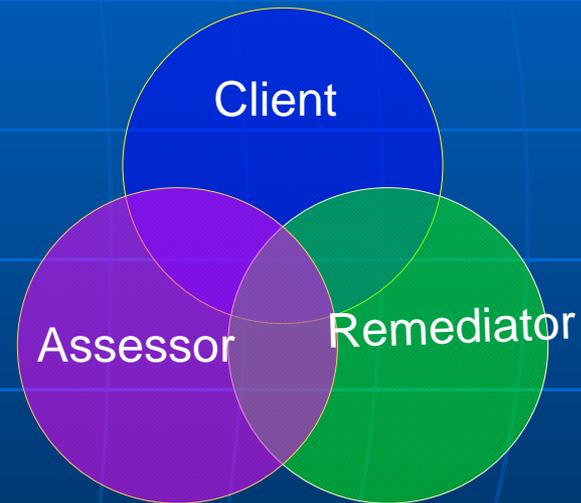
PURPOSE

“State of Professional Mold Remediation Practice”

- Diversity in opinions and practices of Mold Remediation
- Challenges & Barriers
- Areas of Conformity and Variance
- Gaps between existing scientific information and field practices
- Field practices where current guidance or its delivery is inadequate
- Field practices requiring further validation

Impact

1. Best Practices
2. Policy



Presentation Today

- Web Survey Design
- Select Findings



Web Survey

Sources of Information

- Interviews with industry professionals
- Visits to Katrina impacted areas
- Prior experience in characterization of mold contamination in flooded buildings in urban, suburban and rural Missouri and Illinois
- Prior experience in characterization of indoor mold exposure of children and adults with environment-linked health complaints
- Guidelines documents
- Scientific literature
- Information available in public domain



Mold Assessment & Remediation – Process

- Site visit/Walk through
- Mold, Moisture intrusion and Water damage inspections and Psychrometric measurements
- Work Plan, Scope, or Remediation Protocol Development
- Implementation of Remediation Protocol
- Post-remediation Verification (PRV)





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Web Survey- Design

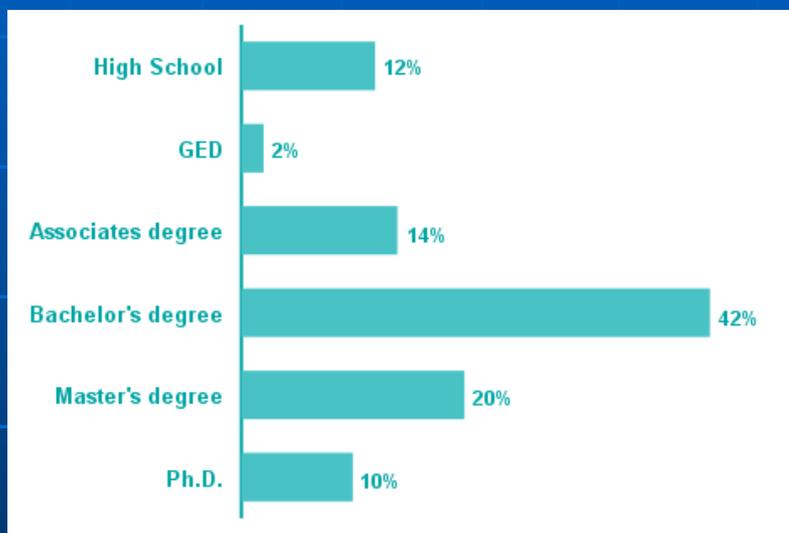
Participants

- 4,500 mold professionals contacted
- >200 individuals agreed to participate and received access links
- 108 individuals contributed

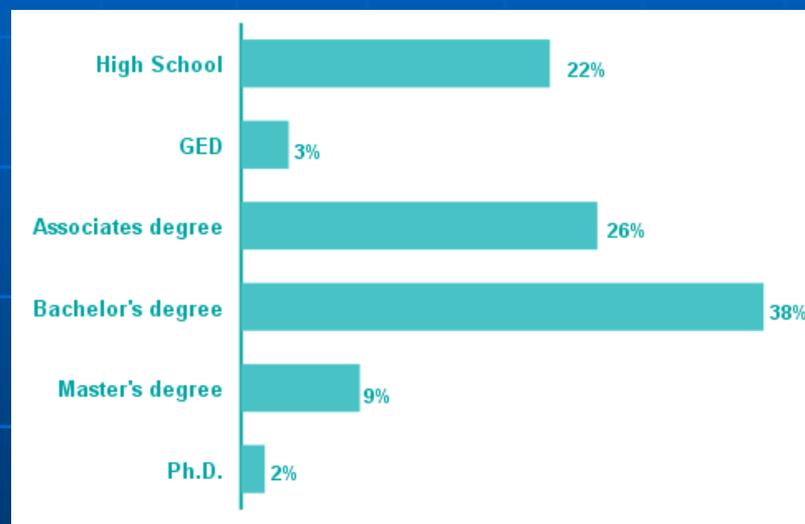


Participants - Highest Level of Education

Assessors (N=50)

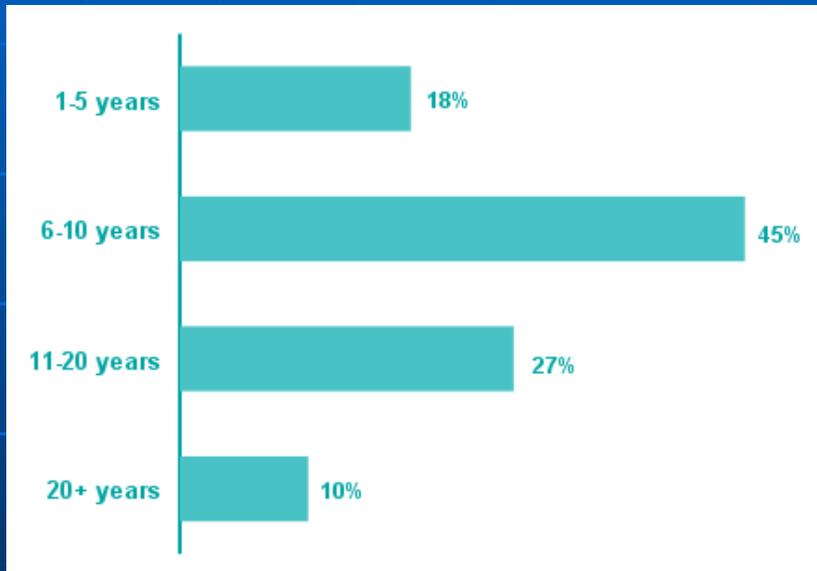


Remediators (N=58)

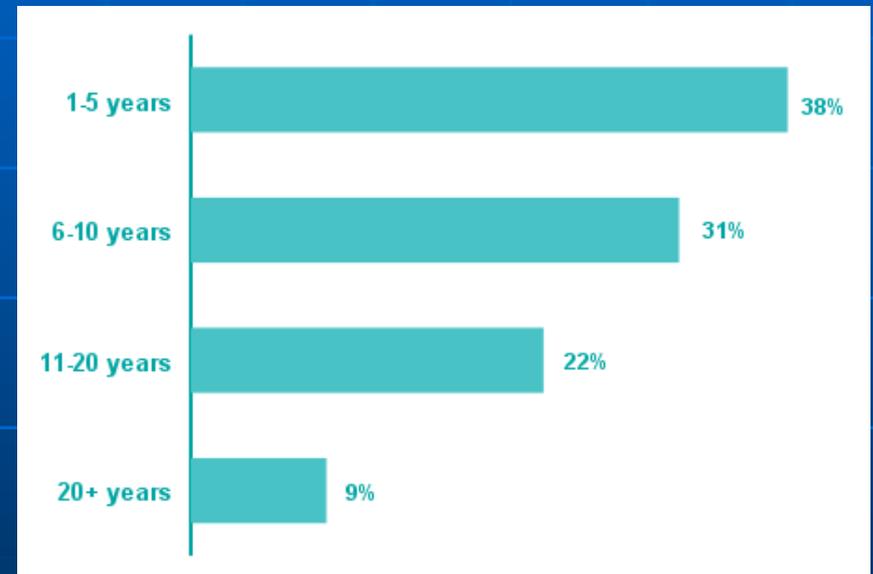


Participants-Years Working in Mold Remediation Industry

Assessors (N=49)

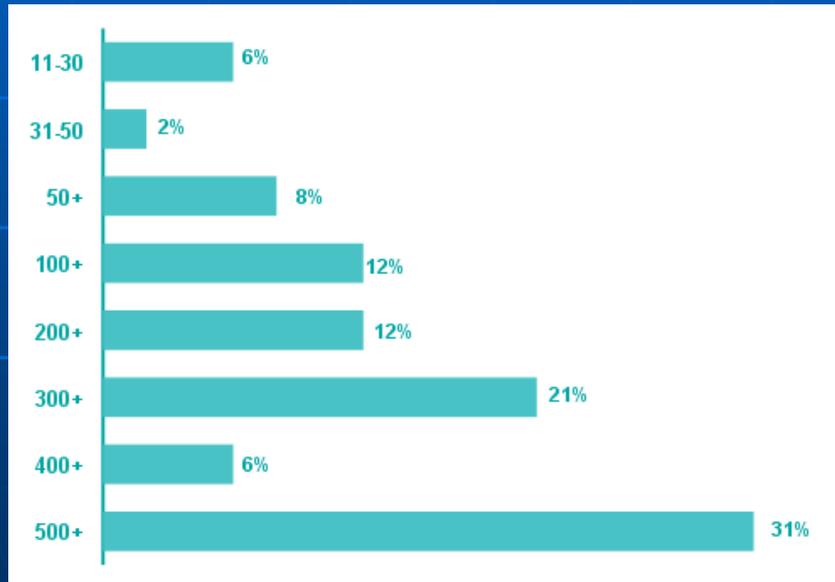


Remediators (N=58)

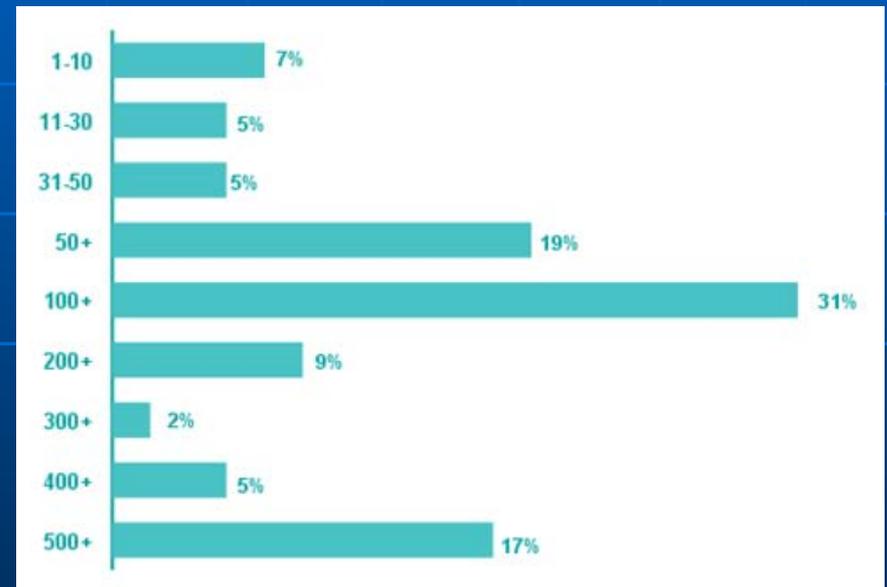


Number of Mold Remediation projects conducted or participated in from inception to completion

Assessors (N=48)



Remediators (N=58)

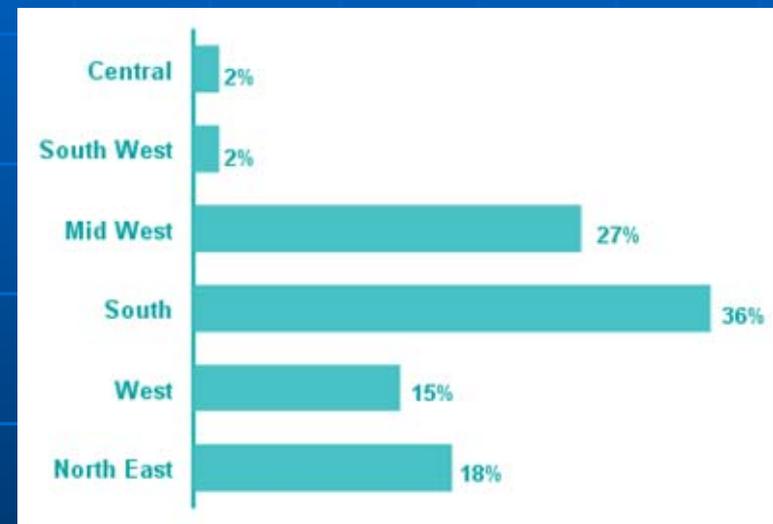


Geographic Location of Business & Activity

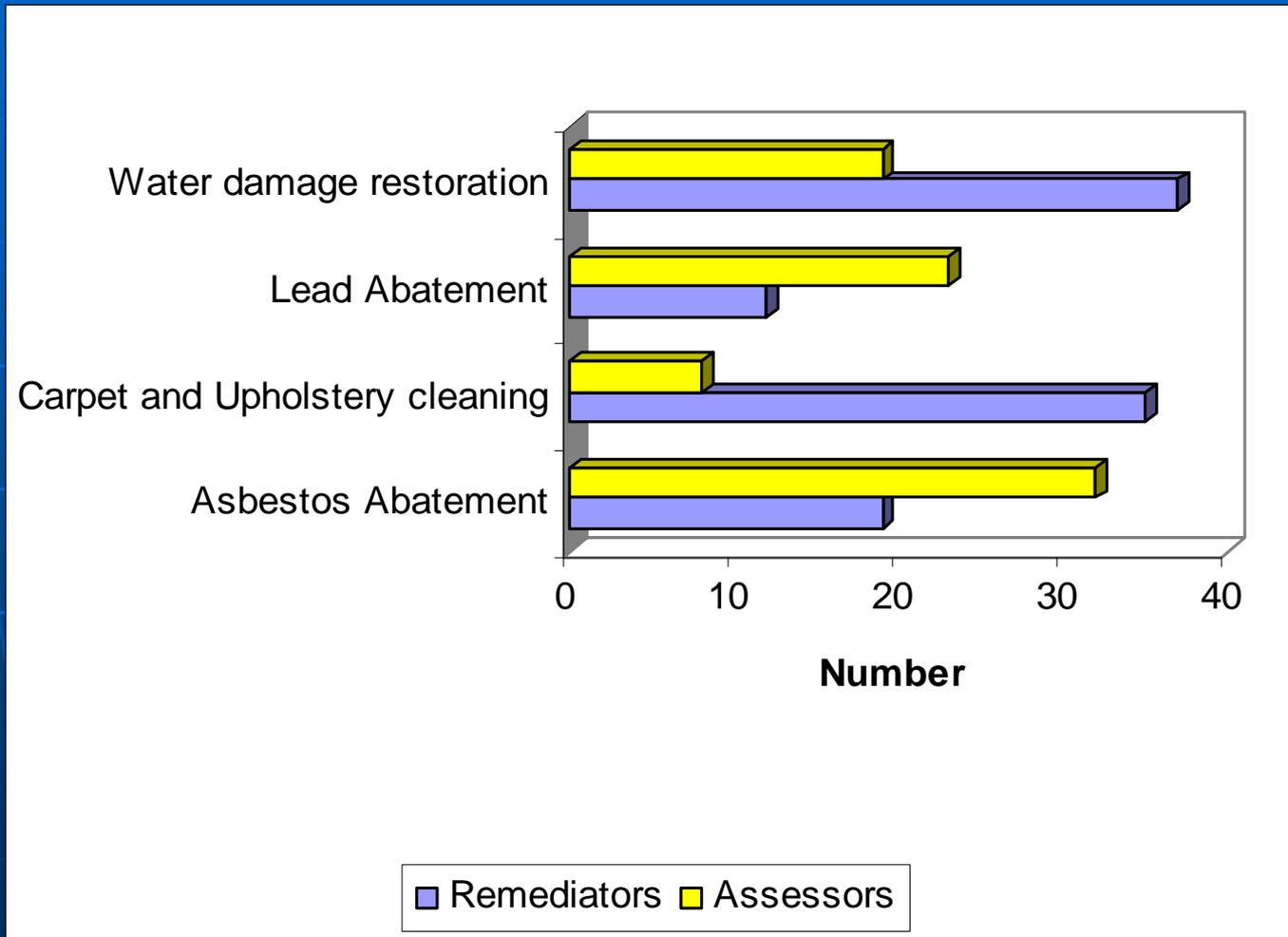
Assessors (N=50)



Remediators (N=55)



Experience in Related Industries



Module 1 Q17. Guidance Documents Preference

Assessors		Remediators	
Guidance Documents (descending order of preference)	Rank	Guidance Documents (descending order of preference)	Rank
ACGIH - Bioaerosols: Assessment and Control, 1999	1, 2, (3)	IICRC S520 - Standard and Reference Guide for Professional Mold Remediation, First edition (December 2003)	1, (2, 3)
IICRC S520 - Standard and Reference Guide for Professional Mold Remediation, First edition (December 2003)	1, 2, (3)	IICRC S500 - Standard and Reference Guide for Professional Water Damage Restoration, ANSI-approved Third Edition	3, 2, 1
EPA -402-K-01-001 , March 2001 Mold Remediation in Schools and Commercial Buildings	1, 3, (2)	EPA -402-K-01-001 , March 2001 Mold Remediation in Schools and Commercial Buildings	1, 2, 3
New York City Department of Health and Mental Hygiene , May 7, 1993 - Guidelines on Assessment and Remediation of Fungi in Indoor Environments	2, 3, (1)	New York City Department of Health and Mental Hygiene , May 7, 1993 - Guidelines on Assessment and Remediation of Fungi in Indoor Environments	2, 3, (1)
AIHA Guideline 3 - 2004, Assessment, Remediation, and Post-Remediation Verification of Mold in Buildings	2, 3, (1)	ACGIH - Bioaerosols: Assessment and Control, 1999	2, 3, (1)



Module 1 Q14. Challenges and Barriers to Successful Mold Remediation – Top 5

Assessors

(N=49)

1st Client-imposed financial restrictions (86%)

2nd Liability concerns (84%)

3rd - Private vs. insurance payout (80%)

- Deficient construction and retrofitting practices in buildings (80%)

-Client-imposed time constraints for job performance and completion (80%)

4th Insurance company-imposed financial restrictions (78%)

5th - Multi-party involvement (76%)

- Multiple materially interested parties (76%)



Module 1 Q14. Challenges and Barriers to Successful Mold Remediation -Top 5

REMIATIORS

(N=56-57)

1st Client-imposed financial restrictions
91%

2nd Insurance company-imposed financial
restrictions 89%

3rd Liability concerns 83%

4th Knowledge/sophistication of
owner/occupant/client regarding IAQ
issues and remediation 79%

5th - Multi-party involvement
- Unexpected mold contamination
discovered during remediation (Hidden Mold



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Least Significant Challenges and Barriers for Successful Mold Remediation

30-40%

Lack of legislation or enforcement (A and R)

Restricted hours for remedial activities due to nature of job (R only)

A= Assessors

R = Remediators





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Mechanics of Mold Remediation

Mold Contamination Assessment Criteria (Always-Most Jobs)

- 1) **Condition 1 (No contamination); Condition 2 Settled spores or surfaces exposed to settled spores); Condition 3 (Active growth) (ICRC S520 Standard and Reference Guide for Professional Mold Remediation, First Edition, 2003)**
- 2) **Small (<10 sq. ft); Medium (10-100 sq. ft); Large (>100 sq.ft.) (U.S. EPA, 2001)**
- 3) **Level I (<=10 sq.ft; Level II(10-30 sq.ft; Level III (30-100 sq.ft); Level IV (>100 sq.ft; Level V (HVAC) (NYCDOH 2000)**
- 4) **Minimal; Moderate; Extensive (ACGIH, 1999 Bioaerosols: Assessment and Control)**
- 5) **Consider entire building contaminated irrespective of the degree of mold contamination for remediation planning and implementation**
- 6) **<3.23 sq.m; 3.23-32 sq.m; >32 sq.m (Health Canada, 1995)**
- 7) **No specific criteria necessary for remediation planning and implementation**

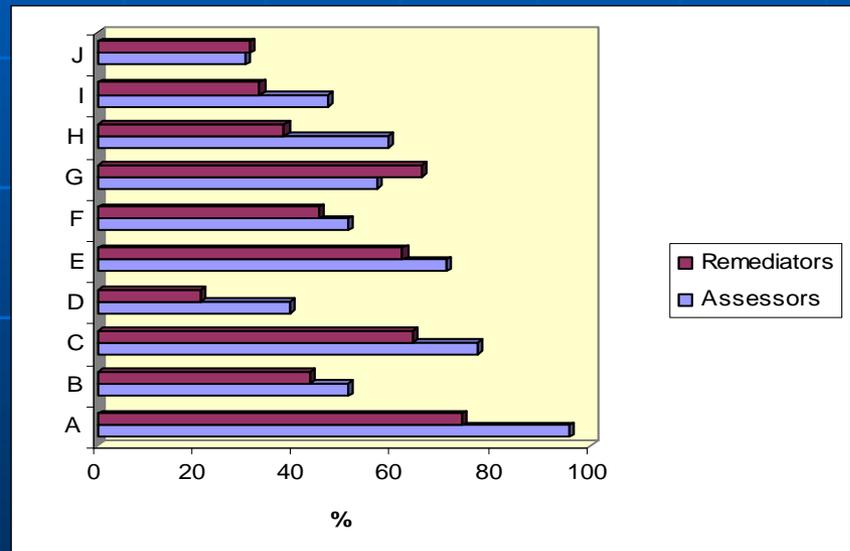
Module 2 Q3. Indicate the frequency of the mold contamination assessment criteria used. Respond to All listed (7).



Elements of Work Specification Protocol (Always to Most Projects)

- A. as a prerequisite for controlling or repairing the moisture source if necessary
- B. for legal or training requirements
- C. because of specifications contained in industry guidelines
- D. because of applicable government regulations
- E. as a requirement for worker safety and health protection
- F. because of necessary submittals to clients
- G. as summaries and findings of pre-remediation measurements, including lab reports
- H. as a part of instructions for dealing with unexpected situations (e.g., contamination, water-damage, safety)
- I. as a consideration for handling of regulated hazardous materials, when discovered
- J. as part of a recommendation for using a specialist or expert from other disciplines, when necessary

Module 1. Q35 In mold remediation protocols or work specifications that you have written to date, indicate the percentage of completed projects where elements were included:





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Pre-remediation Mold sampling



Module 1 Q34 Is it necessary to perform mold sampling prior to initiating restoration or remediation activities when...

- **HVAC system**, with a built-in humidifier, is suspected to be microbial/mold contaminated. There is no visible mold growth elsewhere in the residence
- **HVAC system** has visibly contaminated components in an old historical residence. Hidden mold was discovered during a recent renovation attempt
- **Health complaints** from the occupants, irrespective of the presence or absence of visible mold growth
- **Health complaints** from new occupants of a residence without a known source of water intrusion or visible mold growth
- **Diffused widespread mold contamination** evident on several painted interior walls inside a building

...preliminary examination suggests indoor conditions favorable for mold growth or indicates existence of visible mold contamination

Good Agreement between Assessors (N=48) and Remediators (N=56)

Required (65%-75%)



Preliminary examination suggests indoor conditions favorable for mold growth or indicates existence of visible mold contamination

Module 1. Q34: Is it necessary to perform mold sampling prior to initiating restoration or remediation activities?

- **An entire building has been exposed to rising flood waters for less than 24 hours**

Agreement

**Not Required
(60-70%)**



Preliminary examination suggests indoor conditions favorable for mold growth or indicates existence of visible mold contamination

Module 1. Q34: Is it necessary to perform mold sampling prior to initiation of restoration or remediation activities?

No Agreement!

- **Remediators favor conducting mold sampling even when extensive mold growth is clearly evident**
- **Assessors favored mold sampling when mold growth may not be visible but conditions are favorable**

Areas of Uncertainty

When visible mold growth is very limited or not evident at all

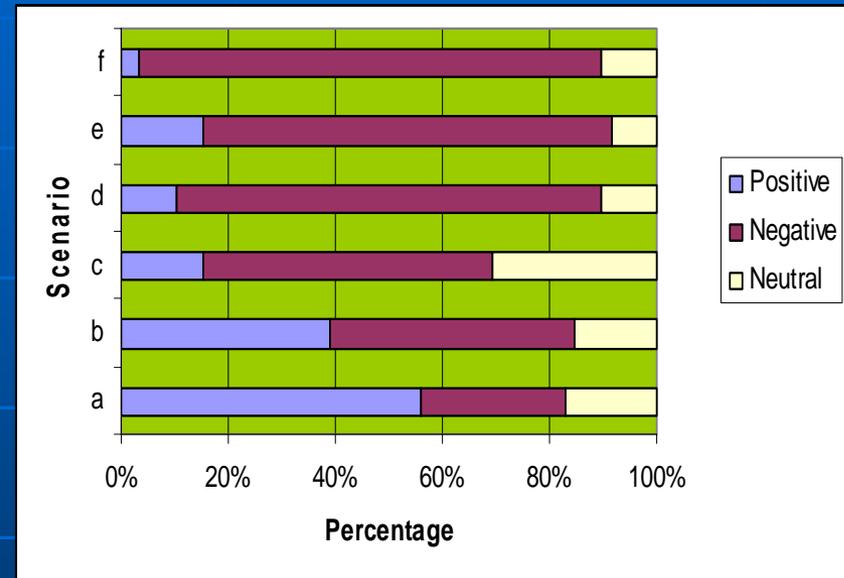
- **Flooding and resulting water damage** are restricted to the ground floor of a residence where **abundant** mold growth is evident (**Required: R 60%**)
- **Flood waters** have entered a building and caused some water damage, but **mold growth is not observed** (**Required: A 58%**)
- Fully finished basement of a residence, renovated within last six months **due to flooding**, shows small **multiple patches of mold growth on the drywall board** (**Required: A 60%**)
- Residence shows **extensive mold growth** covering one or more sections of a basement (**Required R: 65%**)
- A ranch-style residence on concrete slab shows **extensive mold growth** inside one or more rooms (**Required: R 64%**)
- **Mold contamination is visible on films of condensed water vapor** around multiple windows in the living room of a residence (**Not Required: A 60%**)



Pressure Differential System to Prevent Cross-Contamination (N=59)

When:

- a. Cleaning multiple adjacent rooms, the cleaned rooms must be pressurized...
- b. Outside mold spore counts are higher than indoor spore counts in a mold-contaminated building; the interior space being remediated must be pressurized...
- c. A residence has been fully exposed to flood waters; the interior space being remediated must be pressurized...
- d. A residence has wide-spread mold contamination; the areas under remediation must be pressurized...
- e. A mold-contaminated residence has indoor relative humidity of 70% compared to 40% outdoors, the rooms being restored must be pressurized...
- f. A residence has mold contamination restricted to one small section of a room; the contaminated area being remediated must be pressurized...





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Remediation Scenarios

Module 4. C Scenario D

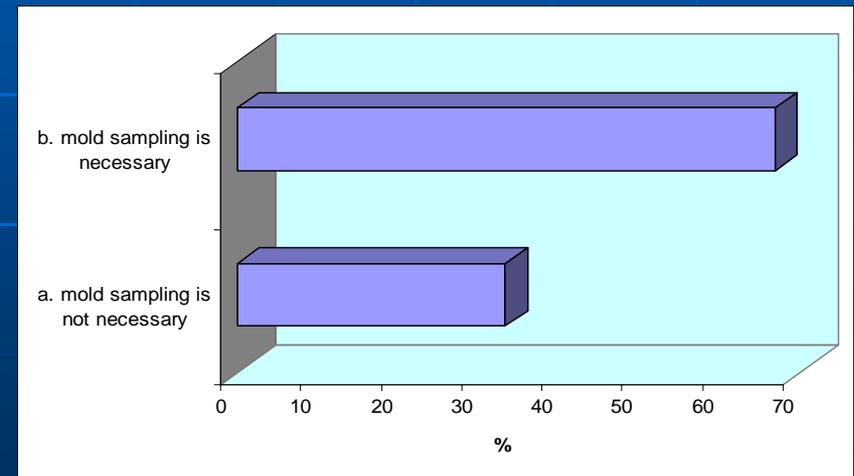
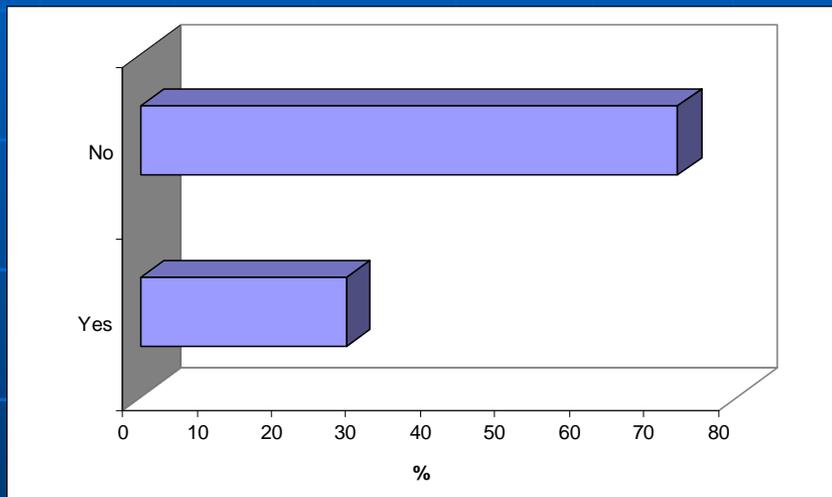
- **Flood Scenario** A 1800 sq. ft two storey residence with partial basement was recently flooded due to rising river waters (2.5 ft on first floor). All water damaged and mold contaminated contents and furnishings have been removed. Only bare plaster walls and flooring remain on the 1st floor. The majority of wall assemblies are plaster over wood lathe. Relatively newer addition to the house contains insulated plaster walls. Some sections of the older plaster walls are visibly compromised (i.e., have lifted from the lathe).



Scenario D - Visual Examination & Mold Sampling

- Q2. Given this situation, is pre-remediation mold sampling necessary for developing mold remediation plan?

(N= 42)



Q1. Given this situation, is visual examination alone adequate to develop remediation plan?

(N=55)

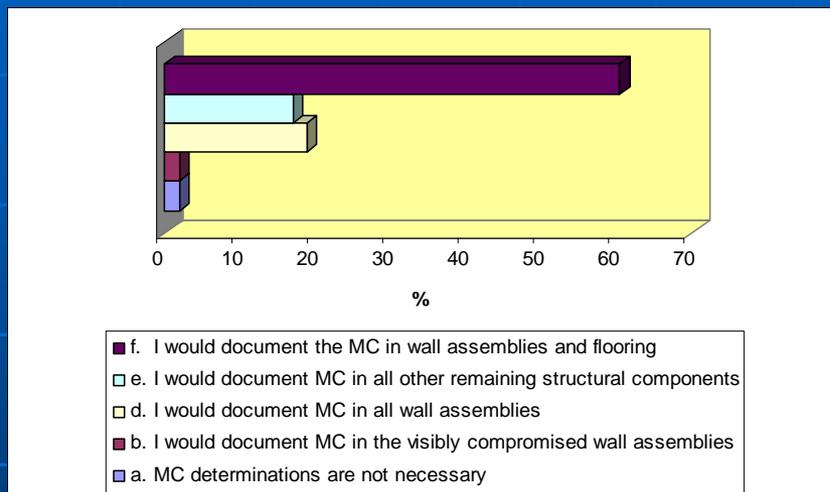


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Scenario D-Material Moisture Content

- Q3. Do you need to determine the moisture content of structural components on the flooded first floor? (N=53)

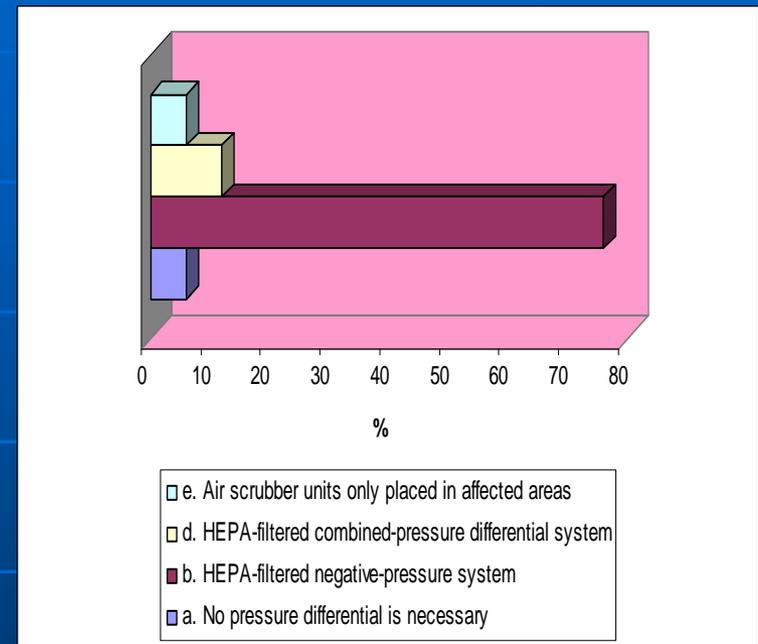
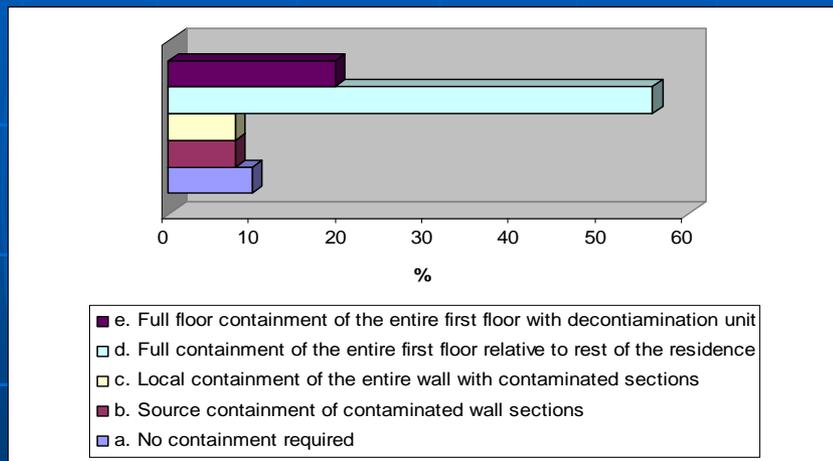


- Not Selected: c. I would document moisture content only in walls with insulation.



Scenario D - Containment & Pressure Differential

- Q6. What level of containment would you consider necessary for this project?
(N=52)



- Not Selected: c. HEPA-filtered positive pressure system
- Q7. Which type of pressure differential would you apply for controlling cross-contamination?
(N=50)

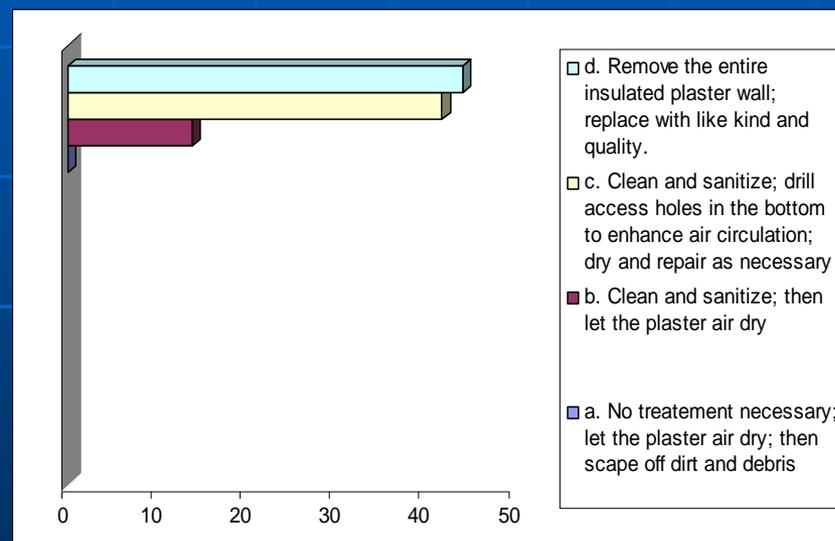
Module 4.Scenario D. Remediation of Plaster Wall Assemblies exposed to two and half feet of rising river waters for few weeks.

- Q11. If an insulated plaster wall appears to be physically intact, how would you address remediation?

(N= 45)

VERBATIM COMMENTS

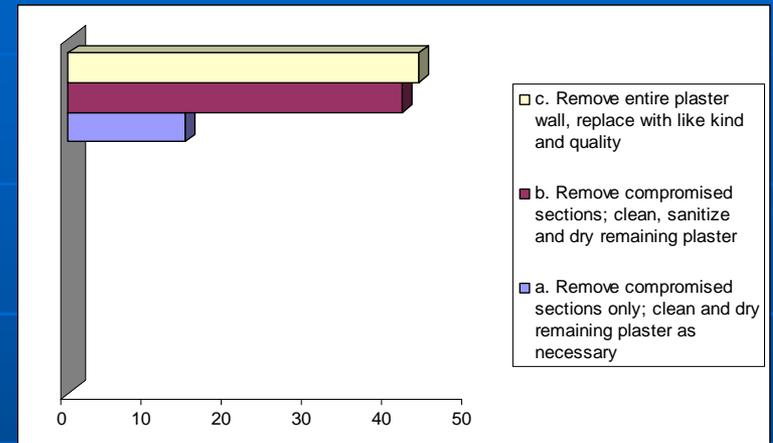
- “All porous building materials wet from category 3 flood waters must be removed and replaced”
- “Remove flood affected plaster and clean and treat remaining plaster”
- “Further inspection of the plaster walls would be required to determine remedial and repair specifics”
- “Investigate interstitial conditions with boroscope, moisture meter and/or destructive investigation”
- “I highly recommend removing all the insulation, which more than likely was compromised”



Module 4. Scenario D. Remediation of Plaster Wall assemblies exposed to two and half feet of rising river waters for few weeks.

Q10. If some sections of the older plaster wall show separation from the wood lathe, how would you remediate?

(N=45)



VERBATIM COMMENTS

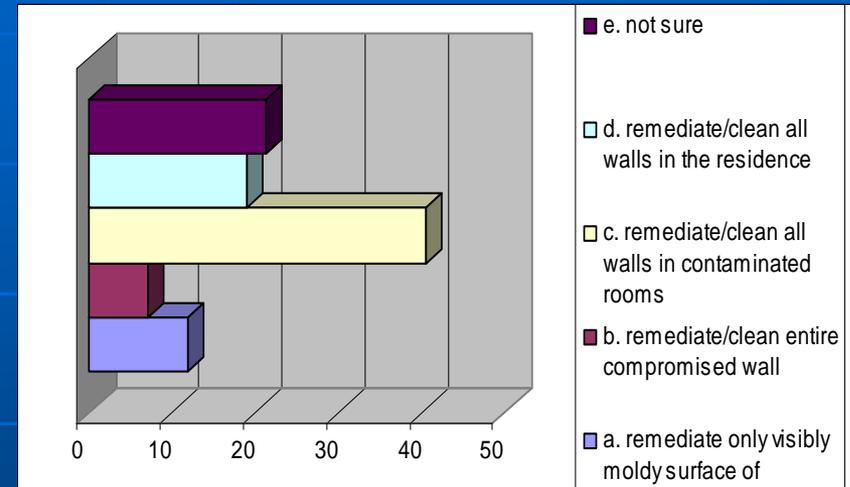


- "further inspection of the plaster walls would be required to determine remedial and repair specifics"
- "infrared thermography anomalies scan"
- "must view, assess, clean wall cavities"
- "need to investigate further- either visually or air sample from inside wall cavities"
- "refer to scope"
- "remove compromised sections until 2 foot clearance of no mold growth, Clean and dry remaining plaster"

Module 4 Scenario E. Wide-spread and diffused visible mold growth on some painted wall surfaces inside a residence. No obvious source or cause of moisture detected during preliminary walkthrough.

Q22. What would be your suggested best strategy for remediating mold contaminated wall surfaces?

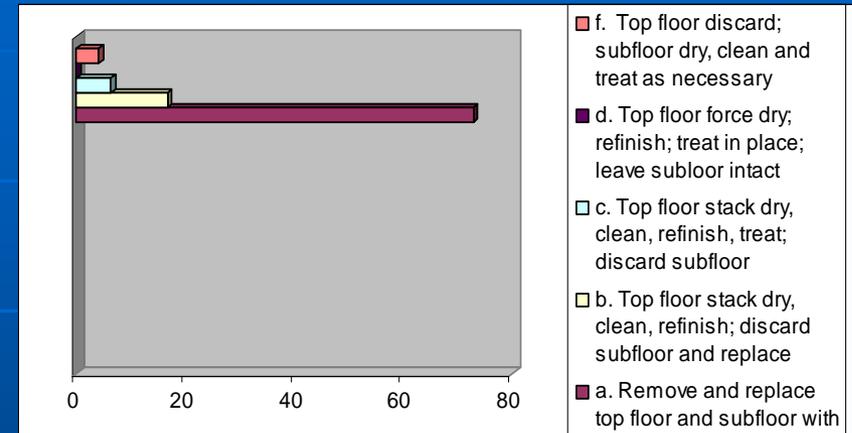
(N=42)



Module 4.Scenario D Remediation of Hardwood Floors Subjected to Flood Waters for Extended periods

Q 14 Select method for remediating hardwood floors on the first floor assuming that the subflooring and support materials are deteriorated and physically compromised.

(N=48)



VERBATIM COMMENTS



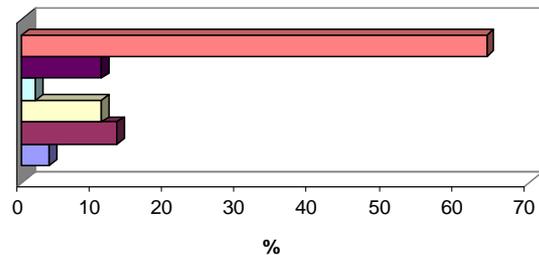
- "Architectural issue"
- "Remove top floor to replace subfloor- either replace top floor also or get dry and see what needed"



Scenario D – Post Remediation Verification

- Q16. Specify your chosen post-remediation verification strategy:

(N=53)



- f. Combination
- e. employ air mold testing
- d. employ surface mold assessment and testing
- c. verify implementation of appropriate remediation protocol
- b. verify resolution of the moisture problem
- a. post-remediation verification not required in this case

VERBATIM COMMENTS

“Materials moisture testing, visual inspection and air sampling”

“Verify MC levels, air test for mold”

“visible inspection, moisture testing, humidity level”

“Visual Inspect, air & surface testing”

“Visual surface air sampling verify protocol followed”

“Visual, air, olfactory”

“Visual, Surface, Bulk”



Efficiency Ratings of Physical Methods of Mold Removal from Wood Framing

(N=42-49)

Q35 Part C Scenario F - G

Methods of Mold Removal	F: Mold on lower six inch sections of wood framing in a 4x8 ft. bathroom	G: Diffuse mold growth on wood framing in a 10x15 ft. basement office	H: Mold contamination of wood framing in 1000 sq. ft. basement area exposed to 3 ft. high flood waters
a. Demolition under containment and negative pressure	52.0%	57.0%	59.8%
b. Hand scrubbing/brushing	83.6%	59.2%	55.1%
c. HEPA sanding	97.9%	80.0%	84.0%
d. HEPA vacuuming	83.0%	67.0%	74.0%
e. HEPA vacuum, damp wipe, HEPA vacuum	85.4%	81.3%	80.0%
f. HEPA wire brushing	83.3%	65.0%	63.0%
g. Media blasting	62.5%	75.0%	77.5%
h. Pressure washing	33.3%	28.0%	26.3%
i. Wet or damp wipe	64.3%	40.5%	52.1%

Efficiency is defined by the efficacy, costs, and time requirements for each mold removal method.





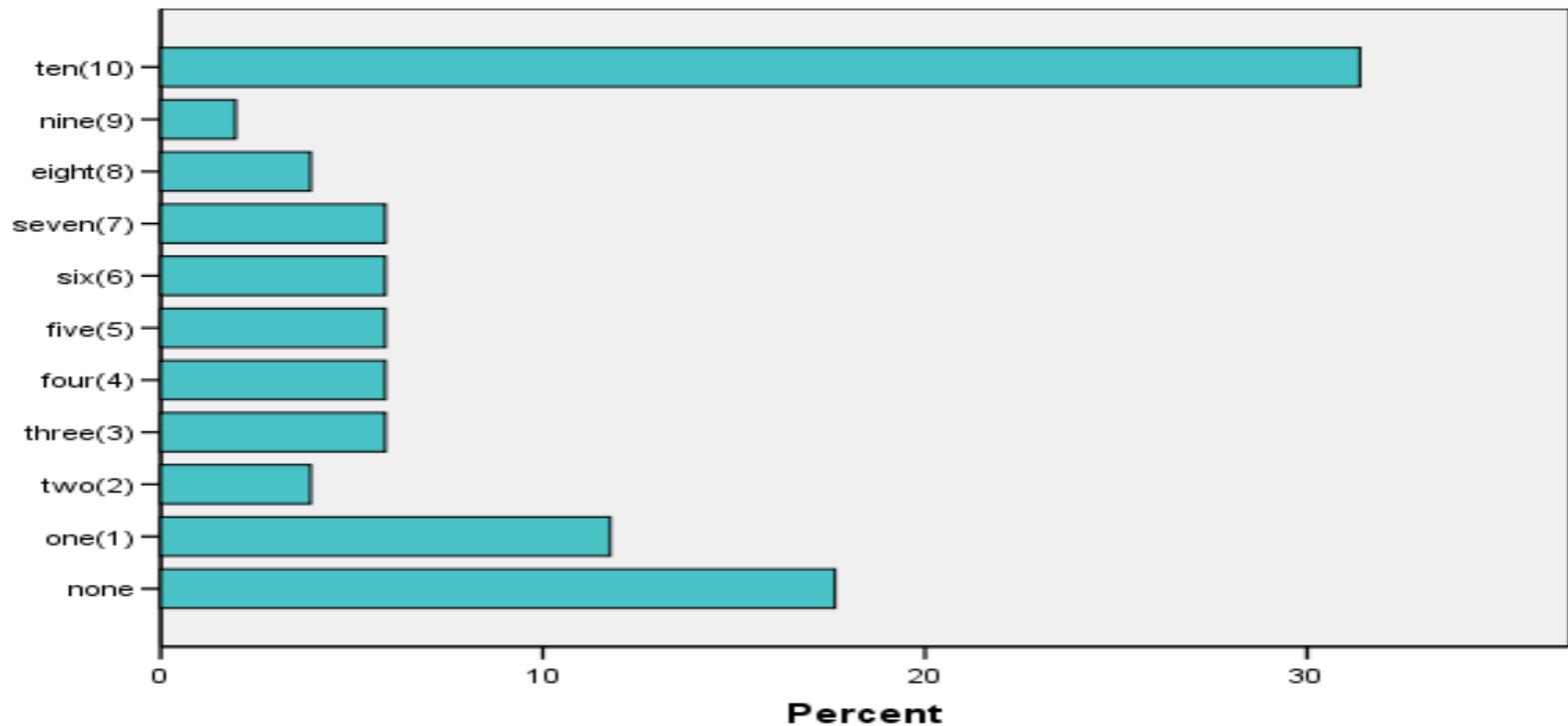
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Antimicrobials

Antimicrobial Use

Module 6 Q2. Out of the last ten (10) completed mold projects, how many required use of antimicrobials?



N=52



Antimicrobials and Other Chemical Products Use Considerations

(N=49)

75-80%

- To accommodate client request
- For treating inaccessible areas or building spaces
- To ensure further microbial growth does not occur

60-67%

- Liability protection
- Odor Control
- To delay/ensure further microbial growth does not occur
- When the water incursion is from potentially contaminated source
- When there is delayed response of 48-72 hrs in responding to water damage

-

-

-

-

-

29% - When the building's housekeeping is poor

10% - To defray remediation costs

Module 6 Q6. Would you consider the use of antimicrobials and other chemical products appropriate for listed purposes (16)?

(N=49)



“State of Mold Remediation Practice”

- **Conformity** (e.g., moisture inspection, work plan specifications, appropriate PPE)
- **Variance** (e.g., mold sampling and interpretation, post-remediation verification, containment, pressure differential, chemical products usage)
- **Liability** concerns seem to be driving many practices
- **Cost** a major consideration in protocol design
- **Insufficient guidance** for managing water damaged and moldy materials
- **Lack of Effective Communication** between the mold remediation practitioners, scientific and health community, policy makers, and the general public



Dissemination of Findings

Scientific manuscripts

“White Paper” on Managing Moldy Materials in Residences



Thanks

Study Participants



Acknowledgements

- Denise Turnell
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 - Prabhjot Singh
 - Jeff Bishop
 - Peter Ashley
-

- US Department of Housing and Urban Development
- Indoor Air Quality Association
- Saint Louis University



Questions?



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BUILDING DAMPNESS AND MOLD: HEALTH AND ECONOMIC EFFECTS*

**2008 National Healthy Homes
Conference**

September 15 - 17, 2008

William Fisk*

**Sr. Scientist, Department Head
Indoor Environment Department
Lawrence Berkeley National Laboratory**

***Presentation supported by the U.S. EPA**

Early Concerns About Mold

Leviticus, Chapter 14:

“On the seventh day, the priest shall return to inspect inspect the house. If the mildew has spread on the the walls, he is to order that the contaminated stones stones be torn out and thrown into an unclean place place outside of town. If the mildew reappears in the in the house after the stones have been torn out and the and the house is scraped and plastered, it is a destructive mildew and the house is unclean. It must must be torn down-its stones, timbers and all plaster-plaster-~~and taken out of town.~~

Main messages from this Bible passage:

- Mold is bad
- Solution is cleaning and/or removal

Presentation Overview

- ❑ What is building dampness?
- ❑ What aspects of health are affected by dampness in homes?
 - ❑ **What about toxic molds?**
- ❑ How large are the effects?
 - ❑ **Health**
 - ❑ **Economics**
- ❑ Are remediations effective?
- ❑ Does dampness at work or at schools affect health?
- ❑ Is dampness in air conditioning systems a risk?
- ❑ Prevention and remediation
- ❑ Next steps



The background of the slide is a light blue surface covered with numerous water droplets of various sizes. The droplets are scattered across the entire frame, creating a textured, moist appearance. The lighting is soft, highlighting the spherical shape and reflective surfaces of the water droplets.

Part 1

What is Building Dampness?

Dampness is Multifaceted

Signs of dampness

- ❑ Standing water, wet surfaces, moisture stains, material damage, visible mold, mold odors, high humidity
- ❑ No widely accepted criteria for a problem damp building

Sources of dampness

- ❑ Leaky walls or roofs, plumbing leaks, floods, groundwater entry, capillary water transport, vapor condensation, wet construction materials, indoor evaporation, outdoor air & inadequate dehumidification, air conditioning cooling coils

Locations of dampness

- ❑ Interior surfaces, wall cavities, crawl spaces, attics, HVAC systems

Exposures Associated With Building Dampness

Molds and bacteria (many types)

- Spores a few micrometers in size, bacterial cells, microbial fragments sometimes less than one micrometer
 - may carry allergens, inflammatory agents, toxins
 - settling and resuspension → inhalation exposures
- Microbial volatile organic compounds → odors

Chemicals

- Formaldehyde
- Alcohols and products of degradation of plasticizers
 - Damp concrete and PVC flooring

House dust mites

- Survival depends on sufficient indoor humidity

Cockroach

From Dampness to Microbial Growth

Microbial growth requires a damp substrate

- Moisture at surfaces is key

Surface characteristics are important

- Easily biodegradable materials are more readily colonized
- Almost any damp surface can become sufficiently soiled to support microbial growth

Time is important

- Slow drying → more chance of serious growth



Building Dampness is Common

Author	Location	Population	Mold or mildew	Water damage or dampness	Any dampness or mold
Spengler 1994	24 Cities in US & Canada	12,842 homes	36%	24%	50%
Mendell 2002	US Cities	100 offices		43% (current) 85% (past)	
RTI 2003	California	1181 classrooms	11%	43%	

Part 2

What Are the Health Effects of Dampness and Mold?

**Results of a Review by the
National Academy of Science,
Institute of Medicine (IOM)**

Upper Respiratory Track (URT) Symptoms

Description

- Nasal congestion, nasal irritation, runny nose
- Throat irritation, sore throat
- Hay fever like symptoms

IOM Findings

- Increased URT symptoms are associated with dampness
- Increased URT symptoms are associated with mold

What does “associated” mean?

- Correlated in numerous quality studies
- Statistically significant
- Studies controlled for anticipated confounding

Other Respiratory Symptoms

Description

- Wheeze → breathing sound often from restricted or labored breathing
- Cough
- Shortness of breath (dyspnea)

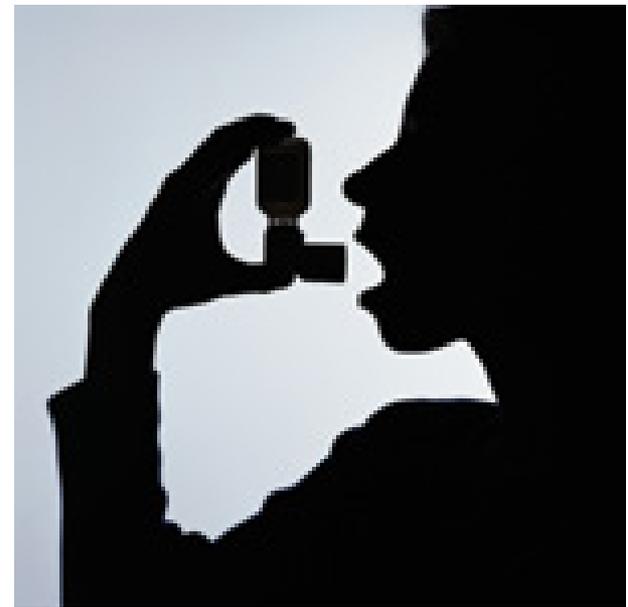
IOM Findings

- Increased wheeze is associated with dampness
- Increased cough & wheeze are associated with mold
- Limited or suggestive evidence that increased shortness of breath is associated with dampness

Asthma

Description

- ❑ Chronic disease of 6-7% of population, airway inflammation and normally episodic symptoms of wheezing, breathlessness, chest tightness, cough
- ❑ Can lead to irreversible remodeling of lung
- ❑ 2 million emergency room visits and 0.5 million hospitalizations per year in US
- ❑ 5000 deaths per year
- ❑ Annual ~\$17 billion annual cost



IOM Findings

Asthma exacerbation

- ❑ Increased asthma exacerbation is associated with dampness & with mold

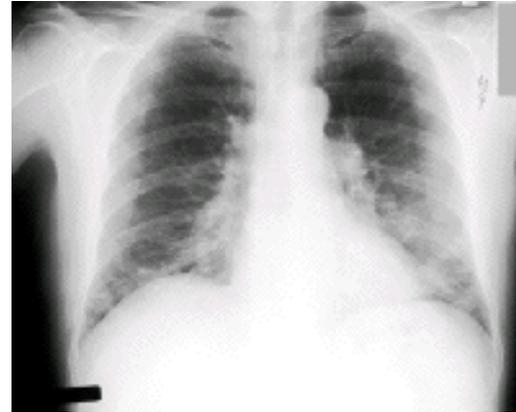
Asthma development

- ❑ Limited or suggestive evidence that asthma development is associated with dampness

Hypersensitivity Pneumonitis (HP)

Description

- ❑ Lung disease from exposure to organic dusts
- ❑ Cough, shortness of breath, fever several hours after exposure
- ❑ Only small portion of population appear to manifest disease after exposure



IOM Findings

- ❑ HP is associated with mold and bacteria in damp buildings – in susceptible individuals

Respiratory Infections



Description

- Fungi can infect the respiratory system of immune compromised individuals
- In individuals with normal immune function, prevalence of normal respiratory illnesses might be affected by mold exposures
 - **Animal and cellular studies suggest potential immune system suppression**

IOM Findings

- In severely immunocompromised persons, exposure to indoor molds (*Aspergillus*) can lead to severe respiratory infections
- In otherwise healthy children, there is limited or suggestive evidence of an association of respiratory illnesses with building dampness or mold

Pulmonary Hemorrhage or Hemosiderosis

Description

- ❑ Bleeding or hemorrhage in lungs, mostly in infants
- ❑ In 1993/1994, a cluster of pulmonary hemorrhage in eight infants from Cleveland was initially linked to exposure to the molds (*Stachybotrys chartarum*)
- ❑ Follow up review by CDC found that *Stachybotrys chartarum* was not clearly associated with acute pulmonary hemorrhage in infants

IOM Findings

- ❑ Available data (very limited), are inadequate to determine whether pulmonary hemorrhage in infants is associated with *Stachybotrys chartarum*, dampness, or other mold

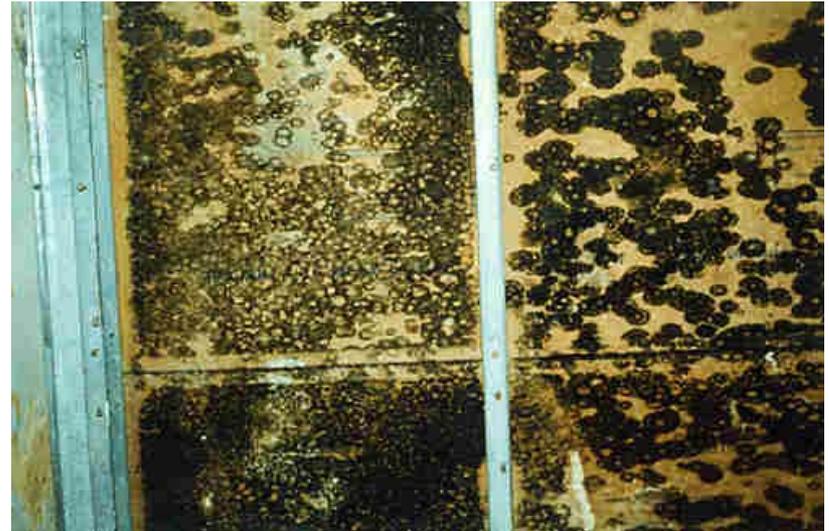
Other IOM Findings about Health Effects of Indoor Dampness and Mold

There is inadequate evidence to determine whether whether dampness or mold in buildings is associated with:

- Skin symptoms
- Gastrointestinal tract problems
- Fatigue
- Cancer
- Reproductive effects
- Rheumatologic and other immune diseases

Toxic Molds: IOM Conclusions

- Some molds (and bacteria) that grow indoors can produce potent toxins under appropriate environmental conditions
- Animal and cell studies have demonstrated adverse effects (immunologic, neurologic, respiratory, and dermal)

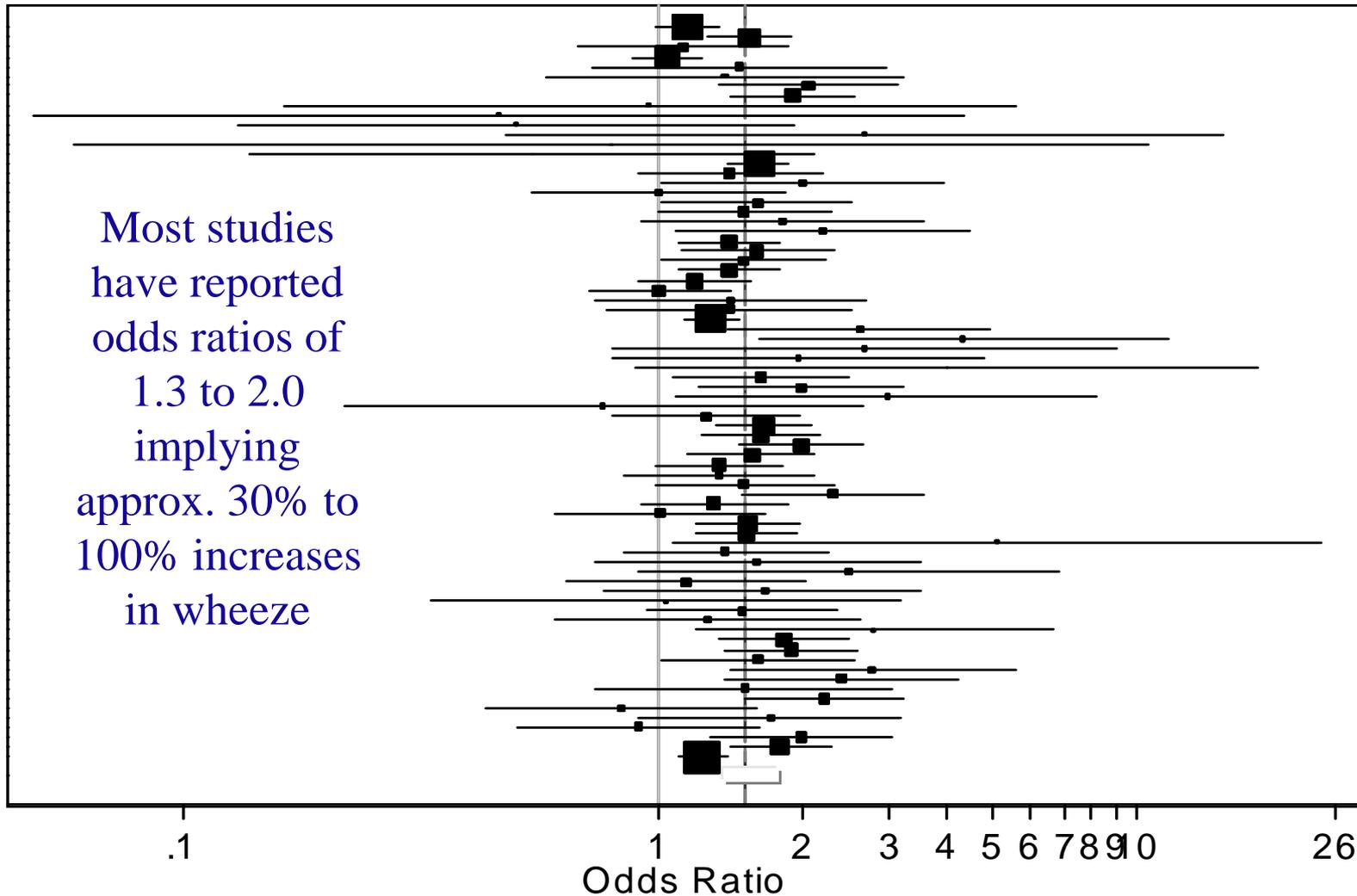


- Magnitude of people's exposures to mold toxins in damp buildings is unknown
- Dose required to cause health effects in people is unknown

Part 3

**How Strongly is Dampness and
Mold in Homes Associated with
Adverse Health?**

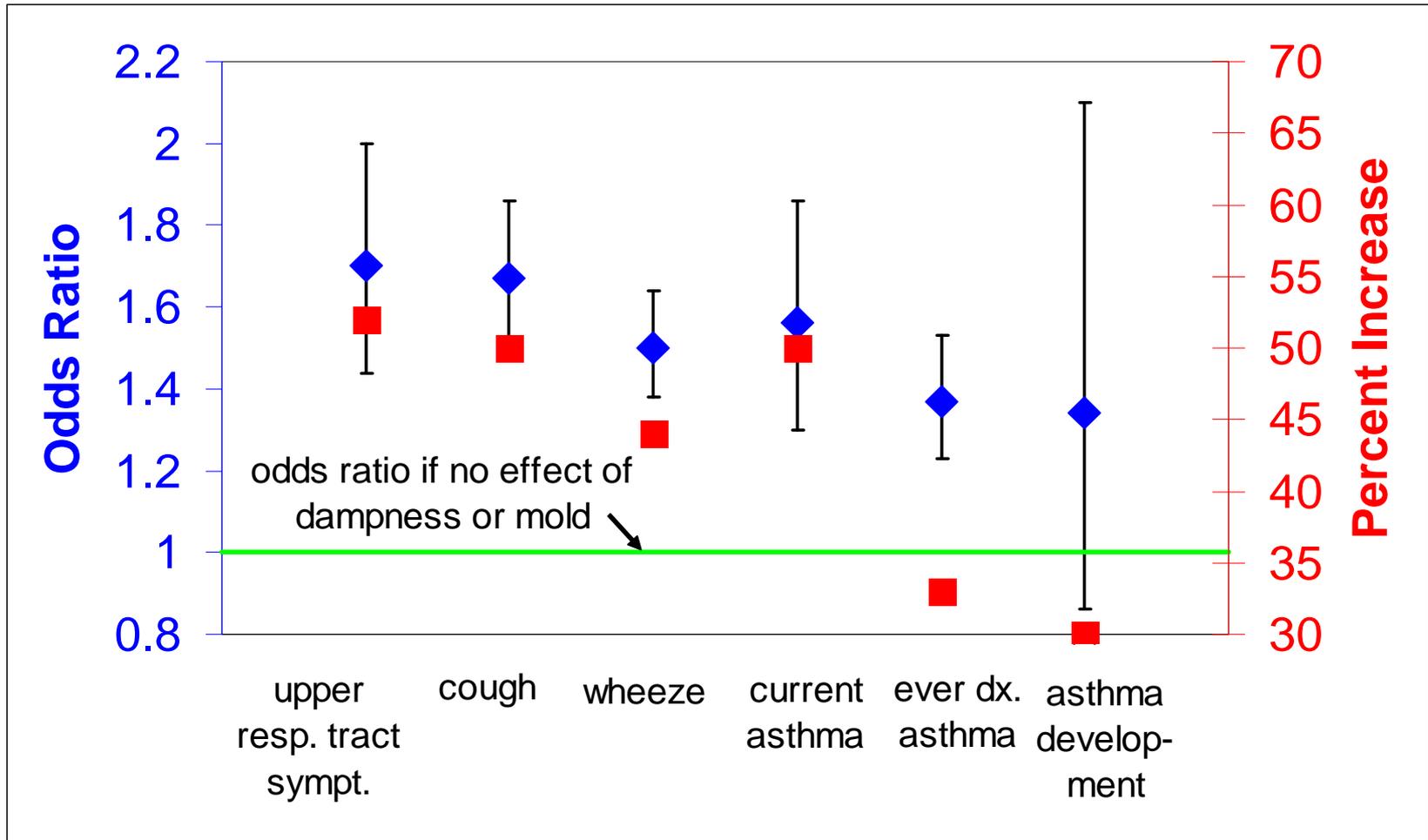
Example of Available Data -- Associations of wheeze with dampness or mold



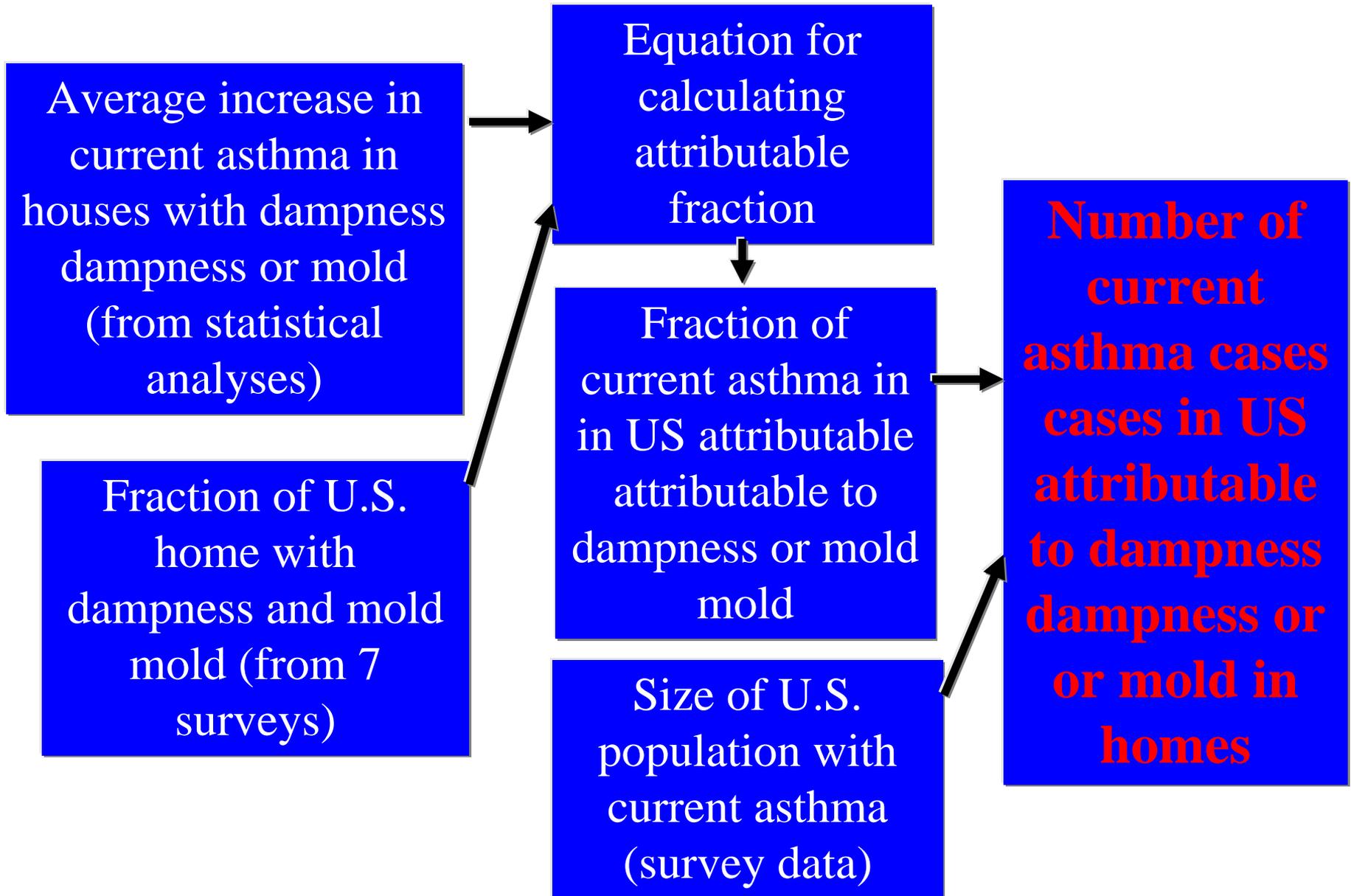
Quantifying the Health Risk -- Methods

- Establish quality criteria for study selection
 - e.g., control for other factors that may affect risk
- Identify studies meeting criteria
- Perform a statistical analysis of data from sets of studies with same risk factor (e.g., visible dampness and/or mold) and health outcome (e.g., wheeze)
 - Analyses account for variable level of uncertainty in individual study results and possible correlation among multiple results from the same study
- End product is a best overall estimate of magnitude of risk of adverse health in houses with dampness and mold, plus uncertainty bounds

Quantifying the Health Risk -- Results



Quantifying the Public Health Impact -- Method



Estimated Public Health Impact of Dampness and Mold in U.S. Houses

4.6 (2.9 – 6.3) million cases of current asthma

12% to 29% of all cases

Issues

- Additional types of health effects
- Range does not reflect uncertainty in dampness and mold prevalence
- Correlation versus causation

Estimated Cost of Current Asthma Attributable to Dampness and Mold

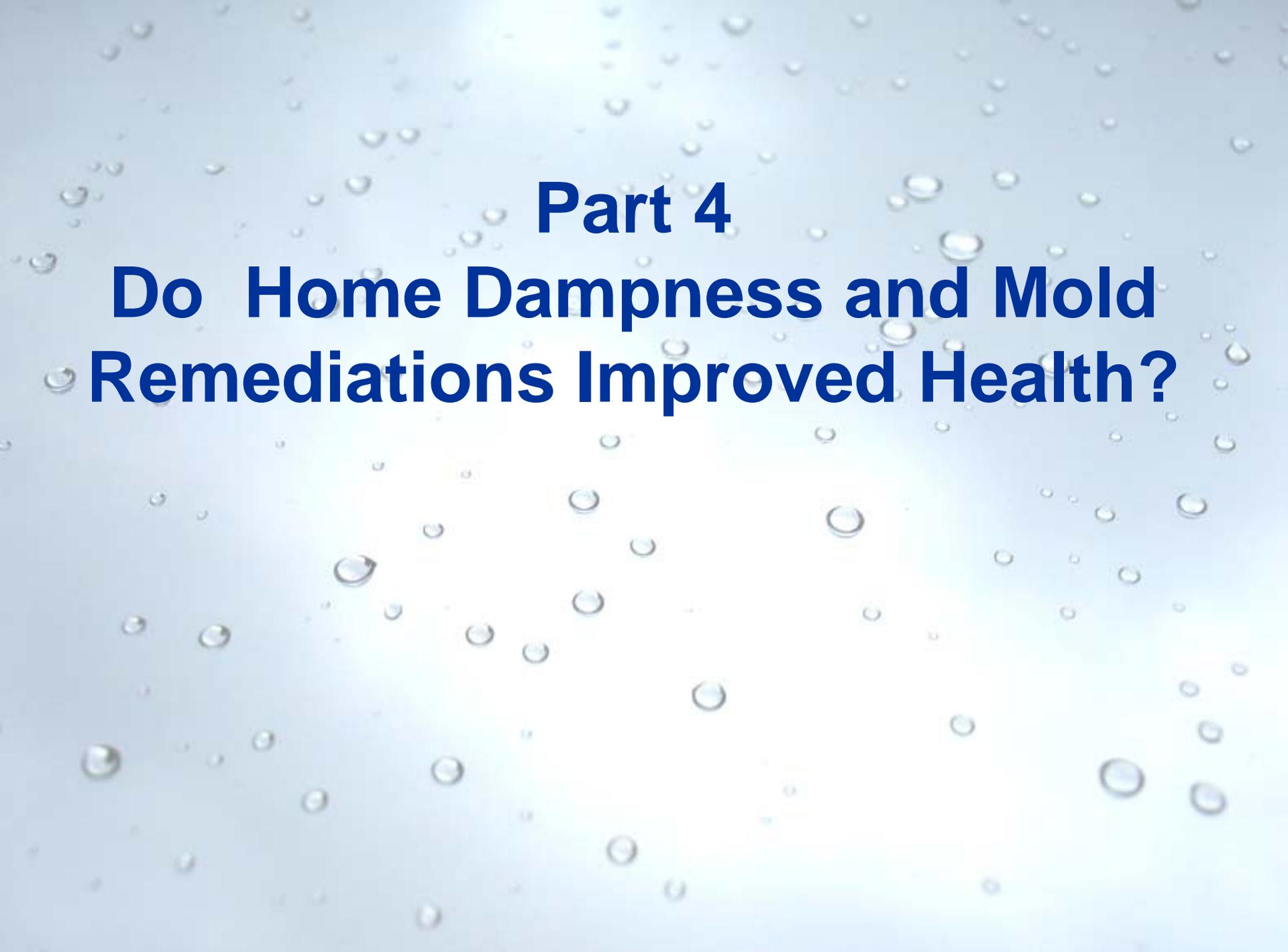
Fraction of current asthma
asthma cases in US
attributable to dampness or
or mold in homes
0.21 (0.12 – 0.29)

**Total annual cost of asthma
cases in US (\$16.8 B)**

- Health care \$12.2 B
- Premature death \$1.9 B
- Lost work & school \$2.7 B

**US annual cost of
asthma attributable to
to dampness or mold
in homes**

\$3.5B (\$2.1 – \$4.8B)



Part 4

Do Home Dampness and Mold Remediations Improved Health?

Do Dampness Remediations Help?

Kerscmar et al. (2006) Environmental Health Perspectives 114: 1574-1580

Homes of 33 Asthmatic Children

Asthma Control Education

10-45% decrease in mold score
15% reduction in airborne
airborne "indoor" mold

No significant reduction in
in asthma symptom days
days or emergency
hospitalizations

Homes of 29 Asthmatic Children

Asthma Control Education
& Dampness &
& Mold Remediation (avg.
(avg. cost \$3458)

50-75% decrease in mold score
score
50% reduction in airborne
"indoor" mold

Statistically significant 33%
reduction in asthma symptom
days and large reduction in
emergency hospitalizations

Part 5

Is Dampness and Mold in Offices and Schools a Risk to Health?

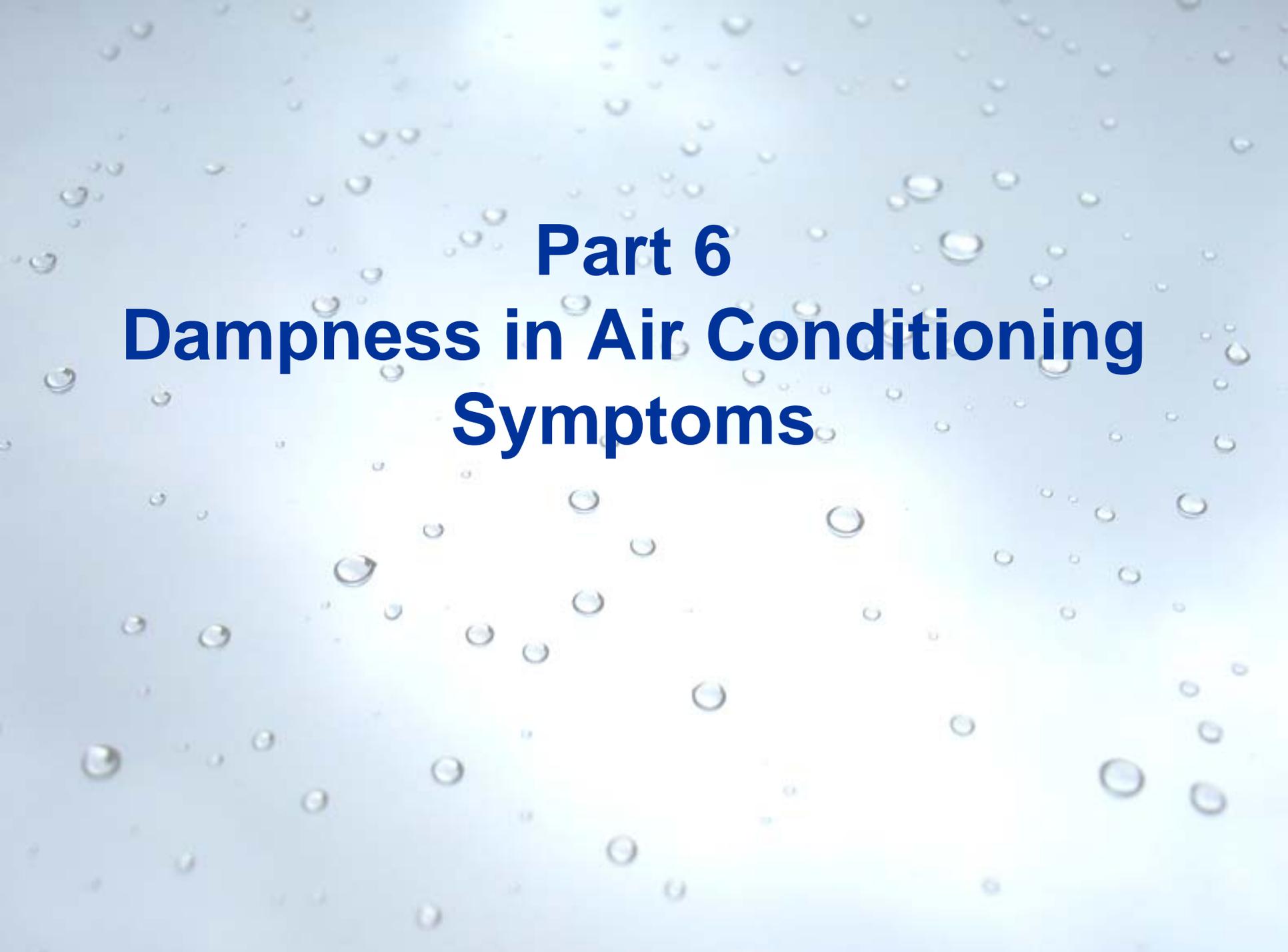
Offices and Schools: A Synopsis of the Available Literature

Offices

- 8 studies published in journals
- Every study found a statistically significant increase in at least 1 health effect
- In several studies, risk increased > 100%

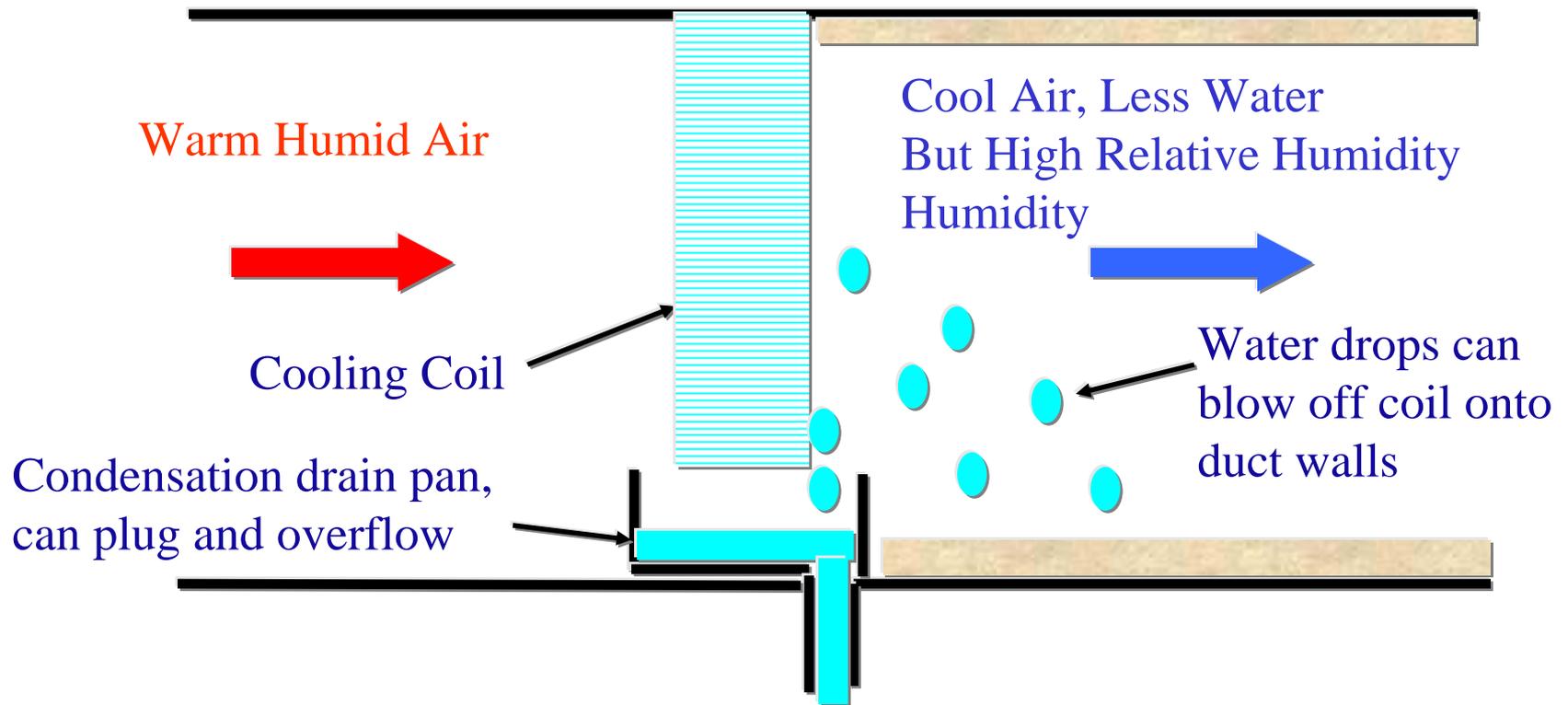
Schools

- 14 studies published in journals
- Most studies small in size – some have weak study designs
- Most studies reported statistically significant increases in some health effects



Part 6
Dampness in Air Conditioning
Symptoms

Illustration of Dampness Inside Air Conditioning Systems*



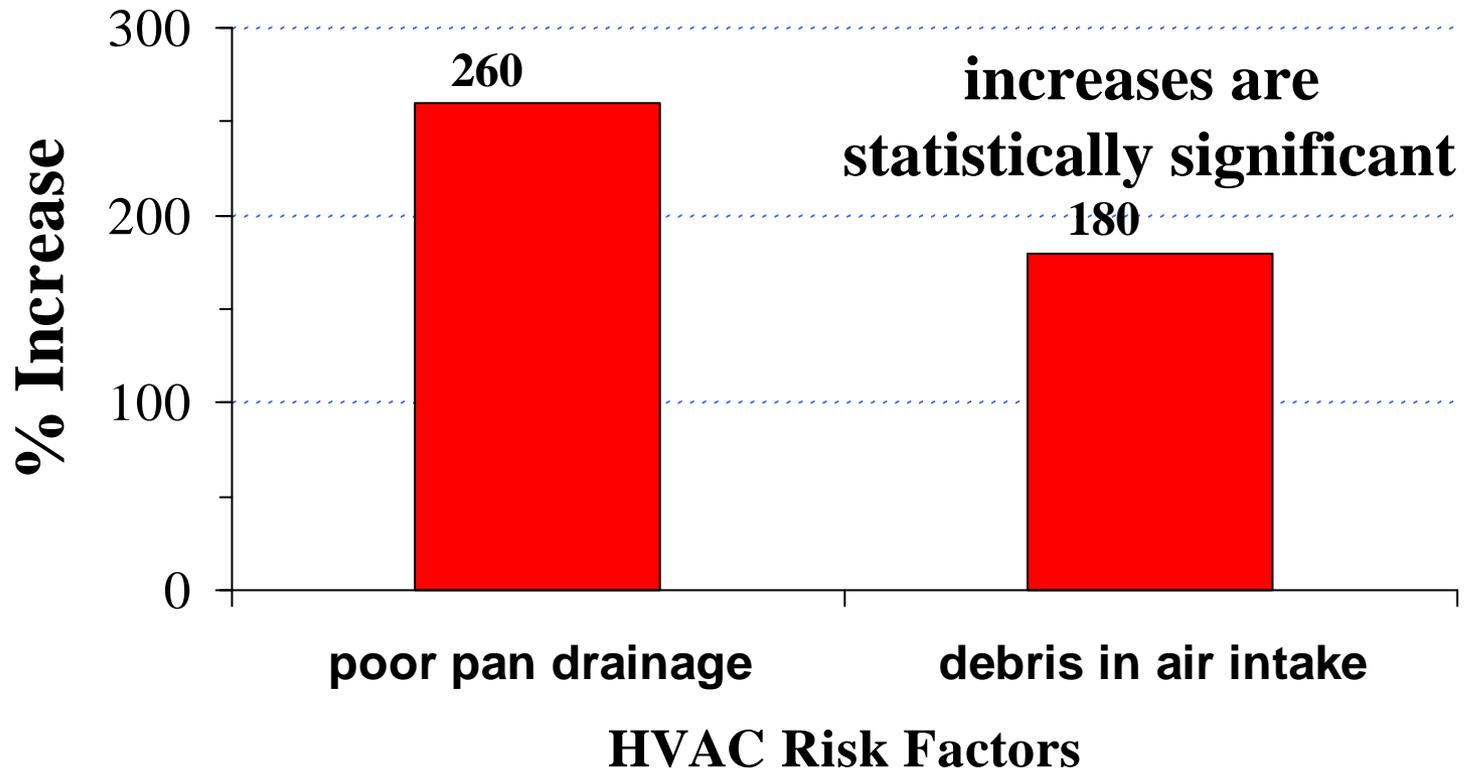
*Also, rain, fog, or snow can be drawn into AC system with outdoor air

Dampness in Air Conditioning (AC) Systems: What is Known

- Microbial contamination in AC systems is common
- AC increases risks of respiratory or other health symptoms
 - In 16 of 17 office building studies, typically 30% to 100% increase in symptoms with AC
 - In European study of 19,000 homes, 30% more wheeze, 46% more current asthma
 - In US study of 13,000 homes, 14% more lower respiratory symptoms, 28% more bronchitis symptoms
 - But not certain that dampness and mold causes the increased symptoms

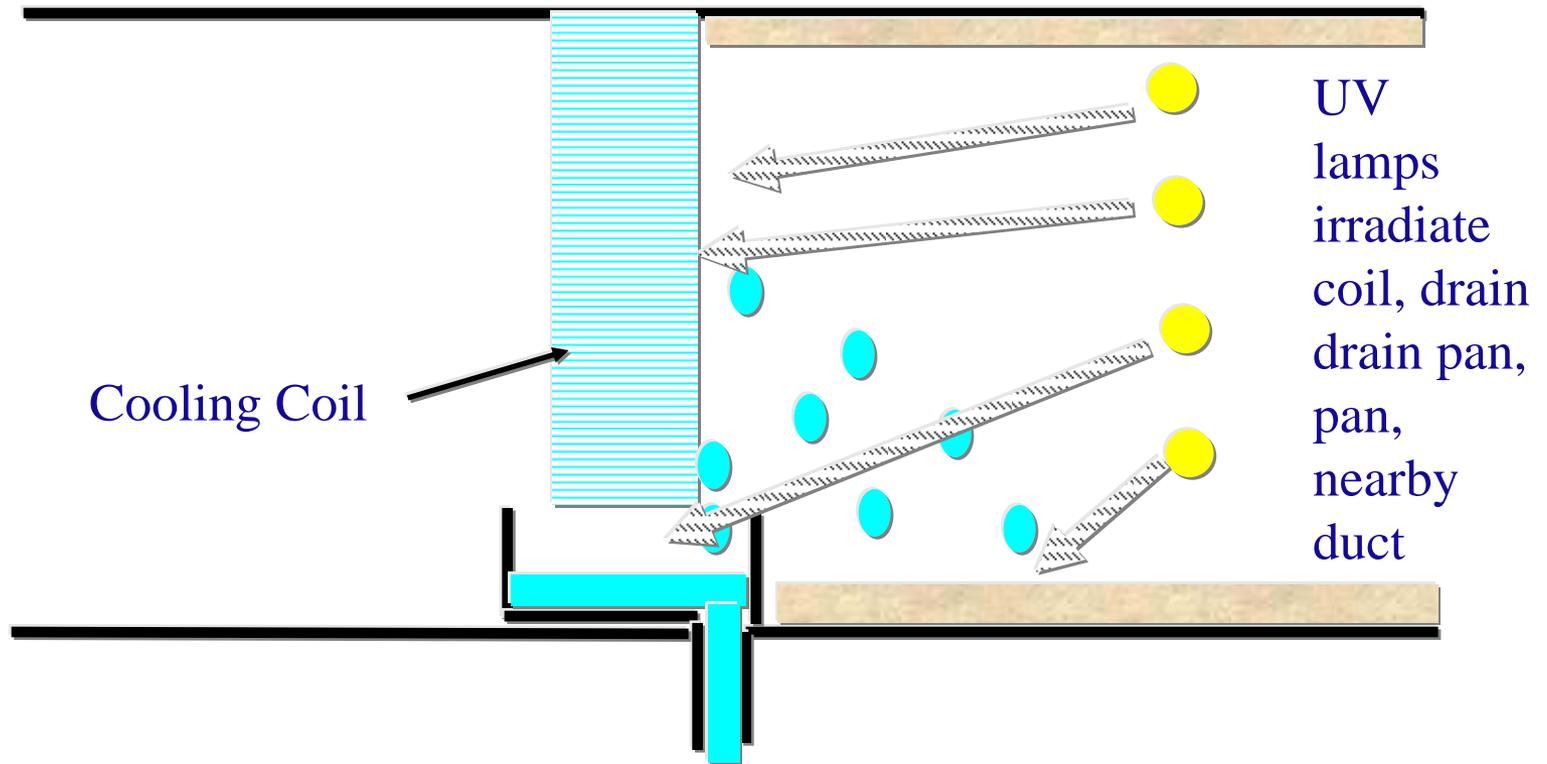


Increase in Asthma-like Respiratory Symptoms* with Evidence of HVAC Contamination in 80 Complaint Buildings



* wheeze, shortness of breath, cough

Ultraviolet Germicidal Irradiation of Cooling Coils and Drain Pans

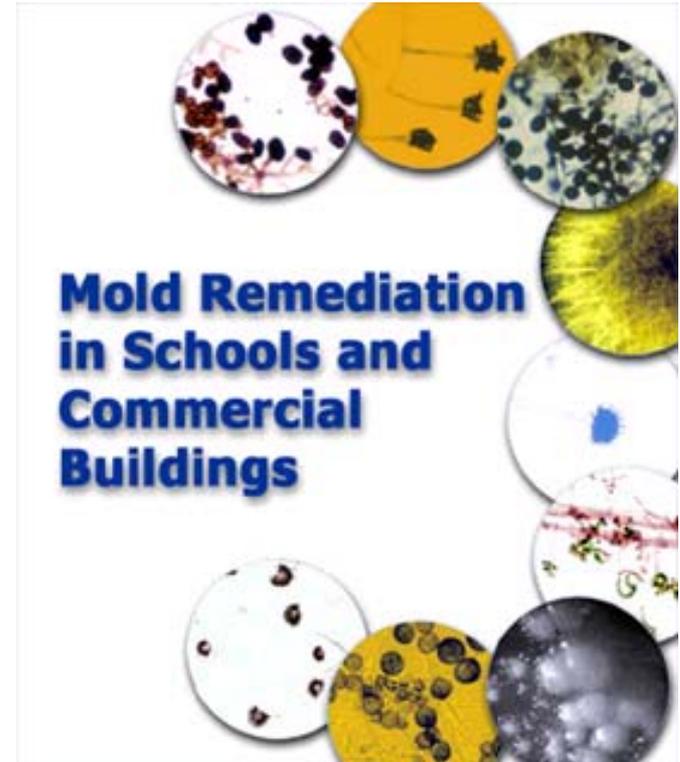


- ❑ UV irradiation can dramatically reduce microbial growth on coils, pans, ducts
- ❑ In single health study performed (Menzies 2003) , UV reduced respiratory symptoms by 40% (10% to 60%), and mucosal symptoms by 30% (10% to 50%)
- ❑ May be energy savings

Prevention and Remediation

A Few Key Points

- Better building design, construction, operation, and maintenance is the key long term solution
 - Much existing guidance exists
 - Are many barriers to implementation
- When microbial contamination is present, it should be eliminated
 - Solve the moisture problem
 - Remove or clean contaminated surfaces
 - Use respiratory protection (except with small problems)
 - Apply the widely available remediation guidance



- Other reasons to reduce dampness problems
 - Reduced structural damage
 - Energy savings from dry insulation

IOMs Suggested Next Steps

- Perform education and training
 - Public, builders, code officials, health professionals, etc.
- Perform ongoing surveillance and assessment of dampness problems
- Review building codes and building-related contracts, and modify as necessary
- Evaluate economic incentives
 - Tax incentives or low interest loans
 - Fines by health departments
 - Bonuses for managers of public housing
- Quantify and communicate economic costs of dampness
- Conduct Research

Take Home Messages

- Dampness and mold are common
- Excessive building dampness is a public health problem → substantial morbidity and cost
- When microbial contamination is present, it should be eliminated
 - **must address the source of dampness**
- Better building design, construction, operation and maintenance are the key to reducing dampness
 - **Much existing knowledge is underutilized**
- Special attention to low income & public housing is warranted

**in the
Bible**

```
graph LR; A["in the Bible"] --> B["Excessive building dampness is a public health problem"]; A --> C["When microbial contamination is present"]; D["Missing from Bible"] --> E["must address the source of dampness"]; D --> F["Better building design, construction, operation and maintenance are the key to reducing dampness"]; D --> G["Special attention to low income & public housing is warranted"];
```

**Missing
from
Bible**

For More Information

- **National Academy of Sciences Review**
www.nap.edu (search for “damp”)
- **US EPA web site** www.epa.gov/mold
- **IAQ Scientific Findings Resource Bank website**
www.iaqscience.lbl.gov
- **Indoor Air Journal: vol 17: 226-235; and vol 17: 285-295**
- **Guidance on residential building envelope design by climate**
<http://buildingscience.com/designsthatwork/>
- **Guidance for commercial building design at Canadian Mortgage and Housing Corporation “Best Practice Guides”** <http://www.cmhc-schl.gc.ca/en/>