New York State Toxic Mold Task Force

Final Report to the Governor and Legislature

December 2010

New York State Department of Health **New York State Department of State**

Contents

List of Abbreviations

AAEM	American Academy of Emergency Medicine
ACAC	American Council for Accredited Certification (formerly American Indoor Air Quality Council)
ACOEM	American College of Occupational and Environmental Medicine
AIA	American Institute of Architects
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air-conditioning Engineers
ASTM	ASTM International (formerly American Society for Testing and Materials)
CA DHS	California Department of Health Services (now California Department of Public Health)
CDC	US Centers for Disease Control
CEO	Code Enforcement Official
CFU	Colony-Forming Units
CFU/g	Colony-forming units per gram
CFU/in^2	Colony-forming units per square inch
CFU/m^3	Colony-forming units per cubic meter
CHSA	Children's Health Survey for Asthma
CRB	California Research Bureau
DHHS	US Department of Health and Human Services
EPA	US Environmental Protection Agency
EUROEXPO	European expert panel follow-up review of NORDDAMP panel (see below)
FTE	Full Time Equivalent or equivalent to one year of work
HPD	New York City Department of Housing Preservation and Development
IAQ	Indoor Air Quality
ICC	International Code Council
IDPH	Illinois Department of Public Health
IICRC	Institute of Inspection, Cleaning, and Restoration Certification
IOM	Institute of Medicine
NIOSH	National Institute of Occupational Safety and Health
NOCA	National Organization for Competency Assurance (now Institute for Credentialing Excellence)
NORDDAMP	European expert panel review of dampness in buildings as a risk factor for health effects
NS	Not Statistically Significant
NYCDHMH	New York City Department of Health and Mental Hygiene
NYSBA	New York State Builders Association
NYSDHCR	New York State Division of Housing and Community Renewal
NYSDOH	New York State Department of Health
NYSDOS	New York State Department of State
NYSED	New York State Education Department
NYSOGS	New York State Office of General Services
NYSTAR	New York State Office for Science, Technology, and Academic Research
OSB	Oriented Strand Board
OSHA	Occupational Safety and Health Administration
PA DOH	Pennsylvania Department of Health
PCR	Polymerase Chain Reaction
PEL	Permissible Exposure Limit

PHL	Public Health Law
REL	Recommended Exposure Limit
RfC	Reference Concentration
RfD	Reference Dose
SPARCS	State Planning, Research and Cooperative System
SUNY	State University of New York
TX DSHS	Texas Department of State Health Services
TX RCC	Texas Residential Construction Commission
VOC	Volatile Organic Compound
WHO	World Health Organization

Glossary

Abatement – see remediation.

Acute Idiopathic Pulmonary Hemorrhage (AIPH) – as defined by the US Centers for Disease Control (MMWR, Recommendations and Reports, 53(RR02);1-12, March 12, 2004): "AIPH is the sudden onset of pulmonary hemorrhage in a previously healthy infant in whom differential diagnoses and neonatal medical problems that might cause pulmonary hemorrhage have been ruled out."

Allergen – any chemical substance (primarily proteins, but also other biological and non-biological chemicals) exposure to which by inhalation, ingestion or skin contact provokes an immediate or delayed immune reaction. Allergic reactions can range from mild rash or hay-fever symptoms to potentially fatal asthma exacerbations or anaphylaxis.

Ambient Air – air in the outdoor environment.

Antimicrobial Treatment – application of any antimicrobial pesticide product. Pesticide products that are intended to reduce, inhibit, destroy or eliminate micro-organisms (bacteria, fungi, viruses, algae or protozoans) on inanimate surfaces are referred to as antimicrobial pesticides. Antimicrobial pesticides include (by increasing order of treatment strength) sanitizers, disinfectants and chemical sterilants.

Asbestos – any naturally occurring hydrated mineral silicate separable into commercially usable fibers, including chrysotile (serpentine), amosite (cummingtonite-grunerite), crocidolite (riebeckite), tremolite, anthrophyllite and actinolite.

Asthma – inflammation and reversible obstruction of the airways in the lung. The term asthma is used both for the chronic disease where airway inflammation predisposes the airways to being hyper-responsive to triggers and for acute attacks or exacerbations that result in coughing, wheezing and shortness of breath.

Assessment – as used in this report: inspection of buildings for the presence of moisture problems and associated mold growth. Mold assessment activities also involve developing work plans for remediating dampness and mold problems that have been identified in a building and follow-up inspection to establish that remediation work has been successfully completed. Other common terms used for assessment include inspection and evaluation.

Association – see statistical association

Causal Relationship – the relationship between cause (such as environmental exposure) and effect (such as a disease or health symptom). Causation can be clearly established in an experimental setting where only one variable is manipulated at a time while holding others constant and a change is measured in the effect variable. When considering health studies in communities or populations (i.e., epidemiology studies), determining causation is a scientific judgment based on an assessment of the overall weight of evidence, taking into account factors such as measurement bias, confounding by other variables, chance associations, consistency among studies, biological plausibility, time sequence of exposure and effects and other factors.

Certificate – as used in this report: a document indicating that a person has successfully completed a single training course.

Certification – as used in this report: an industry credential in a specific field of expertise that is conferred on an individual who has met specific criteria for educational background and relevant work experience and has passed required examinations. Certifications generally require ongoing continuing education and periodic renewal. Certifying organizations should be independent of any training provider.

Chronic Exposure – exposure that occurs over an extended period of time from many months to years. Chronic exposures can be continuous (such as breathing contaminants in ambient air) or repeated (such as daily exposure from food or in the workplace).

Clinical Study – study that investigates disease or health symptoms in individual patients or small groups of patients. If known medical causes of the disease or health effects under study are not found, these studies can suggest hypotheses for possible alternative causes that could be investigated with other studies (such as epidemiology studies).

Code Enforcement Official – in NYS, municipal government (i.e., town or city) officials responsible for enforcement of the state (and New York City) uniform codes that include construction, fire prevention and property maintenance codes.

Cognitive – brain functions involved in processing information such as memory, problem solving, decision making, language comprehension and math skills

Culturable Fungal Counts – counts of fungi from environmental samples (air, water, dust or other materials) that grow on a laboratory growth medium such as malt dextrose agar. Only those fungi present that can grow under the chosen laboratory conditions (such as growth medium, temperature, relative humidity) will be counted. Different results can be obtained from the same sample for different choices of growth medium, temperature and other variables.

Dampness – used throughout this document, along with excess moisture, moisture problems and water damage, to refer to conditions where bulk water or water vapor has affected building materials or the indoor environment. These terms are somewhat interchangeable, but may have subtly different meanings depending on the context.

Disinfection – application of disinfectant antimicrobial pesticide products intended to destroy or eliminate micro-organisms (except bacterial endospores) on inanimate surfaces. See Antimicrobial Treatment.

Encapsulant Treatment – a surface treatment that is intended to encase the surface, and any contaminant present on the surface, in a material to prevent release of the contaminant from the surface. This could include treatments that are painted or sprayed onto a surface or treatments that wrap the surface in covering material.

Endotoxin – a chemical product of some types of bacteria that forms a part of the bacterial cell wall. Endotoxin exposure can be common in some occupational settings, such as cotton and lumber processing.

Epidemiology Study – study that investigates possible statistical associations or causal relationships between exposures and diseases or health symptoms in a defined community or population.

Excess Moisture – see dampness.

False Negatives – in exposure assessment, a measurement that appears to indicate no exposure (i.e., a 'negative' finding) when some exposure is actually occurring. This may be due to an insensitive measurement technique or a sampling method that is not adequately representative of actual exposure.

Fungi – a biological kingdom separate from plants, animals and other micro-organisms. Fungi have cells that contain a true nucleus, lack chlorophyll and use organic carbon sources for growth and energy. Fungi include yeasts, molds, smuts, rusts and mushrooms.

Hazard Assessment – a qualitative (i.e., presence or absence) conclusion regarding whether exposure to a chemical, physical or biological agent causes a particular type of health effect. For example, a conclusion (based on available evidence) that a chemical does or does not cause liver damage, developmental toxicity or cancer. Hazard assessment conclusions often are based on experimental animal studies and do not consider the level of exposure needed to cause an effect. Also see dose-response assessment.

Hypersensitivity Pneumonitis – an inflammation of the deep regions of the lung where gas exchanges takes place (the alveoli) due to immune reactions to inhaled dust or aerosol particles containing bacteria or organic matter. Acute symptoms occur after exposures to large amounts of inhaled material. Chronic exposure can lead to permanent lung damage.

Hypothesis Generating – with respect to health effects, studies that do not provide direct evidence of a statistical association or causal relationship but only suggest hypotheses about possible associations between a cause and a health outcome that could be tested through more scientifically rigorous study designs.

Intervention – as used in this report: a portion of a study protocol that involves remediation of mold or water damage in buildings as a way to reduce mold exposures in building occupants.

Lower Respiratory Illness – illnesses such as asthma, bronchitis, pneumonia or hypersensitivity pneumonitis affecting the deep regions of the lung including small airways (bronchi) and where gas-exchange takes place (the alveoli).

Metabolism – the chemical changes in living cells by which energy is provided for cell processes and activities, new material is assimilated and waste products are disposed of.

Mitigation – as used in Public Health Law Section 1384(1)(e), assumed to be synonymous with remediation (see below).

Moisture Problems – see dampness.

Mold – defined in the Public Health Law Section 1384 as: "any form of multicellular fungi that live on plant or animal matter and in indoor environments. Types of mold shall include, but not be limited to, cladosporium, alternaria, aspergillus, trichoderma, memnoniella, mucor, and stachybotrys chartarum, often found in water damaged building materials." Commonly used to refer to any fungus growth; more properly used for fungi that are not yeasts or mushrooms.

Mycelium – the vegetative part of a fungus, consisting of a mass of branching, threadlike filaments.

Mycotoxin – certain types of chemicals produced by fungi as by-products of their metabolism that do not readily evaporate into the air (i.e., are non-volatile) and have the potential to cause adverse health effects.

Prevention – taking steps to avoid the causes of a health problem rather than to treat the health problem after it has occurred.

Reference Concentration (RfC) – as defined by US EPA (http://www.epa.gov/iris/help_gloss.htm): "An estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime."

Reference Dose (RfD) – as defined by US EPA (http://www.epa.gov/iris/help_gloss.htm): "An estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime."

Remediation – work involved in repairing, cleaning or removing mold-contaminated building materials following work plans based on a building inspection. This can include several components, depending on the extent of the mold problem, including establishing proper containment, demolition, cleaning, surface disinfection, worker protection and waste handling. Remediation work can also include work to repair sources of building dampness such as roof or plumbing leaks, but these repairs can also be done by workers or companies with expertise not specific to mold remediation (e.g., plumbers or roofers).

Spore – as used in this report: any reproductive unit produced by fungi, somewhat analogous to the seeds of plants that are dispersed by being released into the air. Fungal spores are produced by either sexual or asexual reproduction, depending on the fungus involved.

Statistical Association or Correlation – a consistent numerical relationship between two variables such that when one variable increases, the second variable consistently increases (positive association) or consistently decreases (negative association). Observing an association does not prove that a change in one variable causes the change in the other variable (see causal relationship).

Substrate – as used in this report: any material that provides nutrient and energy requirements for mold growth.

Toxic – as used in this report: any adverse effects that might occur as a result of mold exposure (by inhalation, ingestion or skin contact), including allergic, inflammatory or mucous membrane irritation responses as well as effects such as tissue damage that could be caused by mycotoxins. Adverse responses in people exposed to any chemical agent produced by molds can be considered toxic responses.

Toxic Mold – this term is not specifically defined in Public Health Law Section 1384 and there is no generally accepted scientific definition or category of "toxic mold." (also see Toxic).

Upper Respiratory Symptoms – health symptoms involving the region from the nose to the throat.

Water Damage – see dampness.

Weight of Evidence – as used in this report: a characterization, based on systematic review of existing studies and data, of the extent to which the available data support a hypothesis that a causal relationship exists between exposure to an environmental agent and an adverse health effect.

Executive Summary

Section 1384 of the New York State (NYS) Public Health Law (enacted in Chapter 356 of the laws of 2005; amended by Chapter 198 of the laws of 2006) established the NYS Toxic Mold Task Force (hereafter Task Force). The Task Force was charged with assessing and measuring, based on scientific evidence, the adverse environmental and health effects of mold exposure, including specific effects on population subgroups at greater risk of adverse effects; assessing the latest scientific data on mold exposure limits; identifying actions taken by state and local government and other entities; determining methods to control and mitigate mold and preparing a report to the Governor and Legislature. Under Section 1384, the Task Force consists of 12 at-large members with specific technical affiliations or technical expertise and the Commissioner of Health and the Secretary of State or their designees as co-chairs.

The main goals of the Task Force were to summarize and assess existing evidence and information relevant to the tasks listed in the law and to assess the feasibility of possible recommendations for any further actions to be taken by the state legislature or state agencies based on its analysis. To achieve these goals, the Task Force activities were organized into four main areas of inquiry: (1) health effects of molds in indoor environments; (2) exposure limits and assessment of mold in buildings; (3) approaches to mold mitigation and remediation; (4) building codes, regulations and other actions taken by other governments and private-sector organizations that relate to building mold problems.

The Task Force held four public meetings to obtain and discuss technical information on the four main areas of inquiry. Several additional working meetings were held by conference call while drafting the Task Force report. Supporting information was obtained from peer-reviewed scientific literature and other technical documents. In addition to its review and synthesis of scientific data, the Task Force considered a large amount of information provided by interested members of the public in written form or given as oral comments during public meetings.

A draft version of this report was released for public comment on August 25, 2010 and written public comments were accepted on the draft through October 12, 2010. Copies of the comments received are included in the Supplemental Material to this report (see Appendix L).

Conclusions and Recommendations

Conclusions and recommendations are presented below for each of the Task Force's main areas of inquiry. Where recommended actions are included, they are accompanied by judgments regarding the feasibility of the recommended action, as required by Public Health Law Section 1384. The costs of any recommended action, as well as what the action would and would not be expected to accomplish, were considered as part of the feasibility judgments.

Mold Background

Conclusions:

- Mold growth in buildings is a symptom of water damage or moisture problems. Therefore, actions intended to prevent mold growth in buildings and associated public health consequences should focus on prevention of water or moisture problems.
- When water damage or moisture problems occur in buildings, efforts and resources should be focused on mitigating the water or moisture source and effectively cleaning or removing affected building materials that are, or could become, sources of mold growth.
- Some mold spore exposure is unavoidable because mold spores are naturally present in outdoor (ambient) air. This is also true in most building environments because outdoor air routinely mixes with indoor air.
- Dampness in buildings can promote other exposure sources aside from mold such as bacteria, dust mites, cockroaches and chemical releases associated with some building materials. Since multiple agents may be present in damp buildings simultaneously, accurately attributing particular health effects to one particular exposure source, such as mold growth, can be difficult.
- A practical objective for building owners and managers is to maintain buildings so that they do not contribute to additional mold exposures. In other words, avoid active growth of molds indoors by keeping indoor materials and surfaces dry and by promptly mitigating any water problems (and associated mold growth) that do occur.
- Evidence does not exist supporting clear distinctions between a category of “toxic mold” species versus other “non-toxic” mold species or between “toxic mold” health effects and health effects associated with other molds.

Health Effects

Conclusions:

- Exposure to building dampness and dampness-related agents including mold has been recognized nationally and at the state and local level as a potential public health problem.
- The strongest evidence exists for associations between indoor mold exposures and upper and lower respiratory health effects such as nasal symptoms and asthma exacerbations.
- Asthma and other allergic respiratory diseases that can be exacerbated by mold exposures are common in NYS. This means many people are at risk for exacerbation of their respiratory conditions by exposure to mold conditions in buildings.
- Evidence for associations between non-respiratory effects and mold exposures in buildings is much more limited and generally does not allow clear conclusions to be drawn one way or the other.
- Molds, along with other organisms such as bacteria, mites and insects that proliferate in damp buildings, produce volatile compounds, spores and other minute particles that can cause irritant and allergic responses that range from annoying to serious depending on the amount of exposure and the immune system of the individual. Although some molds produce toxins, their contribution to adverse health effects in damp buildings, based on existing scientific information, is uncertain.

Implications:

- Since mold problems in buildings are preventable with proper building construction, maintenance and housekeeping aimed at preventing excess building dampness, opportunities exist to prevent morbidity from exposure to indoor molds.
- Overabundant growth of any mold or other dampness-related organisms is undesirable and can be addressed by removing contaminants and correcting water problems. Whether or not exposure to mold toxins is likely when mold growth occurs in a damp building does not substantially change the need for mitigation of the water and mold problem.

State and Local Actions

a) Codes

Conclusions:

- The State Uniform Fire Prevention and Building Code and the State Energy Conservation Construction Code (and analogous New York City [NYC] codes) are the mechanisms that NYS uses to prevent or minimize moisture problems in buildings through design, construction and property maintenance requirements.
- The presence and power of the code enforcement official (CEO) can also help minimize the potential for mold problems in buildings when approving construction documents, during construction inspections of new buildings and when issuing property-maintenance violations related to moisture conditions in existing buildings during required inspections.
- The codes and their enforcement are important tools to help prevent moisture problems in buildings. Opportunities should be pursued by the State and NYC to strengthen building codes and code enforcement with respect to preventing and correcting moisture problems.

Recommended actions:

- NYS and NYC should continue to improve building code requirements that address building design, construction techniques and property maintenance so that they prevent or minimize the potential for water problems to occur. They should both work within the framework of the International Code Council (ICC) code adoption process to monitor and develop proposals to prevent or minimize mold in new and existing buildings.
- Provide targeted training and education to CEOs to improve understanding of subtle moisture problems in buildings (e.g., uncontrolled air flows causing condensation) and to enable them to address potential or existing water and mold problems more effectively.

Feasibility:

- NYS (except NYC) has a State Uniform Fire Prevention and Building Code that since 2003 has been based on the model codes used throughout most of the United States, written by the ICC. As of 2008, the Building Code of the City of New York is also based on the ICC codes. The ICC issues new editions of its code every three years to keep up with changes in the building industry.
- The NYS Department of State (NYSDOS) and the NYC Department of Buildings are both active in the ICC code adoption process. Assistance of the NYS Department of Health (NYSDOH) in creating code language and providing supporting documentation could be necessary for code proposals intended to prevent dampness and mold problems.

- CEO training outside of NYC is done by NYSDOS at no cost to municipalities. NYSDOS trainers working with NYSDOH indoor environmental quality experts can update existing courses on code changes or mold problems for CEOs, as necessary. Any new CEO training should reflect any changes made to the codes regarding mold.

b) Regulation of Mold Assessment or Remediation Services
Conclusion:

- Having persons who provide mold assessment and remediation services properly trained and following accepted protocols is desirable. Approaches that have been tried to accomplish this range from providing specific guidance for recommended work practices to an extensive regulatory program.
- Although several states and NYC have developed some level of formal guidance or regulatory oversight, mostly for the mold remediation industry, information evaluating the effectiveness of these various regulatory approaches was not found.
- Voluntary industry standards that could apply to mold-related assessment and remediation services exist for training programs and certification.

Recommended Action:

- The main public health goal of any additional guidance or regulation of mold assessment or mold remediation industries should be to reduce the potential for mold exposures and the concomitant risk of health effects in damp buildings by improving the quality of mold assessment or remediation work done in the State. State agencies should, at a minimum, provide guidance about recommended work practices for assessment and remediation and about the existence of training curricula and certification (see Table 5, items A, B). Other possible regulatory actions that could be considered by the State are also presented (see Table 5, items C, D).

Feasibility:

- General recommended work practices and certification programs for building assessment and remediation have already been developed by reputable organizations. Providing information about these practices and programs, along with any limitations as to their effectiveness would be relatively easy and would cost about $150,000 annually.
- The above concerns about effectiveness of regulation notwithstanding, if legislation to establish authority to regulate the mold assessment or remediation industries is considered, state funding support would be needed for agency staff and overhead administrative costs. These funds would support the development and implementation of regulations and their continuing administration and enforcement. Examples from an analogous NYS program suggest annual costs could be in the range of $4.5 million. Fees and fines that are established in regulation and paid into a special revenue account established for the program could be considered as one way of paying for these new government services. Fees and fines should be structured to continue to provide adequate program funding over time.

c) Education and Outreach

Conclusion:

- Recognition of potential adverse health effects from dampness and resulting mold growth in buildings has driven preventive education and outreach messages toward water and mold problems in buildings by state and local health departments for over 10 years. For example, NYC initially developed guidelines in 1993 (revised in 2000 and 2008) that focused on minimizing indoor mold exposures by minimizing or correcting water, dampness and mold conditions in buildings.
- Additional targeted education could enhance efforts to prevent building moisture problems, mold problems and any concomitant health effects.

Recommended action:

- Governmental, private and non-profit organizations should develop or enhance educational materials related to building moisture prevention and tailor those materials to specific audiences dealing with building design, construction and maintenance. These organizations should proactively disseminate the materials to the intended audiences. A coordinated proactive, multi-media educational campaign is likely to be more effective than simple distribution of brochures or other written outreach materials. Potential audiences for targeted education on preventing building moisture include architects, builders, contractors, remodelers, weatherization assistance programs, building performance consultants, building owners, CEOs and building occupants.
- Education and outreach messages for the general public should emphasize that potential health problems associated with dampness and mold in buildings can be reduced by correcting water problems and removing sources of indoor mold growth in a timely manner.

Feasibility:

- State agencies with relevant outreach and education programs related to aspects of moisture prevention in building construction and maintenance include, but are not limited to, NYSDOS, NYSDOH, NYS Education Department (NYSED), NYS Department of Housing and Community Renewal (NYSDHCR) and the NYS Office of General Services (NYSOGS). Non-governmental organizations include professional and trade associations (e.g., American Institute of Architects, NYS Builder's Association, Commercial Lumberman's Association) and tenants' organizations.
- Costs for enhancing educational materials and programs would depend on how much existing programs were augmented. Costs could include increased expenditures on supplies, printing, public media resources (e.g., TV, radio, print), travel, meeting venues and other operational resources, in addition to personnel time.
- The efficiency of educational efforts could be increased by leveraging existing outreach venues such as professional society meetings and continuing education programs; commercial trade associations and tenants' associations. Extensive multi-media educational campaigns, such as the recent NYSDOH tobacco control campaign, can be expensive. The annual funding level for the tobacco control program is $55.1 million dollars in the State fiscal year 09-10 (see Appendix K for additional details).

d) Research

Conclusion:

- Better information obtained through careful research would help inform decision making regarding many issues related to dampness and mold problems in buildings.

Recommended action:

- Additional research is needed on the following issues:
  - the prevention and mitigation of building moisture problems and mold growth;
  - the effectiveness of different education approaches to dampness and mold prevention;
  - the effectiveness of different antimicrobial treatments as part of mold remediation;
  - the effectiveness of specific aspects of mold remediation protocols including the level of containment needed, salvage or disposal of wet or contaminated materials and the level of cleanliness required at the end of remediation;
  - the development and effectiveness of methods for identifying moisture problems in buildings undergoing energy retrofits;
  - the effectiveness of moisture-resistant building materials and the relationship between green building and energy conservation building criteria and the prevention of building moisture problems; and
  - the possible relationship between indoor mold exposure and chronic health effects.

Feasibility:

- State agencies have extensive expertise in many issues related to preventing and mitigation building water and mold problems. NYSDOH and the NYC Department of Health and Mental Hygiene (NYCDHMH) have extensive experience in conducting health studies related to environmental exposures. Obtaining external funding for such research should be explored when available.

e) Other possible actions

Conclusions:

- Other actions were outside of the Task Force scope, but might be considered as part of NYS's response to dampness and mold problems in buildings:
  - requirement for disclosure by property sellers or landlords of known mold-related conditions as part of a real estate transaction (see Section II.C.1, page 39);
  - requirement for "right to cure" clauses in construction contract language that provide contractors an opportunity to correct construction defects in a timely manner to avoid litigation (see Section II.C.1, page 39);
  - requirement for mediation in landlord-tenant mold/moisture-related disputes to avoid litigation (e.g., as recommended by the Maine mold task force, see Section II.C.5, page 57); and
  - a process that would quickly resolve how building remediation is to be paid could help prevent delays that can allow water damage to lead to significant mold problems. State insurance laws or regulations could be reviewed for opportunities to improve the timeliness of response to moisture problems in buildings.

Exposure Limits

Conclusions:

- The development of reliable, health-based quantitative mold exposure limits is not currently feasible due to a number of technical challenges. Many other recent state, federal and international expert panel reports have reached similar conclusions on this issue.
- The technical challenges to the development of reliable quantitative exposure limits for building clearance do not preclude the use of qualitative clearance guidance for water damage and mold remediation. Qualitative guidance focuses on correcting water problems that cause indoor mold growth and cleaning or removing sources of overabundant mold growth on building surfaces and furnishings regardless of the type of mold.
- Narrative guidance, such as the 2008 NYCDHMH guidelines checklist of quality assurance indicators, exists for qualitative assessment during and after remediation that can help document successful work to abate moisture problems and any associated mold growth in buildings. A similar visual assessment tool for building dampness and mold conditions is currently being developed by the National Institute of Occupational Safety and Health.

Recommended action:

- NYSDOH and NYSDOS should work together to promote the use of qualitative building assessment and clearance checklists or similar qualitative guidance such as the NYCDHMH quality assurance indicators.
- NYSDOH should continue to follow the scientific literature and regulations and should provide guidance if quantitative exposure limits become useful in the future.

Feasibility:

- NYSDOH has promoted qualitative approaches to building assessment and can continue to stay abreast of useful assessment approaches such as the NYCDHMH quality assurance guidelines.
- NYSDOH routinely reviews the scientific literature on mold and will share information about quantitative exposure limits as it becomes available.
- DOH should continue to emphasize in its public education materials that clearance sampling for airborne mold is unlikely to provide reliable information for decision-making in damp or moldy buildings.

Mold Control and Mitigation

Conclusions:

- Laboratory studies provide limited evidence that some chemical disinfectant or encapsulant treatments have utility for mitigating or preventing mold growth on building materials. Overall, these laboratory results are not very robust, as they do not address what happens on treated surfaces after more than six months.
- Existing evidence, although limited, suggests approaches directed toward correcting moisture problems and removing mold exposure sources can help reduce occupant respiratory symptoms.
- Written mold and water-damage assessment and remediation guidelines developed by many organizations provide practical guidance focused on identifying and repairing water damage in buildings and removing mold source materials.
- This approach to building mitigation is health protective because its goal is elimination of exposure sources. It is also less complicated to implement than mitigation based on attaining a

numerical clearance criterion, since its main mitigation goal is that the building be returned to a clean and dry condition.

- If water sources are properly corrected and existing sources of mold growth are eliminated, further treatment with disinfectants may not provide significant additional value in preventing further mold growth or exposure. Disinfectants may be useful for controlling mold in certain situations (e.g., circumstances where permanently correcting dampness conditions is not feasible such as poorly ventilated bathrooms).

Recommended actions:

- State and local government agencies and professional organizations addressing building performance and indoor air quality issues should continue to emphasize these practical water-damage and mold mitigation approaches.
- The decision to use disinfectants as part of remediation will be case-specific and should take into account potential adverse effects of disinfectant exposure to applicators and building occupants.

Feasibility:

- State and local health departments and professional organizations currently emphasize assessment and remediation guidance designed to return buildings to a clean and dry condition. Any additional costs would come from expanding existing programs. This could include expanding education and outreach regarding building assessment and remediation.

I. Introduction

A. New York State Toxic Mold Task Force legislation

Chapter 356 of the laws of 2005 (amended by Chapter 198 of the laws of 2006) amended article 13 of the NYS Public Health Law (PHL) by adding a new title 11-A (complete text in Appendix A) establishing the NYS Toxic Mold Task Force (hereafter Task Force).

Public Health Law, article 13, title 11-A, Section 1384 (1) states:

"The New York State toxic mold task force is hereby established. The task force shall:

a) assess, based on scientific evidence, the nature, scope and magnitude of the adverse environmental and health impacts caused by toxic mold in the state;

b) measure, based on scientific evidence, the adverse health effects of exposure to molds on the general population, including specific effects on subgroups identifiable as being at greater risk of adverse health effects when exposed to molds;

c) identify actions taken by state, and local governments, and other entities;

d) assess the latest scientific data on exposure limits to mold in indoor environments;

e) determine methods for the control of mold in a cost-effective and environmentally sound manner and identify measures to mitigate mold; and

f) prepare a report to the governor and the legislature that assesses the current body of knowledge on toxic mold, provides the status of toxic mold in the state, and assesses the feasibility of any further actions to be taken by the legislature or state agencies as recommended by the task force."

Under PHL Section 1384, the Task Force shall consist of 14 members to include 12 at-large members, who shall be selected to represent specific technical affiliations or areas of expertise specified in the law, and the Commissioner of Health and the Secretary of State or their designees as co-chairs. In addition to the agency co-chairs, the Task Force membership shall include representatives of four specific organizations: SUNY College of Environmental Science and Forestry; New York Indoor Environmental Quality Center, Inc.; NYCDHMH and NY STAR Center for Environmental Quality Systems. Other members shall have the following technical expertise or credentials: mycology, toxicology, public health officer, environmental health officer, certified public health engineer, pediatric environmental health, expertise in mold abatement from a labor organization, expertise in real estate management including building renovation. The number of members making up the Task Force and the qualifications for each Task Force seat were explicitly established by the statute that created the Task Force. Section 1384 did not provide authority to alter the number of Task Force members or the required

qualifications for each seat. The Task Force membership and affiliations are listed in Appendix B.

B. Task Force strategy and scope

The main goals of the Task Force were to summarize and assess existing evidence and information relevant to the tasks listed in the law and to assess the feasibility of possible recommendations for any further actions to be taken by the state legislature or state agencies. To achieve these goals, the Task Force activities were organized into four main areas of inquiry: (1) health effects of molds in indoor environments; (2) exposure limits and assessment of mold in buildings; (3) approaches to mold mitigation and remediation; and (4) building codes, regulations and other actions taken by other governments and private-sector organizations that relate to building mold problems. The Task Force held four public meetings to obtain and discuss technical information on these main areas of inquiry. Public comment was also solicited during each meeting. Several additional working meetings were held by conference call while drafting the Task Force report. Copies of Task Force meeting agendas are included in Appendix B. Supporting information was obtained from written materials submitted to the Task Force, peer-reviewed scientific literature and other technical documents. This report summarizes the Task Force's synthesis of the information obtained from these different sources as well as the Task Force's recommendations based on its analysis.

Under Section 1384, tasks (a), (b) and (d) indicate that assessment of health effects and exposure limits is to be based on scientific information. A substantial body of scientific literature already exists investigating the toxicology and human health effects of mold exposures and approaches to mold exposure assessment. Many scientific conferences exploring these issues and expert-panel reviews of this information have taken place in recent years. The Task Force members agreed that acknowledging and building on the major findings of these efforts would be more productive than attempting to repeat these efforts. Therefore, the Task Force focused their analysis of these issues primarily on any newly-emerging scientific information and on identifying areas where significant knowledge gaps still exist that appear to substantially hinder decision making. A similar approach to update existing scientific summaries and identify relevant knowledge gaps was taken with respect to other elements of the Task Force's charge where scientific information was more limited (e.g., identifying effective mold control and mitigation measures). The Task Force's evaluation considered scientific literature published through the end of 2008. Results pertaining to tasks (a) through (e) are presented in Section II of this report. Any recommended actions and consideration of their feasibility are included at the end of the relevant task sub-sections. Appendix C briefly summarizes how the Task Force addressed the elements of tasks (a) through (f).

In addition to its review and synthesis of peer-reviewed, published scientific information, the Task Force considered a large amount of information provided by interested members of the public in written form or given as oral comments during public meetings. These comments and written materials helped inform the Task Force in developing its conclusions and recommendations presented in this report. The written materials are compiled on a compact

disc that is included as a supplement to this report (see Appendix L). Briefly, these comments and written materials addressed the following topics:

- suggested changes to building codes;
- limitations of the NYC Housing Preservation and Development mold inspection program and the ability of the NYC housing court to enforce mold remediation guidelines;
- difficulties reported by tenants getting landlords to properly correct water and mold problems in their apartments;
- experiences described by individuals involving exposures to mold and health problems;
- offers of direct assistance to the Task Force and requests for membership on the Task Force from industry and community advocacy individuals and groups;
- copies of correspondence from advocacy groups to US legislators, US government agencies, President Obama and the World Health Organization;
- bibliographic collections of books, reports and scientific publications for the Task Force to include in their review;
- observations of individual physicians regarding mold health effects, based on treating patients;
- information about antimicrobial pesticide products for mold control; and
- opinions of remediation industry representatives on the need for mold hazard levels and remediation standards.

C. Public Comment Period

A draft version of this report was released for public comment on August 25, 2010 and written public comments were accepted on the draft through October 12, 2010. Twenty-three separate comments were received that covered issues including mold health effects, building code requirements, building assessment and remediation, practical approaches to reducing dampness and associated mold exposures, training and certification programs, education and outreach programs and mycology research. After reviewing and considering the comments, the report was revised, primarily to clarify existing concepts in the report. Copies of the comments received are included in the Supplemental Material to this report (see Appendix L).

II. Task Force Findings

A. Mold background

1. What is mold?

Section 1384 defines mold for the purposes of the law as "any form of multicellular fungi that live on plant or animal matter and in indoor environments. Types of mold shall include, but not be limited to, cladosporium, alternaria, aspergillus, trichoderma, memnoniella, mucor, and stachybotrys chartarum, often found in water damaged building materials." Fungi form a biological kingdom separate from plants and animals and are characterized by cells that lack chlorophyll (i.e., do not use photosynthesis as plants do) and use organic-carbon sources (e.g., sugars, starch, cellulose, proteins) for growth and energy. Fungi commonly referred to as molds usually grow as a mass of thread-like cells, collectively called the mycelium, that occurs within and on the surface of materials that provide the fungus nutrients such as soil, leaves, food or various

building materials. Most molds reproduce by producing airborne spores. Their spore-producing structures are generally too small to be seen without a microscope, in contrast to mushrooms. Mildew is another common name for mold. The law's definition is consistent with this common use of the term "mold." Yeasts are single-celled fungi that do not form a mycelium but are also often found in buildings. In the context of water-damaged buildings, mold and fungi can be used essentially interchangeably.

Visible mold growth on surfaces can appear slimy, sooty, velvety or fuzzy and can be a variety of colors including blue, green, gray, brown, white or black. The color is mostly from the microscopic spores formed when the fungus matures. Mold spores are somewhat analogous to the seeds of plants. While the fungus grows attached to a surface, the spores are released into the air as a way to spread to other locations suitable for the spores to germinate and begin growth of a new mycelium.

2. What is "toxic mold?"

Some of the tasks listed in Section 1384 refer specifically to "toxic mold," while others only mention "mold." However, the law does not define toxic mold or the term toxic. A simple dictionary definition for toxic as "harmful, destructive, deadly, poisonous" is appropriate when considering health effects of mold exposures. This broadens the scope of potential health effects considered by the Task Force beyond effects that might be associated with certain chemicals produced by molds (known as mycotoxins) to include adverse effects such as allergic, inflammatory or mucous membrane irritation responses. Chemicals produced by molds in buildings that have potential to cause adverse reactions in building occupants can include protein allergens; complex carbohydrates such as 1,3-beta-D-glucan and extracellular polysaccharides; volatile organic compounds such as aldehydes, ketones and alcohols; and non-volatile mycotoxins. Some mix of these different chemicals can be produced by any type of mold growing in buildings and adverse responses in people exposed to any of these agents can be considered toxic responses.

The Task Force members agreed that scientific evidence does not exist supporting clear distinctions between a category of "toxic mold" species versus other "non-toxic" mold species or between "toxic mold" health effects and health effects associated with other molds. Therefore, the remainder of this report will address all molds as a group, recognizing that there is tremendous variability among mold species in the way they grow, their metabolism, the chemicals they produce, how they interact with their environment and their potential to cause adverse health effects when people are exposed to them.

3. Mold ecology

Molds in nature

All molds have a source in nature such as soil, leaf litter or water. No mold has evolved to live exclusively in buildings. Molds and other fungi perform the useful function of breaking down and recycling the nutrients in dead plant and animal matter. There are thousands of species of mold, all of which have a specialized role or niche in nature, but

up to only a few hundred of these species have found conditions in damp or water-damaged buildings[1] suitable for growth.

"Normal" air in the outdoor environment (also called ambient air) can contain huge numbers of mold and other fungus spores. The kinds and amounts of spores depend on season and weather. The air in the warmest, wettest months can contain airborne spores in numbers exceeding 100,000 per cubic meter of air, while the coldest, driest months may have less than a few hundred. These spores – like airborne pollen from trees, grasses or weeds – have nothing to do with human activity and constitute a natural background of spores expected to be present in ambient air. Most of us inhale thousands of these spores every day without noticeable effect.

Molds in buildings

Mold spores are found in virtually all air outdoors. Since air inside buildings usually comes from outdoors, mold spores are expected to be found in most indoor air as well. Keeping a building free of spores requires highly specialized equipment and protocols such as those used in industrial clean rooms and hospital isolation units. This is obviously not practical in more common building environments such as homes, schools or office buildings. Mechanical air handling systems in some buildings can filter out some spores and the air in these buildings normally has fewer spores than outdoor air, but in many homes the air inside is normally very similar to the air outside in terms of spore levels.

A substantial amount of information exists describing the types of molds that commonly grow in buildings and the environmental conditions that encourage mold growth (e.g., IOM 2004, chapter 2). In buildings, water is the problem; mold growth is a symptom and a consequence of water problems. Dampness, excess moisture or water damage in buildings is the major factor in promoting mold growth. That is because spores are always present in the air. Indoors, airborne spores eventually settle on all exposed surfaces, including floors, walls, ceilings and furnishings. If a water source is not present where spores settle, the spores become part of the settled dust that occurs in all buildings. They can remain dormant in settled dust, in some cases for many years, as long as they remain dry. Dormant spores in settled dust will be triggered to germinate and begin growing only when the material where the dust has settled becomes wet. Mold will almost always develop if dampness occurs in the form of dripping or seeping water or condensation affecting certain types of building materials. Without water mold growth cannot develop, and existing mold will stop growing.

[1] The terms water damage, excess moisture, moisture problems and dampness are used throughout this document to refer to conditions where water has affected building materials or the indoor environment. They are somewhat interchangeable, but may have subtly different meanings depending on the context. For example, water damage may be used more commonly when referring to the effects of bulk water intrusions from flooding or plumbing leaks, while moisture damage may more often be used to refer to condensation problems. Dampness is often used in the biomedical literature in a general way to refer to any building condition related to water problems. See IOM (2004, pp 30–44) for a thorough discussion of the related concepts of dampness, moisture and humidity and sources of excess moisture in buildings.

The distinction between airborne mold spores and mold growth on surfaces in buildings is important because mold spores can always be detected in air samples from buildings, even buildings without any water or dampness problems (e.g., Shelton et al., 2002). A building cannot be said to have a mold problem based simply on detecting mold spores in air samples. Mold problems occur in buildings when dampness or water damage occurs which then triggers indoor mold growth.

4. Dampness vs. mold in buildings

Dampness in buildings can promote other exposure sources aside from mold such as bacteria, dust mites, cockroaches and chemical releases associated with some building materials (see IOM, 2004). Since multiple agents may be present in damp buildings simultaneously, accurately attributing particular health effects to one particular exposure source, such as mold growth, can be difficult. Likewise, evaluating the efficacy of remediation techniques becomes more complicated when multiple exposure sources occur together. Many health-effects studies have chosen to assess effects associated with the presence of dampness *per se*, rather than focus on particular chemical or biological agents. In the remainder of this report, the Task Force has attempted to draw distinctions between conclusions that relate specifically to mold exposures and conclusions that relate to building dampness.

5. Conclusions – mold background

- Mold growth in buildings is a symptom of water damage or moisture problems. Therefore, actions intended to prevent mold growth in buildings and associated public health consequences should focus on prevention of water or moisture problems.
- When water damage or moisture problems occur in buildings, efforts and resources should be focused on mitigating the water or moisture source and effectively cleaning or removing affected building materials that are, or could become, sources of mold growth.
- Some mold spore exposure is unavoidable because mold spores are naturally present in outdoor (ambient) air. This is also true in most building environments because outdoor air routinely mixes with indoor air.
- Dampness in buildings can promote other exposure sources aside from mold such as bacteria, dust mites, cockroaches and chemical releases associated with some building materials. Since multiple agents may be present in damp buildings simultaneously, accurately attributing particular health effects to one particular exposure source, such as mold growth, can be difficult.
- A practical objective for building owners and managers is to maintain buildings so that they do not contribute to additional mold exposures. In other words, avoid active growth of molds indoors by keeping indoor materials and surfaces dry and by promptly mitigating any water problems (and associated mold growth) that do occur.
- Evidence does not exist supporting clear distinctions between a category of “toxic mold” species versus other “non-toxic” mold species or between “toxic mold” health effects and health effects associated with other molds.

B. Health effects of mold and dampness exposure

For many years, public health agencies in NYS have generally recommended that buildings with dampness and mold-growth problems be remediated to correct dampness problems and control or remove mold-contaminated materials that could act as exposure sources for building occupants (e.g., NYCDHMH, 2008 guidelines are revisions of guidelines first issued in 1993). This is a cautious approach recognizing that dampness problems in buildings can have effects on exposed occupants, but it does not depend on knowing precisely what all the possible effects are or precisely what dampness-related agents are involved. The Task Force chose to focus its health effects review primarily on any new information that would substantially alter that paradigm. A comprehensive study of all health-related information including clinical studies and basic biomedical research investigations was not necessary to fulfill the legislative charge to the Task Force. The Task Force's evaluation considered scientific literature published through the end of 2008.

Most published scientific information on the human health consequences of dampness and mold in buildings comes from epidemiology studies[2]. Environmental epidemiology studies provide important information about potential associations between environmental exposures and adverse human health effects by directly observing or measuring health outcomes and exposures in human populations. However, these studies often have limitations that complicate their interpretation due to the inability of researchers to control many factors that can influence the apparent relationship between an environmental exposure and the health outcome of interest. As a result, establishing a causal relationship between an environmental exposure and a health outcome (as opposed to a statistical correlation or association) is rarely possible for a single epidemiology study. Rather, scientific judgment is used to assess the weight of evidence for causal relationships based on the total body of evidence related to a particular exposure or disease outcome. Evaluations of weight-of-evidence from epidemiologic studies are often informed by a set of criteria described by Hill (1965) that include, among other factors, the strength of measured associations, their biological plausibility, their temporality (i.e., did the exposure precede the health outcome?), the coherence among studies and how well studies control for factors such as bias, confounding and chance findings.[3] Although the Task Force did not conduct a formal weight of evidence evaluation, it relied on expert reviews that followed these concepts to summarize large bodies of existing evidence and employed the Hill criteria as an informal conceptual guide when reviewing more recent scientific evidence.

1. Current scientific evidence

Several expert reviews conducted over the past decade in the United States and Europe have evaluated the scientific evidence of associations between adverse health outcomes and mold exposure or dampness in buildings (ACOEM, 2002, 2003; AAEM, 2008; Bornehag et al., 2001, 2004; Bush et al., 2006; CRB, 2006; IOM, 2000; 2004; Shannon

[2] Epidemiology is the study of patterns and causes of diseases in populations. Epidemiology study designs vary substantially in their sophistication and, as a result, in their ability to reliably establish associations between exposures and health outcomes. Important aspects of evaluating human health effects based on epidemiologic evidence are detailed in the IOM Damp Indoor Spaces report (IOM, 2004; pp 21–27 and pp 186–189).

[3] See the IOM (2004) report, pp 21–27 for a more detailed discussion of the Hill criteria and their application to evaluation of epidemiologic evidence and summarizing study conclusions.

et al., 2006; WHO, 2009). These reviews are consistent in their major conclusions that exposures to damp conditions or molds indoors can be associated with adverse effects on occupant health. At the same time, these reports acknowledge that substantial uncertainties continue to exist in our detailed understanding of the qualitative and quantitative relationships between indoor exposures to molds or other dampness-related agents and adverse health effects.

At the time of the first Task Force meeting (December, 2007), the most current and thorough evaluation of the state of the scientific evidence regarding the public health significance of, and response to, dampness and molds in buildings was the Institute of Medicine (IOM, a component of the National Academies) report entitled *Damp Indoor Spaces and Health* (2004).[4] This report presented the results of an expert panel review commissioned by the US Centers for Disease Control and Prevention (CDC). The expert panel conducted a comprehensive evaluation of the scientific literature regarding the relationship between damp or moldy indoor environments and adverse health outcomes, focusing on non-infectious health effects of fungi, including allergens, mycotoxins and other biologically active products. This comprehensive review also evaluated evidence regarding exposure assessment and control and mitigation of molds in buildings and discussed recommendations for public health responses to dampness and molds in buildings.

The IOM Damp Indoor Spaces Committee concluded in its report that excessive indoor dampness is a public health problem and, therefore, it is an appropriate public health goal to prevent or reduce the occurrence of potentially problematic damp indoor environments. The committee arrived at this conclusion recognizing that information on health effects related to indoor dampness is incomplete. For example, sufficient information is generally lacking to establish the appropriate level of dampness reduction or "safe" exposure levels to most dampness-related agents such as molds. As noted above, many indoor chemical and biological agents are associated with damp conditions, and the relationship between adverse health outcomes and exposure to a specific agent (e.g., a particular mold species or the presence of any mold) is often unclear because multiple exposures occur simultaneously.

Asthma and other respiratory effects

The IOM committee concluded that there was sufficient evidence of an association between the presence of mold (generally unspecified) in damp buildings and several respiratory health effects.[5] These include upper respiratory symptoms (e.g., sneezing,

[4] Subsequent to the public meetings held by the Task Force and the literature research that contributed to this Task Force report, The World Health Organization (WHO) published *Guidelines for Indoor Air Quality: dampness and mould* (2009). The complete WHO Guidelines document (248 pages) was not thoroughly reviewed for this Task Force report. Its major health effects conclusions that the evidence is strongest for respiratory health effects in occupants of damp and moldy buildings are consistent with conclusions from the IOM (2004) report (although the WHO weight-of-evidence criteria for sufficient evidence differ slightly from IOM's). The WHO (2009) executive summary is included in Appendix I of this report.

[5] IOM review panels evaluate the weight of evidence from epidemiology studies by characterizing evidence for different health outcomes into categories based on commonly-used criteria for judging causality from observational data. As used by

runny or itchy nose, throat irritation), wheeze, cough and acute asthma symptoms in sensitized asthmatics. Sufficient evidence also exists for an association between mold or bacterial exposures in damp buildings and development of hypersensitivity pneumonitis, an immune-mediated lung disease that can progress to permanent loss of lung function. Limited or suggestive evidence was found for an association between the presence of mold in damp buildings and lower respiratory illness (e.g., pneumonia) in otherwise healthy children. No health outcomes were found by the committee that met the "sufficient evidence of a causal relationship" criteria for the presence of mold, dampness or other dampness-related agents.

Sufficient or limited evidence was found for associations between exposure to indoor dampness and the same set of upper and lower respiratory effects (except hypersensitivity pneumonitis) as was found for the presence of mold. In addition, limited evidence of an association between the development of new cases of asthma and exposure to dampness in buildings was found. Dampness in these studies could be an indicator of mold growth, but it could also indicate the presence of other dampness-dependent agents such as dust mites.

The IOM Damp Indoor Spaces Committee found inadequate or insufficient evidence to determine whether an association exists between the presence of mold or dampness in buildings and several other potential health effects, including other respiratory effects, skin symptoms, fatigue, gastrointestinal disease, neuropyschiatric symptoms, rheumatic or other immunologic diseases, reproductive effects, acute idiopathic lung hemorrhage in infants or cancer. In the IOM committee's judgment, studies of these outcomes were either lacking, or of insufficient quality, consistency or statistical power to permit a conclusion about the presence or absence of an association.

Other recent reviews of the scientific evidence regarding adverse health effects of molds and dampness in buildings have come to similar conclusions. An earlier IOM expert panel evaluating the evidence for effects of indoor chemical and biological exposures on asthma (IOM, 2000) concluded that there was sufficient evidence of an association between indoor exposures to fungi or molds and exacerbation of asthma, but that (at that time) there was inadequate or insufficient evidence to determine whether an association existed between indoor mold exposures and development of new asthma cases.

A 2006 report commissioned by the California Research Bureau (CRB, a unit of the California State Library) reached similar conclusions based on a review of existing literature and consultation with a panel of outside experts. The report's conclusions

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the IOM, sufficient evidence of an association indicates that a statistical association between an agent and a health outcome has been demonstrated for which chance, bias and confounding can be ruled out as explanations with reasonable confidence. Limited evidence is suggestive of an association, but limited because chance, bias or confounding cannot be ruled out with reasonable confidence. The strongest weight-of-evidence category, "sufficient evidence of a causal relationship," indicates that the criteria for sufficient evidence of an association have been met, and, in addition, criteria for strength of association, biologic gradient, consistency of association, biological plausibility, coherence and temporality have also been met.

from section 2 (Health Effects and Risks, page 20) regarding asthma, allergies and other respiratory effects stated:

- Damp and unremediated water-damaged indoor environments can contribute to conditions that harm health. Those conditions should be avoided and the causes corrected.
- Molds that result from indoor dampness and prior water intrusion or accumulation contribute to allergies and may aggravate other health conditions, including asthma, but the mere presence of indoor mold has not in itself been proven to impair health.
- The best documented and most common effects attributed to exposure to indoor mold, such as typical allergic responses, are relatively mild and reversible (if the exposure is stopped) in persons who are otherwise in good health.
- Symptoms attributed to the presence of molds in indoor environments (especially nonspecific symptoms) may be the result of other sources and conditions, such as bacteria, dust mites, animal allergens, or prior water damage and dampness.
- Exposure to indoor mold poses higher risks to children, to persons with preexisting conditions, such as asthma, and especially to persons with impaired immune systems, who are susceptible to serious fungal infections.
- Symptoms associated with exposure to damp indoor spaces and to related conditions, including mold, tend to subside when the individual is removed from that setting or when the conditions are corrected (remediated).

Two European reviews have evaluated the scientific evidence for associations between damp buildings and health effects. The NORDDAMP panel (Bornehag et al., 2001) concluded that living or working in damp buildings increases the risk of respiratory symptoms such as cough, wheeze and asthma symptoms as well as unspecific symptoms including headache and tiredness. They considered the evidence that these associations were causal to be strong. However, the specific agents associated with damp buildings (e.g., mold, bacteria or dust mites) that cause the observed effects could not be determined from the existing evidence.

The EUROEXPO panel conducted an update of the NORDDAMP review (Bornehag et al., 2004) and reported very similar conclusions. Some evidence indicated that both mold spore and dust mite exposures in buildings were associated with respiratory symptoms and also with allergic sensitization to molds and mites (respectively), but the panel still considered the evidence inconclusive in terms of the specific agents causing effects in damp buildings. The NORDDAMP and EUROEXPO panels both recommended that, despite the lack of clear evidence on the specific agents causing health effects, dampness in buildings should be avoided by remediating damp buildings or taking measures to prevent dampness in dry buildings.

Recent statements and reviews by medical associations have also concluded that indoor mold exposures can contribute to respiratory health effects including cough, wheeze, asthma symptoms, upper respiratory symptoms and, less commonly, hypersensitivity pneumonitis, allergic sinusitis and allergic bronchopulmonary aspergillosis (ACOEM, 2002, 2003; Bush et al., 2006; Mazur and Kim, 2006). A meta-analysis of asthma and

respiratory health studies from the IOM (2004) report conducted by researchers at Lawrence Berkley National Laboratory concluded that dampness and mold in homes was associated with about a 30 – 50 percent increase in these health outcomes compared to homes without dampness or mold (Fisk et al., 2007).

Mold toxins

Scientific evidence for associations between indoor exposures to mold toxins (also called mycotoxins) and adverse health effects in building occupants is inconclusive. The IOM (2004) expert panel concluded that current scientific evidence was inadequate or insufficient to determine whether or not an association exists between exposure to damp indoor environments or the presence of mold or other agents in damp buildings and many adverse effects hypothesized to be attributable to indoor "toxic mold" exposure. These effects included skin symptoms, gastrointestinal symptoms, fatigue, neuropyschiatric symptoms, reproductive effects, rhuematological and other immune disorders and acute idiopathic pulmonary hemorrhage in infants.

Similarly, the CRB noted in their report (2006, page 21) that "Evidence for other adverse health effects *specifically* due to indoor molds, especially toxic effects, is inconclusive and has been questioned by some scientists on the grounds that the evidence does not meet strict scientific standards for proof of causation. However, such effects appear to be plausible under unusual environmental and individual circumstances" (emphasis from original).

The IOM (2004) expert panel reviewed the extensive scientific data on toxicity of chemical products from molds and bacteria (referred to collectively below as microbial toxins). They concluded that molds and bacteria that produce toxins under certain environmental conditions can and do grow indoors in damp buildings. Evidence suggests exposure to mycotoxins can occur via inhalation as well as by dermal contact with moldy materials and ingestion of contaminated food. More recent studies (e.g., Brasel et al., 2005a,b) have established that mold toxins can occur in airborne particles sampled in moldy buildings. *In vitro* studies (studies on cells in test tubes) and studies using laboratory animals indicate that microbial toxins can cause adverse effects to many body organs or systems, including respiratory, immune, neurological, liver, kidney and skin (see, for example, reviews by Fung and Clark, 2004; Pestka et al., 2008). Existing animal study results are largely based on high-dose, single exposure or short-term repeated experiments using exposure routes that may not be relevant to indoor air exposures (injection, ingestion or forced tracheal instillation). These experimental data provide mechanistic and qualitative hazard assessment[6] information that suggests adverse effects in building occupants who inhale airborne microbial toxins are possible, but they do not directly document such effects or establish the degree of health risk that may exist. Long-term inhalation studies in laboratory animals that

[6] Hazard assessment indicates whether a certain type of toxic effect is possible, but does not identify the exposure level at which risk of the effect is increased.

would help to evaluate the risk of adverse health effects from chronic exposure to low levels of toxin-producing molds or mycotoxins in buildings were not found.

Well designed epidemiology studies investigating the risk of adverse effects from exposure to mold toxins in damp or moldy buildings are lacking. Several studies have reported results of clinical symptom surveys (e.g., headache, fatigue, lethargy, cough or muscle pain) and cognitive testing (e.g., memory, learning, language or problem solving) from series of self-selected patients reporting a history of exposure to wet and/or moldy building conditions and subsequent health complaints. Several of these studies report apparent high frequency of symptoms or neurocognitive impairment among patients compared to historical population ("normative") data or unmatched control groups (e.g., Baldo et al., 2002; Crago et al., 2003; Gordon et al., 1999, 2004; Gray et al., 2003; Johanning et al., 1996; Johanning & Landsbergis, 1999; Kilburn 2003; Shoemaker and House, 2006). Others have not observed increased symptoms or impairment or have associated symptoms with other medical conditions unrelated to mold toxins (Khalili and Bardana, 2005; Reinhard et al., 2007; Stone et al., 2006). However, none of these studies allows a clear conclusion to be drawn as to whether living or working in a damp or moldy building is associated with increased risk of neurological effects because they are essentially descriptive case-series studies of patients who have self-selected based on both health complaints and assumed mold exposure (see exposure discussion below). This type of study is not well-suited to evaluating disease associations. Major design deficiencies include lack of a clear case or disease definition (Fung and Clark, 2004), lack of appropriate matched control subjects, lack of control for bias and confounding and lack of statistical control for chance findings (Fox et al., 2005; McCaffrey and Yantz, 2005).

The clinical studies of mold-exposed patients described above also lack detailed exposure information. The papers generally state that patients report occupying a building with mold problems and that these reports were confirmed by reviewing sampling or other building assessment records, but detailed documentation is not provided. Exposures are generally described interchangeably as involving mold, toxic mold or mycotoxins, although direct evidence for exposure to or the presence of mold toxins or toxin-producing molds is absent in most cases. One report (Khalili and Bardana, 2005) noted that among the 50 cases they reviewed, none of the indoor air quality studies accompanying the cases met minimum expectations for indoor fungal sampling as described by Portnoy et al. (2004). All self-reports of the existence of any mold condition in a building are interpreted as implying toxin exposure and essentially treated as equivalent. However, mycotoxin production varies substantially by mold species and also by growth substrate and environmental conditions even within species considered to be toxin producing (e.g., Kuhn and Ghannoum, 2003; Nikulin et al., 1994). Additionally, environmental assessment of other potential contributing exposures (e.g., dust mites, bacterial endotoxin, environmental tobacco smoke or volatile organic compounds) appears lacking in these reports, so they are unable to evaluate alternative hypotheses related to these potential exposures for observed symptoms or clinical testing results.

Results from a series of clinical patient evaluations as presented in the reports described above can only be considered hypothesis generating; that is, they can suggest possible relationships between an environmental exposure and health effects that could be investigated systematically in epidemiology studies designed to control for bias, confounding, temporality and chance findings. These types of clinical reports do not allow conclusions to be drawn about causal associations between mold exposures and health risk. For example, Gordon et al. (2006) acknowledged that their 2004 study was not an epidemiological study designed to evaluate causal associations between mold exposure and cognitive impairment. Nevertheless, the main title of the 2004 paper ("Cognitive impairment associated with toxigenic fungal exposure") and the conclusion stated in the last paragraph[7] both strongly imply that conclusions about associations are being drawn. Other clinical studies cited above draw similarly strong conclusions that are not supported by thorough epidemiological analysis.

Over-interpretation of the results of descriptive clinical studies could give a misleading impression that neurological or cognitive effects are a well-understood consequence of indoor mold exposures. Conversely, large-scale, population-based studies have not been done that clearly reject a hypothesis of adverse effects from mycotoxins in buildings. Carefully conducted epidemiology studies that thoroughly characterize exposures in damp and moldy building environments and attempt to control for bias and confounding while comparing health outcomes in exposed and unexposed populations are needed to gain a better understanding of the potential health risks of chronic exposure to indoor molds and mold toxins. Without such studies, whether or not living or working in buildings with mold growth is associated with an increased risk of neurological effects remains in dispute scientifically. There is a lack of definitive research on both sides.

This is an area where scientific investigation interacts with personal injury claims, liability litigation and claims of conflict of interest.[8] Some lay literature may overstate strengths and weaknesses of scientific evidence on both sides, particularly when drawing conclusions based on litigation documents.[9]

[7] "This study adds to a growing body of evidence (Baldo et al., 2002; Gordon et al., 1999) that suggests *exposure to mycotoxins can result in* significant and measurable cognitive deficits in memory, learning, attention, processing speed, and executive functions" (emphasis added; Gordon et al., 2004).

[8] For example, see the series of commentaries published in the September 2006 issue (v118, n3) of the Journal of Allergy and Clinical Immunology in response to Bush et al. (2006) and commentaries on the ACOEM 2002, 2003 position papers such as Craner (2008) on the one hand; and concerns about speculative opinion and recall bias, particularly in disputed situations, on the other (e.g., Fung and Clark, 2004; Khalili and Bardana, 2005; Lees-Haley, 2003).

[9] It is also important to note that assessing the weight of evidence for health risks from environmental exposures is a very different question than a medical assessment of the cause of an individual patient's health condition. Judgments about the weight of evidence regarding whether or not certain health effects are associated with indoor mold growth address potential health risks at a population level. These judgments are based on statistical trends in populations and cannot be used to prove or disprove the cause of an individual's health condition. For example, the IOM (2004) concluded that exposure to building dampness is associated with an increased risk of developing asthma in children. If this association is causal, it would imply that, for two hypothetical groups of children who differed only in whether or not they were exposed to damp building conditions, more asthma cases would be expected in the exposed group. However, the population-based evidence cannot predict which individuals will or won't develop asthma, and the existence of a demonstrated population-based association does not imply that any particular case of asthma in a child exposed to damp building conditions was definitely

Infectious disease and damp buildings

Most cases of infectious disease caused by fungi (including both molds and yeasts) in otherwise healthy people are relatively minor skin or mucous membrane infections (e.g., athlete's foot, ringworm, thrush) that have no particular connection to molds associated with building dampness. Buildings can be exposure sources for important fungal pathogens, especially *Histoplasma capsulatum* and *Cryptococcus neoformans*, when large accumulations of bird or bat guano occur at roost sites (Chamany et al., 2004; Dean et al., 1978; Lenhart et al., 2004; Pal, 1989; Stobierski et al., 1996). Otherwise, more serious fungal infections mostly occur in people with conditions that substantially suppress immune function (e.g., certain cancer treatments, organ transplant, HIV/AIDS). Susceptibility to these opportunistic infections depends more on the host's immune status than on the level of mold spore exposure, so that severely immune compromised patients are at risk from background exposure levels common in outdoor air. Hospital construction is a well-known risk factor for opportunistic fungal infection in susceptible patients (e.g., Chang et al., 2008; Opal et al., 1986). Otherwise, searches of the published scientific literature did not find evidence of fungal infectious disease risk specifically attributable to mold growth in damp buildings.

The IOM (2004) report concluded that there was limited or suggestive evidence of an association between exposure to a damp indoor environment or the presence of mold (unspecified) and unspecified lower respiratory illness in otherwise healthy children. The evidence supporting this conclusion does not clearly distinguish between infectious (e.g., pneumonia) and non-infectious respiratory diseases or the specific dampness-related agents involved.

2. Mold in New York State

Information documenting adverse health effects specifically attributable to mold exposure in the general population or specific subgroups in NYS is limited. The only routinely-collected disease surveillance data available are hospital admissions collected under the State Planning, Research and Cooperative System (SPARCS) that include a fungal infection diagnosis. SPARCS hospitalization data for fungal infections were summarized for 2000 – 2006 (Table 1). All of these fungal infections except candidiasis (yeast infection) are likely the result of an environmental exposure, although determining whether the source was indoors or outdoors is not possible from these data. Annual rates of fungal infections reported as the principal diagnosis did not vary substantially over this interval. Candidiasis (yeast infection) was the most common diagnoses, accounting for nearly two-thirds of all SPARCS cases. *Aspergillus* and *Cryptococcus* infections were the next two most common diagnoses. SPARCS primary diagnosis data are one measure of the burden of disease associated with mold exposures

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caused by the building conditions (because many other factors also contribute to increased asthma risk). Similarly, the inconclusive evidence for associations between occupancy in moldy buildings and neurotoxic or other mycotoxin effects does not prove or disprove a clinical judgment about the cause of observed medical conditions in an individual patient.

in NYS. The results in Table 1 suggest serious fungal infection rates have remained fairly constant over the last several years.

SPARCS primary diagnosis data are subject to some limitations. Hospitalizations for fungal infections are relatively severe cases. However, they likely represent a small fraction of all the health effects to which mold exposure contributes. Mild infections and non-infectious health effects such as asthma exacerbations are not captured by these data. The data in Table 1 are principal hospital diagnoses, so additional fungal infections reported as secondary diagnoses are not included in the table.

Individuals with mold allergies are clearly at some increased risk for allergic respiratory effects such as asthma, rhinitis or sinusitis compared to those not sensitized to mold allergens. Routine surveillance data for respiratory health effects that could be associated with mold exposure such as asthma exacerbations or upper-respiratory symptoms are only collected if the outcome is severe enough to require an emergency department visit or hospital admission (for example, see http://www.health.state.ny.us/diseases/asthma/ for NYS asthma surveillance data). Even when surveillance data for a potentially mold-related respiratory health outcome exist (e.g., emergency department visits for acute asthma exacerbation), those data do not identify environmental exposures associated with cases. Separating the contribution due to mold exposures from other exposures that also contribute to the same health outcomes is not possible with these data.

Table 1. Annual statewide rate of NYS resident hospitalizations for fungal infections by ICD-9 principal diagnosis code, 2000 – 2006. Data are number of hospitalizations per 1 million population per year.*

	Year						
Principal diagnosis (ICD-9 Code)	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Dermatophytosis (110)	3.5	3.2	3.5	3.5	2.9	3.9	4.0
Dermatomycosis, other and unspecified (111)	0.3	0.4	0.5	0.5	0.5	0.6	0.7
Candidiasis (112)	37	38	41	42	42	40	41
Coccidioidomycosis (114)	0.4	0.4	0.6	0.8	0.5	0.3	0.6
Histoplasmosis (115)	0.7	0.9	1.0	0.8	0.7	0.7	1.3
Blastomycotic infection (116)	0.2	0.3	0.1	0.1	0.2	0	0.1
Other mycoses (117) (sub-total of 117.1 – 117.9)	16	17	18	16	17	16	14
Sporotrichosis (117.1)	0.3	0	0.1	0	0	0.1	0.1
Chromoblastomycosis (117.2)	0	0.2	0.1	0	0	0	0.1
Aspergillosis (117.3)	8.0	9.3	9.0	8.3	8.8	8.1	6.0
Mycotic mycetoma (117.4)	0.1	0	0.1	0.1	0.1	0.1	0
Cryptococcosis (117.5)	4.9	4.8	4.3	3.7	4.4	2.8	3.9
Allescheriosis (117.6)	0	0	0	0	0	0	0.1
Zygomycosis (117.7)	0.3	0.1	0.6	0.4	0.1	0.4	0.2
Phaehyphomycosis (117.8)	0	0	0.1	0.1	0.1	0	0
Other and unspecified (117.9)	2.6	3.0	4.0	3.6	3.6	4.1	3.6
Opportunistic mycoses (118)	0.2	0	0	0	0.1	0.2	0.1
Total (110 – 118)	58	61	65	63	64	62	62

* Source: NYS Statewide Planning and Research Cooperative System (SPARCS) inpatient data with principal diagnoses ICD-9 110 – 118. US Census Bureau annual population estimates for NYS (http://www.census.gov/popest/states/NST-ann-est.html). Overall totals may differ from sum of separate items due to rounding.

Historical records from the NYSDOH and local health departments give some indication that concerns about indoor mold exposures have been common across the state for many years. During the period from January 2006 through December 2008, the Indoor Health Assessment section in the NYSDOH Center for Environmental Health received an average of 37 calls per month related to mold concerns (Figure 1). Since many health inquiries from the public are handled by local health departments rather than the NYSDOH, this likely represents a small fraction of the total mold inquiries to health departments, and does not reflect inquiries fielded by private companies, consultants or physicians. An earlier summary of NYSDOH indoor air quality activities related to mold found that NYSDOH provided technical assistance to local health departments for over 500 mold investigations for the years 2000 and 2001. Local health department

staff carried out many more investigations without NYSDOH assistance.[10] Not all inquiries involve adverse health effects; many only involved investigating the presence of mold growth due to water problems in buildings.

The NYC Department of Housing Preservation and Development (HPD), Division of Code Enforcement investigates mold complaints made by tenants in private, multi-unit residential buildings in NYC. Since September of 2004, HPD fielded between 1200 and 2300 mold complaints per month and issued between 600 and 1500 disrepair violations per month for mold (Figures 2 – 3). In 2007, HPD received over 20,000 mold complaints and issued over 14,000 violations related to mold. Mold violations that are not corrected by the building owner are referred to the HPD emergency repair program. Under this program, HPD contractors repair the violation and bill the building owner. In 2007, almost 1400 apartments were referred for emergency repair, at a cost of approximately $211,000 (an average cost of approximately $150 per repair). The HPD program responds to complaints related to building conditions and does not assess whether adverse health effects are associated with the conditions.

Many of the oral and written comments provided to the Task Force by members of the public described experiences involving mold growth in water-damaged buildings where people lived or worked. These testimonials commonly included descriptions of health problems such as respiratory or neurological symptoms that the commentors associated with indoor mold exposures. This type of testimonial information does not allow an evaluation of the degree of population-level health risk (see footnote 9 above) associated with indoor mold exposures. However, these reports reinforce the message from HPD and NYSDOH investigation data that water damage leading to mold growth occurs frequently in NYS buildings. Many of the reports are also consistent with what is known about some of the respiratory consequences of indoor mold exposures.

[10] Edward G. Horn, Ph.D. Testimony before the New York State Senate Standing Committee on Health and the Standing Committee on Environmental Conservation, May 23, 2002.

Figure 1. Total monthly mold calls received by the Indoor Health Assessment section of the NYSDOH (January 2006 – November 2008).

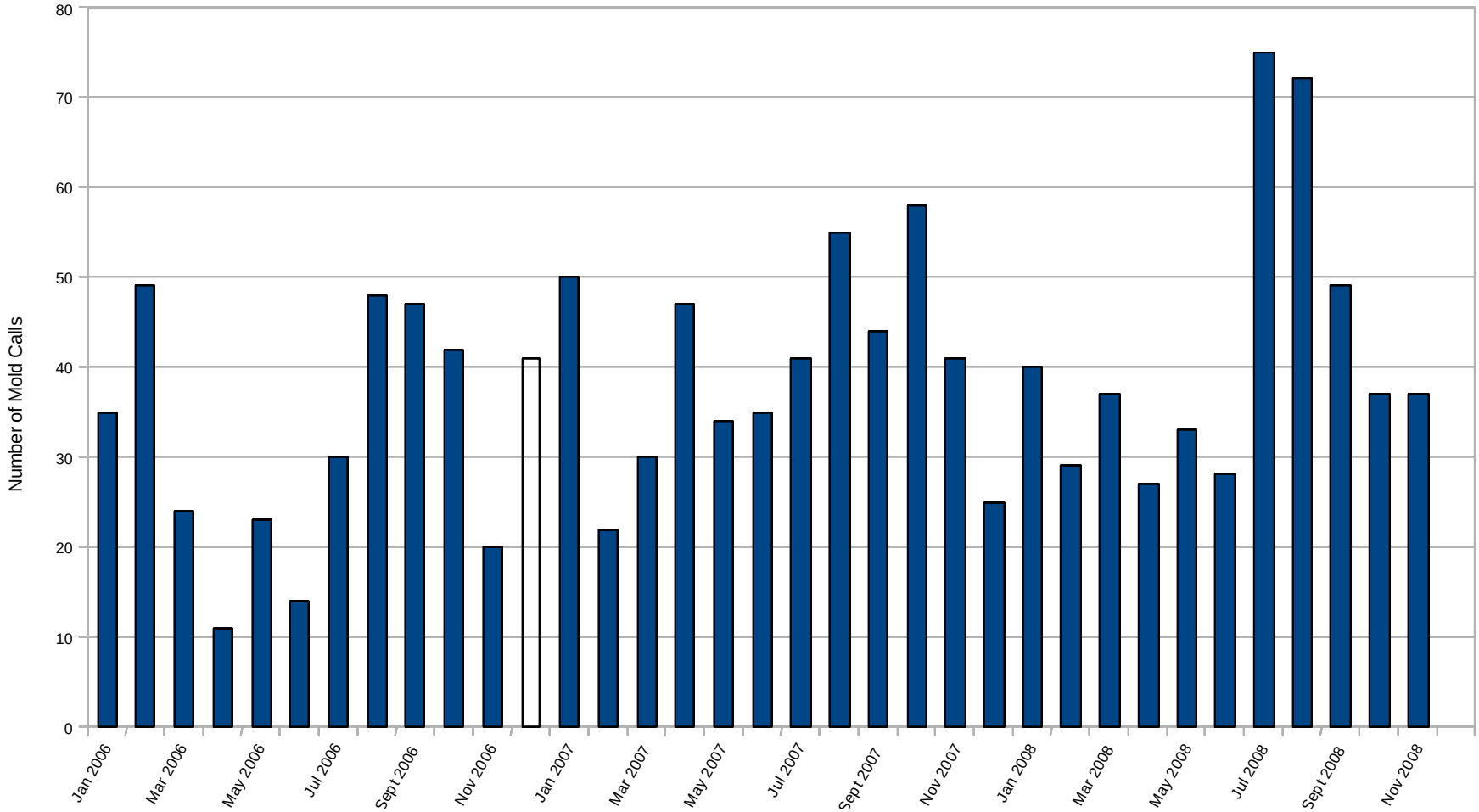


Figure 2. Total monthly mold complaints received by the NYC Department of Housing Preservation and Development (September 2004 – March 2008).

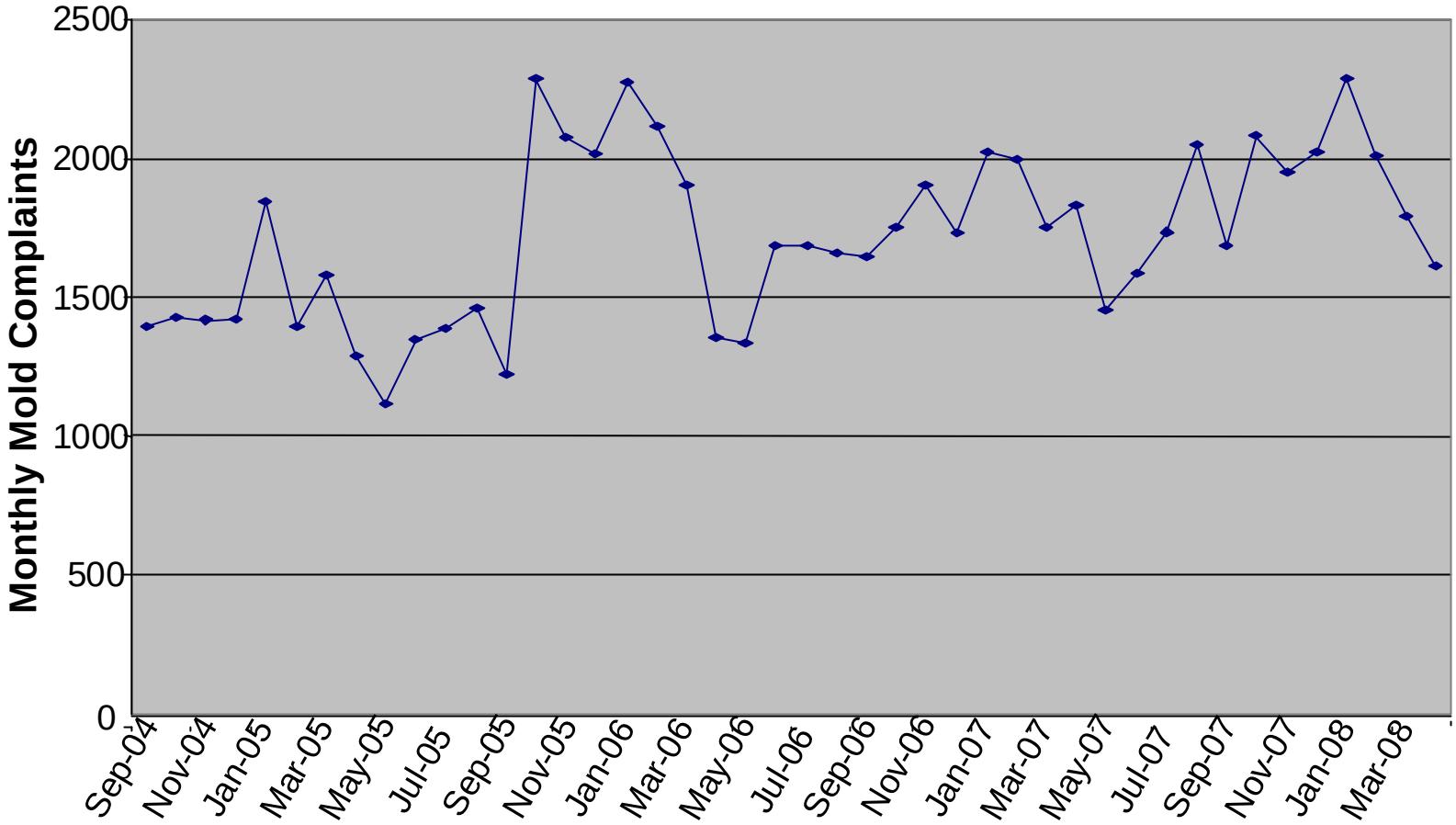
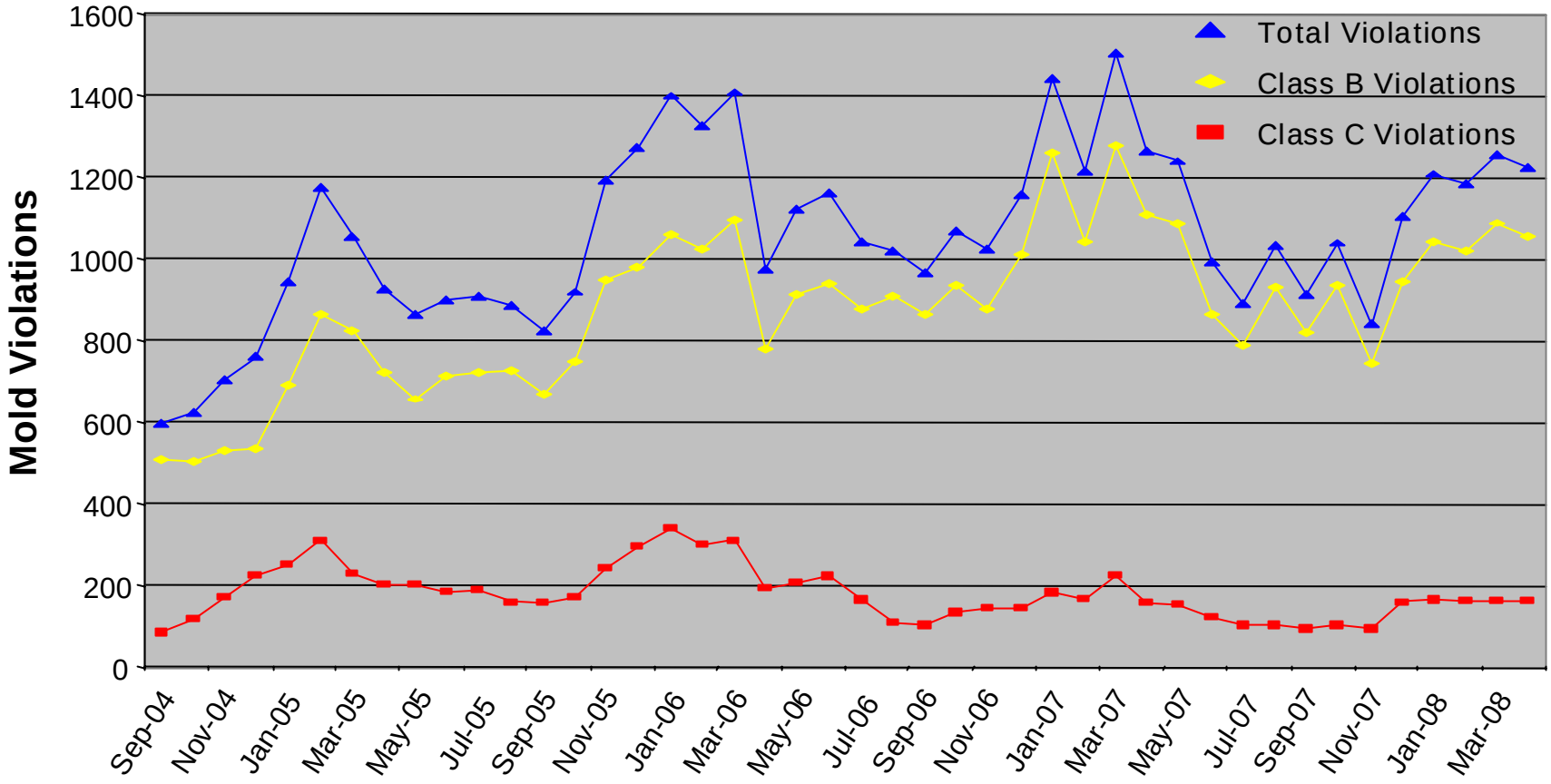


Figure 3. Total monthly mold violations cited by the NYC Department of Housing Preservation and Development (September 2004 – March 2008). Class B violations are less serious than Class C violations. Building owners are required to correct Class C violations within 24 hours.



3. Conclusions – health effects

- Exposure to building dampness and dampness-related agents including mold has been recognized nationally and at the state and local levels as a potential public health problem.

- The strongest evidence exists for associations between indoor mold exposures and upper and lower respiratory health effects such as nasal symptoms and asthma exacerbations.

- Asthma and other allergic respiratory diseases that can be exacerbated by mold exposures are common in New York. For example, approximately 15 – 20 percent of NYS middle-school and high-school aged children report having asthma, based on surveys from 2005 and 2006 (NYSDOH, 2007). This means many people are at risk for exacerbation of their respiratory conditions by exposure to mold conditions in buildings.

- Evidence for associations between other health effects (such as neurological, gastro-intestinal, muscular or immunological effects) and mold exposures in buildings is much more limited and generally does not allow clear conclusions to be drawn one way or the other.

- Molds, along with other organisms such as bacteria, mites and insects that proliferate in damp buildings, produce volatile compounds, spores and other minute particles that can cause irritant and allergic responses that range from annoying to serious depending on the amount of exposure and the immune system of the individual. Although some molds produce toxins, their contribution to adverse health effects in damp buildings, based on existing scientific information, is uncertain.

<u>Implications:</u>

- Since most mold problems in buildings are preventable with proper building construction, maintenance and housekeeping aimed at preventing excess building dampness, opportunities exist to prevent morbidity from exposure to indoor molds.

- Overabundant growth of any mold or other dampness-related organisms is undesirable and can be addressed by removing contaminants and correcting water problems. Whether or not exposure to mold toxins is likely when mold growth occurs in a damp building does not substantially change the need for mitigation of the water and mold problem.

C. Actions taken by state and local governments and other entities

1. Survey approach and results

NYSDOH and NYSDOS staff conducted multiple searches for published materials addressing any actions taken by state and local governments or other entities relevant to the Task Force scope as defined in Section 1384.[11] The information obtained was categorized into four main topic areas:

- Building and housing codes and industry standards;
- Regulatory programs;
- Outreach and education; and
- Mold task force laws or initiatives.

These are discussed in detail below.

Two other common actions were identified during these searches that were considered outside of the scope of Section 1384 and are mentioned here without further discussion. One of these is the use of or requirement for real estate disclosures. These generally are either recommended by local real estate broker associations or required by state or local law and are intended to protect a property seller or landlord from liability and/or inform prospective purchasers or tenants by disclosing a property's known mold-related conditions or history (see, for example, http://www.cdph.ca.gov/programs/CLPPB/Documents/ResEnviroHaz2005.pdf and http://www.realtor.org/realtororg.nsf/pages/moldchart0403). The other action involved legal requirements for "right to cure" clauses in construction contract language. This is intended to provide an opportunity for builders to correct construction problems that lead to water damage and/or mold problems in exchange for some protection from liability claims (see, for example, http://commerce.wi.gov/SB/SB-DivPublications.html).

2. Building and housing codes and industry standards

Existing building codes

NYSDOS staff reviewed construction codes for NYS (available at: http://www.dos.state.ny.us/code/ls-codes.html) and other states and consulted with International Code Council staff to review building, residential and mechanical codes for 12 large states and localities. Construction, property maintenance and housing codes generally do not specifically address the presence of mold. Codes are

[11] There is no central source for this type of information, so internet-based searches focused on state health departments, relevant federal agencies and industry standards organizations, along with additional searches using internet search engines and contacts with other state agencies and independent associations knowledgeable in related technical areas. Although this approach cannot claim to be exhaustive, there was an effort made to survey all states for any relevant guidance, legislative or regulatory actions and all state health department web sites specifically for relevant outreach and education materials. A broad survey of state building codes was conducted, along with a more focused survey of building, residential and mechanical codes for 12 states. Web site addresses appearing in the report were verified as of August, 2009.

prevention oriented and contain many provisions aimed at building moisture control such as building ventilation requirements, drainage and building envelope elements (e.g., caulking and flashing).

In NYS, code chapters (2007 revision) that address building moisture prevention and control include:

- Building code, Chapter 14, Exterior Walls;
- Building code, Chapter 15, Roof Assemblies and Rooftop Structures;
- Building code, Chapter 18, Soils and Foundations;
- Residential code, Chapter 3, Building Planning;
- Residential code, Chapter 4, Foundations;
- Residential code, Chapter 7, Wall Covering;
- Residential code, Chapter 9, Roof Assemblies;
- Residential code, Chapter 11, Energy Efficiency;
- Residential code, Chapter 15, Exhaust Systems;
- Residential code, Chapter 18, Chimneys and Vents;
- Mechanical code, Chapter 4, Ventilation;
- Plumbing Code, Chapter 11, Storm Drainage;
- Property Maintenance Code, Chapter 1, General Requirements;
- Property Maintenance Code, Chapter 3, General Requirements; and
- Property Maintenance Code, Chapter 5, Plumbing Facilities and Fixture Requirements.

Industry standards organizations have developed many standards relevant to construction materials or building dampness (Appendix D). For example, the American Society for Testing and Materials (ASTM) has many testing standards for assessment of water or mold resistance of various building materials. The American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) has developed performance standards for building ventilation systems that include consideration of moisture prevention. These are consensus industry technical standards that can be incorporated into building codes by reference, but are otherwise generally voluntary.

Building code enforcement

Code enforcement in NYS is largely the responsibility of the local municipality. Code enforcement officials (CEOs) are the individuals who are responsible for approving construction documents, doing inspections during construction and issuing certificates of occupancy upon successful completion of the building. They also are required to inspect existing buildings (except one and two family dwellings) on a regular basis and can issue violations.

Dampness problems and mold growth in buildings can be addressed by CEOs under existing authority to control nuisance conditions that affect building habitability. CEOs should understand obvious problems with plumbing leaks or weatherproofing

that could lead to a mold problem. However, their ability to recognize subtle moisture problems in buildings (e.g., uncontrolled airflows causing condensation) probably varies and, as result, potential construction or maintenance violations that can lead to mold problems may be missed.

The NYC HPD inspection program for disrepair violations described previously (Section II.B.2) is an example of building-code enforcement applied to dampness and mold problems. NYC also has a separate part under its judicial system that specializes in housing issues, including landlord-tenant conflicts that can arise from dampness and mold problems in apartments.

Despite the extensive enforcement infrastructure for property-maintenance issues in NYC, public comments made at Task Force meetings stated that the enforcement system is limited in its ability to successfully resolve many building owner-building resident conflicts related to dampness and mold problems. For example, some public speakers reported that HPD mold violations were repaired by simple measures such as surface cleaning and re-painting without fully abating contaminated building materials or the underlying water problem causing the mold growth. Although these repairs initially corrected the letter of the violation (based on visual appearance), mold problems were reported to recur after a short period of time. Information was not available to the Task Force to determine how common this type of superficial repair work is. Another limitation of the HPD program is that it does not apply to all residential situations in NYC (e.g., Co-Op buildings and public housing are outside HPD's jurisdiction).

The Task Force also heard from attorneys who pointed out that NYC Housing Court judges cannot require building owners to follow the details of the NYCDHMH mold assessment and remediation guidance when making dampness and mold-related repairs, because, as guidelines, they are not legally enforceable.

In NYS outside of NYC, no other formal enforcement programs appear to exist, based on information available to NYSDOS staff, as well as responses to an informal email poll of CEOs. However, isolated examples were found where town CEOs have used their authority on an *ad hoc* basis to require mitigation of water and mold problems in buildings based on disrepair conditions or habitability judgments. The application of this authority is subject to local discretion on the part of each town code enforcement office.

Indoor mold may be addressed as a building code issue in other states, although this appears to vary. Internet searches were conducted to find examples of how building-code enforcement is applied to dampness and mold problems in other states. This was not intended to be an exhaustive survey. Links to relevant documents found are provided in Table 2. These examples show that mold problems are sometimes addressed by local CEOs, while in other locations this does not appear to be an option.

3. Regulatory approaches to mold problems in buildings

Assessment and remediation industry regulation

In the sections that follow, mold assessment refers to inspection of buildings for the presence of moisture problems and associated mold growth. Mold assessment activities also involve developing work plans for remediating dampness and mold problems that have been identified in a building and follow-up inspection to establish that remediation work has been successfully completed. Other common terms used for assessment include inspection and evaluation.

Mold remediation is used in this report to refer to the actual work involved in repairing or removing mold-contaminated building materials following work plans based on a building inspection. This can include several components, depending on the extent of the mold problem, including establishing proper containment, demolition, cleaning, surface disinfection, worker protection and waste handling. Remediation work can also include work to repair sources of building dampness such as roof or plumbing leaks, but these repairs can also be done by workers or companies with expertise not specific to mold remediation (e.g., plumbers or roofers). Other common terms used for remediation include abatement, mitigation and clean-up.

The scope of any mold assessment or mold remediation job and the need for specialized services will depend on the extent of the problem. Small-scale, temporary moisture and mold problems can often be successfully assessed and remediated by a homeowner or building maintenance staff with minimal technical resources. Successfully assessing and remediating extensive flooding or widespread, chronic roof leaks leading to extensive mold contamination will generally require hiring specialized services. Many variations on the need for either assessment or remediation services fall in-between these two extremes. It is not simple to foresee all the possible combinations of assessment and remediation conditions that might arise within this continuum.

Table 2. Examples of the way dampness and mold problems are addressed through building-code enforcement in other states.

State or Locality	Document link
North Carolina	http://www.ncbar.org/download/environmentalLaw/moldContamination.pdf
Sacramento County, California	http://www.emd.saccounty.net/EH/Tenant-Landlord-mold.pdf & http://www.hrfh.org/mold.html
San Francisco, California	http://www.sfdph.org/dph/files/EHSdocs/ehsPublsdocs/Art11FAQ.pdf
Maywood, Illinois	http://www.maywood-il.org/VoM_Depts/Code/Code_1indx.htm
Delta Township, Michigan	http://www.deltami.gov/wp-content/uploads/2009/08/Moldabatementpolicy.pdf
Peoria, Illinois	http://www.ci.peoria.il.us/frequently-asked-questions-code-enforcement#6
New Mexico	http://www.health.state.nm.us/eheb/tenants.shtml
Bradenton, Florida	http://www.cityofbradenton.com/vertical/Sites/%7B2D1C3C91-86C5-4ACC-86B6-6CFA76381D46%7D/uploads/%7BF34266B0-0749-454D-9C1E-318175F91098%7D.PDF

Assessment and remediation of buildings affected by water damage and resulting mold problems are subject to different levels of government oversight in different states. Nine states were found to have some form of statute or regulation that applied to building assessment and/or remediation for mold problems (Table 3). There is an inherent trade-off when attempting to regulate these industries between providing needed flexibility for service providers to respond to specific conditions as they encounter them and providing prescriptive solutions to many possible dampness and mold situations. More flexibility can also mean more variation in the quality of work that is done. Conversely, prescriptive rules may provide greater quality control but are more likely to create unnecessary obstacles in some situations. The regulatory approaches taken by different state and local governments can affect how these two competing goals are balanced, and there seems to be relatively little consistency in way this problem has been approached.

Existing regulatory approaches vary in terms of which providers are regulated (assessment, remediation or both). They also vary in terms of the stringency of their licensing requirements. States sometimes rely on completion of third party training courses or industry certification programs (discussed in detail below) as the basis for licensure, while in others the state has developed its own training and testing criteria for obtaining licenses. Most states appear to have addressed mold assessment and mold remediation by issuing guidance (or endorsing existing guidance) and have not taken any specific regulatory action.

In Texas, mold assessors, mold remediators and mold laboratories must be licensed to operate legally in the state. The Texas Department of State Health Services (TX

DSHS) administers this program, establishes minimum work practices for each discipline, certifies training programs and administers the testing program that is used to issue licenses (http://www.dshs.state.tx.us/mold/default.shtm). The Texas program also includes work site inspections and complaint investigations related to mold remediation jobs. This is currently the most extensive regulatory program of any state for mold assessment and remediation. When contacted, TX DSHS staff estimated that the mold licensing program requires approximately 10 full time equivalents (FTEs). However, the mold program is not budgeted separately from other programs, so detailed program expenses are not available. See Appendix K for additional details.

In Louisiana, mold remediators are licensed by the State Licensing Board for Contractors (http://www.lslbc.louisiana.gov/mold_remediation_menu.htm). The Board sets training requirements that can be met by third party training courses. Mold assessors apparently do not require licensure. The Louisiana State Licensing Board for Contractors was not able to provide a precise cost estimate for its mold remediator licensing program, because they do not assign dedicated staff to that activity. However, license applications and renewals for mold remediators in Louisiana constitute approximately 1.5 percent of the total license and registration applications and renewals processed by the State Licensing Board annually. The Board has 55 employees (August 2008), nearly evenly divided between licensing and enforcement responsibilities. This suggests licensing and enforcement related to mold remediation contractors in Louisiana accounts for about three-quarters of one full-time-equivalent per year (55 x 0.015 = 0.82). See Appendix K for additional details.

A licensing program for both assessors and remediators based on meeting training requirements and passing a state exam is scheduled to go into effect in Florida in 2010 (2008 Florida Statutes, Chapter 468, Part XVI, ss 468.84-468.8423; http://www.myfloridalicense.com/dbpr/pro/mold/statutes.html). The Florida program will be administered by the State Department of Business and Professional Regulation.

In Arizona, mold assessment and remediation is defined under state law as a form of structural pest control (http://www.sb.state.az.us/PDFDocuments/Laws&Rules/OPM_Statutes7-07-08.pdf; http://www.sb.state.az.us/LicCatDefConv.php). Companies and individuals in Arizona are licensed by the Structural Pest Control Commission to inspect and treat structures for visible fungus. Requirements for mold assessment and remediation licensure under this program appear to be the same as for other structural pest control applicators.

Table 3. Summary of state regulations for mold assessment and remediation

State	Type of Regulatory Program	Bill/Law Establishing Legal Authority	Responsible Agency	Program Summary
Arizona	License	Chapter 115 of 46th Legislature, First Regular session 2003	Structural Pest Control Commission	• Assessment and control of fungi added to pests under structural pesticide law • Individuals and companies licensed as for other pest control • http://www.azleg.gov/FormatDocument.asp?inDoc=/legtext/46leg/1R/laws/0115.htm • http://www.sb.state.az.us/PDFDocuments/Laws&Rules/OPM_Statutes7-07-08.pdf
Arkansas	License	Act 1467 of 2009	State Plant Board	• License mold investigators • Establish standards for mold investigations • Establish qualifications for mold investigators • http://www.arkleg.state.ar.us/assembly/2009/R/Pages/BillInformation.aspx?measureno=sb803
Florida	License	2008 Florida Statutes, Chapter 468, Part XVI, ss 468.84-468.8423;	Dept of Business and Professional Regulation	• Applies to assessment and remediation • Sets training and experience requirements • Establishes state exam or equivalent • http://www.myfloridalicense.com/dbpr/pro/mold/statutes.html
Illinois	-	Public Act 095-0456; 2007	Dept of Public Health	• Requires the Department to report annually on any Federal regulations implemented for indoor air quality standards and training or licensing • The Department may adopt rules requiring mold remediation companies to register with the State and provide proof of financial responsibility • http://www.ilga.gov/legislation/publicacts/95/095-0456.htm
Louisiana	License	Act 800, Regular Session 2003	State Licensing Board for Contractors	• Applies to remediation • Sets training requirement • Only explicit work practice requirement is written report to client • http://www.lslbc.louisiana.gov/pdf_files/Mold%20Act.pdf
Maryland	License	Chapter 537 of Laws of 2008	Maryland Home Improvement Commission	• Applies to remediation • Based on certification by independent accreditation body • Does not apply to nonresidential property • http://mlis.state.md.us/2008rs/chapters_noln/Ch_537_hb1309E.pdf

Table 3 continued

State	Type of Regulatory Program	Bill/Law Establishing Legal Authority	Responsible Agency	Program Summary
Oklahoma	-	2004 OK Session Laws Section 425	-	• Prohibits a firm from conducting both mold assessment and remediation on the same property
Texas	License	Acts of 2003, Chapter 205, Sec. 1	Dept of State Health Services	• Applies to assessment, remediation and laboratory analysis • Specifies training, examination and minimum work standards • Remediation protocol required to include unspecified clearance criteria • http://www.statutes.legis.state.tx.us/Docs/OC/htm/OC.1958.htm
Virginia	License	Chapter 358 of Virginia Acts of Assembly, 2009	State Board for Asbestos, Lead, Mold and Home Inspectors	• Requires license to perform mold inspection or remediation in state • Board to promulgate regulations setting licensing requirements • Mold-related provisions become effective July, 2011 • http://leg1.state.va.us/cgi-bin/legp504.exe?091+sum+HB2032

In Maryland, mold remediation companies are required to be licensed by the state Home Improvement Commission (Title 8, Business Regulation, Sections 8-701 – 8-718; http://www.dllr.state.md.us/license/law/mhiclaw.shtml and follow instructions for Title 8 Annotated Code of Maryland). Employees who provide remediation services must be certified by the American Indoor Air Quality Council (renamed the American Council for Accredited Certifications [ACAC] in 2009) or other accreditation body that is independent of training, industry or trade organizations.

A law passed in 2009 requires that, beginning in January 2010, persons in Arkansas wishing to perform mold investigation services for a fee must be licensed by the state (http://www.arkleg.state.ar.us/assembly/2009/R/Bills/SB803.pdf). The licensure program is to be administered by the State Plant Board, a state agency that regulates certain aspects of agriculture, including pesticide regulation. The Plant Board is charged with developing regulations to implement the new law.

Oklahoma does not appear to require mold assessors or remediators to be licensed or certified, but a state law prohibits companies or individuals from conducting assessment and remediation activities on the same property (2004 OK Session Laws Section 425).

A 2007 law passed in Illinois (Public Act 095-0456; http://www.ilga.gov/legislation/publicacts/95/095-0456.htm) requires the Illinois Department of Public Health (IDPH) to report annually to the State Legislature on any federal regulations that establish indoor air quality standards or any standards for training, certification or licensing of mold remediation services. The law gives authority to the IDPH to develop rules to register parties offering mold remediation services in the state and have them provide evidence of financial responsibility. The law's effective date was January 1, 2008, but no rules implementing the law have been promulgated as of July 2010.

A 2009 law passed in Virginia (Acts of Assembly, Chapter 358; http://leg1.state.va.us/cgi-bin/legp504.exe?091+sum+HB2032) requires mold inspectors and mold remediators to be licensed by the state Board for Asbestos, Lead, Mold and Home Inspectors. The Board is required to promulgate regulations establishing the licensing requirements. The law becomes effective July 2011.

Table 4. Standards and guidance documents for assessment and remediation of mold and dampness in buildings*

Organization	Year	Title
American Conference of Governmental and Industrial Hygienists	1999	Bioaerosol: assessment and control
American Industrial Hygiene Association	2005	Assessment, Remediation, and Post-Remediation Verification of Mold in Buildings
American Industrial Hygiene Association	2008	Recognition, Evaluation and Control of Indoor Mold
American Society for Testing and Materials	2006	ASTM E2418 Standard Guide for Readily Observable Mold and Conditions Conducive to Mold in Commercial Buildings: Baseline Survey Process
American Society for Testing and Materials	Draft May 2010	ASTM WK3792: Guide for Assessment of Fungal Growth in Buildings (draft work item)
CT Department of Public Health	2006	Connecticut Guidelines for Mold Abatement Contractors
CT Department of Public Health	2007	Get The Mold Out: Mold Clean-Up Guidance for Residences
Enterprise Community Partners & the National Center for Healthy Housing	2006	Creating a healthy home: a field guide for clean-up of flooded homes
Health Canada	2007	Residential Indoor Air Quality Guidelines: Moulds
Institute of Inspection Cleaning and Restoration Certification	2003	IICRC S520 Standard and Reference Guide for Professional Mold Remediation
Institute of Inspection Cleaning and Restoration Certification	2006 (3rd edition)	ANSI/IICRC S500-2006 Standard and Reference Guide for Professional Water Damage Restoration
New York City Dept of Health and Mental Hygiene	2008 (revised)	Guidelines on Assessment and Remediation of Fungi in Indoor Environments
US Environmental Protection Agency	2001	Mold Remediation in Schools and Commercial Buildings
US Environmental Protection Agency	2002	A Brief Guide to Mold, Moisture, and Your Home
US Environmental Protection Agency	Sept 2008 update	Mold resources web site: http://www.epa.gov/mold/moldresources.html
World Health Organization	2009	WHO Indoor air quality guidelines for dampness and mould

* Major guidance documents and standards are listed. A more extensive list of fact sheets, brief guidance and other related documents from many states, cooperative extension offices and other organizations is presented in Appendix F.

Guidance materials and voluntary industry credentials

Beyond formal regulation, many government agencies and private organizations provide guidance materials related to building assessment and remediation for dampness and mold (Table 4). For example, detailed guidance for response to water damage and mold growth in buildings was developed by the NYCDHMH in 1993 and has been revised twice since then (NYCDHMH, 2008). This guidance

document has been adopted as a minimum work practice by Pennsylvania (PA DOH, 2006). Similar detailed guidance has been produced by the Connecticut Department of Health and US EPA. Industry associations and standard-setting organizations (for example, the American Industrial Hygiene Association and the American Society of Testing and Materials) have also developed several detailed guidance documents for various aspects of prevention, assessment and remediation of dampness or flooding and mold growth in buildings.

Many private organizations provide credentials related to aspects of mold assessment and remediation in buildings (a list of some of these found through internet searches is provided in Appendix E). Information was gathered to explore how different types of credentialing programs compare in terms of their requirements and what they indicate about the credential-holder's knowledge and experience. In the discussion that follows, mention of specific training, credentialing or certification organizations or programs does not constitute endorsement of that organization, program or credential. The discussion is only intended to describe and compare various alternative approaches that currently exist.

In general, private credentialing for activities such as mold assessment and remediation falls into two categories: 1) "certificates" indicating completion of a specific training course or 2) "certifications" based on an assessment of an individual's specific industry knowledge and experience that are issued by an organization independent of any training program. Certificates represent completion of a single training course that could range from a short online course to a multi-day in-person course. In contrast, certifications are based on meeting a series of established criteria that demonstrate industry knowledge and experience. The criteria can include requirements for relevant post-secondary education (e.g., bachelors or masters degree), a minimum level of work experience in relevant fields and passing written or practical examinations that are not tied to any particular training course.

Certifications are granted for a limited time after which they need to be renewed to remain valid. The only mold-related certifications found in our review are offered by ACAC (formerly American Indoor Air Quality Council). ACAC requires re-certification every two years. The current ACAC re-certification fee is $300 and documentation of 40 hours of continuing education or professional development credits is also required during the two-year certification term (http://www.acac.org/recertification/rchome.htm). Examples of two to three day re-certification courses listed on the ACAC web site cost between $500 and $1000 each. ACAC does not develop, audit or administer these courses.

As of October 2009, 145 NYS residents held ACAC-administered mold-related certifications, 354 residents of states bordering NYS held ACAC mold-related certifications and a total of 3298 US residents held ACAC mold-related certifications (personal communication from ACAC representative Adam Andrews).

Another example of a certification program is the Certified Industrial Hygienist (CIH) credential provided by the American Board of Industrial Hygiene. Individuals with CIH credentials would generally be qualified to conduct building assessments, although assessing potential mold exposure in damp buildings is not a primary focus of this certification.

Most certificates for mold training are provided by non-governmental organizations. In general, mold training programs from non-governmental organizations cost between $300 and $1000 per person. Numbers of mold-related certificate holders from various training organizations are not available. However, the number of certificate holders is likely to exceed the number of ACAC certifications because certificates can be obtained in a training class, but certifications can only be issued after a person's training, experience and capability are reviewed and approved.

One industry standard was found relating to the development of training courses that issue certificates: the National Organization for Competency Assurance (NOCA)[12] 'Quality Standard for Assessment-Based Certificate Programs' (NOCA 1100, 2009).[13] NOCA 1100 is an American National Standards Institute (ANSI) accredited industry standard. It is intended to set minimum quality standards for training courses that issue certificates. A certificate issued by a NOCA 1100 compliant training course should indicate that course participants have achieved intended learning outcomes for the course based on rigorous assessment.

The very similar terminology (i.e., certificate vs. certification) used to categorize different types of credentials possessed by mold assessors and remediators could be confusing for those in need of services. The training, experience and industry knowledge – and therefore the quality of services provided – of individuals and companies claiming to be "certified" might vary substantially. NOCA 1100 stipulates that the term "certified" or the use of acronyms after an individual's name to indicate certification are reserved for holders of professional certifications (such as those administered by ACAC). Under NOCA 1100, individuals possessing only a training certificate may not use "certified" to describe their credentials or follow their name with acronyms implying certification (see industry bulletins from the American Council for Accredited Certification: http://www.acac.org/forms/otherpdfs/NOCA%20Article%203-09.pdf; http://www.acac.org/forms/otherpdfs/NOCA1100.pdf). However, NOCA 1100 is

[12] In November, 2009, NOCA officially changed its name to the Institute for Credentialing Excellence.

[13] The standard's scope is described by ANSI as follows (http://www.nssn.org/search/DetailResults.aspx?docid=659060&selnode=):

> "This standard pertains to assessment-based certificate programs defined as a non-degree granting program that: a) provides training to aid participants in acquiring specific knowledge, skills, and/or competencies; b) evaluates participants' achievement of the intended learning outcomes; and c) awards a certificate only to those participants who meet the performance, proficiency, or passing standard for the assessment(s). This standard is NOT intended to cover classes, courses, programs, or events that award only a certificate of attendance or participation; nor is it intended to apply to professional or personnel certification programs."

relatively new and compliance with industry standards such as NOCA 1100 is voluntary.

Possible approaches to developing guidance or regulation of mold-related industries

As indicated by the preceding discussion, state and local governments have taken many different approaches to guidance, oversight or regulation of industries involved in mold assessment or mold remediation. Different approaches to industry self-regulation (e.g., voluntary training-course standards and certification criteria) also exist. Based on this review, there does not appear to be a clear consensus about an ideal regulatory approach to mold assessment or remediation.

The main public health goal of any additional guidance or regulation of mold assessment or mold remediation industries should be to reduce the potential for mold exposures and the concomitant risk of health effects in damp buildings by improving the quality of mold assessment or remediation work done in the State. To achieve this, state oversight approaches could include encouraging or requiring that assessment and/or remediation workers have appropriate training and could also involve inspection and enforcement activities.

It is important to note that any goals pertaining to oversight of the mold assessment or remediation industries should be supplemental to the primary goal of preventing dampness or water damage conditions in buildings in the first place. As discussed at the beginning of this section, that goal depends on strengthening construction and property-maintenance codes and their enforcement to prevent water problems.

Another important element of any government activity in this area is to improve awareness of building dampness and mold growth issues among building owners and occupants. A number of guidance materials intended for residential building occupants already exist that help explain the relationship between building dampness or moisture problems and mold contamination (see Section II.C.4, page 57). Additional guidance materials are needed that will help building owners and occupants when they need to hire mold assessment or remediation service providers. Consumers considering prospective service companies should ask what certifications or other qualifications are held by the company or its employees. They should also ask for a written itemized description of the water damage or mold contamination that has been identified, the specific remediation actions that are proposed to correct the identified problems and what assessment criteria will be used to determine that the job has been completed satisfactorily.

In the following discussion and in Table 5, several possible alternative guidance or regulation approaches are described for mold assessment or mold remediation services. The limited number of regulatory strategies considered below and in the table is intended to provide examples of the range of possible oversight actions from voluntary guidance to a relatively regimented regulatory program. Table 5 provides

cost estimates for this range of examples. Other combinations of government requirements within this broad continuum are possible, and the discussion here is not intended to precisely define specific regulatory frameworks. There is no assumption implied that mold assessment and mold remediation companies should have the same level of government oversight; any of these approaches could be applied only to mold assessment companies or only to mold remediation companies.

Mold assessment and mold remediation services can be provided by contracting or consulting companies with many employees or by individual contractors. The licensing approaches described below and in Table 5 are assumed to apply to mold assessment or mold remediation companies. The companies would then be responsible for documenting that their employees have obtained the proper training or industry credentials. However, in cases where the "company" is an independent contractor the licensing and documentation requirements would obviously apply to the same individual as both the regulated entity and the employee.

Based on the review of relevant programs in NYS and other states, several levels of potential government oversight of the mold assessment and remediation industries are outlined:

A. Voluntary guidance: Guidance materials (e.g., the 2008 NYCDHMH mold assessment and remediation guidance, the 2007 Cornell University Cooperative Extension guidance (Cornell, 2007) on hiring a mold remediation contractor) could be recommended that establish a basic set of preferred work practices for assessing and remediating moisture and mold problems in buildings, but would not carry any government oversight or enforcement authority. Information should also be developed to assist consumers with making decisions about responding to moisture and mold problems.
B. Voluntary training or certification programs: Government agencies could review available training courses or certification programs for mold assessment or remediation and identify recommended courses or certification, but not make obtaining the preferred training or certification a legal requirement to perform work in the state. This could help establish preferred work practices that emphasize the basic set of recommended principles for addressing moisture and mold problems in buildings. The state could create a list of providers who are self-identified as having obtained the preferred training or industry credentials. This would be a market-driven approach putting the onus on consumers to be informed about recommended training or certification and thereby creating demand for compliant providers. Additional guidance for consumers to assist them in selecting providers should accompany this approach.
C. State licensing of service companies: Under this approach, mold assessment or remediation companies would be licensed by the state and would be required to document that their workers have the appropriate training or certification credentials. Offering services without a license would be a violation. Different variations on this approach have been implemented in other states. These variations on licensing companies providing mold assessment or remediation

services (based on approving training courses or certification programs or providing direct training and certification) differ in their required state resources and the level of credentialing required of licensed companies' employees.

1. A licensing program based on requiring companies to document that their employees have attended certain third party training courses would require dedicated state resources to review training programs and identify those that qualify. Under this option, workers of licensed companies should all be exposed to the same set of basic recommended assessment and/or remediation principles. This would be similar to option (B) above, with the additional requirement that companies would have to submit a license application (with any associated fees) and document compliance. The level of state resources required would be less than in option (2) below if the training programs are not directly accredited by the state and if there is no state audit process to verify worker attendance at training courses. This option is also a relatively less stringent requirement on companies compared to option (3) requiring workers have full industry certification from a third party.
2. A licensing program that includes review and accreditation of training courses would require an organization similar to the current NYS asbestos program, where the state regulates both the abatement companies and the training programs. Under this option, workers of licensed companies should all be exposed to the same set of basic recommended assessment and/or remediation principles. This option would require more dedicated state resources, compared to options (1) or (3), to review and process applications for approval of training curricula and to conduct training-course audits. Course audits would probably be limited, but would provide some degree of compliance assurance. Having employees attend required training courses should be a less stringent requirement on companies than requiring that employees possess full industry certification from a third party.
3. A licensing program based on requiring companies to document that their employees possess approved industry certification from a third party would require dedicated state agency resources to review a limited number of alternative programs and to administer the company licensing program. Certification programs (e.g., ACAC Certified Mold Remediator) already have established criteria for educational background, work experience and continuing education to maintain the certification credential. Relying on an independent certification program to identify acceptable education, experience and re-certification training would remove the need for the state to undertake a more costly training review and approval program (as compared with the accredited training-based alternative (2) above). However, requiring formal industry certification for employees of licensed mold assessment or remediation companies is a more stringent requirement on the companies than requiring that employees attend training courses. Requiring companies to document that their employees have formal

certification is modeled after the law in Maryland (requiring that workers possess certification by ACAC or equivalent).

4. A licensing program based on requiring companies' employees to possess state certification would be similar to combining options (2) and (3) above, except a state agency would be directly responsible for the establishment of all certification criteria and for conducting training and testing programs. Developing and administering a state-operated training and certification program for employees of licensed mold assessment or remediation companies would require a similar or slightly greater level of dedicated state resources compared to option (2) above. This approach is modeled after the regulatory program in Texas.

D. Field inspection and enforcement: The alternative regulatory approaches described in item (C) above focus on documentation of appropriate worker training or certification as the basis for licensing mold assessment or remediation companies. Separate enforcement authority could also be created that could apply to any of those alternatives. Licensed companies could be subject to field inspection of actual mold assessment or remediation work sites by a state agency and work-practice violations could be issued. Based on the inspection and enforcement elements of the NYS asbestos regulatory program, these activities would require substantial state resources in addition to those required for any of the alternatives under item (C) above.

The regulatory approaches considered above rely on identifying existing guidance, training courses or certification programs that emphasize the general building assessment and remediation principles to find and correct water problems and clean or remove moldy building materials. Focusing on these basic principles is preferred over attempting to codify detailed building inspection or remediation protocols through regulation. There are major challenges to developing detailed prescriptive regulations for building assessment and remediation. Each building assessment and remediation plan for dampness and mold problems will have unique features. It is probably not possible to anticipate all the possible circumstances that could arise so as to avoid creating adverse unintended consequences for building owners, occupants or service providers when attempting to codify detailed protocols for building inspection or remediation.

It should also be noted that a state licensing program can emphasize certain work practices and discourage others, but cannot verify that preferred work practices are actually being implemented without an enforcement program that includes field inspection of actual work sites and the authority to issue violations. Enforcement activities are particularly costly and, depending on available resources, would probably only be able to cover a small fraction of all mold assessments or mold remediation jobs.

In addition to any oversight approach for assessment and remediation companies, written guidance materials should be developed for service consumers (building owners and occupants) to help them when obtaining assessment or remediation services. This includes obtaining information from prospective companies about their qualifications and obtaining written documentation of assessment findings, proposed remediation work plans and criteria to be used to assess whether the job has been completed satisfactorily.

Cost estimates in Table 5 for different potential oversight approaches are based on available information from similar existing programs.[14] Guidance and licensing approaches that depend on third-party training courses or industry certification programs were assumed to require a minimal level of dedicated state resources (one to two full-time equivalents) to administer. This was informed, in part, by cost estimates for the Louisiana licensing program and the recognition that establishing and administering a new licensing program without dedicated resources is likely to be burdensome for state agencies.[15] Cost estimates could be up to twice as high as those shown in Table 5 if separate staff and administrative costs are required to administer programs regulating both the building assessment and building remediation industries.

The NYS regulatory program for asbestos abatement companies was used as a model for the level of resources that might be required to implement a relatively extensive regulatory program (including enforcement authority) for mold remediation. The NYS asbestos program requires that asbestos abatement companies be licensed and that licensed companies oversee projects that involve the abatement of asbestos. The program requires asbestos training programs to be accredited by the State and asbestos workers to obtain training from accredited training programs (see additional details in Appendix K). Detailed information was available from that program to develop cost estimates for different regulatory approaches for analogous mold assessment and remediation services. Limited information from the Texas program was also used to estimate the number of staff that would be needed for two of the five approaches, although those estimates are less certain than the estimates based on the asbestos program.

[14] Cost estimates for personal services and administrative costs are based on 2010 salary, fringe and other operating expenses (e.g., supplies, etc.) assuming relevant civil service titles for the programmatic functions described. The actual legal requirements for program implementation will influence program costs. Many other factors such as the effects of climate or age of housing stock could affect the actual cost of implementing a New York State program compared to other states' programs. Also, New York State does not currently license general building contractors, so additional resources could be required to create a new programmatic infrastructure to administer such a licensing program.

[15] Fees and fines paid into a special revenue account established for the program could be considered as one means of off-setting agency costs. However, the special account should be created in legislation and the legislation should give the agency the authority to set fees in regulation. Fees and fines should be structured to continue to provide adequate program funding over time.

Table 5. Cost estimates for potential alternative approaches to developing guidance or regulation of mold assessment or remediation service companies. Refer to discussion in Section II.C.3 (page 42) for further detailed explanations of items **A – D**.

Potential approach	Annual cost estimate[a]
A. Voluntary guidance	
recommend specific guidance (e.g., NYCDHMH) as preferred work practices for assessment and remediation in state	1 FTE[b] approximately $150,000 for ongoing review and updating of guidance materials
B. Voluntary training or certification programs	
identify particular third-party training curricula or industry certification credentials as preferred without requiring them by law or regulation	1 FTE approximately $150,000 for ongoing review of third-party training curricula or industry certification programs and administering list of providers; does not include auditing of providers for compliance with training or certification requirements
C. State licensing of service companies	
1) require licensing of assessment or remediation companies based on documenting that workers obtain preferred third-party training curricula do not require state accreditation or auditing of training providers or courses	2 FTEs approximately $200,000 for ongoing review of third-party training curricula and administering licensing program
2) require licensing of assessment or remediation companies based on documenting that workers successfully complete state-accredited, third-party training course require state accreditation of training providers and auditing of training courses by regulator as in DOH asbestos program	Up to 10 FTEs approximately $1.2 million including auditing of some training courses (based on analogy to asbestos program)
3) require licensing of assessment or remediation companies based on documenting that workers have obtained specific independent industry certification (e.g., ACAC[c]-certified mold inspector or mold remediator)	2 FTEs approximately $200,000 for ongoing review of third-party certification criteria and administering licensing program
4) require licensing of assessment or remediation companies based on workers obtaining certification through state-developed training and testing program	10 – 15 FTEs approximately $1.2 – 1.6 million without field inspection (based on analogy to NYS asbestos program and limited feedback from TX)
D. Field inspection and enforcement	
for any of the licensing options **(C)** above: include authority for state agency to conduct inspections of assessment and/or remediation work and issue violations	approximately 30 additional FTEs approximately $3.3 million based on analogy with NYS DOL/DOH asbestos program

[a] Cost estimates could be up to twice as high as indicated if separate staff and administrative costs are required to implement programs for mold assessment companies and mold remediation companies

[b] FTE = full-time equivalent; one person working full-time for one year, based on 2010 salary estimates

[c] ACAC = American Council for Accredited Certification (formerly American Indoor Air Quality Council)

4. Outreach and education

Almost all state health departments and some cooperative-extension services provide education and outreach materials developed for the general public that address water problems and mold growth in buildings. These were reviewed and an itemized list of these resources is provided in Appendix F. Major messages or attributes that are common to many of these educational and outreach materials are summarized here.

Public health education and outreach materials generally cover some elements of potential mold health effects and the prevention, assessment and mitigation of water and mold problems. A number of common messages occur in these materials. Health department educational materials indicate that indoor mold growth resulting from dampness or moisture problems has the potential to contribute to adverse health effects in building occupants and, therefore, should be abated to minimize the potential risks by minimizing exposures. The goal of abatement is generally to minimize potential mold exposure in buildings by controlling exposure sources and correcting the root cause of the mold condition (i.e., moisture problems). This includes tracing and correcting water sources in the building and removal or cleaning of mold-damaged building materials. Many educational materials include recommendations for precautions to take during abatement work to limit mold dispersal and worker exposure. Most educational materials developed by health agencies recommend little need for environmental mold sampling to achieve or confirm the remediation goal of complete elimination of the water problem and any moldy materials in the building, especially in residences.

5. State mold task force laws

At least four other states convened advisory committees similar to the NYS Task Force to investigate various aspects of the mold and damp buildings issue and have issued reports (CA DHS, 2005; CRB, 2006; ME DHHS/DEP, 2007; PA DOH, 2006; TX RCC, 2005). The major recommendations from each task force are listed *verbatim* in Appendix G. Selected observations from two state reports are mentioned here.

California passed a law in 2001 entitled “The Toxic Mold Protection Act.” The law directed the California Department of Health Services (DHS; now the Department of Public Health) to determine the feasibility of establishing permissible exposure limits (PELs) for indoor mold and to convene a stakeholder task force to consult with DHS in developing enforceable standards and voluntary guidelines to prevent health conditions that may occur with exposures in damp or moldy indoor environments. DHS issued a report (2005) where it concluded, based on several significant information gaps, that sound, science-based PELs were not feasible (see Section II.D, page 63 on exposure limits for details). DHS further reported that, due to severe resource limitations, the agency could not complete the remainder of the

tasks in the law. Nevertheless, DHS concluded that indoor dampness, water intrusion or fungal growth should always be eliminated in a safe and efficient manner and that public health was best protected by limiting indoor mold exposures.[16]

The Maine Departments of Health and Human Services and Environmental Protection issued a "Mold in Maine Buildings Task Force" report in 2007. Several of its primary recommendations dealt with aspects of building management issues particular to Maine, including modifying model building codes (local adoption of residential codes is voluntary in Maine) and construction contract language. The task force also recommended that the state publicize existing guidelines and standards for building assessment; building remediation; education and certification of mold assessment and remediation professionals; and worker protection. Two recommendations not addressed in other state reports related to dispute resolution and enforcement actions and are reproduced *verbatim* here:

- Strengthen Tenants Rights
  - Tenants rights laws and guidance must be strengthened by requiring mediation between tenants and landlords in mold/moisture disputes, prior to requiring the tenant to pursue legal action against the landlord as is currently the case under the Maine Warranty of Habitability Act, 14 M.R.S.A. § 6021.

  - Rationale: Under current statute, tenants engaged in a dispute with a landlord over mold/moisture issues have little or no recourse other than to initiate litigation. This can be a hardship for many tenants, particularly the elderly or those with small children. (Based on the mold-related calls received by Maine CDC, the preponderance of tenants who call the State looking for assistance for mold issues are elderly, have a debilitating disease, or have small children.)

- Strengthen Authority of Local Health Officers
  - Add a provision to 17 MRSA c. 91 that specifically grants authority to the Local Health Officer for the purpose of investigating mold as a public or private nuisance.

  - Rationale: Consumers often look to their municipality to assist them with their mold/moisture problems, particularly those in landlord/tenant situations. Specifically granting authority to local health officers to investigate mold/moisture problems in homes and buildings will provide consumers with some recourse for getting their nuisance mold problem investigated, and subsequently resolved.

[16] "Notwithstanding the inability to develop PELs for indoor molds, DHS agrees with other building and health professionals that indoor dampness, water intrusion, or fungal growth should always be eliminated in a safe and efficient manner. The public health is best protected by limiting exposure to mold growth, other biological contaminants, and chemicals in damp buildings to prevent allergic, irritant, and infectious health effects."

6. Conclusions and recommendations – state and local actions

a) Codes

Conclusions:

- The State Uniform Fire Prevention and Building Code and the State Energy Conservation Construction Code (and analogous NYC codes) are the mechanisms that NYS uses to prevent or minimize moisture problems in buildings through design, construction and property maintenance requirements.
- The presence and power of the CEO can also help minimize the potential for mold problems in buildings when approving construction documents, during construction inspections of new buildings and when issuing property-maintenance violations related to moisture conditions in existing buildings during required inspections.
- The codes and their enforcement are important tools to help prevent moisture problems in buildings. Opportunities should be pursued by NYS and NYC to strengthen building codes and code enforcement with respect to preventing and correcting moisture problems.

Recommended actions:

- NYS and NYC should continue to improve building code requirements that address building design, construction techniques and property maintenance so that they prevent or minimize the potential for water problems to occur. They should both work within the framework of the International Code Council (ICC) code adoption process to monitor and develop proposals to prevent or minimize dampness and mold in new and existing buildings.
- Provide targeted training and education to CEOs to improve understanding of subtle moisture problems in buildings (e.g., uncontrolled air flows causing condensation) and to enable them to address potential or existing water and mold problems more effectively.

Feasibility:

- NYS (except NYC) has a State Uniform Fire Prevention and Building Code that since 2003 has been based on the model codes used throughout most of the United States, written by ICC. As of 2008, the Building Code of the City of New York is also based on the ICC codes. The ICC issues new editions of its code every three years to keep up with changes in the building industry.
- The NYSDOS and the NYC Department of Buildings are both active in the ICC code adoption process. Assistance of the NYSDOH in creating code language and providing supporting documentation could be necessary for code proposals intended to prevent dampness and mold problems. Some specific examples of areas to consider for potential building code enhancements are listed in Appendix J.

- CEO training outside of NYC is done by NYSDOS at no cost to municipalities. NYSDOS trainers working with NYSDOH indoor environmental quality experts can update existing courses on code changes or mold problems for CEOs as necessary. Any new CEO training should reflect any changes made to the codes regarding mold.

b) Regulation of mold assessment or remediation services

Conclusions:

- Having persons who provide mold assessment and remediation services properly trained and following accepted protocols is desirable. Approaches that have been tried to accomplish this range from providing specific guidance for recommended work practices to an extensive regulatory program.
- Although several states and NYC have developed some level of formal guidance or regulatory oversight, mostly for the mold remediation industry, information evaluating the effectiveness of these various regulatory approaches was not found.
- Voluntary industry standards that could apply to mold-related assessment and remediation services exist for training programs and certification.

Recommended Actions:

- The main public health goal of any additional guidance or regulation of mold assessment or mold remediation industries should be to reduce the potential for mold exposures and the concomitant risk of health effects in damp buildings by improving the quality of mold assessment or remediation work done in the State. State agencies should, at a minimum, provide guidance about recommended work practices for assessment and remediation and about the existence of training curricula and certification (see Table 5, items A, B). Other possible regulatory actions that could be considered by the state are also presented in Table 5, items C, D.

Feasibility:

- General recommended work practices and certification programs for building assessment and remediation have already been developed by reputable organizations. Providing information about these practices and programs, along with any limitations as to their effectiveness would be relatively easy and would cost about $150,000 annually.
- The above concerns about effectiveness of regulation notwithstanding, if legislation to establish authority to regulate the mold assessment or remediation industries is considered, state funding support would be needed for agency staff and overhead administrative costs. These funds would support the development and implementation of regulations and their continuing administration and enforcement. Examples from an analogous NYS program suggests annuals costs could be in the range of

$4.5 million. Fees and fines that are established in regulation and paid into a special revenue account established for the program could be considered as one way of paying for these new government services. Fees and fines should be structured to continue to provide adequate program funding over time.

c) Education and outreach

Conclusions:

- Recognition of potential adverse health effects from dampness and resulting mold growth in buildings has driven preventive education and outreach messages toward water and mold problems in buildings by state and local health departments for over 10 years. For example, NYC initially developed guidelines in 1993 (revised in 2000 and 2008) that focused on minimizing indoor mold exposures by minimizing or correcting water, dampness and mold conditions in buildings.
- Additional targeted education might enhance efforts to prevent building moisture problems, mold problems and any concomitant health effects.

Recommended actions:

- Governmental, private and non-profit organizations should develop or enhance educational materials related to building moisture prevention and tailor those materials to specific audiences dealing with building design, construction and maintenance. These organizations should proactively disseminate the materials to the intended audiences. A coordinated proactive, multi-media educational campaign is likely to be more effective than simple distribution of brochures or other written outreach materials. Potential audiences for targeted education on preventing building moisture include architects, builders, contractors, remodelers, weatherization assistance programs, building performance consultants, building owners, code officials and building occupants.
- Education and outreach messages for the general public should emphasize that potential health problems associated with dampness and mold in buildings can be reduced by correcting water problems and removing sources of indoor mold growth in a timely manner.

Feasibility:

- State agencies with relevant outreach and education programs related to aspects of moisture prevention in building construction and maintenance include, but are not limited to, NYSDOS, NYSDOH, NYSED, NYSDHCR and the NYSOGS. Non-governmental organizations include professional and trade associations (e.g., American Institute of Architects, NYS Builder's Association, Commercial Lumberman's Association) and tenants' organizations.
- Costs for enhancing educational materials and programs would depend on how much existing programs were augmented. Costs could include

increased expenditures on supplies, printing, public media resources (e.g., TV, radio, print), travel, meeting venues and other operational resources, in addition to personnel time.

- The efficiency of educational efforts could be increased by leveraging existing outreach venues such as professional society meetings and continuing education programs, commercial trade associations and tenants' associations. Extensive multi-media educational campaigns, such as the recent NYSDOH tobacco control campaign, can be expensive. The current annual funding level for the tobacco control program was $55.1 million dollars in state fiscal year 09-10 (see Appendix K for additional details).

d) Research

Conclusion:

- Better information obtained through careful research would help inform decision making regarding many issues related to dampness and mold problems in buildings.

Recommended action:

- Additional research is needed on the following issues:
  - the prevention and mitigation of building moisture problems and mold growth;
  - the effectiveness of different education approaches to dampness and mold prevention;
  - the effectiveness of different antimicrobial treatments as part of mold remediation;
  - the effectiveness of specific aspects of mold remediation protocols including the level of containment needed, salvage or disposal of wet or contaminated materials and the level of cleanliness required at the end of remediation;
  - the development and effectiveness of methods for identifying moisture problems in buildings undergoing energy retrofits;
  - the effectiveness of moisture-resistant building materials and the relationship between green-building and energy-conservation criteria and the prevention of building moisture problems; and
  - the possible relationship between indoor mold exposure and chronic health effects.

Feasibility:

- State agencies have extensive expertise in many issues related to preventing and mitigating building water and mold problems. NYSDOH and NYCDHMH both have extensive experience in conducting health studies related to environmental exposures. Obtaining external funding for such research should be explored when available.

e) Other possible actions

Conclusions:

- Other actions were outside of the Task Force scope, but might be considered as part of NYS's response to dampness and mold problems in buildings:
  - requirement for disclosure by property sellers or landlords of known mold-related conditions as part of a real estate transaction (see Section II.C.1, page 39);
  - requirement for "right to cure" clauses in construction contract language that provide contractors an opportunity to correct construction defects in a timely manner to avoid litigation (see Section II.C.1, page 39);
  - requirement for mediation in landlord-tenant mold/moisture-related disputes to avoid litigation (e.g., as recommended by the Maine mold task force, see Section II.C.5, page 57); and
  - a process that would quickly resolve how building remediation is to be paid could help prevent delays that can allow water damage to lead to significant mold problems. State insurance laws or regulations could be reviewed for opportunities to improve the timeliness of response to moisture problems in buildings.

D. Mold exposure limits

Section 1384 requires the Task Force to "assess the latest scientific data on exposure limits to mold in indoor environments." Several Task Force members gave presentations that considered aspects of this charge (see supplemental material on CD). Additional information was obtained from published research and other expert panel or advisory committee reports that have addressed this issue.

1. Existing exposure limits

Section 1384 does not define mold exposure limits or what level of health protection they should provide. Exposure limits can be developed for different potential exposure scenarios (e.g., single exposure or long-term repeated exposure), different environmental media (e.g., air or food) and different populations (e.g., workers in a specific industry or the general public). These differences can result in different limits for the same agent under different circumstances. For example, limits intended to protect workers from short-term, high-level chemical exposures that

could be immediately life-threatening can be hundreds or thousands of times higher than corresponding workplace limits intended to protect workers from effects associated with long-term repeated exposure to low levels of the same chemicals. Similarly, limits developed for workplace chemical exposures might be higher than limits developed for residential exposure to the same chemical, since residential exposure patterns could be different from workplace exposures and the general population could include individuals who are more susceptible than healthy adult workers.

Exposure limits can also differ in their legal enforceability. For example, at the federal level, the National Institute of Occupational Safety and Health (NIOSH) develops Recommended Exposure Limits (REL) for workplace chemical exposures. The Occupational Safety and Health Administration (OSHA) establishes PELs for the same chemical exposures. A REL is a non-enforceable guideline, while a PEL is a legally-enforceable workplace standard. The numerical values of many RELs and their corresponding PELs are the same. However, in some cases the REL is lower than the PEL. In this case, the REL is a recommended guideline, but is not a legally-enforceable standard, while the corresponding PEL is legally enforceable. Even among enforceable standards, the level of a standard can vary depending on the legal authority for the standard. In some cases, enforceable limits are only to be based on health risk, while in other cases, benefits of a particular chemical use or process, feasibility or costs are to be weighed against the potential health risks in establishing an enforceable standard. As a result of differing legal construction, the same health risks from an exposure could be managed by two different enforceable standards in different contexts.

Section 1384 does not address any of these factors related to setting exposure limits and only requires the Task Force to assess the latest scientific data on exposure limits. Therefore, the following discussion focuses on a general assessment of the health basis for mold exposure limits in indoor environments.

Existing chemical exposure limits for chronic, repeated exposures generally aim to identify (within a defined exposure-scenario context) an exposure level that can be experienced over a period of many years without appreciable risk of adverse health effects. For example, the US Environmental Protection Agency defines their Reference Dose (RfD) and Reference Concentration (RfC) as repeated daily exposure doses or continuous air concentrations (with uncertainty spanning perhaps an order of magnitude), respectively, exposure to which (including susceptible sub-groups in the general population) is

> "...likely to be without an appreciable risk of deleterious effects during a lifetime." (see, for example, http://www.epa.gov/ncea/iris/index.html)

Applying this concept to airborne mold[17] exposure limits would require identifying the highest concentration of a specific mold agent or indicator (such as spores, particles or cellular/chemical components) in air that people could be exposed to continuously or repeatedly without appreciable risk of adverse health effects. No health-based exposure limits of this type for indoor molds have been set by federal, state or local health agencies in the US.

In its 2005 evaluation of scientific evidence regarding PELs for molds in buildings, the California DHS (now the Department of Public Health) noted that five components were needed to establish a PEL:

- the scientific basis for the standard;[18]
- a standardized, validated field sampling or detection method;
- a standardized, validated laboratory analytical method;
- a sampling strategy; and
- a limit value.[19]

DHS concluded that sound, scientifically-based exposure limits for mold were not feasible due to limitations or data gaps in all five PEL components. Critical information gaps they identified included:

- The absence of exposure-response data to determine the types of human health problems occurring after inhalation of various concentrations of different mold spores or fragments.
- Differences in individual susceptibilities to molds due to factors such as genetics, age, nutritional status, personal habits and medical conditions.
- The existence of hundreds of mold species capable of growing indoors, each varying in its ability to produce airborne spores, allergens or toxins depending on environmental conditions.
- The lack of widely-accepted, standardized and validated field sampling methods, laboratory analysis methods and sampling strategies (i.e., where, when, what and how frequently to sample) to characterize building conditions for molds.

Published reports from Texas (TX RCC, 2005), the IOM (2004) expert panel, NYCDHMH (2008), Health Canada (2007) and the World Health Organization (2009) have also addressed the technical feasibility of establishing mold exposure limits. All have reached similar conclusions to the DHS (2005) report that

[17] It is important to note that "mold" is not a defined, uniform substance analogous to a specific chemical compound (e.g., benzene). A single mold spore is a complex mixture of chemical components and a sample of indoor air is a mixture of many different types of mold spores plus other airborne agents. The mix of agents present in two air samples reporting the same total concentration of mold spores cannot be expected to be the same. Even two samples reporting the same concentration of one fungal species cannot be expected to contain identical allergens, toxins or other fungal products because of variability due to strain differences and differing growth conditions.

[18] Scientific documentation of the health effects associated with exposure to the agent and the quantitative dose-response relationship for those effects.

[19] The actual numerical exposure limit based on the documented relationship between exposure and health effects.

scientifically-sound, health-based quantitative mold exposure limits are not currently feasible.

2. New information available to the Task Force

Despite evidence indicating that indoor mold exposures can contribute to allergic respiratory morbidity and possibly other health problems, new data that would allow scientifically-sound, quantitative, health-based mold exposure limits to be developed were not identified. Clear evidence necessary to resolve the critical information gaps identified by DHS in 2005 was not identified. A major gap continues to be the lack of dose-response information for molds or dampness and associated health effects that is necessary to derive exposure levels expected to pose minimal health risk. Several other technical obstacles related to evaluating mold exposures were identified and are briefly summarized below.

Although the presence of indoor mold is associated in many studies with respiratory effects such as cough or asthma exacerbation (see Section II.A, page 21), a single causative agent is not clearly identified from these studies. Many studies suggest fungal allergens are probably important exposure agents. However, mold growth in damp buildings almost always involves multiple fungal species, many of which may produce multiple allergen proteins that vary in their ability to cause allergic reactions. Furthermore, the allergenicity of many fungal species that can occur in wet buildings has not been studied, so that focusing on one or a few well-characterized fungal allergens will not adequately describe exposure (and therefore health risks) in many cases.[20]

It is also common to detect many fungi that are, at least initially, unidentifiable in indoor air samples. For example, an extensive air-sampling survey of homes in Central New York found almost one-third of initial fungal isolates were categorized as unknown (Rosenbaum et al., 2005, 2009). This was the most common single category among initial isolate identifications. Extensive follow-up laboratory work can characterize many of these initially unknown isolates, and can also detect slow-growing species that are commonly outcompeted in culture samples by fast-growing isolates (e.g., Catranis et al., 2006).[21] However these follow-up analyses are complex, labor-intensive research methods and are not typical of damp building

[20] Even when narrowly-defined fungal groups (e.g., genus) can be identified as dominant in mold samples, this does not necessarily give precise information about allergen exposure. For instance, air sampling results often report concentrations for *Penicillium* or *Aspergillus* without identifying the species detected. There are approximately 100 *Penicillium* species and 200 *Aspergillus* species. Not all species within a genus are the same in terms of their allergens, so grouping these species together as total counts for each genus does not adequately characterize relevant allergen exposure either qualitatively or quantitatively. Furthermore, individual species can have different strains that vary substantially in their allergen production, and allergen production can vary depending on the growth conditions. For example, one well-studied allergenic fungal species, *Alternaria alternata*, has over 50 recognized strains that can vary in their allergen content.

[21] Partial results of the Central NY survey study reported a total of 14,552 fungal isolates observed on 11,629 voucher slides that were obtained from four Anderson impactor air samples (three indoor, one outdoor) collected from each of 130 homes (i.e., 520 air samples).

investigations. Also, having more precise species identifications would not significantly change remediation best practices.[22]

Aside from fungal allergens, other fungal products may also be present in damp environments (e.g., glucans, extracellular polysaccharides, volatile organic compounds, mycotoxins; see, for instance Hope and Simon, 2007), along with numerous other agents that can contribute to similar health effects (e.g., animal allergens from dust mites, cockroaches, cats, dogs or rodents; pollen; bacteria; bacterial endotoxin or chemicals off-gassing from building materials). Epidemiological studies have rarely been able to pinpoint the single agent or mix of agents from among this complex mixture that is the primary factor associated with adverse health effects. Crude mold or dampness exposure metrics (e.g., dampness, presence of mold growth, airborne spore counts) in these studies nearly always constitute an imprecise surrogate for the specific (and usually unknown) agent causing health effects. In the NORDAMP and EUROEXPO expert panel reviews, Bornehag et al. (2001, 2004) noted that the reviewed studies clearly supported associations between building dampness and respiratory health effects, but results became much more equivocal when only studies that attempted to more precisely define exposures to specific agents in damp buildings were considered.

In addition to any adverse effects they might contribute to directly, fungal products such as glucans or mycotoxins and other agents (e.g., VOCs, animal allergens) may also act to modify immune responses and, as a result, modify responses to fungal or other allergens (e.g., Jarvis and Miller, 2005). The World Health Organization (WHO) guideline on indoor dampness and mold (2009) noted that mechanistic data from laboratory studies suggest complex interactions are possible among multiple microbial agents affecting different cellular or tissue responses such as inflammation, cytotoxicity and immune suppression, and that these interactions could give rise to unexpected responses in people exposed to such mixtures. This may be one factor making it difficult to detect specific exposures as causally-related to building-associated health effects.

Another major obstacle to establishing health-based, quantitative exposure limits is that no single mold sampling method provides complete information to characterize indoor mold exposure. Inhalation would be the relevant exposure route to assess the risk of respiratory health effects from molds in buildings, and air sampling should provide more directly relevant exposure information for inhalation effects than surface sampling methods. However, two major air sampling approaches commonly used to measure airborne indoor molds (viable sampling and total count sampling)

[22] Even if such research methods were to precisely identify a fungal species or strain associated with adverse health effects and were made cost effective, the practical impact on the approach to building assessment and remediation would probably be minimal. Whether or not a specific type of mold is present should not change the basic remediation approach of removing or cleaning all moldy material after correcting the source of dampness or water intrusion. In other words, the absence of a certain type of mold known to cause health problems would not be a reasonable rationale for leaving visible mold growth unremediated.

both only provide partial information about species present.[23] Molecular (e.g., DNA-based) analysis methods (e.g., Fierer et al., 2008; Vesper et al., 2007) could potentially improve information obtained from air sampling by making species identifications in samples more complete.[24] However, these techniques are currently still primarily research tools and very costly.

An important limitation of mold-spore air sampling is that it generally only characterizes short exposure "snap-shots" of usually less than one hour. Studies have demonstrated that disturbance of settled dust by human activities can cause substantial changes in fungal-spore air levels on these short time scales (e.g., Buttner & Stetzenbach, 1993; Chew et al., 2006; Lehtonen et al., 1993). This brings into question the reliability of a single, short-term grab sample result (often seen in consultant reports to characterize individual rooms in a building, or the entire building in some cases) for comparison with an exposure limit value. WHO (2009) cites one published estimate that 27 – 36 viable-count samples would be needed per house to limit statistical bias to 10 percent when estimating average exposure in epidemiology studies. This level of assessment effort is rare in typical residential mold investigations and would increase costs for residential mold remediation substantially.

Results from surface samples such as swabs, wipes, tape lifts or bulk samples can describe mold species present and the spatial distribution of growth in a building, but do not characterize airborne exposure levels experienced by building occupants.

3. Building clearance limits

Clearance sampling is commonly used by private mold remediation consultants in an effort to assess whether remediation efforts were adequate. Mold assessment reports from building investigations where the NYSDOH was requested to provide technical review or assistance were reviewed to determine if there were any common approaches to building clearance among these reports (thumbnail report descriptions are provided in Appendix H).

The reports demonstrate a lack of consistency in clearance criteria employed by private consultants evaluating mold-related indoor air quality complaints. While the

[23] Total count methods detect nearly all airborne particles (including cell fragments that may still be allergenic or carry mycotoxin) in the size range that includes fungal spores, but require highly trained expert judgment to identify captured particles, and still often can only categorize the particles at a high (non-specific) level of identification (for example, mushroom spores of many different species are virtually indistinguishable and are generally only identified collectively as 'basidiospores.' Viable counts depend on the growth of captured particles deposited on a growth medium. Many fungal species simply do not grow on typical culture media and the limited range of species that can be detected varies depending on the growth medium chosen. Evidence also suggests that fast-growing species often outcompete and, therefore, mask the presence of slower-growing species in these air samples. This approach is also time-consuming and labor-intensive, especially if complete identifications are made for the isolates that can grow on the selected medium.

[24] Uncertainty can still exist with these methods, depending on how they are employed, because detection of isolated DNA sequences does not necessarily infer the presence of particular allergens, cell-wall components, mycotoxins or other products. Conversely, cell-wall fragments containing agents such as allergens but without DNA would not be detected.

basis for these clearance limits is not always clearly stated, they are generally not intended to be based on health risk, and are sometimes presented as representing 'reference' or 'acceptable' indoor conditions that should be attained after mold remediation. A basis sometimes stated is the recommendation in several mold assessment and remediation guidelines that indoor mold levels should be similar to or less than corresponding outdoor levels with a similar species mix. In other cases, a fixed numerical cutoff value is invoked as a clearance criterion. Most consultant reports note that regulatory clearance limits or health comparison values for mold levels in buildings are not available.

Empirical evidence from studies surveying molds in buildings suggests characterizing "normal" or "typical" indoor mold levels in buildings based on air or dust sampling is a complex technical problem potentially affected by many variables such as climate, season, type of building, sampling method and analytical method (e.g., Anagnost 2008; Baxter et al., 2005; Gots et al., 2003; Horner et al., 2004; Lee et al., 2006; Light, 2005; Macher, 2001; Shelton et al., 2002). In some published surveys, airborne fungal spore concentrations correlate with the presence of water damage and mold growth in buildings (e.g., Baxter et al., 2005; Ren et al., 1999), but not in others (e.g., Foto et al., 2005; Miller et al., 2000). Indoor-to-outdoor ratios for different fungal categories tend toward values less than one in buildings without water and mold-growth problems, but this is not a universal observation, and daily variation in this ratio can be high in buildings unaffected by water or mold problems (e.g., LeBouf et al., 2008). A presentation at the Task Force public meeting in April 2008 showed that indoor/outdoor ratios from a survey of homes in central New York averaged less than one during the summer, but greater than one during the winter, largely due to very low outdoor mold levels that are common in winter (Anagnost, 2008). Some authors have concluded that shifts in the relative proportions of certain types of fungi in indoor samples compared to outdoor is a better indicator of the presence of indoor mold growth than absolute spore counts (e.g., Horner et al., 2004). However, all of these survey results suggest tendencies toward certain relationships between building conditions and sampling results, rather than precise interpretations about meeting a specific numerical value.

For example, data suggest dust samples from houses without mold problems tend to have higher proportions of leaf surface fungi, while higher proportions of soil fungi occur in dust samples from houses with water and mold problems. In a sampling survey of 50 homes, Horner et al. (2004) concluded that settled dust samples dominated by soil fungi are "atypical" in non-problem homes and suggest that dust samples from buildings without a moisture or mold problem should have a mold species composition dominated by leaf surface fungi. However, 15 percent of their dust samples from non-problem homes were dominated by soil fungi. If dust samples dominated by soil fungi were considered an indicator of water or mold problems in a house, this would imply a false-positive rate (i.e., interpreting results as showing the building is contaminated when it is not) for that clearance criterion of 15 percent from their sample of non-problem homes. At a false-positive rate of 15

percent, about one of every 7 non-problem homes tested using this clearance criterion would "fail." Other possible clearance criteria based on trends in mold spore counts, indoor/outdoor ratios or species composition would be subject to similar problems when trying to implement them as bright-line (i.e., accept/reject or pass/fail) cutoffs for building clearance.

If a simple, objective pass/fail criterion is not sufficiently predictive of actual mold conditions in a building to avoid frequent false positives and false negatives (i.e., failing to detect building contamination that is actually present) when making clearance decisions, some degree of subjective judgment would have to be employed in interpreting sampling results. A recent study demonstrated that clearance decisions based on professional judgement applied to mold air sampling data varied substantially among a group of 18 indoor-air quality practitioners evaluating 30 separate data sets (Johnson et al, 2008).

The inherent subjectivity in the interpretation of mold spore sampling data from buildings was acknowledged by one member of the public at the September 2008 Task Force meeting held in NYC (see supplemental material CD). This speaker operated an environmental microbiology laboratory business and expressed the opinion that, although interpreting mold-sampling results was inherently subjective, it was acceptable to rely on such expert judgment when using sampling for decision making such as building clearance or re-entry. It may be possible for individuals to develop such judgment through experience, and, as a result, make effective use of some types of mold sampling as a supplement to other assessment methods. However, it would probably not be possible to implement a regulatory scheme for building clearance based on subjective judgment that would not be open to criticism as being arbitrary.

4. Conclusions and recommendations – exposure limits

Conclusions:

- The development of reliable, health-based quantitative mold exposure limits is not currently feasible due to a number of technical challenges. Many other recent state, federal and international expert panel reports have reached similar conclusions on this issue.
- The technical challenges to the development of reliable quantitative exposure limits for building clearance do not preclude the use of qualitative clearance guidance for water damage and mold remediation. Qualitative guidance focuses on correcting water problems that cause indoor mold growth and cleaning or removing sources of overabundant mold growth on building surfaces and furnishings regardless of the type of mold.
- Narrative guidance exists for qualitative assessment during and post-remediation that can document successful work to abate moisture problems and any associated mold growth in buildings. For example, AIHA (2001) recommends documenting successful intervention in the moisture source, containment,

cleaning or removal of contaminated materials and final surface dust cleaning. The NYCDHMH guidelines (2008 update) provide a similar checklist of quality assurance indicators and states as the final criterion for all levels of remediation work that "all areas should be left dry and visibly free from mold, dust, and debris." A similar visual assessment tool for building dampness and mold conditions is currently being developed by the National Institute of Occupational Safety and Health (NIOSH, 2010).

Recommended actions:

- DOH and NYSDOS should work together to promote the use of qualitative building assessment and clearance checklists or similar qualitative guidance such as the NYCDHMH quality assurance indicators.
- DOH should continue to follow the scientific literature and regulations, and provide guidance if quantitative exposure limits become useful in the future.
- DOH should continue to emphasize in its public education materials that clearance sampling for airborne mold is unlikely to provide reliable information for decision-making in damp or moldy buildings.

Feasibility:

- DOH has promoted qualitative approaches to building assessment and can continue to stay abreast of useful assessment approaches such as the NYCDHMH quality assurance guidelines.
- DOH routinely reviews the scientific literature on mold and will share information about quantitative exposure limits as it becomes available.

E. Methods to control and mitigate mold

Section 1384 requires the committee to "determine methods for the control of mold in a cost-effective and environmentally sound manner and identify measures to mitigate mold." The scope of this task was taken to refer to both prevention and remediation of indoor mold problems. The Task Force focused on assessing available information on prevention and remediation methods, including any published information evaluating exposure-reduction effectiveness.

1. Prevention

In public health, prevention of exposures and adverse health impacts is generally a preferable goal to mitigating exposures after health impacts have occurred. As noted in the introduction, airborne mold spores in outdoor air are unavoidable. Since air moves between the outdoors and indoors in buildings, movement of outdoor airborne spores to indoor environments is also usually unavoidable without elaborate building systems to isolate rooms from ambient air. However, prevention of mold growth indoors is feasible by focusing on the underlying cause of indoor mold problems, which is indoor dampness. The IOM (2004) Damp Indoor Spaces and Health report includes the following recommendation:

> "Homes and other buildings should be designed, operated, and maintained to prevent water intrusion and excessive moisture accumulation when possible. When water intrusion or moisture accumulation is discovered, the sources should be identified and eliminated as soon as practicable to reduce the possibility of problematic microbial growth and building-material degradation."

As discussed in Section II.C.2 (page 40), building codes already contain many elements intended to prevent indoor dampness problems. Construction and building design elements in existing codes are intended to: prevent water damage to building materials during construction; prevent water intrusions from outdoors; prevent conditions that promote leaks or condensation indoors; and enhance water resistance of building materials used in certain situations. Property maintenance elements in existing codes are intended to prevent adverse consequences of water intrusions and other dampness sources by encouraging appropriate and timely responses to maintenance problems.

Several areas were discussed where building code changes could improve prevention of building dampness problems (see Section II.C.6.a, page 59). One emerging area is requiring the use, in particular circumstances, of water-resistant or mold-resistant materials that would not promote mold growth when wet. For example, gypsum wallboard products are now available that do not contain cellulose-based paper facing. The Task Force received input from some industry representatives suggesting this type of wallboard should be required in the construction codes for situations where dampness problems are common (e.g., below-grade finished basements, bathrooms).

2. Remediation methods

As described in Section II.C (page 39), many states, cooperative extension services and private organizations have developed general mold remediation guidance for residential settings. More detailed mold remediation guidance documents have been developed by several government agencies or technical associations.[25] The IOM (2004) report summarized seven written guidance documents that address aspects of the assessment and remediation of water damage and mold growth in buildings (IOM, 2004, Table 6-1). The IOM committee found the seven documents agreed on the following general conclusions:

- Molds should not be allowed to colonize materials and furnishings in buildings.
- The underlying moisture condition supporting mold growth should be identified and eliminated.
- The best way to remediate problematic mold growth is to remove it from materials that can be effectively cleaned and to discard materials that cannot be cleaned or are physically damaged beyond use.

[25] New York City Department of Health and Mental Hygiene (1993 with revisions in 2000 and 2008); US Environmental Protection Agency; Health Canada; American Industrial Hygiene Association; American Conference of Governmental and Industrial Hygienists; International Society of Indoor Air and Climate.

- Occupants and workers must be protected from dampness-related contaminants during remediation.

Since the publication of the IOM damp indoor spaces report, other formal assessment and remediation guidance documents have been published, including the American Society for Testing and Materials (ASTM) E-2418-06 *Standard Guide for Readily Observable Mold and Conditions Conducive to Mold in Commercial Buildings: Baseline Survey Process*; and the Institute for Inspection, Cleaning and Restoration Certification (IICRC) S500 *Standard and Reference Guide for Professional Water Damage Restoration* and S520 *Standard and Reference Guide for Mold Remediation.* S500 and S520 are American National Standards Institute (ANSI) endorsed procedural standards. The NYCDHMH *Guidelines on Assessment and Remediation of Fungi in Indoor Environments* was also revised (NYCDHMH, 2008). The NYCDHMH and the two IICRC standards are generally consistent in philosophy with the four conclusions quoted above from the IOM review of the earlier guidance documents. The ASTM standard only relates to conducting baseline building surveys that identify water and mold problems by visual inspection, but is consistent in philosophy with the first two conclusions above.

Prior to the IOM (2004) report, published documentation evaluating the effectiveness of mold remediation practices was sparse. Several reports have been published since the IOM report evaluating the effects of remediation interventions on building materials, on mold exposure levels or occupant health status in homes, schools and commercial buildings. Because this is a relatively new area of emerging scientific investigation, it is reviewed in some detail in this section.

a) Laboratory studies

Cleaning with detergents and surface disinfection (primarily with bleach, but other disinfectants for mold are available) are frequently recommended methods for removing mold from building materials. However, little research has been done to compare the two methods. Also, research on the use of bleach alone on building materials has produced inconsistent results. Martyny et al. (2005) showed that bleach (sodium hypochlorite) solutions sprayed onto a mold contaminated oriented-strand board (OSB) modified the spore-producing surface of *Aspergillus fumigatus*. Both diluted bleach and Tilex™, a bleach based product, inhibited recognition of *A. fumigatus* antigens from extracts of the treated OSB materials in a standard antigen measurement test. In human testing, eight individuals had an initial positive reaction to *A. fumigatus*, but only four tested positive to extracts from water-treated moldy OSB in a skin prick test, also suggesting a loss of antigen activity. Of these four positive results, only one person tested positive to moldy OSB treated with bleach, and two people tested positive to the moldy OSB treated with Tilex™, indicating a reduction in allergenicity after treating mold with these hypochlorite solutions.

Wilson et al. (2004) evaluated three techniques for cleaning and disinfecting typical home materials including paper, cloth and wood. Treatment with a solution containing two percent sodium hypochlorite and two percent of a commercial detergent was effective in either inactivating or eliminating *Stachybotrys chartarum*, *Penicillium chrysogenum*, and *Aspergillus niger* spores from all of the materials. The bleach and detergent treatment also reduced the number of spores of *Chaetomium globosum* on wood and cloth, but the number of spores increased on paper. The treatment removed two macrocyclic trichothecene mycotoxins (roridin A and verrucarin A) and one simple trichothecene (T-2) from cloth and paper, but not carpet or untreated wood. A gamma irradiation technique inactivated all of the spores, but did not reduce the mycotoxin levels. Steam cleaning only reduced the number of spores of *S. chartarum* and *C. globosum* on wood. This study was also small in scope, consisting of nine samples and five controls. These results suggest that the performance of surface treatments for molds on porous materials is variable and complex, depending on the surface type, the treatment and the microbial agent on the surface.

Krause et al. (2006) investigated the effectiveness of disinfecting gypsum wallboard with bleach. One panel was sprayed with a bleach solution containing 6 percent sodium hypochlorite and wiped with paper towels, and another panel was treated with a 6–7 percent sodium hypochlorite solution plus detergent. These two inoculated panels contained very few mold spores or hyphae immediately after treatment. Vacuuming after cleaning also slightly reduced the spore counts. A brushing technique used to clean one panel containing mold growth was found to be ineffective. This study also evaluated spore growth over an eight-week period and found different mold species varied in their timing of appearance on wet wallboards. The authors identified hyphae without spores after two weeks and other species appearing from week three to week eight on wet panels. Their observations suggest the often recommended 24–48 hour maximum limit for drying out wet building materials to avoid mold contamination (e.g., EPA, CDC, OSHA mold guidance documents) might be too short, but more detailed study would be needed to better define this time limit.

Krause et al. (2006) also presented data comparing the ability of three surface treatment products (two borate products and one titanium-dioxide plus glycol product) to prevent mold growth on new gypsum wallboard panels that were suspended vertically with one edge in a tray of water. Wallboard panels pre-treated with one of the borates and with the titanium-dioxide/glycol product showed no mold growth for the full length of the 10-week experiment. In contrast, wallboard panels treated with the other borate product and the untreated control panels become colonized with mold growth after four to five weeks. Likewise, Menetrez et al. (2008) reported no mold re-growth for up to 180 days for several encapsulant paint products that were applied after cleaning mold-contaminated wallboard. These results are intriguing, but do not address whether pre-treating wallboard or other

building materials could prevent mold contamination for longer periods of time (i.e., years) that would be relevant in buildings.

Menetrez et al. (2007) also investigated the ability of different cleaner or disinfectant products to prevent re-growth of *Stachybotrys chartarum* on different types of gypsum wallboard after surface cleaning. Of 13 treatments tested on each of 6 different wallboard surfaces, borax and two commercial cleaners (one containing alcohol ethoxylates and quaternary ammonium compounds and one containing d-limonene and glycol ethers) performed the best, preventing regrowth for up to 180 days on most surfaces. Three products containing bleach did not perform as well, with some re-growth after 180 days on most types of wallboard.

Price and Ahearn (1999) investigated the efficacy of different sanitizer treatments on gypsum wallboard colonized with *S. chartarum*. The treatments included using a quaternary ammonium solution, a quaternary ammonium and chlorine dioxide solution and an oxygen-saline solution. The quaternary ammonium solution was least effective in preventing reemergence of *S. chartarum*, which occurred after five weeks. After 9-12 weeks, other fungi including species of *Aspergillus*, *Chaetomium* and *Penicillium* colonized both uninoculated (control) wallboard and most treated surfaces. The wallboard treated with a quaternary sanitizing treatment coupled with an acrylic antimicrobial coating was most effective for inhibiting regrowth of *S. chartarum*. Post-treatment growth was not visible on this wallboard until after 90 days of high humidity conditions.

Nickmilder et al. (2007) surveyed 234 children for allergic and respiratory disease measures in relation to the use of chlorine bleach as part of house cleaning. The authors found statistically significant lower prevalence of asthma, eczema and sensitization to indoor aeroallergens among children from households that used bleach compared to the non-bleach households. The authors suggest that use of chlorine bleach as a household cleaner offers a protective effect for these health effects. In contrast, there was an increased prevalence of recurrent bronchitis among children in households that used bleach and where at least one parent smoked. Recurrent colds and hay fever also tended to be more prevalent among children from bleach households, but the trends were not statistically significant. It is possible that the results reflect a prior decision by families of children with asthma or eczema to avoid use of bleach, rather than use of bleach protecting from these diseases. The authors did not consider that hypothesis for their results.

The variety of fungi that may proliferate inside a building, the variety of building materials that can be involved and the variety of building environmental conditions can all make it difficult to identify a single successful approach to application of disinfectants for mold remediation. Some of the lab studies reviewed here suggest that a few types of products showed success preventing mold growth or re-growth on building materials such as gypsum wallboard for a period of several months. Borate-based products seemed to be more consistently effective at preventing

growth or re-growth on wallboard for extended periods compared to other types of products, but this was not true for every borate product tested. Fungal spore production may be inhibited by solutions containing sodium hypochlorite and these solutions may produce a short-term decrease in allergic symptoms, but long-term reduction in symptoms has not been shown. Prevention of fungal re-growth under damp conditions has also not been demonstrated. The limited scope of the studies reviewed – especially the limited time periods studied (up to six months) – indicates a need for more representative investigations of real-world uses of disinfectants and detergents in mold remediation and prevention.

b) Remediation studies in water-damaged buildings

Four studies evaluated the effectiveness of remediation protocols in buildings where water damage and visible mold growth were present by assessing levels of molds or mold-related materials before and after remediation work. Remediation protocols in three of the studies (Barnes et al., 2007; Chew et al., 2006; Huttunen et al., 2008) included: identifying and correcting water or dampness sources; some combination of surface cleaning, surface disinfection and tear-out/replacement of mold-contaminated building materials; and drying the remaining building interior prior to reconstruction. One study evaluated whole-building fumigation with a gaseous disinfectant (chlorine dioxide) without any other surface treatments or removal of contaminated building materials (Clark Burton et al., 2008).

Seventeen homes that underwent "professional remediation" in the Kansas City area were evaluated by measuring total airborne fungal spore counts and spore counts for specific fungal genera indoors and outdoors before and after remediation (Barnes et al., 2007). The median total spore count decreased about 10-fold after remediation, compared to before remediation, and the median indoor/outdoor spore ratio trend was similar. Although the overall trend showed a decrease in mold levels, total spore counts and counts of *Pencillium*/*Aspergillus* spores were unchanged or increased in 3 of 17 and 2 of 17 homes, respectively.

Three houses flooded during Hurricane Katrina underwent water damage and mold remediation as a demonstration project (Chew et al., 2006). Indoor and outdoor air samples were collected before, during and after remediation. Fungal levels were measured as total spore counts, culturable fungal counts (i.e., colony-forming units or CFU) and polymerase chain-reaction (PCR) spore equivalents, and airborne bacterial endotoxin was also measured. Comparing pre-remediation to post-remediation results, PCR counts decreased in all three homes, and total CFU decreased in two of the homes while remaining unchanged in the third. Most decreases varied between one and two orders of magnitude. Only one home had pre- and post-remediation total spore count samples collected; levels decreased about four-fold. Pre- and post-remediation outdoor levels for each fungal measure were approximately unchanged, suggesting observed differences were attributable to

the intervention. Endotoxin levels decreased about 10-fold in 2 homes, but increased almost 10-fold in the third home.

A school and an unspecified commercial building that had moisture problems and visible mold growth were evaluated by air sampling for several fungal measures (total spore counts, PCR counts and ergosterol, a chemical marker of fungal cell membranes) as well as total airborne particle counts before and after remediation (Huttunen et al., 2008). Samples were also analyzed for their ability to elicit production of inflammatory chemical markers in a cell-culture bioassay. Comparisons were made between pre- and post-remediation results as well as between the intervention buildings and matched reference comparison buildings without water damage. In the school building, fungal measures were generally unchanged comparing pre- vs. post-remediation and intervention vs. reference building. Ergosterol increased, while total particle counts decreased in the intervention building. However, the ability of samples from the school to elicit inflammatory markers was significantly decreased from the pre- to the post-remediation samples, with post-remediation levels similar to the reference building levels. Results from the commercial building were somewhat opposite those from the school, with increases in total fungal counts post-remediation and no change in ergosterol, particle counts or inflammatory markers. Total PCR fungal counts did not change pre- vs. post-remediation and were higher than corresponding outdoor levels at the school, but decreased to below corresponding outdoor levels at the commercial building after remediation.

Clark Burton et al. (2008) evaluated the effectiveness of a whole-building fumigation method for mold mitigation. The method involves sealing the building exterior with a tent and pumping in chlorine dioxide gas which acts as a biocide. An abandoned house in upstate New York that had significant indoor mold growth was used as a pilot test of this procedure. Because this mitigation did not include complete removal of the mold-contaminated materials, it did not adhere to conventional remediation guidance and is not directly comparable with most other remediation studies reviewed here. Comparing pre- and post-remediation air samples from this mitigation test showed 7- to 30-fold decreases in levels of airborne fungi and bacteria using several different measurement methods. Interestingly, airborne β-glucan (a fungal cell-wall component) was increased post-treatment about five-fold. Also, surface tape-lifts showed fungal remnants were still present on surfaces in the home.

Eight studies (Åhman et al., 2000; Ebbehøj et al., 2002; Haverinen-Shaughnessy et al., 2008; Jarvis & Morey, 2001; Meklin et al., 2002, 2005; Patrovirta et al., 2004; Rudblad et al., 2002; Savilahti et al., 2000) report results from building mold remediation efforts similar to the building remediation studies summarized above, except that some type of health assessment of the building occupants was conducted along with the building assessment. These studies compared a single snap-shot in time of occupant health status before and after the remediation. All eight studies

employed the general renovation strategy of fixing water intrusions and cleaning or replacing any wet or moldy building materials, although the degree of renovation described in the papers varies. In some cases, renovations were accompanied by changes to the building ventilation system. Seven of the eight interventions took place in Finland or Sweden. The eighth was located in the southeastern United States. Among the eight studies, the subject buildings included nine schools, three office buildings (one included attached athletic facilities), three health-care facilities and a group of row houses. Building evaluations were similar to the building remediation studies above, primarily comparing before and after air sampling results and visual inspection. Before vs. after samples from a reference location were included in some cases. Health assessments were primarily based on self-reported symptoms and responses to health questionnaires that were focused on respiratory outcomes, but also included other symptoms such as neurological (headache, fatigue, concentration) and skin. Objective clinical measurements of nasal and lung function, blood biomarkers and clinical exam observations were collected in some of the studies. Seven studies report fairly detailed results from one building or, in two cases, three buildings. One report (Haverinen-Shaughnessey et al., 2008) summarizes case studies from seven separate building investigations conducted following a standardized protocol, but provides less detailed results for each building.

An abbreviated summary of the results from the eight published reports is presented in Table 6. A total of 17 buildings was assessed in the 8 studies (including 1 combining an office building with athletic facilities in an attached building). Seven of the 17 were assessed for changes in general indoor air quality parameters (such as temperature, relative humidity, ventilation, air movement, surface moisture, visual observations). Of these, improvement on several parameters was found in four, and partial improvement in the other three. Bioaerosol assessment (including measures of fungi, bacteria and visual detection of any microbial growth) was reported for 12 of 17 buildings, with half of those (6) showing improvement post-intervention in several parameters and only partial or no improvement reported for the other 6.

Health assessments were reported for each of the 17 buildings, but teacher health reports were combined in one study of 3 schools (student health reports for one of those schools were reported separately in another publication). For the study combining teacher assessments from three schools, self-reported health assessments were reported separately for nervous-system symptoms and respiratory symptoms, and no objective or clinical evaluation is reported for those schools. Therefore, 16 self-reported or questionnaire health assessments and 15 clinical assessments are possible.

Two reports did not include any health assessment based on self-reported information. Of the remaining 14 health assessments based on self-reported symptoms or questionnaire results, 5 reported post-remediation improvement on several health parameters or symptoms and another 5 reported either partial or no

improvement among the parameters assessed. The remaining four assessments showed decreases in symptom frequency in the intervention occupants comparing post-intervention to baseline health status, but symptom frequency was still higher than for a control group. Most of these studies did not report any health assessment based on clinical examination or objective laboratory measurements (11 of 15). Of the four where some objective measures where reported, two reported post-intervention improvement in multiple parameters, one reported no improvement and one reported similar changes relative to baseline in the intervention and control groups.

Three additional studies randomly assigned homes to either an intervention treatment or a control (non- or sham-treatment) group and assessed changes in building conditions and occupant health over time, comparing changes post-treatment to baseline, and comparing changes between the treatment and control groups (Table 7). This is a potentially more powerful study design for evaluating the effect of interventions compared to the studies described above. Randomization helps control for confounding effects of extraneous variables (e.g., building age, lifestyle factors) and makes interpretation of the actual effect of the intervention clearer. Collecting data prospectively over time also provides more information about the long-term effectiveness of the intervention.

In two studies, asthma patients with visible evidence of mold growth in their homes were recruited (Burr et al., 2007; Kercsmar et al., 2006). In the third (Howden-Chapman et al., 2007), patients with current respiratory symptoms living in uninsulated homes in a moderate temperate climate (New Zealand) were recruited. The Kercsmar intervention study included reducing water infiltration, removal of water-damaged or moldy materials, improvement in ventilation, lead hazard control and focused indoor cleaning. The Burr intervention was similar, except that all visible mold removal was done through a surface cleaning/disinfectant treatment and application of surface fungicide treatment. Ventilation was also improved through installation of an attic fan. The Howden-Chapman intervention did not specifically address visible mold, but was focused on insulating ceilings, weatherproofing doors and creating a vapor barrier between the ground and the house.

Table 6. Abbreviated summary of non-randomized building remediation studies that include an occupant health-assessment component. Studies included some form of pre- and post-remediation health assessment of occupants (usually by single questionnaire) and, in some cases, included pre- and post-remediation environmental assessment. Health comparisons were made between baseline (pre-remediation) and post-remediation and, in some cases, also between post-remediation and responses from occupants in control buildings without water/mold problems.

Building type	Population N		Exposure Results[a]		Health Results[a]		
	Exposed	Control	General IAQ	Bioaerosols	Self-reports	Objective/ Clinical	Reference
school	303 children	175 children	NA	++	+/-	+/-	Savilahti et al., 2000
school	44 adults	29 adults	NA	NA	+/-	NA	Ahman et al., 2000
school	460 children	301 children	NA	NA	+/-	NA	
school	408 children	296 children/ 238 children[b]	NA	++	++	NA	Meklin et al., 2002; Meklin et al., 2005
school	28 adults	18 adults	++	NA	+/-	--	Rudblad et al., 2002
school (3) (health results merged)	56 adults	none	NA	++	++ (headache/ fatigue) -- (respiratory)	NA	Patrovirta et al., 2004
			NA	++			
			NA	--			
office + pool	25 adults	none	NA	+	++	++	Ebbehøj et al., 2002
office	461 adults	242 (118[c]) adults	NA	++	++	NA	Jarvis & Morey, 2001
health clinic	summary of seven case-studies did not include occupant details	summary of seven case-studies did not include occupant details	NA	NA	++	NA	Haverinen-Shaughnessy et al., 2008
lab/office			++	++	low response	#	
school			+	--	--	NA	
university			++	+	--	#	
nursing home			++	+	+	NA	
hospital ward			+	+	low response	#	
row houses			+	NA	+	#	

[a] ++ = improvement on several parameters; + = partial improvement; +/- = improvement vs. baseline but not vs. control; -- = no improvement; NA = not available or not reported; IAQ = indoor air quality; # = clinical or laboratory performed on an as-needed basis, but results not reported.

[b] the comparison school (N=296) in Meklin et al. (2002) appears to also be reported as a partially renovated school in Meklin et al. (2005) and results for an additional reference school (N=238) are reported in the 2005 study.

[c] a second comparison group was included comprised of former occupants of the subject building who had moved to another (unaffected) building

Table 7. Summary of residential intervention studies for patients with asthma (Kercsmar et al., 2006, Burr et al., 2007) or any respiratory symptoms (Howden-Chapman et al., 2007) using randomized assignment to intervention or control group. Health comparisons were pre- vs. post-remediation for intervention and control groups and comparison of net change between intervention and control groups.

Primary Interventions (Treatment N) (Control N)	**Exposure Results**	**Health Results[a]**		**Reference**
		Self-reports	**Objective/Clinical**	
- control water - remove moldy materials - correct heating, ventilation & exhaust systems - cleaning (29 children) (33 children)	observed net improvement for intervention: visible mold score no net improvement observed for intervention: dustborne spore levels endotoxin 6 allergens	symptoms declined both groups NS treatment v. control	fewer acute care visits transient spirometry improvement NS CHSA[b] treatment v. control	Kercsmar et al., 2006
- cleaning - disinfectant - improve ventilation (115 adults & children) (117 adults & children)	any visible mold 12 months post intervention: 40% treatment 78% control significant groupwise decrease in absolute humidity	net improvement v. control: medication use preventer use reliever use breathing wheeze rhinitis/conjunctivitis	peak flow variability declined in both NS group differences	Burr et al., 2007
- insulation - weatherize - vapor barrier (2262 adults & children) (2145 adults & children)	self-reported improvement v. control: any mold house always cold heating ineffective 2 dampness metrics decreased energy use improved temperature & relative humidity	significant improvement: 5 well being metrics 5 respiratory symptoms lost work days lost school days physician visits	NS group differences: physician visit records hospitalizations	Howden-Chapman et al., 2007

[a] NS = not statistically significant

[b] CHSA = Children's Health Survey for Asthma

In the Kercsmar et al. (2006) study, the intervention significantly reduced visible mold in the treatment group, but other bioaerosol measures (dustborne spore levels, bacterial endotoxin and six non-fungal allergens in dust) were not changed. Self-reported days with asthma symptoms decreased in the intervention and control groups, with a weak trend toward improvement persisting in the intervention group after one year of follow-up. Treatment-group patients had fewer acute-care doctor visits and fewer emergency room visits for acute asthma exacerbations. Pulmonary function tests showed a slight improvement post-remediation in the treatment group compared to controls at 6 months, but this effect disappeared by the end of the 12 month follow-up.

Burr et al. (2007) assessed the effect of their intervention treatment on mold by visual inspection. Frequency of observing any indoor mold was less in the treatment group (40 percent) compared to the control group (78 percent). Most of the mold observed in the treatment group was new growth on surfaces previously unaffected and untreated during the intervention protocol. Only 5 of the 27 houses in the treatment group with post-intervention mold showed re-growth of mold on previously-treated surfaces. Self-reported asthma symptoms at 6 and 12 months post-intervention follow-up showed a net improvement (i.e., number reporting improvement was greater than number reporting worsening) in all categories for the treatment group and some categories for the control group. Overall, significantly greater net improvement occurred in the treatment group for measures of medication use, breathing difficulty, wheeze and rhinitis/conjunctivitis symptoms. Lung function as assessed by change in daily peak flow rate variability compared to baseline did not differ between the treatment and control groups.

Although mold remediation was not the central focus of the Howden-Chapman et al. (2008) study, about 75 percent of the homes in the study reported at least some mold present at baseline. Twelve months after the intervention aimed at reducing indoor dampness, improvements were reported more frequently in the intervention group compared to controls for presence of any mold, as well as thermal comfort, condensation and general dampness. Average temperature increased significantly in treatment vs. control homes and average relative humidity decreased significantly. Improvements in most self-reported health metrics were significantly more frequent among the treatment group compared to the controls. Five measures of respiratory symptoms were significantly improved, as well as five measures of overall well-being, two scales of social functioning, lost work days, lost school days and physician visits. Although self-reported physician visits were decreased more among the treatment group compared to the controls, the corresponding general practitioner medical records did not show this difference. Frequency of respiratory hospitalizations post intervention tended to decrease more among the treatment group, but numbers were small for both groups and differences were not significant.

c) Summary of remediation and mitigation studies

The body of scientific literature investigating environmental and health effects of building interventions for mold and dampness has grown substantially since the publication of the IOM (2004) damp indoor spaces report. Despite the increased attention to this issue, comparisons among various mold mitigation approaches are still inconclusive. Evidence from visual inspection of treated buildings generally supports actions to reduce water intrusions and dampness in buildings combined with physical removal of moldy building materials as effective for reducing or eliminating visible mold growth. The Burr et al. (2007) prospective, randomized intervention trial provides suggestive evidence that surface cleaning and disinfection, combined with building dampness reduction, also has some potential as an effective mold mitigation approach. Consistent with the Burr et al. results, some limited data from laboratory studies were found that support the possibility of disinfectant treatments that could prevent mold growth or inhibit mold re-growth after cleaning moldy building materials (e.g., Kraus et al., 2006; Menetrez et al., 2008).

Air and surface sampling to evaluate environmental conditions following building interventions tends to show reduced mold levels in many, but not all, cases. In some cases, while levels of intact organisms (i.e., bacterial cells or fungal spores) declined, levels of some chemical markers such as glucans (fungi) or endotoxin (bacteria) increased. The variability in environmental sampling results raises questions about the effects of subtle differences in remediation protocols used in the different studies such as dust control or various approaches to surface cleaning. It also raises further questions (in addition to those raised above in Section II.D, page 63) about the utility of any one type of sampling method to adequately characterize post-remediation conditions for building clearance compared to a pre-defined exposure limit.

Evaluations of mold and dampness intervention effects on occupant health tend to be more equivocal than the environmental results. Self-reported respiratory symptoms often improve among building occupants after remediation actions, but similar improvements are sometimes observed in control groups in the randomized treatment studies, or symptoms in the treatment group, although decreased, were still higher than symptoms in unaffected control groups in non-randomized studies. In general, demonstrating clinically-relevant improvement in respiratory symptoms related to environmental interventions is challenging for several reasons. Chief among these is that multiple environmental factors influence respiratory health outcomes such as asthma and rhinitis, and focus on only one agent or one control method is generally not sufficient to reduce all relevant exposures sufficiently (e.g., Morgan et al., 2004; Platts-Mills, 2003; Recer, 2004). Population-based asthma interventions have demonstrated successful clinical improvement in asthma morbidity when designed to include comprehensive, multi-factorial environmental and clinical actions tailored to each individual patient's circumstances and implemented using direct, in-home education from an intervention counselor (Evans

et al., 1999; Morgan et al., 2004). One element of such comprehensive interventions would be correcting sources of dampness and cleaning or removing moldy building materials.

3. Conclusions and recommendations – mold control and mitigation

Conclusions:

- Laboratory studies provide limited evidence that some chemical disinfectant or encapsulant treatments have utility for mitigating or preventing mold growth on building materials. These studies suggest some products (particularly those based on borate, titanium-dioxide/glycol or chlorothalonil) can prevent mold growth or re-growth on gypsum wallboard for several months. Bleach products can reduce mold growth on treated surfaces, but do not appear to be very effective at preventing longer-term re-growth. Overall, these laboratory results are not very robust, as they do not address what happens on treated surfaces after more than six months.
- Existing evidence, although limited, suggests approaches directed toward correcting moisture problems and removing mold exposure sources can help reduce occupant respiratory symptoms.
- Written mold and water-damage assessment and remediation guidelines developed by many organizations (including, but not limited to, USEPA, NYCDHMH, Enterprise Community Partners/National Center for Healthy Housing, NYSDOH and numerous other state health departments) provide practical guidance focused on identifying and repairing water damage in buildings and removing mold source materials.
- This approach to building mitigation is health protective because its goal is elimination of exposure sources. It is also less complicated to implement than mitigation based on attaining a numerical clearance criterion, since its main mitigation goal is that the building be returned to a clean and dry condition.
- If water sources are properly corrected and existing sources of mold growth are eliminated, further treatment with disinfectants may not provide significant additional value in preventing further mold growth or exposure. Disinfectants may be useful for controlling mold in certain situations, e.g., circumstances where permanently correcting dampness conditions is not feasible such as poorly ventilated bathrooms.

Recommended actions:

- State and local government agencies and professional organizations addressing building performance and indoor air quality issues should continue to emphasize these practical water-damage and mold mitigation approaches.
- The decision to use disinfectants as part of remediation will be case-specific and should take into account potential adverse effects of disinfectant exposure to applicators and building occupants.

Feasibility:

- State and local health departments and professional organizations currently emphasize assessment and remediation guidance designed to return buildings to a clean and dry condition. Any additional costs would come from expanding existing programs. This could include expanding education and outreach regarding building assessment and remediation (see Section II.C.6.b, page 60).

III. References

Note: This report cites numerous internet documents. All cited internet document addresses were active as of May, 2010.

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IV. Acknowledgements

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V. Appendices

A. Chapter 356 of the Laws of New York, 2005 (as amended by Chapter 198 of the Laws of New York, 2006)

CHAPTER TEXT:

LAWS OF NEW YORK, 2005

CHAPTER 356

AN ACT to amend the public health law, in relation to establishing the New York state toxic mold task force

Became a law August 2, 2005, with the approval of the Governor. Passed by a majority vote, three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Legislative intent. The legislature finds that certain forms of mold pose an unacceptable risk to New York state's health and environment. Moreover, the legislature finds that indoor toxins, specifically toxic mold, have been an under recognized health and environmental problem.

The legislature recognizes that numerous studies have indicated possible health effects from mold spores, varying from cold like symptoms to more serious symptoms, such as allergy and asthma outbreaks. These toxins can have negative effects on humans when ingested, inhaled, or when they come in contact with the skin. These effects can have serious consequences for some subgroups especially infants, children, pregnant women, the elderly, asthmatics, allergic individuals, and immune compromised individuals. Healthcare professionals now know that molds can cause allergies, trigger asthma attacks, detrimentally affect the function of vital human organs and increase susceptibility to colds and flu.

The legislature further recognizes that though all molds are not

toxic, there are certain dangers that molds present within buildings and structures. It is imperative that the toxicity of its presence be determined and a corresponding plan of action be taken to address such hazards in buildings and structures within the state. The legislature recognizes that it is in the best interest of the public health, welfare and safety, to establish a comprehensive, scientific study of toxic mold.

§ 2. Article 13 of the public health law is amended by adding a new title 11-A to read as follows:

TITLE XI-A

NEW YORK STATE TOXIC MOLD TASK FORCE

Section 1384. New York state toxic mold task force.

§ 1384. New York state toxic mold task force. 1. The New York state toxic mold task force is hereby established. The task force shall:

(a) assess, based on scientific evidence, the nature, scope and magnitude of the adverse environmental and health impacts caused by toxic mold in the state;

(b) measure, based on scientific evidence, the adverse health effects of exposure to molds on the general population, including specific effects on subgroups identifiable as being at greater risk of adverse health effects when exposed to molds;

(c) identify actions taken by state, and local governments, and other entities;

EXPLANATION--Matter in ***italics*** is new; matter in brackets [—] is old law to be omitted.

(d) assess the latest scientific data on exposure limits to mold in indoor environments;

(e) determine methods for the control of mold in a cost-effective and environmentally sound manner and identify measures to mitigate mold; and

(f) prepare a report to the governor and the legislature that assesses the current body of knowledge on toxic mold, provides the status of toxic mold in the state, and assesses the feasibility of any further actions to be taken by the legislature or state agencies as recommended by the task force.

2. For purpose of this title, the term "mold" shall mean any form of

multicellular fungi that live on plant or animal matter and in indoor environments. Types of mold shall include, but not be limited to, cladosporium, alternaria, aspergillus, trichoderma, memnoniella, mucor, and stachybotrys chartarum, often found in water damaged building materials.

3. The task force shall issue its findings, in the form of a report, no later than November thirtieth, two thousand six.

4. The task force shall consist of a total of fourteen members and shall include the commissioner and the secretary of state or their designees. The commissioner and the secretary of state shall select the task force's ~~eleven~~ twelve at-large members from each of the following: SUNY college of environmental science and forestry, New York Indoor Environmental Quality Center, Inc., New York city department of health and mental hygiene, NY STAR Center for Environmental Quality Systems, public health officer, environmental health officer, certified public health engineer, pediatric environmental health specialist, a person with an expertise in toxicology, a person with an expertise in mycology, a person with expertise in mold abatement from a labor organization that represents workers performing mold abatement and a person with expertise in real estate management, including building repair, renovation or rehabilitation of multi-family and single family residences.

5. The commissioner and the secretary of state or their designees shall serve as joint chairs of the task force.

6. The task force may consult with any organization, educational institution, governmental agency, or person including, but not limited to, the United States department of health and human services, the United States environmental protection agency, and the occupational safety and health administration.

7. The commissioner and the secretary of state may reconvene the task force, with the same or different members, after issuance of the report, to address any toxic mold issues.

8. The members of the task force shall serve without compensation, except that at-large members shall be allowed their necessary and actual expenses incurred in the performance of their duties under this title.

§ 3. This act shall take effect immediately.

B. New York State Toxic Mold Task Force membership and meeting agendas

Name **Member Seat**	**Affiliation**
Nancy Kim, Ph.D., Co-Chair DOH designee	Center for Environmental Health New York State Department of Health
Thomas Mahar, Co-Chair DOS designee	Division of Code Enforcement and Administration New York State Department of State
Susan Anagnost, Ph.D. SUNY ESF	SUNY College of Environmental Science and Forestry
Terry Brennan, M.S. Building Management	Camroden Associates Inc.
Ginger Chew, Sc.D. Toxicology	Columbia University
Christopher D'Andrea, M.S. NYCDHMH	New York City Department of Health and Mental Hygiene
Robert Denz, P.E. Public Health Engineer	Broome County Health Department (retired January 1, 2010)
Melanie Desiderio, M.S. Environmental Health Officer	Erie County Department of Health
Eric Faisst, M.P.H. Public Health Officer	Madison County Health Department
John Haines, Ph.D. Mycology	New York State Museum
Meyer Kattan, M.D. Pediatric Environmental Health	Columbia University Medical Center
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New York State Staff	
Gregg Recer, Ph.D.	Center for Environmental Health, Department of Health
Diana Yang, Esq.	Division of Legal Affairs, Department of Health
Ray Andrews, R.A.	Assistant Director for Code Development, Department of State

Meeting Agendas:

NYS Toxic Mold Task Force
Tuesday, December 4, 2007
New York State Nurses Association Headquarters Office
11 Cornell Rd, Latham NY
8:00 a.m. – 2:45 p.m.
Draft Agenda

Objectives

Obtain committee input on proposed report strategy
Understand current building assessment and mitigation practices
Consider whether potential alternative practices are desirable or necessary

8:30	Introductions Nancy Kim, PhD, Interim Director, Center for Environmental Health Thomas Mahar, Assistant Director, Division of Code Enforcement and Administration, Department of State
8:45	Meeting Agenda Format of Meetings Legislation and Charge to the Task Force Nancy Kim, PhD Thomas Mahar
9:15	Draft strategy for completing report followed by discussion Nancy Kim, PhD
10:00	New York City Department of Health and Mental Hygiene guidelines and practices for assessment and mitigation of mold and dampness in buildings Chris D'Andrea, Research Scientist, New York City Department of Health and Mental Hygiene
10:30	Break
10:40	Discussion – NYC guidelines and practices
11:10	Assessment of mold and dampness in buildings: range of current industry practices and standards Terry Brennan, President, Camroden Associates
11:40	Discussion – Industry practices and standards
12:00 PM	Lunch
1:00	Discussion - Assessment and mitigation of mold and dampness in buildings
2:00	Public Comment Period
2:30	Meeting wrap-up, action items Task Force Chairs
2:45	Adjourn

NYS Toxic Mold Task Force
Tuesday, April 22, 2008
NYS Nurses Association Headquarters
8:00 a.m. – 5:00 p.m.
Draft Agenda

Objectives

Understand health effects of mold exposure
Understand strengths and limitations of mold sampling methods & interpretation
Understand alternatives for setting mold exposure limits
Begin discussion of Task Force report outline

8:30	Introductions Nancy Kim, PhD, Interim Director, Center for Environmental Health Thomas Mahar, Assistant Director, Division of Code Enforcement and Administration, Department of State
8:45	Meeting Agenda
9:00	Health effects of mold exposures -- Epidemiology Ginger Chew, ScD Columbia University
9:30	Health effects of mold exposures -- Clinical Meyer Kattan, MD Columbia University Medical Center
10:00	Health effects of mold exposures – Clinical, Occupational Eckardt Johanning, MD, MSc Occupational and Environmental Life Science, Fungal Research Group Foundation, Inc.
10:30	Break
10:45	Discussion – Health effects of mold exposures
11:30	NYS Building codes relating to water and mold prevention Thomas Mahar, NYS Department of State
12:00 PM	Lunch
1:00	Mold sampling methods & interpretation John Haines, PhD, NYS Museum Emeritus Scientist
1:30	Mold sampling methods & interpretation Susan Anagnost, PhD, SUNY College of Environmental Science and Forestry
2:00	Alternatives for setting exposure limits Ginger Chew, PhD, Columbia University
2:30	Break
2:45	Discussion – Mold sampling and exposure limits
3:30	Public Comment Period
4:00	Discussion -- Task Force Report outline
5:00	Adjourn

NYS Toxic Mold Task Force
Tuesday, July 8, 2008
NYS Dept of Health Conference Room
217 Broadway
New York, NY
10:00 AM – 5:30 PM
Draft Agenda

Objectives

Understand efforts by housing and code enforcement officers to deal with mold in buildings
Understand code enforcement legal issues, successful strategies and obstacles to compliance
Brief the Task Force on proposed revisions to NYC mold guidelines
Discussion of Task Force report outline

10:00	Introductions & Meeting Agenda Nancy Kim, PhD, Interim Director, Center for Environmental Health Thomas Mahar, Assistant Director, Division of Code Enforcement and Administration, Department of State
10:15	NYC Mold Guidelines Update Chris D'Andrea, Research Scientist NYC Dept. Health and Mental Hygiene
11:00	Discussion – Task Force Report Draft Outline
11:45	Lunch
1:00 PM	Public Comment Period
3:00	Break
3:15	NYC HPD/Code Enforcement Perspective Vito Mustaciuolo and Staff NYC Dept. of Housing Preservation and Development
4:00	NYC Housing Court Perspective Judge Gerald Lebovits NYC Housing Court
4:45	Discussion
5:30	Adjourn

NYS Toxic Mold Task Force
Tuesday, September 23, 2008
Bronfman Center at New York University
7 E 10th St
New York, NY
11:00 AM – 7:15 PM
Draft Agenda – Revised* September 15, 2008

Objectives

Understand actions taken by other state and local governments and other entities
Information and regulations related to mold and buildings
Education and outreach messages and materials
Understand guidance, practices and regulations related to molds and disinfectant use
Discussion of draft task force report and possible recommendations

11:00 AM	Introductions and meeting agenda Nancy Kim, PhD, Center for Environmental Health, NYS Department of Health Thomas Mahar, Assistant Director, Division of Code Enforcement and Administration, NY Department of State
11:15	Mold-IAQ-related actions taken by governments and other entities Gregg Recer, PhD, Research Scientist, NYS Department of Health
12:15 PM	Lunch
1:00*	Public comment period
2:30*	Mold remediation and disinfectant use Gregg Recer, PhD, Research Scientist, NYS Department of Health Judy Stasack, MPH, Research Scientist,NYS Department of Health
3:30	Break
3:45*	Discuss draft task force report and possible recommendations Task Force Members
5:15*	Break
5:30*	Public comment period
7:00	Task Force discussion and next steps
7:15	Adjourn

NYS Toxic Mold Task Force
Monday, March 2, 2009
2:00 PM – 4:00 PM by Conference Call
Draft Agenda

Objectives

Obtain task force comments on draft report and agree on direction of next draft.
Obtain ideas for possible recommendations and agree on approach for including them in the next draft

Conference Call Agenda:

2:00 PM Introduction and roll call

2:05 Task Force members' comments on overall-content questions:

- Intended audience and language level?
- Use of terms moisture, water, dampness?
- Additional tables or other summary exhibits?
- Any other sections that need to be developed?
- Degree of reference citations needed?
- Any other major comments?

Topics for possible Task Force recommendations and discussion of feasibility:

2:35 Moisture control –

Possible alternatives for improving construction, building maintenance and building inspection with respect to moisture prevention and mitigation:

- promote continuing education for construction professionals, building owners and code officials
- promote occupant education for moisture prevention
- possible code enhancements (e.g., require more use of moisture-resistant building materials; identify any areas where construction and energy codes conflict)
- opportunities for strengthening code enforcement, especially during construction?

3:15 Assessment and remediation –

Possible alternatives for improving building assessment and remediation of moisture and mold problems:

- promote training following recommended protocols for inspectors, remediators and code officials
- develop list of specific companies
- state certification or licensing of inspectors or remediators
- opportunities to enhance HPD program in NYC?

3:55 Next steps

4:00 Adjourn call

NYS Toxic Mold Task Force
Friday, August 28, 2009
10:00 AM – 12:00 PM by Conference Call
Draft Agenda

Objectives

Obtain task force comments on major additions, deletions, etc. in draft report.
Obtain comments on the draft approach for conclusion and recommendation section.

Conference Call Agenda:

10:00 AM Introduction and roll call

10:05 Task Force members' comments on overall-content questions:
- Additions?
- Deletions?
- Any other major comments?

10:30 Approach to the content of the conclusions and recommendations section
- Description
- Comments, suggestions, etc. on approach

11:00 Discussion of specific sections of the conclusions and recommendations
- Major Conclusions – Additions?
- Education and Outreach
- Codes
- Quantitative Exposure Limits
- Assessment and Remediation Guides
- Inspection and Remediation Services
- Research
- Other issues

11:55 Next steps
12:00 PM Adjourn call

NYS Toxic Mold Task Force
Friday, October 30, 2009
10:00 AM – 12:00 PM by Conference Call
Draft Agenda

Objectives

Obtain final comments on the draft approach for conclusions and recommendations.

Conference Call Agenda:

10:00 AM Introduction and roll call

10:05 Any further comments on overall content or organization?

10:15 Discussion of conclusions and recommendations related to mold assessment and remediation guidance or regulation

11:00 Discussion of other conclusions and recommendations

- Health effects
- Education and Outreach
- Codes
- Quantitative Exposure Limits
- Research
- Other issues

11:55 Next steps

12:00 PM Adjourn call

C. Summary of task force scope for the tasks listed in Public Health Law Section 1384

Tasks (a) through (f) of Public Health Law Section 1384 were accomplished by the Task Force by obtaining and synthesizing relevant information from numerous sources, including peer-reviewed scientific publications, expert-panel reports, web-based materials, government records and technical documentation from private organizations. Data gaps limited the Task Force's ability to fully address some elements of the tasks in (a) through (f). The information considered by the Task Force for each of the law's tasks is briefly listed below (section referred to in the task bullets are sections in this report):

"Toxic mold" (Section II.A)

The law makes reference in some tasks to "toxic mold" and "mold" in others, but "toxic mold" is not defined in the law and has no scientifically-accepted definition as a separate category of mold. To be inclusive, all types of molds were considered by the Task Force to be relevant to each of the law's tasks.

Health effects tasks (Section II.B)
"(a) assess, based on scientific evidence, the nature, scope and magnitude of the adverse environmental and health impacts caused by toxic mold in the state;
(b) measure, based on scientific evidence, the adverse health effects of exposure to molds on the general population, including specific effects on subgroups identifiable as being at greater risk of adverse health effects when exposed to molds"

The nature and scope of adverse health effects from mold exposure in the general population and in groups at increased risk were evaluated and summarized qualitatively by considering the strength of evidence from published health studies. Factors that contribute to increased risk of adverse health effects from mold exposure were identified. Data were sought that quantify adverse health effects from mold exposures and the extent of impacts from water-damage and resulting mold growth on buildings in NYS.

Actions by governments and other entities (Section II.C)

"(c) identify actions taken by state, and local governments, and other entities"

The Task Force considered actions relevant to mold problems in buildings, including development and enforcement of building construction and maintenance codes; education and outreach activities; credentialing of mold assessment and remediation services; development of guidance documents for mold assessment and remediation; and research activities.

Exposure limits (Section II.D)

"(d) assess the latest scientific data on exposure limits to mold in indoor environments"

The Task Force considered information relevant to the collection of mold exposure data and whether such data can be used to set reliable quantitative, health-based mold exposure limits in buildings. Information was also sought regarding the use of qualitative building assessment and clearance approaches.

Mold control and mitigation (Section II.E)

"(e) determine methods for the control of mold in a cost-effective and environmentally sound manner and identify measures to mitigate mold"

The Task Force evaluated information on the effectiveness of prevention and remediation approaches for mold problems in buildings including narrative guidance on controlling moisture sources and removal of mold-contaminated building materials; evidence for effectiveness of surface disinfectants and evidence of mold and moisture intervention effectiveness to improve occupant health status.

Task Force report

"(f) prepare a report to the governor and the legislature that assesses the current body of knowledge on toxic mold, provides the status of toxic mold in the state, and assesses the feasibility of any further actions to be taken by the legislature or state agencies as recommended by the task force."

Each section of the Task Force report assesses what relevant information is available and draws conclusions based on a synthesis of that information. NYS-related information relevant to each section of the report is included, when available. A discussion of feasibility accompanies actions recommended by the Task Force.

D. Examples of consensus industry technical standards and guidelines that address building assessment and remediation or the performance of construction materials or buildings with respect to moisture or mold growth

Reference Designation	Title
American Industrial Hygiene Association http://www.aiha.org	
AIHA MOLD GUIDELINE	Assessment, Remediation and Post-remediation Verification of Mold in Buildings
AIHA HVAC WORKBOOK	Indoor Air Quality and HVAC Workbook
AIHA AIR QUALITY	The Industrial Hygienist's Guide to Indoor Air Quality Investigations
ASTM International http://www.astm.org	
ASTM C 1338	Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings
ASTM D 2020	Standard Test Methods for Mildew (Fungus) Resistance of Paper and Paperboard
ASTM D 3273	Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
ASTM D 4300	Standard Test Methods for Ability of Adhesive Films to Support or Resist the Growth of Fungi
ASTM D 4445	Standard Test Method for Fungicides for Controlling Sapstain and Mold on Unseasoned Lumber (Laboratory Method)
ASTM D 1151	Standard Practice for Effect of Moisture and Temperature on Adhesive Bonds
ASTM D 1860	Moisture and Creosote - Type Preservative in Wood
ASTM D 2065	Standard Test Method for Determination of Edge Performance of Composite Wood Products under Surfactant Accelerated Moisture Stress
ASTM D 2118	Assigning a Standard Commercial Moisture Content
ASTM D 2247	Standard Practice for Testing Water Resistance of Coatings In 100% Relative Humidity
ASTM D 2987	Standard Test Method for Moisture Content of Asbestos Fiber
ASTM D 4442	Standard Test Method for Direct Moisture Content Measurement of Wood and Wood-Base Materials
ASTM D 4502	Test Method of Heat and Moisture Resistance of Wood-Adhesive Joint
ASTM D 4610	Standard Guide for Determining the Presence of and Removing Microbial (Fungal or Algal) Growth on Paint and Related Coatings
ASTM D 4933	Standard Guide for Moisture Conditioning of Wood and Wood-Based Materials
ASTM D 6403	Test Method for Determining Moisture in Raw and Spent Materials
ASTM MNL 18	Moisture Control in Buildings
ASTM MNL 40	Moisture Analysis and Condensation Control in Building Envelopes
ASTM E 2267	Standard Guide for Specifying and Evaluating Performance of Single Family Attached and Detached Dwellings - Indoor Air Quality (IAQ)
ASTM D 5157	Standard Guide for Statistical Evaluation of Indoor Air Quality Models
ASTM D 5791	Standard Guide for Using Probability Sampling Methods in Studies of Indoor Air Quality in Buildings
ASTM D 6245	Standard Guide for Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation
ASTM D 7391	Standard Test Method for Categorization and Quantification of Airborne Fungal Structures in an Inertial Impaction Sample by Optical Microscopy
ASTM STP 1205	Modeling Of Indoor Air Quality and Exposure
ASTM WK3792	Guide for Assessment of Fungal Growth in Buildings (work item in progress as of August, 2009)
American Conference of Governmental and Industrial Hygienists http://www.acgih.org	
ACGIH INDOOR AIR QUALITY	Indoor Air Quality 2nd Edition
ACGIH Bioaerosols	Bioaerosols: Assessment and Control
American Society of Heating, Refrigerating and Air-Conditioning Engineers http://www.ashrae.org	
ASHRAE STD 55	Thermal Environmental Conditions for Human Occupancy
ASHRAE STD 62	Ventilation for Acceptable Indoor Air Quality

Reference Designation	Title
American Association of Textile Chemists and Colorists http://www.aatcc.org	
AATCC 100	Assessment of Antibacterial Finishes on Textile Materials
AATCC 30	Antifungal Activities Assessment on Textile Materials: Mildew and Rot Resistance of Textile Materials
Sheet Metal and Air Conditioning Contractors' National Association http://www.smacna.org	
SMACNA 1637	Indoor Air Quality - A System Approach 3rd Edition
Technical Association of the Pulp and Paper Industry http://www.tappi.org	
TAPPI T 487	Fungus Resistance of Paper & Paperboard
ANSI/Greenguard Environmental Institute http://www.greenguard.org/Default.aspx?tabid=115	
ANSI/GEI – MMS1001	ANSI/GREENGUARD Environmental Institute. Mold And Moisture Management Standard For New Construction

E. Organizations offering training certificates or certification for mold assessment and remediation

The following list was developed from internet searches conducted in 2008 for organizations offering mold assessment and remediation credentials or training. It is not intended to be comprehensive, but provides examples of the types of credential-granting organizations that existed at the time the report was being prepared. This list may include some organizations that provide both training and also credentials they refer to as certification. Ideally, certification is done by organizations that are independent of any training provider. The nature, scope and quality of training or credentialing services provided by the organizations listed here have not been thoroughly investigated and could differ substantially from each other. This list does not imply endorsement of any of the listed organizations.

- National Environmental Trainers http://www.natlenvtrainers.com
- National Association of Mold Professionals http://www.moldpro.org
- Indoor Air Quality Association http://www.iaqa.org
- Mold Inspection Consulting and Remediation Organization http://www.moldcareer.com
- Institute of Inspection Cleaning and Restoration Certification http://www.iicrc.org
- Professional Certification Institute http://www.certifiedmoldinspectors.com
- Southeastern Mold Institute http://www.moldclass.com
- American Council for Accredited Certifications (formerly American Indoor Air Quality Council) http://www.acac.org
- Professional Home Inspection Institute (& PMII) http://www.moldinspectioninstitute.com
- Restoration Industry Association http://www.ascr.org
- American Society of Home Inspectors (ASHI) http://www.ashi.org
- National Air Duct Cleaners Association (NADCA) http://www.nadca.com
- National Association of Home Inspectors (NAHI) http://www.nahi.org
- National Association of Certified Home Inspectors (NACHI) http://www.nachi.org
- National Environmental Health Association (NEHA) http://www.neha.org
- American Board of Industrial Hygiene (ABIH) http://www.abih.org

F. Summary of mold-related outreach and education materials or programs from state health departments and other organizations

Note: Links to these materials were live as of May, 2010.

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
NY	New York State Department of Health	2005	Mold Fact Sheet	Fact sheet	Overview of mold; health effects; prevention; remediation	Extensive mold growth indoors is a potential problem; prevent mold growth; eliminate moisture sources	http://www.health.state.ny.us/environmental/indoors/air/mold.htm	also links to other related materials
NY	New York City Department of Health and Mental Hygiene	2008	Facts About Mold Mold Guidelines	Fact sheet Detailed guidance for assessment and remediation of indoor mold	Fact sheet: Overview of mold; health effects; prevention; remediation Guidelines: Building assessment and remediation	Extensive mold growth indoors is a potential problem; prevent mold growth; eliminate moisture sources	http://www.nyc.gov/html/doh/html/epi/mold.shtml	also links to other related materials
	CDC (also NIOSH)	2010	Mold	Main portal site links to multiple related web pages and documents	Health effects, prevention, remediation	Extensive mold growth indoors is a potential problem; prevent mold growth; eliminate moisture sources	http://www.cdc.gov/mold/default.htm	
	EPA	2010	Mold and Moisture	Main portal site links to multiple related web pages and documents	Health effects, prevention, remediation	Extensive mold growth indoors is a potential problem; prevent mold growth; eliminate moisture sources	http://www.epa.gov/mold/	
	EPA	August 2008	Indoor Air Quality in Large Buildings	Web page listing of resources/ publications	Building assessment and remediation		http://www.epa.gov/iaq/largebldgs/	HTML/PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
	EPA	Not provided	A Brief Guide to Mold, Moisture, and Your Home	Guide (20 page) (English and Spanish)	Info and guidance for homeowners and renters on mold cleanup and prevention	Extensive mold growth indoors is a potential problem; prevent mold growth; eliminate moisture sources	http://www.epa.gov/mold/moldguide.html	HTML/PDF
	EPA	March 2001	Mold Remediation in Schools and Commercial Buildings	Guide (54 page)	Investigating, evaluating, and remediating moisture and mold problems. Remediation checklist.	Extensive mold growth indoors is a potential problem; prevent mold growth; eliminate moisture sources	http://www.epa.gov/mold/mold_remediation.html	HTML/PDF
	U Conn Health Center - Div of Occupational and Environmental Medicine	September 2004	Guidance for Clinicians on the Recognition and Management of Health Effects Related to Mold Exposure and Moisture Indoors	Guide developed in cooperation with EPA	Illustrative Clinical Experience; fungus and Mold; health effects; recognition and mgmt of related illness; environmental assessment;		http://www.oehc.uchc.edu/clinser/MOLD%20GUIDE.pdf	PDF (excellent appendices)
	Navy and Marine Corps – Public Health Center	Not provided	Mold Remediation Wheel	One page resource guide on remediation	Cleanup	Dry out wet materials; clean or remove and discard moldy materials	http://www-nehc.med.navy.mil/Downloads/IH/IHFOM/MR_wheel.pdf	PDF (easy to read visual)
	US Dept of Labor OSHA	Not provided	A Brief Guide to Mold in the Workplace	Web page	Overview of mold; health effects; prevention; remediation;		http://www.osha.gov/dts/shib/shib101003.html	HTML/PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
AL	Alabama Department of Public Health	Not provided	Facts about mold	Information web page	mold problems in homes-health concerns and advice on finding and removing mold	All molds harmful, don't test, cleanup mold, eliminate moisture	http://adph.org/IAQ/Default.asp?id=1597#health	PDF/html
AK	Arkansas Department of Health	March 2003	Mold in Your Indoor Environment	Feature column	Be aware mold can grow indoors and take measure to prevent growth	Mold everywhere, eliminate moisture, mold not problem for everyone-just sensitive individuals	http://www.healthyarkansas.com/news/boozman_briefings_03/feb28_03.pdf	PDF
AZ	Arizona Department of Health Services	December 2004	Indoor Air Quality *Info Sheet* Mold in My Home: What Do I Do?	Information sheet (4-page)	Mold and water damage, health concerns, mold detection, cleanup and removal	Mold is health concern, don't test, control moisture, cleanup, don't use ozone	http://azdhs.gov/phs/oeh/invsurv/air_qual/pdf/moldfact.pdf	PDF
CA	California Department of Health Services	2006	Mold in My Home: What do I do?	Web page	For homeowners with water damage, health concerns, guidelines prevention, detection, cleanup	Mold everywhere, problem when high levels indoors, don't test – look for moisture evidence and odor, don't use ozone to cleanup	http://www.cal-iaq.org/cal-iaq%20moldinformation.htm	HTML
CA	California Department of Health Services	July 2001	Mold in My School: What do I do?	Q&A	For school administrators and managers	Mold can grow within 48hrs with water; anyone can be affected; symptoms could be non-mold related, list of do's and don'ts on prevention/cleanup	http://www.cal-iaq.org/cal-iaq%20moldinformation.htm	PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
CA	California Department of Public Health	November 2005	Molds in Indoor Workplaces	Q&A	Information for workers about mold concerns in the workplace	Mold can be in workplace, what evidence to look for, report mold problems in workplace, resources	http://www.cal-iaq.org/cal-iaq%20moldinformation.htm	PDF
CA	California Research Bureau	January 2006	Indoor Mold: A General Guide to Health Effects, Prevention, and Remediation	Report in response to A.B. 284 (85 pages)	Background information on mold prepared for CA State Assembly member	See report for details	http://www.cal-iaq.org/index.html	PDF
CA	Environmental Health Investigations Branch California Department of Health Services	November 2000	Stachybotrys chartarum – a mold that may be found in water-damaged homes	5-page technical information sheet	Background information on SC, exposure health concerns and remediation	See report for details	http://www.ehib.org/papers/stachygp00.doc	PDF
CA	California Dept of Health Services – EH Investigations Branch	December 2000	Misinterpretation of *Stachybotrys* Serology	Technical fact sheet / Q&A	Issues related to laboratory analysis for SC exposure	See report for details	http://www.ehib.org/paper.jsp?paper_key=STACHYBOTRYS_MISINTERP_2000	PDF
CA	California Dept of Health Services – EH Investigations Branch	April 1998	Health Effects of Toxin-Producing Indoor Molds in CA	Technical article for health professionals	mechanism of action; route of exposure;cases from the medical literature	See report for details	http://www.ehib.org/html_entity.jsp?bcc=papers&paper_key=MOLDS_CA_1998	PDF
CO	Colorado Department of Public Health and Environment	August 2002	Mold Information Sheet	Information sheet	General audience fact sheet / Q&A about mold and it's concern for health	Molds multiply indoors with moisture; health symptoms; detection and cleanup	http://www.cdphe.state.co.us/dc/envtox/index.html	PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
CT	Connecticut Dept of Public Health	June 2007	Mold in the Home: Health Concerns	Fact sheet	Information and guidance for homeowners about mold	Water problem; all mold is a concern; don't' test; guidelines for cleanup	http://www.ct.gov/dph/cwp/view.asp?a=3140&q=387466&dphNav_GID=1828&dphPNavCtr=|#Mold	PDF
CT	Connecticut Dept of Public Health	August 2006	Indoor Air Quality Testing Should Not Be The First Move	Fact sheet	Information for teachers, parents, school admin about not testing for mold	No mold standards; interpretation difficult; what to do instead of testing	http://www.ct.gov/dph/cwp/view.asp?a=3140&q=387466&dphNav_GID=1828&dphPNavCtr=|#Mold	PDF
CT	Connecticut Dept of Public Health	March 2007	Get the Mold Out: Mold Cleanup Guidance for Residences	Fact sheet	Mold assessment and abatement for homeowners	Who should evaluate mold problem and do the abatement work	http://www.ct.gov/dph/cwp/view.asp?a=3140&q=387466&dphNav_GID=1828&dphPNavCtr=|#Mold	PDF
CT	Connecticut Dept of Public Health	Not provided	Guidelines for Mold Abatement Contractors	Guidance document (14 pages)	Guidelines for professional abatement contractors doing work in CT	See publication for details	http://www.ct.gov/dph/cwp/view.asp?a=3140&q=387466&dphNav_GID=1828&dphPNavCtr=|#Mold	PDF
DE	Delaware Health and Social Services	July 2004	Mold in Your Home	Information sheet	For people with mold problems in their home – health concerns and advice of finding and removing mold	Mold not good indoors; all molds are bad; investigate don't test	http://www.dhss.delaware.gov/dph/hsp/i-moldinyourhome.html	HTML/PDF
DE	Delaware Health and Social Services	May 2008	Inside Healthy Homes - Mold	Short Q&A	Where mold can be found, should you test, what to do if mold found	Mold result of moisture problem; testing not recommended; check RH in home; take actions to reduce excessive moisture	http://www.dhss.delaware.gov/dph/hsp/hhinsidemold.html	HTML/PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
FL	Florida Department of Health	Not provided	Indoor Mold and Health: A fungus Among Us	8-page fact sheet/ Q&A	Answer common question/concern mold, how affects health; prevention and removal	Molds common indoors; control moisture; mold always indoors but don't let grow; see and smell not test mold; other black molds not SC; bleach not needed	http://www.doh.state.fl.us/environment/community/indoor-air/Indoor_Mold_and_Health.pdf	HTML/PDF
FL	Florida Solar Energy Center-University of Central Florida	Not provided	Mold Growth	Technical fact sheet	What is mold and factors contributing to moisture/mold in buildings	Mold caused by moisture problem; can be related to building materials/construction	http://www.fsec.ucf.edu/en/consumer/buildings/basics/moldgrowth.htm	HTML/PDF
GA	Georgia Department of Human Resources	Not provided	What Can I do About Mold in My Home?	Tri-fold pamphlet	What is mold, causes, how affects health, cleanup, prevention	Molds natural; need moisture; can grow on anything; allergy symptoms most common	http://health.state.ga.us/pdfs/environmental/misc/IndoorAirBrochure.pdf	PDF
HI	State of Hawaii Department of Health	February 2008	How to Clean Mold from Your House	2-page fact sheet	What causes mold problems in buildings, basic mold cleanup, what to know about floods and mold	All indoor molds bad; dry water damaged areas within 48 hrs, mold problem with flooding	http://hawaii.gov/health/environmental/noise/radiationsection/iaqsection/iaqsection/pdf/moldremoval.pdf	PDF
ID	Idaho Department of Health and Welfare	2007	Indoor Environment: Mold Know the Facts	Main portal site links to multiple related web pages and documents	see below		http://www.healthandwelfare.idaho.gov/Health/EnvironmentalHealth/IndoorEnvironment/Mold/tabid/940/Default.aspx	
ID	Idaho Department of Health and Welfare	August 2003	Mold in Our Homes	Fact sheet	What is mold, how can you tell if problem, health effects, should you test, how to prevent	Many potential moisture sources indoors; if see or smell – have problem; testing not recommended; correct moisture to fix mold; take care when cleaning mold	http://healthandwelfare.idaho.gov/Portals/0/Health/EnvironmentalHealth/Mold in our Homes.pdf	PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
ID	Idaho Department of Health and Welfare	August 2003	Mold and Moisture Problems in Crawlspaces	Fact sheet	Why crawlspaces are problem, addressing problem in existing home and during construction, cold climate concerns, alternatives to crawlspace	Moisture can be problem in crawlspace; take steps to prevent moisture problems;	http://www.healthandwelfare.idaho.gov/Health/EnvironmentalHealth/IndoorEnvironment/Mold/tabid/940/Default.aspx	link to general mold IAQ page; follow specific links to PDF documents
ID	Idaho Department of Health and Welfare	Not provided	Mold in Rentals	Fact sheet	Information to help renters with mold problems in their apartment, tenant rights and responsibilities related to moisture damage and mold.	Many potential moisture sources; some people more susceptible to health problems; immediately notify landlord if moisture/mold problems; take caution when cleaning mold;	http://www.healthandwelfare.idaho.gov/Health/EnvironmentalHealth/IndoorEnvironment/Mold/tabid/940/Default.aspx	link to general mold IAQ page; follow specific links to PDF documents
IL	Illinois Department of Public Health	Not provided	Mold and Your Health	Fact sheet	How can be exposed to mold, how it affects health, mycotoxins,	Mold can cause health effects; mold can produce VOCs; testing a person for exposure not advised; person can be tested for mold allergy; consult doctor if persistent health problems	http://www.idph.state.il.us/envhealth/factsheets/mold.htm	PDF
IL	Illinois Department of Public Health	August 2003	Mold and Mildew	Tri-fold pamphlet	What mold needs to grow, sources of moisture indoors, possible health effects, should you test, how to cleanup, reducing exposure while cleaning up.	Most surfaces can grow mold; multiple moisture sources available; some people more sensitive; large amounts spores present is concern; testing not recommended; some water damage material should be discarded; stop moisture problem before cleanup; take caution during cleanup	http://www.idph.state.il.us/envhealth/pdf/moldmildew.pdf	PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
IL	Illinois Department of Financial and Professional Regulation – Division of Insurance	December 2002	Mold Facts and Homeowners Insurance	Fact sheet	Information for renters, business owners and homeowners about mold and how insurers respond to problems	Mold can be a problem indoors; any mold is a concern; not all causes of water damage/ mold covered under insurance; some insurance companies have started excluding mold coverage; important to take steps to prevent mold	http://insurance.illinois.gov/HomeInsurance/mold.asp	PDF
KS	Kansas Department of Health and Environment	April 2000	Be Concerned, Not Alarmed About Mold, Say Health Officials	Press release	Increased media focus Stachybotrys, should you be concerned about mold, guideline to follow if household mold found	Presence of black mold does not mean it's toxic mold, if no health symptoms identify/ eliminate moisture source first; if health symptoms, consult physician; if chronic lung illness, don't use humidifiers; clean with dilute bleach solution; no need to take special precautions when handling SC contaminated materials.	http://www.kdheks.gov/news/web_archives/2000/068.htm	HTML/PDF
KS	Kansas Department of Health and Environment	May 2007	Kansas Department of Health and Environment Offers Advice on Mold Cleanup	Press release	Advice for property owners on controlling mold after storms and flooding	After flooding, dry surfaces thoroughly and quickly; clean first with soapy solution; dry area using fans and dehumidifiers, if surface remain wet too long – may need to replace them; individuals can handle small mold cleanup, large clean may need professional.	http://www.kdheks.gov/news/web_archives/2007/05142007a.htm	HTML/PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
KS	Kansas Department of Health and Environment	July 2207	Kansas Department of Health and Environment Officer Advice on Post-Flood Mold Cleanup	Press release	Advice for property owners about post-flooding mold cleanup	Thoroughly and quickly dry out wet surfaces after flood; mold can grow on any surface, especially sheetrock; use PPE including N95 respirator; porous materials must be dried within 48 hrs	http://www.kdheks.gov/news/web_archives/2007/07052007.htm	HTML/PDF
KY	Cabinet for Health and Family Services	August 2008	Mold	Web page	Location; recognition; exposure; testing; cleanup; government regulation	Grow in moist areas; reduce humidity; test w/kit or hire consultant; wear protective clothing when cleaning; control moisture; molds themselves are not toxic; state has no law or regulation about mold	http://chfs.ky.gov/dph/info/phps/Mold.htm	HTML/PDF
KY	Division for Air Quality	January 2008	Mold Information about Mold and what to look for in your home	Web page/FAQ	How common; concern; testing; toxic mold; health effects; detection; remediation; hiring professionals; landlord/tenant	Found everywhere; most health effects temporary; no need to test; no evidence linking exposure with toxic effects; detect by seeing and smelling;	http://www.air.ky.gov/EPPCInternet/Templates/MainTemplate_file.aspx?NRMODE=Published&NRORIGINALURL=%2fFAQ%2fMold%2ehtm&NRNODEGUID=%7b84F6F970-AC28-4471-ADF2-456C1665A08A%7d&NRCACHEHINT=NoModifyGuest#whodoIcalltodealwithextensivemoldgrowthinabuilding?	HTML/PDF
LA	Dept of Health and Hospitals – Center for Environmental Health	November 2005	MOLD What You Need to Know About Your Health and Your Property	Brochure	Overview; toxic/black molds; health effects; causes; remediation; testing; cleanup; hiring professionals; buying a home; insurance	Control moisture; don't test; fix problem; real estate agents must disclose know "large " defects in property	http://www.dhh.louisiana.gov/offices/publications/pubs-205/Mold_Brochure.pdf	PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
MA	Office of Health and Human Services	2008	Preventing Mold Growth in Massachusetts Schools during Hot, Humid Weather	Web page	Molds in schools; dew point; humidity reduction; porous materials; prevention	Liquid and vapor create mold; monitor weather; reduce humidity by mechanical means; remove porous materials; seal building	http://www.mass.gov/?pageID=eohhs2terminal&L=8&L0=Home&L1=Consumer&L2=Community+Health+and+Safety&L3=Environmental+Health&L4=Environmental+Exposure+Topics&L5=Indoor+Air+Quality&L6=Sources+of+Indoor+Air+Pollution&L7=Mold%2c+Moisture%2c+and+Mildew&sid=Eeohhs2&b=terminalcontent&f=dph_environmental_c_mold_prevention_schools&csid=Eeohhs2	HTML/PDF
MA	Office of Health and Human Services	2008	Guidance Concerning Remediation and Prevention of Mold Growth and Water Damage in Public Schools/Buildings to Maintain Air Quality	Web page	Guidelines to reduce exposure to mold; cleanup and prevention table	Remove contaminated materials; do not convert below grade space if it is subject to dampness; evaluate building; maintain HVAC systems	http://www.mass.gov/?pageID=eohhs2terminal&L=8&L0=Home&L1=Consumer&L2=Community+Health+and+Safety&L3=Environmental+Health&L4=Environmental+Exposure+Topics&L5=Indoor+Air+Quality&L6=Sources+of+Indoor+Air+Pollution&L7=Mold%2c+Moisture%2c+and+Mildew&sid=Eeohhs2&b=terminalcontent&f=dph_environmental_c_mold_prevention_guidance&csid=Eeohhs2	
MA	Dept of Public Health	July 2007	Use of Moisture Measuring Devices in Evaluating Water Damage in Buildings	guidelines	Instructions for moisture measuring device		http://www.mass.gov/Eeohhs2/docs/dph/environmental/iaq/moisture_measure_device.pdf	PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
MA	Office of Health and Human Services	2008	Preventing Mold Growth in Massachusetts Schools during Hot, Humid Weather	Web page	Molds in schools; dew point; humidity reduction; porous materials; prevention	Liquid and vapor create mold; monitor weather; reduce humidity by mechanical means; remove porous materials; seal building	http://www.mass.gov/?pageID=eohhs2terminal&L=8&L0=Home&L1=Consumer&L2=Community+Health+and+Safety&L3=Environmental+Health&L4=Environmental+Exposure+Topics&L5=Indoor+Air+Quality&L6=Sources+of+Indoor+Air+Pollution&L7=Mold%2c+Moisture%2c+and+Mildew&sid=Eeohhs2&b=terminalcontent&f=dph_environmental_c_mold_prevention_schools&csid=Eeohhs2	HTML/PDF
MA	Office of Health and Human Services	2008	Guidance Concerning Remediation and Prevention of Mold Growth and Water Damage in Public Schools/Buildings to Maintain Air Quality	Web page	Guidelines to reduce exposure to mold; cleanup and prevention table	Remove contaminated materials; do not convert below grade space if it is subject to dampness; evaluate building; maintain HVAC systems	http://www.mass.gov/?pageID=eohhs2terminal&L=8&L0=Home&L1=Consumer&L2=Community+Health+and+Safety&L3=Environmental+Health&L4=Environmental+Exposure+Topics&L5=Indoor+Air+Quality&L6=Sources+of+Indoor+Air+Pollution&L7=Mold%2c+Moisture%2c+and+Mildew&sid=Eeohhs2&b=terminalcontent&f=dph_environmental_c_mold_prevention_guidance&csid=Eeohhs2	
MA	Dept of Public Health	July 2007	Use of Moisture Measuring Devices in Evaluating Water Damage in Buildings	guidelines	Instructions for moisture measuring device		http://www.mass.gov/Eeohhs2/docs/dph/environmental/iaq/moisture_measure_device.pdf	PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
MD	Dept of the Environment	Not provided	Mold Information Page	Web page	links to resources on health effects and cleanup	Links to other resources	http://www.mde.state.md.us/CitizensInfoCenter/Health/mold_information.asp	HTML/PDF
MD	Dept of Health and Mental Hygiene	June 2007	Questions and Answers About Molds	Web page	Location; health effects; *Stachybotrys chartarum*; cleanup	Found everywhere; most harmless; don't test;	http://www.cha.state.md.us/oeh/html/mold.html	HTML/PDF
ME	Maine Indoor Air Quality Council	Not provided	About Mold…	Web page	Health effects; remediation; testing; resources for MDs	Health effects vary; eliminate moisture; fix problem	http://www.miaqc.org/Mold%20Information.htm	HTML/PDF
MI	Dept of Community Health	August 2006	Molds in Your Home	Pamphlet	Growth, detection; health effects; exposure; prevention; testing; cleanup	Detect by seeing and smelling; common health problems; fix problem; no law	http://www.michigan.gov/documents/mdch/Molds_home_179025_7.pdf	PDF
MI	Dept of Community Health (MIOSHA)	October 2006		Q & A	Air Contaminants: Mold – remediation requirements	No standards to address employee exposures to molds	http://www.michigan.gov/documents/cis/wsh_mold_173119_7.doc	.doc
MI	Dept of Community Health	2010	All About Mold	Fact sheet (3 page)	Detection; varieties; cleanup; health effects; prevention; laws; landlord/tenant	Detect by seeing and smelling; don't test; fix problem; exposure does not usually cause health problem; control moisture	http://www.michigan.gov/documents/mdch/ALL_ABOUT_MOLD_MDCH_312221_7.pdf	PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
MN	Dept of Health	April 2008	Mold in Homes	Web page	Health effects; home investigation; cleanup and removal	Control moisture; those more vulnerable at greater risk; don't test	http://www.health.state.mn.us/divs/eh/indoorair/mold/index.html	HTML/PDF
MN	Dept of Health	April 2008	Testing for Mold	Web page	Limitations of testing; finding a problem		http://www.health.state.mn.us/divs/eh/indoorair/mold/moldtest.html	HTML/PDF
MN	Dept of Health	June 2008	Disaster Quick Tips: Mold	Web page	Links to resources for flooding and mold cleanup	Dry as soon as possible; use protective equipment; clean or dispose	http://www.health.state.mn.us/divs/eh/emergency/natural/floods/mold/index.html	PDF
MN	Dept of Health	August 2008	Mold in Rental Housing	Web page	Causes; concerns; tenant action; rights; public housing; resources		http://www.health.state.mn.us/divs/eh/indoorair/mold/renters.htm	HTML/PDF
MN	Dept of Health	May 2010	Guidelines for Selecting an Indoor Air Quality Consultant	Fact sheet (5 page)	Determining the need and type of professional;	List of providers	http://www.health.state.mn.us/divs/eh/indoorair/iaqserviceprovider.pdf	PDF
MN	Dept of Health	April 2008	Investigating and Remediating Mold in Minnesota Public Schools	Web page	Recommended best practices in schools; advice on mold in schools		http://www.health.state.mn.us/divs/eh/indoorair/schools/mold.html	HTML/PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
MO	Dept of Health and Senior Services	Not provided	Mold	Web page	Health effects; remediation; cleanup; what to wear; toxic black mold; testing;	Control moisture; testing not recommended;	http://www.dhss.mo.gov/IndoorAir/mold.html	HTML/PDF
MS	State Dept of Health	Not provided	Mold: Questions and Answers	Web page	Basic facts; health effects; detection; cleanup	Sources; needs to be removed even after disinfected; if you can see or smell it, you have a problem	http://www.msdh.state.ms.us/msdhsite/_static/43,0,230,331.html	HTML/PDF
NC	Dept of Health and Human Services – Div of Public Health Occupational and Env Epidemiology	August 2005	Mold and Human Health	Fact sheet (20 page)	Health effects; growth; conditions; cleanup/removal;hiring consultant/contractor		http://www.epi.state.nc.us/epi/pdf/Mold%20and%20Human%20Health%208-18-05.pdf	PDF
ND	No. Dakota Dept of Health	July 2006	Indoor Air Quality Info Sheet Mold in My Home: What Do I Do?	Information sheet (2 page)	Water damage in the home, health concerns related to mold exposure, mold detection, cleanup and removal	Mold cab be everywhere, can cause negative health effects and structural damage. Detection. Clean-up.	http://www.ndhealth.gov/AQ/IAQ/Biological/Mold/Mold%20in%20My%20Home.pdf	PDF
NE	Health and Human Services System	Not provided	Is Mold Affecting Your Health?	Tri-fold pamphlet	Description; prevention; testing; cleanup;	Easily spread; symptoms; fix problems; don't test	http://www.hhs.state.ne.us/puh/enh/moldaffect.pdf	PDF
NJ	Dept of Health and Senior Services	September 2004	Mold Advisory Bulletin	Fact Sheet (2 page)	Health concerns; identifying; testing; remediation		http://www.state.nj.us/health/iep/documents/mold_bulletin.pdf	PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
NM	Dept of Health	January 2007	Mold Exposure and Health	Fact sheet (2 page)	Exposure methods; health effects; microbial volatile organic compounds; mycotoxins; medical tests	Eliminate moisture; health effects usually only seen in those w/chronic diseases or weakened immune systems	http://www.health.state.nm.us/eheb/rep/Mold/mold%20exposure%20and%20health.pdf	PDF
NM	Dept of Health Office of Health Emergency Management	October 2006	Clean-up and Safe Removal of Mold-Contaminated Building Materials after Flood Damage	Cleanup Guide (2 page)	Finding, cleaning, remediating mold	Recognize by sight and smell; prevent moldy air from going to rest of house	http://www.health.state.nm.us/ohem/documents/OEM%20mold%20and%20flood.pdf	PDF
NM	Dept of Health Environmental Heath Epidemiology Bureau	October 2005	MOLD Frequently Asked Questions	FAQ (2 page)	Testing; regulation; tenant issues; workplace issues; school	State does not test, clean, assess, regulate. Contact info	http://www.health.state.nm.us/eheb/rep/Mold/Freq_Questions.05.pdf	PDF
OK	Oklahoma State Dept of Health	Not provided	Mold Facts	Fact Sheet (3 page)	How molds grow, exposure, neg health effects, detection, control, cleanup.	Fix problem. Cleanup guide small and large surfaces.	http://www.ok.gov/health/documents/MoldFactSheet.pdf	PDF
OR	Dept of Human Services; Health Services; Environmental Toxicology Program	July 2005	Fact Sheet: Household Mold	Fact Sheet which includes compilation of 30 pages from variety of other states resources	Molds in the home, schools, causes, symptoms, ventilation		http://www.oregon.gov/DHS/ph/envtox/docs/Moldinfopacketarticles.pdf	PDF
OR	Dept of Human Services Environmental Toxicology Program	September 2007		Information Web Page	Mold conditions, cleanup.	Can be harmful. Fix problem. Avoid contact.	http://www.oregon.gov/DHS/ph/envtox/mold.shtml	HTML/PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
PA	Dept of Health	August 2006	Pennsylvania Mold Management Task Force Report to the Pennsylvania General Assembly	Recommendations of Mold Task Force	Public education; assessment and remediation; licensing and certification of mold assessors and remediators; insurance coverage for mold assessors and remediators.		http://www.dsf.health.state.pa.us/health/lib/health/injuryprevention/MoldReport2006.pdf	PDF
PA	Dept of Health	October 2007	Fungal (Mold) Contamination in Indoor Environments FAQ	Web page of frequently asked questions	Symptoms; health effects; cleanup	Bldg. materials with mold must be remediated ASAP; people with health problems should see physician; prompt remediation	http://www.portal.state.pa.us/portal/server.pt/community/environmental_health/14143/fungal_(mold)_contamination_in_indoor_environments/557068	HTML/PDF
RI	Dept of Health	Not provided	Some Facts about Mold	Flyer	Testing; Cleanup; health effects; sources; control	Eliminate source; reduce moisture; people with respiratory illness or weak immune system should not clean up	http://www.health.ri.gov/environment/risk/Mold.php	PDF (English and Spanish)
RI	Dept of Health	1998 - 2008	Indoor Air Quality Mold, Mildew, Fungus and Other Indoor Air Quality Problems	Web page – compilation of resources	General info; cleanup; water/flood damage		http://www.health.state.ri.us/environment/risk/mold_indoor.php	
SD	Dept of Health	Not provided	Mold In Your Environment	Web page	Overview of mold; health effects; prevention;	Mold found everywhere; grow in damp places; clean mold; fix problem	http://doh.sd.gov/DiseaseFacts/Mold.aspx	HTML/PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
TN	Dept of Health	Not provided	Mold	Fact Sheet (3 pages)	Mold basics; health effects; prevention; cleanup; schools and work	Molds found anywhere; spores spread easily; mold not toxic; not necessary to test; prevention; cleanup	http://health.state.tn.us/Ceds/mold.pdf	PDF
TX	Dept of State Health Services	July 2004	Consumer Mold Information Sheet *Regulation of Mold Assessment and Remediation in Texas*	Information Sheet (2 page)	Regulation of mold cleanup businesses; mold assessment; clearance criteria; remediation	Mold remediation protocol; certificate of mold remediation;	http://www.dshs.state.tx.us/mold/docs/consumerinfo.doc	HTML
TX	Dept of State Health Services	May 2007	Indoor Air Quality Program *Protecting Your Home From Mold*	Web page	How molds damage homes; health effects; protection; inspection; prevention; signs of mold growth	Keep home clean and dry; identify and correct high moisture conditions; inspect home regularly	http://www.dshs.state.tx.us/iaq/protect.shtm	HTML/PDF
TX	Dept of State Health Services	March 2005	Mold Reduction and Remediation Task Force Report to the Texas Residential Construction Commission	Task Force recommendations	Avoiding and mitigating mold occurrences; reduce mold exposure in homes; recognition; construction standards and practices		http://www.trcc.state.tx.us/publications/resources/Mold%20Task%20Force%20Final.pdf	PDF
VA	Dept of Health	July 2008	Mold	Web page	How molds affect people; controlling moisture; who to contact	Health effects; no way to eliminate all mold; eliminate source; fix problem; prevent condensation	http://www.vdh.virginia.gov/epidemiology/DEE/otherzoonosis/Mold.htm	HTML/PDF
VA	Dept of Health	October 1999	Frequently Asked Questions About Flooding, Molds, and Health	FAQ fact sheet (4 page)	Identification; health effects; control; remediation; exposure risk;		http://www.vdh.virginia.gov/epidemiology/DEE/PublicHealthToxicology/documents/pdf/moldQ&A.PDF	PDF

State	Agency/ Organization	Date	Title	Type of Material	Topic Area	Key Messages	Web Address	Comments
VT	Dept of Health	2005	Mold and Air Quality	Web page	Health effects; growing conditions; testing; carpets; precautions; removal	Not much about relationship between mold and health problems; needs right mix of conditions	http://healthvermont.gov/enviro/indoor_air/Mold.aspx	HTML/PDF
WA	Dept of Health Div of Env Health – Office of Env Health and Safety	June 2008	Got Mold? *Frequently Asked Questions About Mold*	Web page FAQ (English and Spanish	Mold growth; exposure; health effects; testing; control; cleanup; landlord/tenant		http://www.doh.wa.gov/ehp/ts/IAQ/Got_Mold.html	PDF
WA	Dept of Health Div of Env Health – Office of Env Health and Safety	Feb 2010	Landlords are Required to Notify Tenants about Mold	Web page	Info for landlords on legislation compliance		http://www.doh.wa.gov/ehp/ts/IAQ/renter.htm	PDF
WI	Dept of Health Services	June 2008	Mold: Information for Wisconsin Residents	Web page subdivided 9 individual subject areas	Mold in your home; landlord/tenant; contractor hiring tips; prof/technical info		http://dhs.wisconsin.gov/eh/HlthHaz/fs/MoldFAQs.htm	HTML/PDF
WV	Dept of Health and Human Resources	June 2004	Getting Rid of Mold After Flooding	Fact sheet (2 page)	Health concern; locating; protection; cleanup/removal;		http://www.wvdhhr.org/bhhf/flood%5Fweb%5Fold/mold.pdf	PDF
WV	Dept of Health and Human Resources	March 2000	Mold in my Home: What Do I Do?	Indoor Air Quality Info Sheet (4 pages)	Info about water damage to the home; health concerns related to mold exposure; mold detection		http://www.wvdhhr.org/rtia/pdf/iaq%5Finfo%5Fsheet.pdf	PDF

G. Recommendations from other recent state task force reports on mold and building IAQ issues

Note: The following material is reproduced *verbatim* from the original reports for informational purposes. The Task Force has not reviewed or edited the information contained within these quoted materials for accuracy (e.g., web site addresses).

California
Indoor Mold. A General Guide to Health Effects, Prevention, and Remediation
Report in Response to A.B. 284, Chapter 550, Statutes of 2001
California Research Bureau (California State Library) January 2006.
[selected text from pages 53-54]

7. Policy Options
...The Legislature might wish to consider some issues discussed in this report for future legislation or inquiry.

EPIDEMIOLOGICAL ANALYSIS AND HEALTH IMPACT STUDIES
There is a need for continuing study of the possible effects on human health of indoor mold and other water-damage-related contamination.

The Legislature could consider authorizing or requesting public health officials to conduct epidemiological analysis of possible mold-related illnesses when conditions (such as post-flood conditions) provide sufficient cases for meaningful analysis. The Legislature might likewise consider requesting scientific researchers in public institutions of higher education to undertake analysis of health impacts of exposures to mold and mold byproducts indoors, with emphasis on conditions encountered in California.

LICENSING
Where water damage has caused mold growth, homeowners and building managers may need to turn to outside contractors for inspection, assessment, and remediation. Currently, California has no requirements for licensing or certification of mold inspectors or remediators as such. Some other states have such requirements.

The Legislature might wish to evaluate whether similar licensing or certification programs are appropriate for California and might help homeowners and building managers to secure qualified assistance when needed to assess or remediate a mold problem.

LISTING OF SERVICE PROVIDERS
The Minnesota Department of Health publishes a list of providers of mold testing services and other air-testing services. (See www.health.state.mn.us/divs/eh/indoorair/ contractors.pdf).
The Legislature might wish to authorize an agency of the State of California to develop a comparable list of service providers for California, encompassing one or more of the following: air quality services, mold assessment, mold remediation.

That could be done even without licensing of service providers and without certification of licensed contractors specifically to provide the named services, although some standards are appropriate for placement on the published list to assure at least a minimum level of competence.

The Legislature could consider authorizing a State agency to develop procedures and policies and to carry out the task.

BUILDING STANDARDS
Indoor water damage and dampness are damaging and costly and can pose health risks.

The Legislature might wish to examine or request appropriate review of building standards to identify changes that can help to prevent leaks and chronic dampness in buildings.

Issues to be examined might include strengthening architectural and engineering emphasis on dampness control and leak prevention, strengthening methods to assure that waterproofing measures are properly installed during construction, and assuring that energy efficiency measures do not result in indoor water accumulation.

EXPLICIT HAZARD WARNING REQUIREMENTS
Molds (and other microbial contaminants) present risks to persons working in contaminated environments. Those risks are different from the chemical risks typically addressed by workplace hazard communications.

The Legislature might wish to consider enacting a requirement that workers and building occupants be advised explicitly of hazards posed by mold and other microbial contamination affecting work areas.

That could be accomplished by requiring that the HESIS “Molds in Indoor Workplaces” flier or comparable information be posted in workplaces along with other normal workplace health and safety communications. Alternatively, this need might be met through administrative regulation on the subject of workplace health and safety notices.

REVIEW OF RENTERS’ RIGHTS
Renters can face the results of water damage in the form of mold and other microbial contamination even after the cause, such as a plumbing leak, has been repaired. Although current California law and regulation provide certain rights to renters when repair or maintenance is required, the Legislature might wish to initiate an inquiry as to whether the specified rights encompass cleanup and repair of such results of water damage as well as repair of the cause itself, and if not, to address that omission.

Texas

Mold Reduction and Remediation. Task Force Report

Report to the Texas Residential Construction Commission, March 2005

[selected text from page 2]

The task force recommends the commission consider implementing programs that:

• Reinforce the provisions of the IRC [International Code Council's International Residential Code] that specifically address limiting moisture intrusion;

• Encourage the protection of construction materials stored on the job site from long term or intense exposure to moisture prior to installation;

• Recommend Builders/Remodelers and homeowners follow the most current Texas Department of Health rules and other industry guidelines in the assessment and remediation of mold growth when found in the residential environment;

• Postpone identifying quantified permissible limits on mold and microbial volatile organic compounds in indoor residential environments until the scientific communities studying the science of health impacts on humans are able to accurately establish permissible limits of mold exposure; and

• Educate homeowners about how to identify mold in a home, techniques to prevent mold growth, and recommended remediation practices.

Pennsylvania

Pennsylvania Mold Management Task Force Report to the Pennsylvania General Assembly

August 2006

[selected text from page 2]

The following provides a brief summary of the recommendations made with respect to each of the four critical areas. More detailed information regarding each of these topics is contained within the report.

PUBLIC EDUCATION

• Develop a central mold information website.
• Develop a public education media campaign.
• Develop print materials to be made available at public locations throughout the Commonwealth.
• Distribute information at events where large numbers of the general public come together.
• Incorporate mold control education into the integrated pest management curriculum required to be taught in Pennsylvania schools.
• Amend the Pennsylvania Right to Know Act to require the maintenance and disclosure of information concerning biological substances present on site and known to the owner/employer.

ASSESSMENT AND REMEDIATION

• Adopt the 2000 New York City Department of Health & Mental Hygiene Guidelines on Assessment and Remediation of Fungi in Indoor Environments (NYC Guidelines) in their entirety when mold assessment and/or mold remediation take place in the indoor environment.
• Adopt the NYC Guidelines as minimum standards and that additional, more stringent practices be utilized if deemed necessary by the competent professional conducting an assessment or overseeing remediation.

LICENSING AND CERTIFICATION OF MOLD ASSESSORS AND REMEDIATORS

• Evaluate the feasibility of Commonwealth licensing for both mold assessors and remediators by an advisory group of experts representing all potential stakeholders.

INSURANCE COVERAGE OF MOLD ASSESSORS AND REMEDIATORS

• Recommend that assessment and remediation contractors carry commercial general liability insurance, contractors pollution liability insurance (for remediation work), and professional liability insurance (for assessment) insuring them against their general business activities and any negligence in performing their service.
• Promote public education campaigns stressing that home and business owners should require that assessment and service contractors have the type of coverage listed above before commencing work.

Maine

Report of the Mold in Maine Buildings Task Force. Including Recommendations Regarding Mold and Moisture in Maine Buildings

Maine Department of Health & Human Services and Maine Department of Environmental Protection, January 2007

[selected text from pages 2-3]

Priority Recommendations:

• Maine should publish the availability of guidelines and standards for: 1) the assessment of mold problems in Maine buildings, 2) the remediation of mold contamination from Maine buildings, 3) the education and certification of mold assessment and remediation professionals, and 4) worker protection. Preference should be given to ANSI accredited standards, independent third-party certifications, and federal guidelines. Strategies to communicate the availability of this information to professionals and members of the general public must also be considered. An additional staff position should be created within the Department of Health and Human Services, Maine Center for Disease Control (Maine CDC) specifically to address mold issues.

• Add mandatory moisture control provisions to the Maine Model Building Code, including

-- flashing of all windows and doors;

-- insulation and waterproofing of all basement concrete (walls *and* floor); and

-- placement of vapor diffusion retarders on the warm in winter side of insulation surfaces (e.g., walls, ceilings, and floors).

• In cases where project mold assessment and remediation services are provided by the same company, contractors should be required to provide owners/agents with a signed disclosure statement regarding the potential for conflict of interest in providing both mold assessment and remediation services.

• Tenants rights laws and guidance must be strengthened by requiring mediation between tenants and landlords in mold/moisture disputes, prior to requiring the tenant to pursue legal action against the landlord as is currently the case under the Maine Warranty of Habitability Act, 14 M.R.S.A. § 6021.

• Add a provision to 17 MRSA c. 91 that specifically grants authority to the Local Health Officer for the purpose of investigating mold as a public or private nuisance.

• Maine should add a provision to 10 MRSA c.219-A *Home Construction Contracts* within §1487 that requires contractors performing mold remediation or home construction activities to disclose any training received and certifications held by the project supervisor. An additional Assistant Attorney General position within the Office of the Attorney General could be created and funded to enforce the Home Construction Contract Act and related consumer protection laws with a focus on responding to consumer complaints related to mold assessment, mold remediation, and substandard building construction and renovation.

H. Mold assessment consultant recommendations for exposure limits or clearance criteria used to evaluate indoor mold sampling data from building-investigation reports submitted to NYSDOH for review.

This table provides thumbnail descriptions of mold-related indoor air quality investigation reports issued to homeowners or building owners/managers by private consultants that NYSDOH staff were asked to review. They are compiled here primarily to demonstrate the diversity of qualitative and quantitative criteria that have been used by private mold assessment consultants as a basis for making recommendations about mold remediation actions or building clearance decisions. They are not intended to fully evaluate indoor air quality conditions in these buildings or the consultant's assessment practices.

Terms and abbreviations used in this table:
CFU = colony forming units (a measure of mold or bacteria counts from environmental samples)
CFU/g = colony forming units per gram of sample material collected
CFU/in2 = colony forming units per square inch of surface sampled
CFU/m3 = colony forming units per cubic meter of air sampled
NA = information not available
Surface sample = sample collected by wiping or swabbing a surface or using sticky tape to lift a sample from a surface
Bulk sample = sample collected of a piece of building material such as drywall, carpeting or ceiling tile

Building type (Year)	Sample Methods	Air Criteria	Surface or Bulk Criteria	Interpretation and basis of recommendations
9 School survey (1995)	Air – not described Surface – 'nutrient swab' without further details	fungi > 'ambient' level bacteria > 'ambient' level air levels reported as CFU (no volume)	nutrient swab > 250 CFU (area unspecified)	any air level above ambient considered elevated; some ambient fungal results were zero
School (1996)	Air – Anderson volumetric impactor Bulk – nutrient surface swabs	elevated: bacteria > 4500 CFU/m3 fungi vary from 1000 – 10,000 CFU/m3 depending on season also compare to ambient levels	elevated: 250 CFU (area unspecified)	repeated sampling found elevated air levels of bacteria, compared to ambient levels recommendations to repair roof leaks, remove stained ceiling tiles and clean rooms with a disinfectant not directly related to sampling results
School (1997)	Air – Anderson volumetric impactor	none given	NA	qualitative conclusion of no presence of toxigenic molds or pathogenic bacteria indicated recommendations to improve maintenance practices and regularly re-evaluate air quality unrelated to sampling results
School (1997)	Air – Anderson volumetric impactor bulk – viable counts from suspension; direct microscopy; tape lifts	200 CFU/m3 'generally accepted as action level' for fungi and bacteria	< 10,000 CFU/g 'will not normally cause a problem'	'populations indoors should be quantitatively lower but qualitatively similar to outdoor levels' stated action levels 'will not normally cause a problem for the respiratory susceptible population' recommendations to reduce dust in carpets and remove visible mold growth on surfaces

Building type (Year)	Sample Methods	Air Criteria	Surface or Bulk Criteria	Interpretation and basis of recommendations
School (1997)	Air – Anderson volumetric impactor bulk – viable counts from suspension	200 CFU/m3 'generally accepted as action level' for fungi and bacteria	< 10,000 CFU/g 'will not normally cause a problem'	'populations indoors should be quantitatively lower but qualitatively similar to outdoor levels' stated action levels 'will not normally cause a problem for the respiratory susceptible population'
State govt (1998)	bulk – viable counts from suspension; tape lifts	NA	bulk: < 10,000 CFU/g and < 129 CFU/in2 'will not normally cause a problem' tape lift: none given	'populations indoors should be quantitatively lower but qualitatively similar to outdoor levels' stated action levels 'will not normally cause a problem for the respiratory susceptible population'
County govt (1999)	Not described	fungi > 150 – 200 CFU/m3 "as well as type isolated" total bacteria > 500 – 1000 CFU/m3 "as well as type isolated"	NA	identify amplification sites some fungal samples reported 'elevated' although all well below outdoor levels
School (2000)	Air – Anderson volumetric impactor Bulk – materials with visible scaling	acceptable: indoor/outdoor ratio < 2 as well as types of organisms isolated fungal amplification: > 150 – 200 CFU/m3 bacterial upper acceptable limit: 500 – 1000 CFU/m3	none given	air levels similar to outdoor, but considered elevated 'unfavorable' fungi in bulk samples recommendations to find and correct water problems and remove soiled materials

Building type (Year)	Sample Methods	Air Criteria	Surface or Bulk Criteria	Interpretation and basis of recommendations
School (2002)	Air – Anderson volumetric impactor Air -- Zefon Air-O-Cell volumetric spore trap Bulk – unspecified bulks; surface swabs; surface tape lifts (2 different consultants)	<u>consultant 1:</u> none given <u>consultant 2:</u> general reference to evaluate concentrations from spore-trap counts: low: < 900 spores/m3 moderate: 900 – 2500 elevated: 2500 – 25,000 high: > 25,000 also compare inside vs. outdoor levels	<u>consultant 1:</u> none given <u>consultant 2:</u> none given	complaint driven by known water intrusion in newly constructed building <u>consultant 1:</u> recommendations for repeated mitigation and re-sampling based on any detection of Stachybotrys or Aspergillus versicolor in any sample <u>consultant 2:</u> indicated many limitations with interpreting bioaerosol sampling results visual inspection identified small isolated areas of suspected fungal growth concluded air concentrations were low compared to outdoors and mostly similar species results of baseline assessment 'confirm...no significant sources of fungal growth' with foregoing conclusions, recommended thorough microbiological investigation of entire school

Building type (Year)	Sample Methods	Air Criteria	Surface or Bulk Criteria	Interpretation and basis of recommendations
State govt (2002)	Air -- Anderson volumetric impactor Bulk – surface tape lifts	none given	none given	complaint driven by known water intrusion and odors from wet carpet samples collected 'to determine the presence of fungi' if fungi determined to be present, a visual examination and sampling evaluation proposed to 'delineate the extent of the fungi' air samples unable to verify fungi above background because of open windows fungi found in tape lifts more air and surface samples proposed to 'allow for a more definitive analysis of the fungal problem'
Residence (2003)	Air -- Zefon Air-O-Cell volumetric spore trap Bulk – surface swabs	none given	none given	subjective judgment that total counts were generally low, but some higher than background; more investigation needed qualitative listing of detected genera in air and bulk/surface samples 'characteristics' of detected genera including toxigenic and indicators of water damage

Building type (Year)	Sample Methods	Air Criteria	Surface or Bulk Criteria	Interpretation and basis of recommendations
School (2003)	Air – Cycles-D volumetric spore trap Bulk – unspecified bulks; surface swabs; surface tape lifts	none given	none given	qualitative listing of detected genera in air and bulk/surface samples 'characteristics' of detected genera including allergenic, toxigenic and pathogenic subjective judgment that levels of mold and fungus species considered low for the time of year detailed mitigation plan to fix known roof leaks and remove wet/moldy materials
School (2003)	Air -- Anderson volumetric impactor Bulk – surface swabs	none given	none given	no interpretation; only raw data

Building type (Year)	Sample Methods	Air Criteria	Surface or Bulk Criteria	Interpretation and basis of recommendations
School (2004)	Air – Anderson volumetric impactor Air -- Zefon Air-O-Cell volumetric spore trap Bulk – unspecified bulks; surface swabs; surface tape lifts	'industry acceptable reference ranges': fungi & bacteria: < 200 CFU/m3 (lower range) < 1000 CFU/m3 (upper range) total spore trap mold counts < 1000 spores/m3 >1000 spores/m3 = high infiltration/possible growth > 5000 spores/m3 = active indoor growth/inadequate housekeeping >10,000 spores/m3 = contamination present	'industry acceptable reference ranges': bulk: < 10,000 CFU/g swab: < 750 CFU/in2 OR < 10,000 per wipe for fungi and bacteria tape lift: rare: 1 – 5 spores few: 6 – 10 spores moderate: 11 – 50 spores many: > 50 spores loaded: too numerous to count	strict acceptable/unacceptable interpretation based on industry reference values no reference to indoor/outdoor comparisons no reference to visual inspection results
School (2004)	Air -- Zefon Air-O-Cell volumetric spore trap Bulk – surface swabs	none given	none given	one air sample considered 'elevated' for fungi compared to outdoor sample one surface swab considered 'elevated' for bacteria – no comparison value given recommendations to fix known water leaks, remove moldy source materials and conduct periodic bioaerosol monitoring for air quality assessment based on visual assessment

Building type (Year)	Sample Methods	Air Criteria	Surface or Bulk Criteria	Interpretation and basis of recommendations
School (2005)	Air – Zefon Air-O-Cell volumetric spore trap Air – Anderson volumetric impactor Bulk – unspecified dust and bulk materials + surface swabs	'generally accepted' limits for acceptable spore-trap levels: < 500 spores/m3 Aspergillus/Penicillium as 'professional limit for clearing buildings' < 1000 spores/m3 for individual spore types < 0 (sic) spores/m3 for Stachybotrys 'generally accepted' limits for Anderson results as unacceptable conditions: presence of 'certain pathogens such as Aspergillus fumigatus and certain toxigenic fungi such as Stachybotrys' > 50 CFU/m3 any fungal species dominance indoors of species not predominant outdoors	'generally accepted' limits: normal: 0 – 10,000 CFU/g borderline: 10,000 – 100,000 CFU/g elevated: 100,000 – 200,000/g infested: >200,000 CFU/g categories also dependent on presence of unspecified 'indicator' species surface swabs: normal: <2500 CFU/in2 boderline: 2500 – 7500 CFU/in2 elevated: >7500 CFU/in2	an odor from storage room prompted visual investigation that found no signs of water damage or mold growth, but did identify soiled cleaning equipment and a refrigerator in need of cleaning nearly 80 samples collected recommended further investigation and follow-up sampling in areas with elevated Pen/Asp counts recommended fixing water intrusions and removing any mold source materials; primarily from a crawlspace

Building type (Year)	Sample Methods	Air Criteria	Surface or Bulk Criteria	Interpretation and basis of recommendations
State govt (2006)	Air – Zefon Air-O-Cell volumetric spore trap	none given	NA	comparison with outdoor levels and species conclusions of possible fungal reservoirs based on subjective judgment and not directly attributable to air sampling interpretation
Hospital (2006)	Air – Zefon Air-O-Cell volumetric spore trap (fungi) Air – Anderson volumetric impactor (bacteria)	none given	NA	no interpretation; only raw data
Residence (2007)	Air – Zefon Air-O-Cell volumetric spore trap	none given	NA	comparison of one sample from bedroom with one 'control' sample from kitchen post-remediation 'clearance' sampling compared 5 room samples with outdoor sample no mitigation recommendations depended on sampling results or their interpretation
County govt (2007)	Air – Zefon Air-O-Cell volumetric spore trap	none given	NA	first 2 sets: no interpretation; only raw data third set: presence of Stachybotrys spores basis for recommending evacuating space although 'cursory visual assessment' found 'no obvious growth'

Building type (Year)	Sample Methods	Air Criteria	Surface or Bulk Criteria	Interpretation and basis of recommendations
Hospital (2008)	Air -- unspecified 'bioaerosol testing' Bulk – surface swab	none given	none given	visual inspection identified mold source behind baseboard subjective judgment of no indoor air impact no mitigation recommendations depended on sampling results or their interpretation
Residence (2009)	Air – Z5 volumetric spore trap Bulk – unspecified surface sample	< 500 spores/m3 Aspergillus/Penicillium as 'professional limit for clearing buildings' > 1000 spores/m3 Aspergillus/Penicillium as indication of potential mold growth problems	none given	air levels considered elevated visual inspection identified visible water damage and mold growth mitigation recommendations based on cleaning or eliminating source materials no mitigation recommendations depended on sampling results or their interpretation

I. World Health Organization: Guidelines for indoor air quality: dampness and mould *(2009). Executive summary.*

This document presents World Health Organization (WHO) guidelines for the protection of public health from health risks due to dampness, associated microbial growth and contamination of indoor spaces. The guidelines are based on a comprehensive review and evaluation of the accumulated scientific evidence by a multidisciplinary group of experts studying health effects of indoor air pollutants as well as those specialized in identification of the factors that contribute to microbial growth indoors.

Problems of indoor air quality are recognized as important risk factors for human health in both low-income and middle- and high-income countries. Indoor air is also important because populations spend a substantial fraction of time within buildings. In residences, day-care centres, retirement homes and other special environments, indoor air pollution affects population groups that are particularly vulnerable due to their health status or age. Microbial pollution involves hundreds of species of bacteria and fungi that grow indoors when sufficient moisture is available. Exposure to microbial contaminants is clinically associated with respiratory symptoms, allergies, asthma and immunological reactions.

The microbial indoor air pollutants of relevance to health are widely heterogeneous, ranging from pollen and spores of plants coming mainly from outdoors, to bacteria, fungi, algae and some protozoa emitted outdoors or indoors. They also include a wide variety of microbes and allergens that spread from person to person. There is strong evidence regarding the hazards posed by several biological agents that pollute indoor air; however, the WHO working group convened in October 2006 concluded that the individual species of microbes and other biological agents that are responsible for health effects cannot be identified. This is due to the fact that people are often exposed to multiple agents simultaneously, to complexities in accurately estimating exposure and to the large numbers of symptoms and health outcomes due to exposure. The exceptions include some common allergies, which can be attributed to specific agents, such as house-dust mites and pets.

The presence of many biological agents in the indoor environment is due to dampness and inadequate ventilation. Excess moisture on almost all indoor materials leads to growth of microbes, such as mould, fungi and bacteria, which subsequently emit spores, cells, fragments and volatile organic compounds into indoor air. Moreover, dampness initiates chemical or biological degradation of materials, which also pollutes indoor air. Dampness has therefore been suggested to be a strong, consistent indicator of risk of asthma and respiratory symptoms (e.g. cough and wheeze). The health risks of biological contaminants of indoor air could thus be addressed by considering dampness as the risk indicator.

Health hazards result from a complex chain of events that link penetration of water indoors, excessive moisture to biological growth, physical and chemical degradation, and emission of hazardous biological and chemical agents. The review of scientific evidence that supports these guidelines follows this sequence of events. The issues related to building dampness and its effect on indoor exposure to biological and non-biological pollutants are summarized in Chapter 2, which also addresses approaches to exposure assessment. An important determinant of dampness and biological growth in indoor spaces is ventilation, and this issue is discussed in Chapter 3. The evidence for the health effects of indoor exposure is presented in Chapter 4, based on a review of epidemiological studies and of clinical and toxicological research on the health effects of dampness and mould. The results of the epidemiological and toxicological studies are summarized in the appendices.

The background material for the review was prepared by invited experts and discussed at a WHO working group meeting, convened in Bonn, Germany, 17– 18 October 2007. The conclusions of the working group discussion are presented in Chapter 5 and are reproduced in this executive summary, as follows.

- Sufficient epidemiological evidence is available from studies conducted in different countries and under different climatic conditions to show that the occupants of damp or mouldy buildings, both houses and public buildings, are at increased risk of respiratory symptoms, respiratory infections and exacerbation of asthma. Some evidence suggests increased risks of allergic rhinitis and asthma. Although few intervention studies were available, their results show that remediation of dampness can reduce adverse health outcomes.
- There is clinical evidence that exposure to mould and other dampness-related microbial agents increases the risks of rare conditions, such as hypersensitivity pneumonitis, allergic alveolitis, chronic rhinosinusitis and allergic fungal sinusitis.

- Toxicological evidence obtained in vivo and in vitro supports these findings, showing the occurrence of diverse inflammatory and toxic responses after exposure to microorganisms isolated from damp buildings, including their spores, metabolites and components.
- While groups such as atopic and allergic people are particularly susceptible to biological and chemical agents in damp indoor environments, adverse health effects have also been found in nonatopic populations.
- The increasing prevalences of asthma and allergies in many countries increase the number of people susceptible to the effects of dampness and mould in buildings.

The conditions that contribute to the health risk were summarized as follows.

- The prevalence of indoor dampness varies widely within and among countries, continents and climate zones. It is estimated to affect 10–50 percent of indoor environments in Europe, North America, Australia, India and Japan. In certain settings, such as river valleys and coastal areas, the conditions of dampness are substantially more severe than the national averages for such conditions.
- The amount of water on or in materials is the most important trigger of the growth of microorganisms, including fungi, actinomycetes and other bacteria.
- Microorganisms are ubiquitous. Microbes propagate rapidly wherever water is available. The dust and dirt normally present in most indoor spaces provide sufficient nutrients to support extensive microbial growth. While mould can grow on all materials, selection of appropriate materials can prevent dirt accumulation, moisture penetration and mould growth.
- Microbial growth may result in greater numbers of spores, cell fragments, allergens, mycotoxins, endotoxins, β-glucans and volatile organic compounds in indoor air. The causative agents of adverse health effects have not been identified conclusively, but an excess level of any of these agents in the indoor environment is a potential health hazard.
- Microbial interactions and moisture-related physical and chemical emissions from building materials may also play a role in dampness-related health effects.
- Building standards and regulations with regard to comfort and health do not sufficiently emphasize requirements for preventing and controlling excess moisture and dampness.
- Apart from its entry during occasional events (such as water leaks, heavy rain and flooding), most moisture enters a building in incoming air, including that infiltrating through the building envelope or that resulting from the occupants' activities.
- Allowing surfaces to become cooler than the surrounding air may result in unwanted condensation. Thermal bridges (such as metal window frames), inadequate insulation and unplanned air pathways, or cold water plumbing and cool parts of air-conditioning units can result in surface temperatures below the dew point of the air and in dampness.

On the basis of this review, the following guidelines were formulated.

- Persistent dampness and microbial growth on interior surfaces and in building structures should be avoided or minimized, as they may lead to adverse health effects.
- Indicators of dampness and microbial growth include the presence of condensation on surfaces or in structures, visible mould, perceived mouldy odour and a history of water damage, leakage or penetration. Thorough inspection and, if necessary, appropriate measurements can be used to confirm indoor moisture and microbial growth.
- As the relations between dampness, microbial exposure and health effects cannot be quantified precisely, no quantitative health-based guideline values or thresholds can be recommended for acceptable levels of contamination with microorganisms. Instead, it is recommended that dampness and mould-related problems be prevented. When they occur, they should be remediated because they increase the risk of hazardous exposure to microbes and chemicals.
- Well-designed, well-constructed, well-maintained building envelopes are critical to the prevention and control of excess moisture and microbial growth, as they prevent thermal bridges and the entry of liquid or vapour-phase water. Management of moisture requires proper control of temperatures and ventilation to avoid excess humidity, condensation on surfaces and excess moisture in materials. Ventilation should be distributed effectively throughout spaces, and stagnant air zones should be avoided.
- Building owners are responsible for providing a healthy workplace or living environment free of excess moisture and mould, by ensuring proper building construction and maintenance. The occupants are responsible for managing the use of water, heating, ventilation and appliances in a manner that does not lead to dampness and mould growth. Local recommendations for different climatic regions should be updated to control dampness-mediated microbial growth in buildings and to ensure desirable indoor air quality.

- Dampness and mould may be particularly prevalent in poorly maintained housing for low-income people. Remediation of the conditions that lead to adverse exposure should be given priority to prevent an additional contribution to poor health in populations who are already living with an increased burden of disease.

The guidelines are intended for worldwide use, to protect public health under various environmental, social and economic conditions, and to support the achievement of optimal indoor air quality. They focus on building characteristics that prevent the occurrence of adverse health effects associated with dampness or mould. The guidelines pertain to various levels of economic development and different climates, cover all relevant population groups and propose feasible approaches for reducing health risks due to dampness and microbial contamination. Both private and public buildings (e.g. offices and nursing homes) are covered, as dampness and mould are risks everywhere. Settings in which there are particular production processes and hospitals with high-risk patients or sources of exposure to pathogens are not, however, considered.

While the guidelines provide objectives for indoor air quality management, they do not give instructions for achieving those objectives. The necessary action and indicators depend on local technical conditions, the level of development, human capacities and resources. The guidelines recommended by WHO acknowledge this heterogeneity. In formulating policy targets, governments should consider their local circumstances and select actions that will ensure achievement of their health objectives most effectively.

J. Specific ideas to consider related to task force conclusions and recommendations

Codes

- Improve attic design standards to prevent ice dams
- Require that mold resistant materials be used in basements; e.g., materials that achieve the highest mold resistance figures using ASTM D3273 or ASTM D3274
- Include a specific inspection milestone or check off for moisture prevention detailing in new construction
- Provide more specific authority to issue violations for dampness and/or mold problems based on property maintenance/habitability for rental properties, particularly outside of NYC

Education & Outreach

- Seek opportunities for outreach via landlords to tenants; lenders to building buyers; lenders to builders
- Develop a central mold information website
- Develop a public education media campaign
- Distribute information at events where large numbers of the general public come together
- Incorporate moisture and mold prevention and mitigation education into integrated pest management training
- Work with professional associations (e.g., AIA) to identify and disseminate architectural detailing standards that avoid moisture problems in buildings
- Promote the moisture control guidance in the EPA/ASHRAE Indoor Air Quality Guide: Best Practices for Design, Construction, and Commissioning

K. Background information on certification, training and licensing programs for assessment and remediation services and public education programs

Certification, Training and Licensing programs

NYS Asbestos Worker Training Certification Program - Regulates approval of asbestos training providers in NYS so that workers receive training and skills to remove or contain asbestos properly.
1. Reviews and approves applications, including all curricula and instructors for training providers who meet qualifications.
2. Conducts compliance audits of approved trainers.
3. Maintains a list of accredited training providers and course dates.

For calendar years 2002 and 2003 program staff conducted more than 60 audits per year of training programs. The audits are targeted to high volume and suspect providers. About 3,500 courses are given every year and about 2% of the courses are audited. As a result of the audits, about 220 compliance violations were issued, resulting in the suspension of three providers and the revocation of accreditation of one provider. The Department made three referrals to the NYS Office of the Attorney General for serious issues on non-compliance (falsifying certificates, failure to administer final exams and failure to perform hands-on training).

For State Fiscal Years 2002-03 and 2003-04 this program was funded at $573,000 and $579,000, respectively, including five full-time equivalents, travel, supplies, equipment and training**.**

NYS Department of Labor, Asbestos Control Program (ACB) - Oversees the abatement of toxic hazards associated with asbestos fiber during the rehabilitation, reconstruction or demolition of buildings and other structures originally constructed with asbestos or asbestos containing materials. The Bureau enforces the New York State Labor Law and Industrial Code Rule 56 (Asbestos). Requirements of this code include the licensing of contractors, certification of all persons working on asbestos projects, filing of notifications of large asbestos projects and pre-demolition survey of buildings to identify any asbestos, which may be present, to ensure proper abatement of asbestos materials. The Bureau includes staff from central office and 4 district offices in NYS.
The program is currently funded at $3,500,000 and including 30.6 full-time equivalents and non- personnel service costs.
During the state fiscal year 2007-08, the Licensing and Certification Unit of the Bureau received, processed and issued 20,511 certificates and 1221 licenses. In calendar year 2008 the bureau collected $417,352 in penalties. Latest 3 month activity report for the bureau showed 2,372 notifications, 117 complaints, 978 inspections and 480 violations.

Louisiana - Requires licensure and regulation via licensing by the State Licensing Board of Contractors for persons who perform mold remediation services. The license is required for removal, cleaning, sanitizing, demolition or other treatment for prevention of mold growth.
1. Adopt rules/regulations to administer mold remediation
2. Issue, suspend modify revoke license to practice mold remediation
3. Report violations to the attorney general
4. Maintain an up-to-date list of licensees
5. Adopt minimum standard of practice to conduct mold remediation (18 years old, high school education or equivalent, approved training/course work)

Texas- Provides for training and licensing for mold assessment and remediation services to ensure that persons conducting mold assessment and remediation services in Texas are properly trained and licensed and are following minimum standards to protect the health of workers and building occupants. Focus is to provide oversight and education of the regulated community while providing information services to the general public.
Conduct a statewide education and outreach program on the importance of and ways to improve air quality in buildings, including ways to recognize, prevent, control and mitigate mold occurrence (develop and distribute information, education programs, informational or educational exhibits, and other methods of education or communication that dept. considers appropriate).

1. License persons or companies conducting mold assessment/remediation
2. Review/approve mold training programs; providers are accredited after approval of programs
3. Notification of mold remediation projects, field inspectors conduct inspection of notified projects
4. Perform investigations of remediation projects and investigate complaints for possible violations
5. Conduct enforcement activities. Penalty monies do not come back to the program, but go into the general fund
6. Includes fees for licenses, registration and exams.

Texas staff estimate that 10 FTEs are used for this program.
Mold notification projects 1,057
Site Inspections 428
Complaints 57
Penalties (11 months) 134
Number of active credentials (e.g. technicians, consultants, workers, contractors) (as of 10/09) 4,192.

Public Education

Tobacco

New York Tobacco Control Program (NY TCP) - *established in 2000, current funding level for fiscal year 2009 -2010 is $55.1 million.* Three key programmatic strategies: community action, public health communication and cessation intervention approaches. These components are supported by surveillance, evaluation and statewide coordination.

Community Action: Change the community environment to support the tobacco-free norm, change community attitudes about tobacco and denormalize tobacco use. Efforts focused on increasing policy changes have shown to be beneficial by measuring the number of municipalities and community organizations that are instituting tobacco control policies and resolutions. NYS has implemented comprehensive smoke-free air laws to eliminate smoking from workplaces, including bars and restaurants and has increased the cigarette excise tax.

Public Health Communication: Uses mass media, public relations and media advocacy to motivate tobacco users to stop, promote smoke-free homes and cars, promote effective tobacco control community policies, expose tobacco industry propaganda and reduce the social acceptability of tobacco use. New Yorkers confirmed awareness of counter marketing advertisements increase from 5.9 percent in 2003 to 52.8 percent in 2007 among smokers statewide. Evidence suggests the increase in awareness translates into increased quit attempts. In fiscal year 2008 the media budget was about 25 percent of the overall TCP budget.

Cessation Approaches: Work with health care organizations and provider to implement systems to screen patients for tobacco use and prompt providers to offer advice and assistance to quit. Provides cessation support and services through hotline and other venues. Trends in smoking cessation provide further evidence that cigarette use is declining faster in NYS than nationally. The percentage of NYS smokers who indicate they intend to attempt to quit in the next 30 days has increased by 50 percent from 2003 (26 percent) to 2008 (39 percent). The percentage of smokers who have made an attempt to quit in the past 12 months increased from 46 percent in 2003 to 59 percent in 2008.

Lead

Prevention of Childhood Lead Poisoning - *$15.6 million targeted for primary prevention initiative (includes NYC) over 3 years.*

Funding was used to undertake a targeted primary prevention initiative (targeted to houses built before 1978). NYSDOH identified 15 counties with high incidence of childhood lead poisoning (accounts for 79 percent of 2005–2007 elevated blood lead level cases reported statewide. As of June 30, 2009, the following was accomplished:

Education and outreach to at-risk populations and general community. Work with local advisory groups or coalitions to build community awareness. *Reached over 9,000 household through direct outreach and referral,*

nearly 32,000 individuals through informational meetings and other events. Mass media coverage reached nearly 12 million across the twelve participating counties.

Coordinate referral services. *Conducted home visits for almost 1,914 children age six and under, and referred 541 children (60 percent lived in home with identified lead hazards) for blood-lead testing.*

Build relationships with local housing agencies and community organizations. *Investigated over 2,984 housing units for lead-based paint: more than half (½) were found to have a presumptive lead hazards and almost a third had some confirmed hazards. Created at least 459 lead-safe housing units.*

Promote training for contractors, landlords, tenants and do-it-yourselfers. *Trained over 1,310 property owners, contractors and do-it-yourselfers in lead-safe work practices.*

L. Supplemental materials on compact disc

A compact disc (CD) that contains supplemental materials accompanies this report. The CD includes copies of electronic and hard-copy materials submitted to the Task Force by members of the public, a copy of the Task Force law, copies of the Task Force public meeting and conference call agendas and copies of presentation slides from the public meetings. The CD also contains copies of the written comments received during the public comment period for the public review draft of the report.