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Facts About Mold: An AIHA Perspective for IEQ Investigators, Physicians, and Engineers

Fact Sheet

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The U.S. Centers for Disease Control and Prevention (CDC), the Institute of Medicine of the U.S. National Academy of Sciences, the American Academy of Allergy, Asthma & Immunology (AAAAI), Health Canada, and the World Health Organization all agree that living or working in a building with mold-damaged building materials results in increased risk of respiratory diseases such as asthma.

The American Industrial Hygiene Association (AIHA) has worked to translate the advice from these public health and medical authorities into state-of-the-art inspection and sampling protocols. These protocols are captured in AIHA's *Recognition, Evaluation and Control of Indoor Mold* publication, also known as the Green Book. These methods are suitable for assessing visible and hidden mold contamination and developing a mold remediation plan.

Assessments and reports based on the Green Book protocols are useful for industrial hygiene, occupational medicine, and allergy and respiratory medicine as well as the owners and engineers tasked with repairing and/or remediating buildings with mold growth. The information in this document represents a carefully reviewed summary of potentially useful information on the management and remediation of mold and dampness in buildings.

People with symptoms commonly associated with mold exposure and who have been informed that they have been living or working in a building with serious mold damage should consult their doctor. Allergists are best positioned to address specific concerns. Symptoms that may be believed to be from mold exposure may be due to other causes, such as bacterial or viral infections or other environmental allergies.

Authorities throughout the world agree that living or working in a building with active mold growth can result in respiratory health effects including exacerbation of asthma in mold-sensitive asthmatics as well as increased risk of getting allergic disease and

upper-respiratory disease. All of the guidelines referenced below state that if you see visible mold and damage, this should be addressed promptly.

Based on extensive research conducted all over the world, the authorities and guidelines acknowledge that the risk of mold-related health effects of building occupants is proportional to the extent of mold and moisture damage in the building. Hence the risk, as well as the complexity of managing a mold and dampness problem, is proportional to the nature and extent of mold growth and damage. A few square inches of visible mold on, for example, a window frame should be cleaned up as described by the U.S. Environmental Protection Agency (EPA) and other public health agencies' guidelines.

If extensive mold growth or mold-related damage is discovered, the risk of exposure of workers, including during cleaning, is serious, and the remediation should be handled by someone qualified and experienced in this area of practice. However, regardless of the amount of mold growth and related damage, the underlying moisture problem that has resulted in the growth must be addressed.

After the moisture problem is resolved and any mold growth or damage is removed, the space must be given a thorough cleaning to remove fine particles. This can normally be accomplished with a good-quality vacuum cleaner equipped with a high-efficiency particulate air (HEPA) filter and damp wiping of hard surfaces.

The health effects of mold generally relate to breathing fragments of the mixture of fungi that inevitably occur on a damp surface: they are never related to one species of mold. The fragments get into the air when the moisture dries and when there is movement of air across a surface where fungi fragments are found. If there is carpet present, the fungal fragments can accumulate and then can be resuspended by normal room activity.



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Molds can produce a number of biochemicals, notably mold glucan (“beta 1,3 D glucan in triple helical form”), as well as species-specific allergens and low molecular weight organic compounds. There is a broad consensus that allergic reactions reported with mold exposures in buildings are mainly due to mold glucan, allergens, and other mold proteins.

Some molds can also produce mycotoxins under certain conditions. Many of the mold species that can produce mycotoxins are found in agriculture growing on food and feed, but they do not grow on damp building materials. Animal studies have demonstrated that for mycotoxin-related health effects to be of concern, exposures to these agriculturally important mycotoxins generally require either very high airborne concentrations or exposure through ingestion.

There is wide variability in how people are affected by airborne mold spore exposure. People who may be affected more severely and quickly than others include:

- individuals with respiratory conditions, allergies, or asthma
- infants and children
- pregnant women

Investigation and remediation of mold and moisture damage in buildings must be based on an informed inspection augmented by the judicious use of consensus sampling methods. However, it must be noted that, in most cases, sampling (air, wipe, and bulk) is not necessary to identify and address the mold-related problem. The protection of remediation workers and occupants during investigation and remediation is essential to prevent unnecessary exposures.

In cases where occupants have serious preexisting respiratory conditions, relocation may be appropriate. This is particularly true in large buildings, where it is essential to consider that the number of people

in potentially higher risk categories might be quite large. Addressing potentially sensitive populations requires that the risk communication process be well managed and timely, such that people who might need to consult a physician are able to do so prior to mold disturbance and remediation.

It is very important to consider that it is not unusual for buildings to have several concurrent problems that affect indoor environmental quality (IEQ) or the perception of inadequate IEQ. Investigations of apparent or suspected mold-related health complaints should be holistic in nature, and they must consider all of the possible causes of adverse health symptoms and occupant complaints.

Studies of occupant complaints find that a high percentage of complaints perceived to be mold related are due instead to inadequate fresh air ventilation and distribution; a lack of temperature and humidity control; inadequate control of contaminants from outdoor air; and contaminants arising from equipment or activities occurring within the structure (including cooking).

CIHs and other IEQ practitioners

Certified Industrial Hygienists (CIHs) and other IEQ practitioners who are qualified in fungal assessment and remediation practices should approach mold growth and water-intrusion investigations with the same mind-set they use when they approach all IEQ and other investigations addressing potential occupant exposures. The process includes three of the five key industrial hygiene practice elements: anticipation, recognition, and evaluation.

Even though the CIH or IEQ practitioner can reasonably anticipate that there will be mold exposures associated with water intrusion when the water intrusion is not immediately addressed, mold may or may not be the primary cause of any adverse health



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effect(s) that may be experienced by the occupants. The CIH or IEQ practitioner should ensure that, while investigating mold-related complaints, whether apparent or reported, active consideration of other possibilities affecting IEQ in the space is an essential part of the investigation.

The first and most important factor in becoming a competent IEQ practitioner involved in mold assessment is to obtain the necessary experience in each of the broad categories of buildings discussed. A professional who primarily has dealt with single-family dwellings may not be qualified to investigate an office complex, a large school, or other more complex building environment, while the converse may also be true.

A second important factor is for the IEQ professional to become familiar with current best-practice guidelines from the AIHA and other authorities on building inspections and sampling (such as the AIHA Green Book, and the AIHA *Field Guide for the Determination of Biological Contaminants in Environmental Samples*).

In addition, for certain buildings, it is essential to be familiar with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) guidelines on moisture and ventilation management in *Standard 160 - Criteria for Moisture-Control Design Analysis in Buildings*, and the pertinent areas of ASHRAE's *Ventilation for Acceptable Indoor Air Quality Standards 62.1* (commercial buildings) and *62.2* (multifamily residential buildings).

How should a building be evaluated for mold growth?

The first step is to perform an inspection to check building materials and spaces for visible mold growth and signs of moisture damage indicating a history of water leaks and/or condensation. Any occupant complaints should be noted, as well as any musty or moldy odors.

Components of the building ventilation system should be inspected with particular emphasis on the filters, cooling coils (if present), the fan chamber (including drip and condensate pans), any internal insulation, and any plumbing where condensation may occur. If mold growth or moisture problems are identified, the potential for dissemination to other areas (including heating, ventilation and air-conditioning, or HVAC) operating conditions and air-pressure differentials between the area of growth and surrounding areas) should be determined. The nature and extent of the mold and moisture damage should also be characterized to determine its impact on the building and its occupants.

The risk of potential health consequences varies, but it is generally proportional to the amount of visible mold/moisture damage and the degree of isolation of the mold growth from the occupied space.

Exposure risk from greatest to least would be growth:

- on surfaces inside the HVAC system or adjacent to return/makeup air intakes,
- on surfaces exposed to occupied space,
- on interior walls or floor cavities, and
- in the interior of exterior walls with poor air barriers.

If the mold contamination is identified in the HVAC system, immediate steps are required to prevent dissemination of mold spores. If the mold damage is on the surface of walls, ceilings, or floors exposed to the occupied space, prompt steps are required to contain, and remediate, the mold-contaminated areas. These steps are urgent because what is visible on the occupied side of these surfaces is likely just a fraction of the total mold growth.

If mold is suspected but not visibly detected after a thorough inspection, then microbial air sampling conducted in accordance with guidance documents



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can be useful. This sampling may reveal evidence of indoor mold amplification or reservoirs, particularly of mold that is considered “hidden” behind walls and other building structures.

Air and/or settled dust sampling can be used to defend hypotheses about the nature of the contamination, “hidden” sources of contamination, and whether the levels of mold spores in the indoor air are similar to the levels of mold spores in the outdoor air. Laboratories vary in experience and proficiency: using an AIHA-LAP, LLC EMLAP accredited lab, or ISO 17025 equivalent is recommended.

There are several potential audiences for the reports of mold investigations. Regardless of the nature of the client (homeowner, insurance agent, large property company, government), reports must provide information that can (a) be translated into an action plan for repair and rehabilitation of the space; (b) provide a basis for protecting occupants and remediation workers’ health; and (c) be useful in certain situations for the personal physician and/or public health officials. As discussed in the AIHA Green Book, investigators should provide clear and consistent field notes in sufficient detail to allow the fieldwork and sampling data, if any, to be interpreted, verified, and repeated.

Recent guidelines from AAAAI focus on factors that promote allergen and contaminant production (often called “facilitating factors,” or conditions that are necessary for allergen-producing organisms; in this case, moisture) and reservoirs. In this context, properly conducted building inspections, which depend on the training and experience of the investigator(s), are essential to the physician’s evaluation of a patient’s residence or other occupied environment when respiratory symptoms are the major problem.

Physicians reviewing such reports should find clearly described key elements, and they should be able to judge the quality of the data and observations in a

report. At a minimum, reports should include a statement of purpose and limitations, observations, results of any testing, conclusions, and recommendations. Reports generated by IEQ practitioners should not include any speculation or conclusions concerning medical causation, or any other conclusions not within the expertise of the IEQ practitioner.

HVAC Engineers

As noted in the *ASHRAE Position Document on Limiting Indoor Mold and Dampness in Buildings*,

Based on past observation of problem buildings, dampness sufficient to cause problems seldom has a single cause. More often, a series of events, including decisions in many areas of professional and personal responsibility, combine in complex ways to cause a problem. Therefore, it is not appropriate to assign responsibility for building dryness to any one group, because it is not likely that any one group can prevent a problematic level of dampness, mold, and microbial growth by their actions alone.

Where relevant, mold and dampness investigations conducted by CIHs and other professional investigators should follow protocols defined in the AIHA Green Book. These protocols require detailed investigations and reporting on the HVAC system and other relevant factors affecting dampness and mold growth and exposure.

These Green Book protocols have been developed by ASHRAE members who are also involved with AIHA. Thus, terminology and the level of detail provided is designed to be familiar to the practicing engineer in the event there is a mold issue requiring upgrading of the HVAC system (Horner, 2017).

It is not unusual for buildings to have several concurrent problems that affect IEQ or the perception of poor IEQ. Aside from mold damage, studies of oc-



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cupant complaints find that a high percentage are the result of inadequate fresh air, poor temperature and humidity management, inadequate control of contaminants from outdoor air, contaminants arising from equipment or activities within the building or house. If present, these factors should normally be reported if AIHA IEQ protocols are being followed.

Other protocols that may be useful include the development of a mold-prevention program. This might include identifying areas in the building where condensation might occur and where the building is constructed of mold-sensitive materials.

Allergists and Allied Specialists

Ensuring the best patient care requires that mold and dampness contaminants be considered during patient evaluations. Two AAAAI clinical practice parameters discuss the fact that most exposure to cockroach and house dust mite allergens occurs in residential housing (Portnoy et al., 2013a, 2013b). Current best practice for the clinical management of patients who may be allergic to mold suggests the need to evaluate the housing conditions in a step-wise fashion (Kennedy et al., 2019).

For house dust mites (Portnoy et al. 2013b), and mold and dampness (Chew et al. 2016), questionnaires tailored to geographic locations in the United States and Canada have been developed to allow a physician or nurse to make a quick assessment as to whether or not a home assessment might be useful for asthma management. The basic principle is to eliminate *facilitating factors*, or conditions that are necessary for allergen-producing organisms. These conditions would include reducing material settled dust burdens and reducing moisture problems.

Making it difficult for unnecessary and unwanted organisms to survive in a building is a useful intervention (Kader et al., 2018; Kennedy et al., 2019).

Relevant interventions for both house dust mites and mold include reducing settled dust burdens and reducing humidity where condensation can occur. (See detailed discussion in Portnoy et al., 2013a, 2013b.) In addition to improved patient care, whether applied to large commercial buildings or residential buildings, effective interventions to reduce indoor allergen burdens are known to, or are expected to, have a positive return on investment (Horner, 2017; Krieger et al., 2010).

AIHA protocols for inspections in the AIHA Green Book were specifically developed in the context of patients who are potentially allergic to environmental allergens (Barnes et al., 2016). Similarly, the health information in the current AIHA guidance on mold investigations is aligned with material from the AAAAI (Mendell et al., 2020).

References

Listings of indoor air quality consultants can be obtained from AIHA's Consultants Listing, although AIHA does not recommend specific consultants. Additional technical information is included in the following sources.

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