PART III:

PREVENTION / PUBLIC HEALTH

Risk and Hazard Assessment of Molds Growing Indoors

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Learned Scientific Bodies have concluded that being exposed to mold indoors is unhealthful (IOM, 2004, Health Canada, 2007, WHO, 2009, AIHA, 2009). As early as 1996, AIHA recommended that immediate hazard assessment be performed when certain species of fungi were growing indoors in appreciable amounts. A few risk assessments have been attempted for indoor fungal growth, but have not provided credible results. This paper will delineate between hazard assessment and risk assessment and the basic kinds of knowledge required to achieve useful results.

Risk assessments, especially in methodology outlined by the U.S. E.P.A., are generally used to provide a guidance level of exposure that is tolerable or allowable in protecting the health of members the public, most often over long periods of exposure. Risk assessment is used in public health and regulatory efforts to prevent exposure. In contrast, hazard assessment speaks to a more immediate need for decisions about worker or public health protection. It is situation specific, assessing the nature and toxic potency of exposure, and the susceptibility of the particular population exposed, especially those who are vulnerable to the exposure in question. Hazard assessment is used to make immediate risk management decisions concerning removal of unhealthful agents from a site or removing vulnerable populations from exposure.

Since risk assessment is likely to be used for general public health protection or regulatory efforts, developing allowable or permissible exposure levels to human populations of variable susceptibility, its analyses are more extensive. According to EPA guidance, specific steps are involved: Hazard evaluation identifying a critical effect and critical study, Dose-Response Assessment using No-Observed Adverse Effect Levels (NOAELS) and Lowest-Observed Adverse Effect Levels (LOAELS), usually from chronic animal studies, Exposure Assessment, and Risk Characterization resulting in a Reference concentration that can be used in Risk Management.

Hazard Evaluation includes an extensive review of the literature to determine a critical effect that identifies that target organ or system that responds adversely at the lowest level of exposure in animal or epidemiological studies. It also identifies studies that satisfy criteria for adequacy to be used in quantitative dose-response assessments.

Dose-Response Assessment is performed using the critical effect and critical study in at least two relevant long-term animal or epidemiological studies that determine a NOAEL and a NOAEL.

Exposure Assessment requires that adequate measures of human exposure to the specific agents that have been identified in the previous analyses and which can be credibly quantified.

Finally, Risk Characterization using equations (mathematical models) developed to include both the measures of potency (NOAEL and LOAEL) as well as measures of exposure to healthy and susceptible populations, can be performed and may result in values that can be determined to be allowable or permissible exposure numbers. The quality of the risk assessment is determined by the quality of the input data, and always includes uncertainties that must be described.

Recommendations for detection and remediation of mold growth in indoor environments in Germany

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Moldy buildings are a relevant health problem in Germany. This became especially clear from the results of the German Environmental Survey for Children (GerES IV). This survey was the German Federal Environment Agency's fourth Environmental Survey and the environmental module of the German Health Interview and Examination Survey (German acronym: KiGGS) of the Robert Koch Institute (RKI). Conducted from 2003 to 2006, the objective of this cross-sectional nationwide study was to produce an extensive and representative data base to characterize the exposure of children in Germany to environmental factors. This large scale population study included a representative sample of 1790 children aged 3-16 years. The questionnaire-based interviews conducted in GerES IV for all children also asked about mold in the home and characteristics of the building. Visible mold growth was found in 15 % of the homes. Influencing factors for the occurrence of visible mold growth were age, type and location of the building. Mold growth occurred significantly more often ($p \leq 0.001$) in apartment blocks, multi-family buildings, old buildings and in urban areas.

In a case-control study, a sub-sample of GerES IV was used to investigate the correlation between exposure to mold spores in a home and sensitization of children to certain mold fungus species. Homes of all participants were thoroughly checked for visible mold and participants were interviewed about indicators of potential exposure to mold. In addition, samples were taken in the children's rooms or the living rooms to determine concentrations of fungi in indoor air and floor dust. From this study it became clear that 14 % of the dwellings had visible mold growth. Additionally, likely problems with hidden mold sources were discovered by air sampling methods in 17 % to 27 % (depending on the parameters analyzed) of the dwellings according to the criteria of the German Federal Environment Agency's guidelines (see below).

Indoor Water and Mold Damage - investigation and decontamination practices in Germany

Wolfgang Lorenz

It is well known, that different events can lead to high humidity in buildings and on materials such as furniture and other contents. Mold growth can occur with a minimum of 80% relative humidity over days on materials or surfaces. Water may enter a building from the outside such as the roof, outside walls or basement. Water pipes or showers may also leak and brake. Dampness from high water content in the indoor air can condensate on cold surfaces or humid outdoor air can cause condensation in the HVAC Systems.

In Germany, the occurrence of water and mold building damage appeared to have increased significantly in the last 15 years. The reasons for this are not known. One key factor may be the tightness of modern buildings as mandated by the German government to conserve energy. Often older buildings are in a bad condition, because owners do not invest sufficient money in necessary building repairs. New buildings are constructed as fast as possible to save money. For example, when the occupants move in, the foundation concrete may not even be sufficiently dry. Of note, one hundred years ago the Municipality of Berlin ruled that building occupants may not move into a newly constructed house but they have to wait 9 month after the construction was completed! Another factor may be that more hidden or invisible mold damages are identified by improved investigation methods compared to 15 years ago. Furthermore, the importance of mold prevention for improved health received more attention in public over the last years.

When large quantities of water are released into a building, mold damage may be controlled by speedy technical drying. Different specialized equipment is nowadays available and a variety of methods exist to dry up construction materials rapidly. However, it is not uncommon that damages resulting from the water entry are hidden, or overlooked and ignored.

It is necessary to define "water damage", before discussing analytical methods and remediation technologies. It should not only be defined as indoor growth of fungi. An earlier study conducted by this author showed that in most cases of water damage inside buildings, in addition to fungi also bacteria, in particular actinomycetes could be identified in the field samples, see table 1.

Update of Canadian and International Mold Guidelines and Standards

Donald M. Weekes

Since 2008 when the AIHA Green Book (Recognition, Evaluation and Control of Indoor Mold) was published, there have been numerous international (including Canadian) mold and moisture guidelines, reports and standards that have been promulgated by a variety of governmental entities, professional organizations and international agencies. Many of the standards and guidelines since the publication of the AIHA Green Book have utilized this AIHA book as a reference. During the September, 2011 Saratoga Bioaerosols conference presentation, these recent publications were summarized and compared to each other, and to the previous mold documents, including the AIHA 'Green Book'. Available information about forthcoming documents to be published was also discussed.

Defining "Clean" in terms of the unseen fraction: A Representative Marker in Schools

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Cleanliness requirements for public buildings, or specific operations within such buildings, often require facilities to be kept in a "clean" and "sanitary" condition, as typically determined by visual inspection. Such an assessment, however, remains inadequate concerning the removal of many unseen and unwanted pollutants (i.e. biological, chemical, particulate residues), thereby failing to reduce the burden of exposure and health risk to the building's occupants.

Dusts that accumulate in school buildings from track-in on shoes and clothing, fallout from HVAC systems, and from self-generating sources, such as insects and classroom animals, can trigger a variety of allergy and asthma responses in children. Asthma is now recognized as the leading cause of school absences in the US; and studies have shown a variety of potential triggers present in dusts collected from carpeted and hard surface floors in schools, to include pollen, as well as mold, cat, dog, mite, and cockroach allergens, among others (Smedje and Norback, 2001; Abramson et al., 2006). Increased efforts at improved cleaning of floors and desks in schools have been shown to reduce upper respiratory symptoms (Walinder et al., 1999).

Research has indicated that the rapid spread of viral disease in crowded classrooms is associated with the cleanliness of high contact inanimate objects. Inadequate cleaning and maintenance practices in schools, compounded by the effects of emerging infectious disease agents and climate change factors, can severely alter the school building ecosystem and put students' health at increased risk. CDC Guidance on Influenza in schools (2009-2010) states that "school staff should routinely 'clean' areas that students and staff touch often…" The challenge in setting practitioner-based cleaning protocols today is more related to how we define "clean" as it applies to health. The routine cleaning protocol based on visual assessment remains inadequate concerning the removal of the unseen fraction, thereby failing to reduce the burden of exposure and health risk to the building's occupants.

Preliminary research has identified the measurement of adenosine triphosphate (ATP) as a rapid, real-time, quantitative, and economical approach to the characterization and ultimate reduction of potentially harmful contamination on a variety of surfaces and materials. ATP is the energy driver for biological systems and can be measured through an enzymatic luciferin/luciferase reaction detected and quantified as bioluminescence. The method converts ATP into a light signal which is measured by an instrument that provides a quantitative measurement of ATP from biomass in Relative Light Units (RLU). Whereas ATP does not directly monitor viruses in an environment, it does measure a mixture of biological forms that indicate human cellular material, along with bacteria and fungi. Such material includes epithelium from upper respiratory mucus membranes (mouth, throat, nasal passages) from saliva and exudates and associated material from coughs and sneezes from persons with viral, as well as bacterial infections. Viruses are associated with living cells as viruses need them to replicate. Again, ATP is an overall generic marker of biological contamination, and it allows us to monitor potential viral contamination (from viral infections) "indirectly". ATP has more recently been used as a marker for contaminant loads in both hospital settings and the food industry. This paper addresses preliminary measurements of ATP in occupied school conditions.

Effective risk communication concerning environmental change with communities and patients exposed to excessive indoor moisture or mold

Paula Schenck and Robert DeBernardo

Risk communication with many different stakeholders is required to facilitate environmental change when indoor moisture is a concern. Moisture indoors is associated with respiratory disease, especially asthma and corresponding economic burden (Fisk et al., 2007; Mudarri, Fisk, 2007). Intervening on mold and moisture indoors provides an opportunity to improve symptoms, possibly prevent asthma initiation, and address a contributing factor to the disparity in respiratory disease (US asthma prevalence increases with decreasing economic status from 6.4% (richest Americans) to 10.3% (those at or below poverty levels) (Moorman et al., 2007)). When there is moisture damage, there are a number of stakeholders, i.e. the owner of the building, the occupants, and the community. Each has vested interests which may conflict. It is the goal of the risk communicator to inform all the stakeholders of the health and building risks involved, the options and costs, and to propose and negotiate a mutually agreeable solution. Because of the complexity of the exposure and effect on health (Heseltine, 2009), the cost associated with intervention, differences and controversy around published guidelines and policies, and the emotional nature that characterizes this topic, mold and moisture health risks are challenging to explain and manage. Risk communication requires presentation of complex information and consequences in understandable and relatable language. To explain the action of environmental response as an appropriate and critical intervention to prevent illness, the communicator must embody an understanding of risk communication principles as well as knowledge of the subject. It is especially challenging because treatments for individuals and pharmacological remedies are efficacious for symptom relief but may not address probable contributing factors to the cause; and the underlying condition may worsen even while undergoing symptomatic treatment.

Risk communication strategies are discussed with consideration of problem-solving experience with school and office communities and clinical case studies. As our understanding of the health risks associated with chronic moisture in buildings deepens and concerns for patients and the public increase, physicians and health officials will be increasingly tasked to determine the scope of the public health problem related to mold and moisture in indoor environments and to communicate information about the risk to individuals and groups. Two case studies, one involving a school community and the other reflecting the iterative communication of a practitioner with a patient are discussed where risk communication supported environmental change. Risk communication skills are important in efforts to include environmental change in homes, schools and offices as part of patient treatment and community response.

Critical Issues in Art Conservation After A Water Intrusion Event: Pitfalls of The Emergency Response

Karen H. Kahn

The procedure for responding to disasters involving water intrusion into a building containing cultural and heritage materials has become an area of increased interest among art preservation and conservation groups. Many articles have been written on the subject which influence, if not determine, how cultural institutions organize, prepare and conduct salvage and recovery after a disaster (Hawks et al, 2011). Little, if any, review has been made of the methods advocated for use by emergency response teams and how the many risks related to their work are managed.

The author of this article reviewed literature related to salvage and recovery from museums and other cultural institutions, and compared it to the industry standards followed by building water restoration experts. The author concludes, based on this review, that to the extent the conservationist literature recommends procedures for stabilizing the environment by removal of building materials and drying, its guidelines markedly depart from the well-established industry standards for water restoration. This article clarifies how, in the process of salvage and recovery, building contents are subject to increased damage from improper handling of hazardous building materials.

This paper discusses: 1) The Field Guide to Emergency Response (Heritage Preservation, 2006), a primary reference guide which cultural institutions rely upon during the emergency phase of salvage and recovery; 2) The methods which the Field Guide to Emergency Response proposes be utilized by cultural institutions to salvage and recover cultural and heritage materials [hereinafter "contents"] from a building which has sustained water damage; 3) How the methods utilized by cultural institutions compare with the published industry standards for responding to emergencies involving water damage and why the former methods lead to even greater damage; and 4) How managing the risk in the emergency response phase can achieve the goal of properly restoring a building and its contents when decisions are not controlled by the economics of the response.