

National Institute for Occupational Safety and Health (NIOSH)
Response to Public Comments Received from NIOSH Docket #238:
NIOSH Alert: Preventing Occupational Respiratory Disease from Exposures Caused by Dampness in Office Buildings, Schools, and Other Nonindustrial Buildings

Background

The purpose of the *NIOSH Alert: Preventing Occupational Respiratory Disease from Exposures Caused by Dampness in Office Buildings, Schools, and Other Nonindustrial Buildings* is to supply workers and employers with guidance for respiratory disease prevention and appropriate environmental response to damp building conditions.

The Alert provides the most recent scientific information on the relationships between exposures to damp indoor environments and respiratory symptoms, rhinitis/sinusitis, asthma, and hypersensitivity pneumonitis. It presents (1) scientific information from NIOSH research and research of others concerning health effects attributed to exposures to damp indoor environments, (2) respiratory symptoms and diseases associated with dampness, (3) case clusters of asthma and cases of hypersensitivity pneumonitis, and (4) current standards and building-related recommendations on prevention and response to damp indoor environments.

The target audiences are teachers' unions, government workers' unions, advocacy groups such as the American Lung Association, State public health staff that handles IEQ complaints, occupational health professionals, the annual Health Hazard Evaluation (HHE) employer, employees and union requestors (and their management) that request NIOSH HHEs involving indoor dampness, and the general public.

This document has followed a rigorous document development process in order to produce the highest quality information possible. NIOSH strove to reach a broad spectrum of external reviewers including academic researchers, building science engineers, school officials, and government agencies.

Previously, this publication has received scientific peer review. The peer review comments and NIOSH responses are available at <http://www.cdc.gov/niosh/review/peer/default.html>.

Subsequent to peer review, NIOSH created a public docket and a notice was published in the Federal Register on May 18, 2010 announcing the availability of the draft Alert for public comment for a period of 60 days. NIOSH received 123 comments (see: <http://www.cdc.gov/niosh/docket/archive/docket238.html>) from a range of organizations and individuals including public health representatives, environmental consultants, and school representatives.

NIOSH has prepared the following summary of public comments with NIOSH responses.

Summary of Public Comments and NIOSH Responses

Removal of Alert “WARNING!” boxes (2 comments, 2 reviewers)

Secondary themes: accessible text

One commenter (Ex. 10) stated that the two “WARNING!” boxes are not necessary and may alarm the reader. NIOSH Alerts have a “restricted” format which means that the format is routinely designed to follow a basic template. Thus, all Alerts include a “WARNING!” box that delivers a statement of occupational urgency to the readers. We feel that the statement provided adequately defines the nature of this Alert and satisfies the format intent.

Another commenter (Ex. 15) suggested that we edit the fact sheet to a 5-6th grade reading level to assure that all potential readers will be able to understand the text. We have kept the fact sheet as simple as we can to provide a document which all populations can comprehend and benefit from. It has some technical content which makes it difficult to achieve at a 5-6th grade level.

Use of the term “mold” vs. “fungi” (2 comments, 2 reviewers)

Secondary theme: wood-decay fungi

In the fact sheet section (first initial pages) of the Alert, one commenter (Ex. 3) requested that NIOSH define the word “mold” stating “*the term mold is not a scientific term – it is a colloquial term for a group of filamentous fungi that are common on food or wet materials*”. NIOSH agrees and has added a simplified definition that we feel all audiences can understand.

In the same section, another commenter (Ex. 5) suggested that NIOSH replace “mold” with “Fungi” and add “wood decay fungi” after “mold” stating that the “*decay of wood products is not uncommon in moisture damaged buildings and is a separate type of biodeterioration caused by fungi that are not molds*”. We have listed “fungi” with “mold” to recognize that the two are different, and have defined “mold” as being a type of fungi that are common on wet materials. We are targeting all audiences within the general public; therefore, our goal is to keep such complexities to a minimum.

Respiratory and non-respiratory diseases (17 comments, 9 reviewers)

Secondary theme: references, mycotoxins

NIOSH received many comments from several commenters (Ex. 3, 5, 6, 7, 9, 11, 15, 16) on various health effects from dampness. One commenter (Ex. 16) suggested that NIOSH include rhinosinusitis, respiratory infections, aggravation of COPD, and interstitial pulmonary disease other than hypersensitivity pneumonitis in the Background section. We have included “*respiratory infections*”, and “*rhinosinusitis*” as suggested. However, we are not including aggravation of COPD because the IOM concluded that there is inadequate or insufficient information to determine whether an association exists between COPD and indoor dampness or dampness-related agents.

The same commenter also stated that NIOSH should mention exposure or sensitization to molds is a risk factor for severe and persistent asthma, and to add irritation to the larynx and other interstitial pulmonary disease, besides classic hypersensitivity pneumonitis. We agree with the commenter's views on severe and persistent asthma and feel that "exacerbation" defines both terms as written. Also, we feel it is best to provide the health effects known to be associated with dampness and mold through the research literature reviews substantiated by the Institute of Medicine [2004], the World Health Organization (WHO) [2009], and Mendell et al. [2011].

Another commenter (Ex. 16) suggested adding the recent article published by Mendell et al (Environmental Health Perspectives 2011) and to mention the recent meta-analysis by Fisk et al on the association between respiratory infections and molds (Fisk WJ et al. Environmental Health 2010), and the publication by Karvala on incident occupational asthma (Karvala K et al. International Archives of Occupational and Environmental Health 2010). NIOSH is familiar with the publications suggested by the commenter and have included the Mendell et al publication within the Alert.

Several commenters (Ex. 6, 7, 9, 11, 15, 16) felt that NIOSH should discuss exposures to fungal toxins or mycotoxins more thoroughly and list additional symptoms related to mycotoxins including: chronic fatigue, skin problems, mental problems, autoimmune and inflammatory disorders, neurologic symptoms, renal, and cognitive damage among others. We have changed our list in the Background to include additional symptoms:

Occupants of damp office buildings, schools, and other nonindustrial buildings report a broad range of building-related symptoms and illnesses, including headache; fatigue; irritation of eyes, nose, and throat; lack of concentration; rhinitis and sinusitis (or rhinosinusitis); lower respiratory symptoms; exacerbation and onset of asthma; hypersensitivity pneumonitis; respiratory infections; bronchitis; eczema; and neurologic effects.

These changes do not include all of the suggested symptoms and disease; however, we feel our list includes commonly reported symptoms and conditions, especially respiratory conditions, which are the focus of this Alert.

NIOSH received comments regarding the last sentence in this section from a commenter (Ex. 16) which read: *The respiratory outcomes have been the most thoroughly studied, while the least studied are the possible health effects of fungal toxins (mycotoxins).* The commenter suggested changing the first part of the sentence to say: *The respiratory outcomes, particularly asthma, have been well studied.* Additionally, the same commenter stated "Many scientists would disagree with the statement that the possible health effects of fungal toxins are the least studied" and said that such a statement has been "widely criticised" when made in the past. Another commenter (Ex. 5) requested that we reference the statement about the health effects of mycotoxins being the least studied. In an effort to clarify our meaning, we have changed the sentence:

Respiratory outcomes have been the most thoroughly studied and reviewed, while the evidence is limited for the possible health effects of mycotoxins in indoor environments, including neurological outcomes [IOM 2004; WHO 2009; Mendell 2011]. This alert focuses on respiratory disease.

One commenter (Ex. 3) suggested that NIOSH replace the term “*mycotoxins*” with “*fungus metabolites including triple helical glucan*”, stating that the term “*mycotoxins*” is used for low molecular weight fungal toxins in crops that result in human and animal disease. Although the term may be used among researchers as defined by the reviewer, “*mycotoxins*” is more widely known among the general public as “toxins produced by fungi”. Therefore, we will continue to use “*mycotoxins*” for this Alert.

Sarcoidosis as a health effect (4 comments, 3 reviewers)

Secondary themes: Remove sarcoidosis from the Alert, additional reference

In the discussion on respiratory symptoms and disease, one commenter (Ex. 4) expressed concern regarding the inclusion of sarcoidosis as a known disease caused by dampness and mold stating, “*no substantial support is provided that demonstrates sarcoidosis is related to dampness*”. The commenter suggested that NIOSH either provide some evidence (case study or reference to other literature) or remove sarcoidosis from the discussion. Another commenter (Ex. 10) had similar remarks stating that “*while the Institute of Medicine and World Health Organization concluded that there is an association between damp indoor environments and respiratory symptoms, neither stated that there is an association with damp indoor environments and sarcoidosis. The document states that the cause of sarcoidosis is unknown and that there are no definitive tests that ascertain the diagnosis*”. The commenter continues saying “*even though Newman and a few others say that the environment may be a factor in some cases, there is not enough evidence to support it and references to sarcoidosis in this document are misleading*” and suggests that NIOSH eliminate the section. A third commenter (Ex.16) suggested adding *Tercelj M et al. Fungal exposure in homes of patients with sarcoidosis - an environmental exposure study. Environ Health 2011*, as another useful reference.

We had included sarcoidosis based on our experiences through the NIOSH Health Hazard Evaluation (HHE) program and associations through our research and the research of others. However, we agree with the reviewers that there are no definitive research findings to *confirm* a link between sarcoidosis and damp building conditions. Therefore, we have removed the section from the Alert as suggested, and will not need to include the reference given by the third commenter. We have included a sentence regarding sarcoidosis in the Background using a recent review by Newman et al. [2012] as a reference.

Addressing children and parents (3 comments, 2 reviewers)

Secondary themes: healthcare providers

Two commenters (Ex. 2, 15) mentioned the importance of including children and parents in this Alert. One (Ex. 2) stated that “*school occupants include students, yet they are only mentioned once on one page*”. Additionally, this reviewer felt that NIOSH should warn parents and guardians “*of any dangers of exposure to dampness in schools that their children attend and involve parents and guardians in reporting building conditions and their children's health issues to school authorities*” in the fact sheet portion of the Alert and in the last section entitled “*Identification and Management of Affected Workers and Occupants*”.

The other commenter (Ex. 15) had a very similar response and stressed that children are “*more at risk than other occupants of damp buildings*”. This commenter added that parents and families should be informed and that NIOSH should “*be explicit that children have unique characteristics and that their*

parents and health care providers should have the same information that is given to adult workers, managers, and owners”.

We understand and appreciate the extreme concern regarding children and parents and agree that there are major challenges both with the conditions of school buildings and the resulting health symptoms in children. As stated in the title, this Alert focuses on the prevention of respiratory disease from damp exposures in nonindustrial buildings including schools, and we have used “*occupants*” throughout to encompass children. We believe the Alert, by title and subject matter, will be received by various audiences including parents. As part of our dissemination plan, NIOSH will be sending copies of the Alert to numerous school affiliated agencies and unions, among many other targeted audiences. Additionally, we plan to distribute copies through the NIOSH Health Hazard Evaluation program (which includes schools) and will post the Alert on our NIOSH Indoor Environmental Quality website. As an *occupational* safety and health agency, we believe we have satisfied these concerns to the best of our ability given our limitations.

Approaches for building owners and employers (15 comments, 5 reviewers)

Secondary themes: approaches for workers and occupants

For the bulleted items in the Alert fact sheet, one commenter (Ex. 17) suggested that NIOSH add “*listen to any residents or staff who tell you of their concerns or suspicions regarding the health of the building*”. We agree and have added the following as the first bullet:

- *Always respond when occupant health concerns are reported.*

The same commenter suggested that we add “*rectify immediately any obvious dampness or mold in basements in particular, but also anywhere it appears*”. We appreciate the reviewer’s suggestion, but feel we have already stated this in the bullet:

- *Regularly inspect building areas such as roofs, ceilings, walls, basements, crawl spaces and slab construction for evidence of dampness; take prompt steps to identify and correct the causes of any dampness problems found.*

Another commenter (Ex. 2) expressed “*in schools I have found that crawl spaces and slab construction with missing or failed vapor barriers can also be a major source of moisture incursion*”. We agree and have added “*crawl spaces*” and “*slab construction*” as provided in the above bullet. A suggestion to add “*roofs*” to the list of areas that should be inspected was given by another commenter (Ex. 16). We agree and made the requested addition. For the bullet on preventing high indoor humidity through proper design and operation of HVAC systems, the first commenter (Ex. 2) stated “*many older schools do not have AC or dehumidifiers to prevent high indoor air humidity*”, and another commenter (Ex. 5) requested that NIOSH insert “*Assure that energy saving measures consider effects on indoor humidity*”. We are aware that some schools are challenged and lack certain resources, and we appreciate this reviewer’s concerns. However, these issues are beyond the scope of this Alert.

We received several comments regarding the bullets that address drying porous building materials within 48 hours and the bullet addressing remediation. One commenter stated that colonization will be inhibited after 48 hours if the drying was substantial (measurable reduction in moisture content) and may still be free of visible mold growth (Ex. 5). Although it may be possible to prevent colonization with massive

drying efforts after 48 hours of a material getting wet, it is highly circumstantial and effective drying is unlikely if allotted a longer period of time. Our recommendations are based on accepted sources of remediation recommendations such as the EPA and the New York City Department of Health and Mental Hygiene.

The same commenter asked how this bullet differs from the following bullet on remediation of moisture-damaged or moldy building materials and requested that we insert “*visible*” before “*mold growth*” and add the year of publication for the New York City Department of Health and Mental Hygiene reference. Another commenter (Ex. 4) requested that NIOSH add other recognized guidance such as the American Industrial Hygiene Association [2008]. We agree that the two bullets (drying and remediation) were overlapping and have made the requested additions and references:

- *Dry any porous building materials that have become wet from leaks or flooding within 48 hours.*
- *Clean and repair or replace any building materials that are moisture-damaged or show evidence of visible mold growth. Follow remediation guidelines such as those established by the following agencies:*
 - *Environmental Protection Agency’s (EPA) Mold Remediation in Schools and Commercial Buildings [EPA 2008]*
 - *New York City Department of Health and Mental Hygiene’s New York City Guidelines on Assessment and Remediation of Fungi in Indoor Environments [NYC DOHMH 2008]*
 - *American Industrial Hygiene Association’s Recognition, Evaluation, and Control of Indoor Mold [AIHA 2008]*

One commenter (Ex. 5) asked “*what are the criteria for establishing that symptoms or disease are building-related?*” Workers and occupants have shown that they have work-related illness by documenting symptoms at work and improvement away from work in conjunction with counsel from their physicians. The same commenter remarked that the bullet encouraging occupants who have developed persistent or worsening respiratory symptoms while working in the building to see a health care provider “*seems to assume that a physician is competent to conduct a building assessment*”. Our intent with this bullet is to encourage occupants to seek care from their medical providers if they experience symptoms while in a building. We are not stating that it is necessary for the physician to establish that there are problems in the building.

Another commenter (Ex. 2) responded to the bullet for establishing an indoor environmental quality team and requested that parents and guardians also be involved. We appreciate the reviewer’s intent to involve parents and have added the following sentence to the bullet:

IEQ teams for schools may wish to include nurses, school board officials, and parents.

NIOSH received a request from a commenter (Ex. 5) to add “*in situations where dampness problems have been confirmed*” to the Workers or Occupants bullet that states “*Let your employer or building owner know if your health care provider recommends relocation to another work area to prevent exposure to mold or dampness-related contaminants that may be causing or exacerbating your symptoms*”. We have changed the sentence to:

6 ¹ See Exhibits at aforementioned docket website.

- *Let your employer or building manager/owner know if your healthcare provider recommends relocation to another work area to prevent exposure to mold or dampness-related contaminants that may be causing or exacerbating your symptoms in situations where dampness problems persist.*

For the “Occupants” bullet regarding involvement in the IEQ workplace program, another commenter (Ex. 2) suggested that we add “*if there is no IEQ program at the workplace, then work to get one established*”. We have made the suggested addition with a similar statement:

- *Familiarize yourself with the IEQ program at your workplace and become an active member of the IEQ team, if needed. If there is no IEQ program at your workplace, strive for one to be established.*

Case 2 – Hypersensitivity pneumonitis in a damp office building (2 comments, 1 reviewer)

Secondary themes: None

Due to multiple case examples for hypersensitivity pneumonitis, we have removed the Case 2 example entitled: *Hypersensitivity pneumonitis in a damp office building* from the Alert. One commenter (Ex. 5) suggested that NIOSH include dry bulb temperatures with the presentation of relative humidity in Case 2. Because Case 2 has been removed, addressing the commenter’s suggestion is no longer needed.

Air Sampling (5 comments, 3 reviewers)

Secondary themes: None

The issue of whether or not to sample for mold spores in the air to determine whether illness is associated has been ongoing for years and is still debated by many. Current air sampling methods have major limitations in assessing exposure to mold and other biological agents that may prevent the demonstration of associations of bioaerosol exposure with health [J.Park et al. 2004, Mendell et al. 2011]. In buildings with building-related complaints, we found association with respiratory symptoms using observational indices which justifies corrective actions for dampness in buildings. Also, visual observation helps where fiscal resources are an issue because it has lower costs. In the Alert, we stated “we do not recommend air sampling for mold in damp building evaluations”. In response, one commenter (Ex. 16) expressed that “*If the results of air sampling show that the profile of molds is indicative of indoor contamination (using the criteria of ACGIH or AIHA) and if the occupants are experiencing health effects compatible with dampness and molds, you have sufficient information to recommend a thorough investigation of the building in order to find the source of contamination and its cause*”. The commenter continued to state that he/she agrees that air sampling is not the first choice and should not be mandatory and “*it is a combination of tools and data that allows the best assessment of health risk*”. We agree and have changed the statement to: “*NIOSH does not recommend **routine** air sampling....*”

The same commenter (Ex.16) stated “*If sampling is useful to assess the risk, in combination with other data as previously indicated, it should also be useful after corrections are made to evaluate their effectiveness, using the same criteria. Therefore, we have a problem with this statement, although we are perfectly aware of the misuse of such data*”. We disagree with the commenter. As we have stated in the

7 ¹ See Exhibits at aforementioned docket website.

Alert, there has been no demonstration of consistent exposure-response relationships for specific bioaerosol measurements that assures a building is safe after remediation.

One commenter (Ex. 14) mentioned that there is agreement within the infection control community on the value of post-remediation sampling for patient safety. While this may be true within the infection control community, this Alert does not address infection control.

As a preventative measure, a commenter (Ex. 17) suggested having air testing by a professional air quality assessor at least once each year. We appreciate the reviewers concern for prevention and agree that prevention should be a key goal for all building owners and managers. With respect to taking general air samples yearly, we do not think they can be interpreted with respect to health risk. We agree that regular inspections of buildings are vital to systematically inspect for dampness and mold.

Roof leaks (4 comments, 1 reviewer)

Secondary themes: flat roofs

A commenter (Ex. 16) suggested that NIOSH include guidance for roofs; particularly flat roofs. The commenter stated that roofs should be inspected regularly and properly maintained and that roof leaks are a factor that contributes to wet building foundations and dampness in basements. We agree that roofs should be regularly inspected and have added that in our recommendations to building owners and employers. Regarding building foundations and basements, further discussion on roofs for these topics will not be included in this Alert.

Building recommendations (15 comments, 6 reviewers)

Secondary themes: exterior walls, vinyl wall coverings, water pipes, maintenance and repairs, heating, ventilating, and air-conditioning (HVAC) systems and filters, ultra violet germicidal irradiation, dust, remediation, renovation

NIOSH received a variety of comments from several reviewers (EX. 1, 3, 5, 6, 15, 17) regarding the "Recommendations" section of the Alert. One commenter (Ex. 5) raised concern about the mention of a "rain-screen wall" when discussing exterior walls, stating that "*it could easily be construed from this that a "rain-screen wall" is the only acceptable design*". The same commenter also suggested that the discussion be reviewed by an architect or other design professionals to assure that "*other satisfactory designs are not inadvertently implicated as inherently faulty*". We appreciate this point being raised and have changed the paragraph to:

Exterior walls should be designed so any rain water that penetrates openings in the exterior cladding (e.g., brick veneer) can dry and/or drain out of the wall. A common way to accomplish this is by maintaining an air space between the cladding and the next wall layer (the sheathing) and covering the sheathing with a continuous and completely sealed water barrier. Drain holes and flashing are provided at the bottom of the space and air vents at the top. This design is sometimes referred to as a "rain-screen wall" [ASHRAE 2009a].

Additionally, this document has been reviewed by an architect.

Another commenter (Ex. 5) suggested that we add some explanation on permeability to the bullet on vinyl wall covering under the section entitled “*Other Issues*”. The commenter stated that vinyl wall covering greatly reduces permeability of the wall assembly. The commenter also suggested that we add “*chilled water lines*” in front of “*adequately insulated*”. We appreciate the reviewer’s comments and have added the suggested explanation for permeability and the addition of “*chilled water lines*”.

Four commenters (Ex. 1, 3, 5, 17) responded to various aspects of HVAC systems in buildings. In the section that discusses dehumidification of indoor air through proper design, installation, and operation of building HVAC systems, one commenter (Ex. 5) stated “*Another frequent situation where typically designed cooling systems cannot provide adequate dehumidification is during the “shoulder” season between cooling and heating (or between heating and cooling) seasons where outdoor air is already at the design temperature, but humid (i.e. outdoor air is 72°F and 90%RH). In this case, there is no demand on the HVAC system for cooling (or heating) and hence there is no chance for dehumidification unless humidity and temperature control are decoupled by design (which is very rare)*”. We believe the reviewer has brought up a good point and have changed the wording to:

An HVAC system which dehumidifies solely through the operation of air conditioning cooling coils may not be able to lower indoor humidity sufficiently without making the occupied space overly cool. This is a common problem with over-sized HVAC systems where short cycles achieve cooling but are insufficient for adequate dehumidification. Even properly sized systems may be unable to control humidity in some cases. For instance, on days where the outdoor air is at the design temperature but overly humid, the low demand on HVAC systems prevents adequate dehumidification. An additional dedicated unit to dehumidify outdoor ventilation air may be necessary for times when the cooling demand is low (e.g., when the building is unoccupied) but humidity is still high.

Another commenter (Ex. 1) suggested that NIOSH provide more on the American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE) recommendation for the minimum efficiency reporting value (MERV) filtration. We agree with this commenter that higher MERV ratings equal better chances at a dust-free environment, although we were concerned that individuals inexperienced with HVAC systems may install higher MERV filters without assuring the system is capable of the adjustment. Thus, we changed the wording to:

It is important to minimize the amount of dust and dirt that gets into the HVAC system. This can be accomplished by using filters that are efficient at capturing fine airborne particles. Manufacturer’s recommendations or ASHRAE Standard 62.1 should be consulted to determine appropriate filtration. The filters should be sized properly and should fit in the system’s filter racks to prevent unfiltered air from bypassing the filters and entering the occupied space. It is also important to regularly replace air filters on a schedule recommended by the system manufacturer or HVAC consultants.

The same commenter also suggested that we include a checklist to address HVAC system operation and cleanliness, and another (Ex. 17) suggested annual cleaning of HVAC systems. NIOSH understands the concerns of both commenters and agrees on the importance of maintaining HVAC systems in buildings. Thus, we have added the following bulleted list of items to address regular maintenance checks for HVAC system operation and cleanliness.

During regularly scheduled preventive maintenance checks, maintenance personnel should:

- *Verify that systems are operated to meet all appropriate system settings, and seek guidance from a qualified ventilation engineer on design and sizing as needed. Information on how to determine how much outdoor air should be brought into the building is provided in the ANSI/ASHRAE Standard 62.1-2010.*
- *Make sure the system is still balanced and ventilating all areas of the building according to the design specifications. Using areas of the building for purposes other than the original intent may necessitate rebalancing the system.*
- *Regularly replace air filters on a schedule recommended by the system manufacturer or HVAC consultants.*
- *Check all condensate drip pans and drain lines to assure that they are draining properly, and clean the lines according to manufacturers' recommendations or in accordance with ASHRAE recommendations.*
- *Monitor outdoor air intakes and inlet airways for intrusion of snow and rain, dirt, and leaves.*
- *Ensure adequate function of damper controls; control settings should be checked to ensure that the volume of outdoor air brought in by the HVAC system is sufficient for the expected number of building occupants.*
- *Monitor for wet or moldy conditions in air ducts and make necessary changes to correct the problem. If ducts are lined with a fibrous material and wet or moldy conditions are found, the liner should be removed and replaced with non-fibrous, hard-surfaced materials.*

Discussion of ultra violet germicidal irradiation (UVGI) in HVAC systems was raised by one commenter (Ex. 1). We agree that there is spreading popularity of UVGI in HVAC systems for the control of microbial organisms, and we appreciate the point raised. Thus, we have added:

Ultraviolet germicidal irradiation (UVGI) devices installed inside HVAC equipment are being used to prevent microbial growth and maintain coil cleanliness. Little scientific research on in-duct UVGI devices for these applications has been conducted [Levitin et al. 2001]. Most UVGI research focuses on upper-air UVGI systems typically used in health care settings to prevent airborne disease transmission, and not on in-duct devices for indoor office environments or schools [NIOSH 2009]. Scientific evidence linking in-duct UVGI systems to improved indoor air quality or reductions in occupant symptoms is lacking [Menzies et al. 2003]. Similarly, research studies have not yet established clear economic benefits associated with in-duct UVGI systems over traditional coil cleaning and HVAC maintenance practices [Bahnfleth et al. 2009, Lee et al. 2009]. While further research needs to be conducted, facility managers and building maintenance staff should be aware of such systems and the safety precautions necessary when working with any UVGI devices. ASHRAE (2011, 2012) provides additional information on UVGI installation in HVAC systems and associated safety practices.

NIOSH included removing settled dust in occupied spaces or in the HVAC systems in the “*Building Maintenance and Operation*” section. A commenter (Ex. 3) stated that the “*text appears to imply ducts and other HVAC components should be cleaned based on any level of contamination; however, this is neither supported nor recommended by most salient guidance*”. We agree and have taken HVAC systems out of the section.

Another commenter (Ex. 15) suggested that NIOSH add additional items to prompt owners to look outside of a building for problems with dampness such as holes in roofs, pooling water outside, and water staining under windows. The reviewer stated “*as currently drafted a building owner might remove and replace ceiling tiles that are water damaged but never fix the roof that caused the damage*”. We agree and have revised the sentence to:

Most buildings will periodically experience events that occur from outside or inside the building that will contribute to excess moisture or water damage (e.g., improper drainage around building foundations, roof leaks, window leaks, and condensation and leaks from pipes).

Three commenters (Ex. 5, 15, 16) responded to the “*Remediation*” section of the Alert. The first commenter (Ex. 6) suggested removing specific reference to graduated remediation procedures and stated “*we believe this is too much detail for this document and may lead the reader to ascribe levels of protection and containment well beyond those prescribed by the EPA document*”. Their suggested revision stated “*Damaged materials that are to be removed from the containment area should be sealed in plastic bags or within polyethylene sheeting [for removal from the containment area]*”. We appreciate the reviewer’s comments and have simplified the paragraph to:

Precautions are necessary to prevent exposure of remediation workers and building occupants to dampness-related contaminants during remediation work. Guidance on precautions can be found in the EPA publication Mold Remediation in Schools and Commercial Buildings [2008] and the New York City Department of Health and Mental Hygiene document New York City Guidelines on Assessment and Remediation of Fungi in Indoor Environments [2008]. Even with containment, building occupants may be exposed to dampness-related contaminants during remediation work. Therefore, prior to the start of any remediation work, management should strongly consider relocating occupants who might be exposed during the remediation. This is especially true if several building occupants have developed building-related respiratory symptoms or disease that suggests high health risk from dampness-related exposures [AIHA 2008].

Another commenter (Ex. 15) expressed concern about inappropriate remediation practices such as “*painting over water damaged materials, adding room fresheners to mask musty odors, applying disinfectants or fungicides to damp or moldy surfaces*”. The same commenter also suggested that NIOSH add caution on the use of PPE and to warn against using untrained workers for larger remediations. We agree that there are problems with inappropriate remediation practices and have added:

Inappropriate remediation (e.g., painting over water-damaged materials, adding air-fresheners in areas to mask musty odors, and applying disinfectants or biocides to damp or moldy surfaces) can cause further problems with building degradation and symptoms in occupants.

In reference to adding caution on the use of PPE and a warning about using untrained workers for large remediation, we feel these two issues have already been addressed within the text of the remediation section. Another commenter (Ex. 5) stated that “*cleaning of surfaces after removal of colonized materials is a KEY component of an effective mold remediation job*” and suggested that it be added. We have made the suggested addition and have also covered the topic in the EPA remediation example. In the Alert section discussion on sampling for mold, the same commenter expressed concern about the sentence stating that some individuals may have to avoid the building even after an otherwise successful

remediation because their immune systems may continue to react to very small amounts of substances to which they may be allergic. The commenter mentioned that the statement indicated an “immunologic mechanism” for health effects of dampness. We understand that there are both allergic and non-allergic mechanisms for health effects due to dampness, but here we are specifically referring to allergic sensitization.

A commenter (Ex. 4) suggested that NIOSH “*add a paragraph on renovations and other building structure and mechanical changes since these activities frequently involve envelope penetrations and often require mechanical modifications that are not properly designed, implemented, or commissioned*”. We agree and have added “*renovation*” in the section title and added the following paragraph:

Renovation projects can create the release of airborne dusts, microbiological contaminants, gasses, and odors from both inside and outside of a building. Therefore, careful planning is essential to prevent exposures to building occupants. Key factors to consider include scheduling projects during times of low or non-occupancy, isolating work areas from occupied areas using temporary barriers, negative pressurization to prevent migration of air contaminants into occupied areas, and HEPA filtration. It is also important to modify HVAC operations to ensure renovation activity is isolated, to generate temporary containment barriers to separate renovation areas from occupied areas, and to increase housekeeping activities to keep construction debris and dust at a minimum. Once renovation has been completed, necessary modifications should be implemented to affected HVAC systems and other mechanical systems to ensure proper operation.

Appendices (1 comment, 1 reviewer)

Secondary themes: None

One commenter (Ex. 2) responded to the way the building checklist in the appendix was written, stating that one should be able to easily tell where there are problems with the building. The reviewer suggested the “*Yes*” represent “*Good*” and “*No*” represent “*Bad*”. The way it was written, “*Yes*” could be good or bad, making it difficult to determine where problems were without having to read each listed item. We appreciate the commenter’s concern and agree that the checklist should serve as an easy-to-use tool to determine building-related issues. Therefore, we have reworded all items in the checklist so that, as requested by the reviewer, items with a “*Yes*” equals “*Good*” and “*No*” equals “*Bad*”, requiring further inspection.

Word and phrase revisions (34 comments, 6 reviewers)

Secondary themes: references

NIOSH received many suggested word and phrase changes by several reviewers. We have addressed reviewer comments beginning on the first page of the Alert and continuing through to the end.

On the first page (fact sheet) in the first paragraph, one commenter (Ex. 5) asked “what exposures” in reference to the sentence “*These exposures can lead to....*” In response, we have taken out the word “*These*”. In the next paragraph, another commenter (Ex. 4) suggested that the word “*persistent*” be defined to understand what constitutes resolution to building dampness issues. We have taken the word out of the sentence because “*persistent*” means “*continuous*” and our intent is to stress building dampness in general rather than continuing episodes of dampness. In the same sentence, the first commenter (Ex. 5)

suggested that NIOSH add “*designers*” to the list of those who may lack knowledge and understanding of buildings. We have added “*designers*” as suggested. Also in the same sentence, the same commenter (Ex. 5) asked “*which problems*” in reference to the reference of “*these problems*”. We are referring to problems with building dampness and subsequent respiratory illness as initially stated in the text; thus, no changes were made. Another commenter (Ex. 16) suggested that NIOSH add “*and objective measure of*” after the word “*visible*” in the sentence “*The best current evidence suggests visible dampness, water damage ...*” We decided it would be best to change the wording to “*observations of dampness,*” to encompass visual recognition and other methods for determining damp conditions suggested by the reviewer.

There were a couple of places in the Alert where NIOSH recommended “*immediate*” response to dampness. One commenter (Ex. 5) suggested that we replace “*immediate*” with “*prompt*”, stating that “*prompt*” *action needs to be taken, i.e. delay in responding should be minimized. However, the word “immediate” has the risk of being misapplied to infer needing action before the end of the work shift. If taking action before the end of the shift is what is meant, then that should be the wording*”. We have made the suggested change.

In the Alert’s “*Background*” section, one commenter (Ex. 3) suggested that we delete “*can be highly*” in regards to damp building exposures being complex, and replace it with “*are*”. We have made the suggested change. The same commenter suggested that NIOSH insert “*(metabolites)*” after “*specific substances*” to introduce the term. Due to the broad range of audiences we hope to reach with this Alert, we are using simple terms for easy understanding. Another commenter (Ex. 4) suggested that NIOSH add “*something related to building material/growth substrate due to its high importance in determining both fungal/bacterial growth potential and the potential toxicity associated with microbial and other substrate decomposition pathways and products*”. Additionally, a commenter (Ex. 16) requested that NIOSH replace the word “*exposures*” with “*contaminants*” in the same reference. We have replaced the word as suggested and feel the change also addresses the suggestion of commenter (Ex. 4). A commenter (Ex. 5) questioned volatile organic compounds being released from wet vinyl, stating “*this seems overly simplistic and should be clarified. Long term moisture issues in on-grade concrete slabs can lead to alkaline hydrolysis of flooring adhesives and generation of malodorous short chain alcohols. The statement does not however discriminate between this situation and using a wet mop on a floor*”. We appreciate the reviewer’s concern and we have taken the example out of the sentence. In the sentence addressing “*moldiness*” as a common characteristic of damp buildings, a commenter (Ex. 4) suggested replacing “*moldiness*” with “*mold growth*”. We have made the suggested change.

In the next sentence, NIOSH stated “*It is well known that some individuals can develop allergic diseases such as asthma and rhinitis (nasal inflammation) from exposure to certain molds in the environment.*” One commenter (Ex. 3) suggested that we delete “*certain*” and another commenter (Ex. 5) suggested that we provide a reference. We have changed the sentence to:

“Some individuals can develop diseases such as asthma and rhinosinusitis (nasal inflammation) from exposure to molds in the environment.”

We do not feel this sentence needs a reference. In the next paragraph discussing the development of persistent dampness through a variety of mechanisms, a commenter (Ex. 5) stated that “*design*” should be included in the sentence discussing when problems with dampness can begin. Another commenter (Ex.

2) suggested that we add “*commissioning*” after “*design*” and “*construction*” in the next sentence. We have added the words as suggested.

In the “*Respiratory Symptoms and Disease in Occupants of Damp Buildings*” section, one reviewer (Ex. 4) responded to the wording in the asthma discussion that states “*A worker or occupant with allergic asthma may experience symptoms after exposure to very low levels of a sensitizing agent that may still be present...*” suggesting, “*To avoid confusion for physicians and others, the sentence should read, “A worker or occupant with in vivo or in vitro demonstration of allergic asthma may experience symptoms after exposure to very low levels of a sensitizing agent that may still be present...”*”. We are not providing guidance for physicians in this statement. The use of “*in vivo*” and “*in vitro demonstration*” is complex terminology that, while physicians and researchers may understand, will be confusing to the targeted audience. In the discussion on hypersensitivity pneumonitis, the same reviewer commented on the sentence “*HP is often misdiagnosed as a respiratory infection*” and suggested that NIOSH change the sentence to “*HP can often mimic a respiratory infection*” to avoid implicating blame or liability on treating physicians or raising medical disputes. We have made the suggested change. In the discussions on sinusitis and asthma, a commenter (Ex. 6) requested references. We have taken out “*It is well known*”. Thus, we do not feel a reference needs to be included in these sections. Also in the asthma section, a commenter (Ex. 16) requested that we replace “*such as albuterol*” with “*corticosteroids*”. We have made the suggested change.

In the “*Failure to Prevent Building Dampness Can Be Expensive*” section, a commenter (Ex. 5) mentioned that several factors for the problems with this building could have been related to design issues. The commenter stated, “*The prevalence of insufficient design detail or inappropriate design should be discussed on a comparable level with issues related to construction and operations*”. For this section, our focus was to provide an example of costs, rather than a discussion of the potential building-related causes. Thus, no changes were made.

For the “*Current Standards and Recommendations*” section, one commenter (Ex. 5) suggested that NIOSH replace “*contamination*” with “*colonization*”, stating “*the word contamination can have various meanings to different audiences. Colonization more specifically describes the process of microbial growth, including on wet/damp building materials*”. We have made the suggested change. In the same section, the commenter suggested that NIOSH add: Krieger J, Jacobs DE, Ashley PJ, Baeder A, Chew GL, Dearborn D, Hynes HP, Miller JD, Morley R, Rabito F, Zeldin DC (2010) *Housing interventions and control of asthma-related indoor biologic agents: a review of the evidence. J Public Health Man & Practice 16:s11-s20*. Another commenter (Ex. 3) suggested adding the EPA supported ASHRAE guideline: *Indoor Air Quality Guide: Best Practices for Design, Construction, and Commissioning*. We added the suggested references.

In the Alert’s “*Conclusions*” section, one commenter (Ex. 5) requested that we replace “*contamination*” with either “*products*” or “*metabolites*”. We have made the suggested change with the word “*products*”. The same commenter suggested replacing the word “*and*” with “*and/or*” and adding “*operations*” and “*occupant activities to new or existing buildings*” to the sentence on why many building dampness problems occur. We have replaced the word “*and*” as suggested, but do not feel it is necessary to add “*operation*” and “*occupant activities of new or existing buildings*”. Operation is covered in the following sentences on prevention, and we do not agree that occupant activities cause building dampness. We have added “*cleaned and repaired or replaced*” in the sentence addressing moisture-damaged or moldy building materials, as requested by another commenter (Ex. 2).

NIOSH received a couple of comments for the “*Recommendations*” section. One commenter (Ex. 5) suggested amending the sentence addressing contracts to say, “*Contracts should provide specific details on the design and choice of building materials and when and how they are to be assembled and installed*”. We have made the suggested change. In the sub-heading for this section pertaining to moisture-sensitive building materials, another commenter (Ex. 2) suggested that NIOSH mention “*proper sequencing of construction activities to prevent contamination of building materials*”. We agree with the reviewer’s concern; however, we feel this has been implied within the text of this section.

In the section on building maintenance and operation, a commenter (Ex. 5) requested that NIOSH replace “*leaking*” with “*bypass*” in the sentence addressing unfiltered air into the occupied space. We have made the requested word change. The commenter also stated that the “*A*” in “*HEPA*” stands for “*arrestance*”. In this Alert, the acronym HEPA stands for high-efficiency particulate air, as it is in a number of other scientific contexts.

For the section discussing proper operation and maintenance of the HVAC system, a commenter (Ex. 5) stated “*another useful source of information to include is the ANSI/GEI standard MMS1001 – Moisture management and mold prevention for new construction*” (*Greenguard Environmental Institute, 2009*). We agree that this standard may be useful; however, we were unable to reference it in the Alert.

The same commenter suggested that NIOSH replace the word “*might*” with “*should*” in the remediation section sentence about employers undertaking small remediation projects using in-house personnel, and also commented that containment is often done in “*bags*” rather than in “*sheeting*”. NIOSH has replaced “*might*” with “*should*” and has simplified the remediation paragraph mentioned by referring to remediation guidance documents. Thus, details on containment have been removed.

In the last section of the Alert discussing identification and management of affected occupants, a commenter (Ex. 2) suggested adding “*should be established and*” after “*committee*” in the first sentence of the second paragraph. We have made the addition.

Personal experiences (5 reviewers)

Secondary themes: None

Several reviewers provided their personal experiences and challenges with illness in damp buildings. We appreciate all of the feedback given.

Conclusion

NIOSH has followed a rigorous peer review, stakeholder review, and public comment process in order to develop the *NIOSH Alert: Preventing Occupational Respiratory Disease from Exposures Caused by Dampness in Office Buildings, Schools, and Other Nonindustrial Buildings*. NIOSH has made a number of changes to the document in response to the suggestions provided during the review process. NIOSH appreciates the time and effort taken by all of the document reviewers and believes that the guidance will be of greater value as a result of their input. NIOSH intends to issue the final document as: *NIOSH Alert: Preventing Occupational Respiratory Disease from Exposures Caused by Dampness in Office Buildings, Schools, and Other Nonindustrial Buildings*.

Codes for Reviewers for IEQ Alert Public Comment period (May –July 2010)

Commenter	Commenter Title/ Profession and Organization	Primary Commenter
1	Principal Consultant-Microbiology	Phillip Morey
2	Retired teacher	Diane Ethier
3	Professor & NSERC Research Chair, Department of Chemistry, Carleton University	David Miller
4	AIHA President	Elizabeth L. Pullen
5	Principal Scientist, Air Quality Sciences, Inc.	W. Elliot Horner
6	General Counsel, NYCDOHMH	Thomas Merrill
7	Commented as private person	Cheryl Wisecup
8	Commented as private person	Mary Ann Tilford
9	Commented as private person	Barbara R. Rutgers
10	Illinois Department of Public Health	Kathy Marshall
11	Industrial hygienist, Certified Microbial Consultant, AirWays Environmental Services	Steven Temes
12	Commented as private person	Gilbert Vice
13	Commented as private person	Valerie Madeska
14	No title given, School of Public Health, University of Toronto	James Scott
15	Executive Director, Health Schools Network, Inc.	Claire Barnett
16	Medical Specialist/Professor, Department of Medicine, University of Montreal	Louis Jacques
17	Commented as private person	Anonymous