Mold Remediation

While debate continues about whether or to what extent mold exposure leads to human illness in the general population, concerns exist about exposing unhealthy individuals, particularly those who are immunocompromised, to mold. As a result, an appropriate course of action for healthcare facilities is to plan to remediate any visible mold.

If found, mold should be left undisturbed until a remediation plan can be implemented. The first priority should be finding and controlling the source of the moisture because if the moisture returns, so will the mold.

Mold remediation may be handled like a construction project—for example, an infection control risk assessment may be performed. Depending on the capabilities of the facility’s staff, it may be necessary or advisable to bring in outside remediators, particularly for larger or more complex projects.

Remediating mold growth caused by contaminated water, such as after a flood or hurricane, poses additional risks and requires special precautions. Air-handling systems also require special attention because of their potential to spread mold throughout a building.

What HHC Found

No national regulations or healthcare industry standards set a limit on human mold exposure, so facilities should have some leeway in adapting remediation strategies to local circumstances.

Route To:

☐ Administration
☐ Clinical/biomedical engineering
☐ Employee health services
☐ Environmental health
☐ Facilities/building management
☐ Infection control
☐ Patient safety officer
Mold Remediation

Abstract: Whether or to what extent mold exposure leads to human illness in the general population remains a subject of debate, and no national regulations or healthcare industry standards set a limit on human mold exposure. Nevertheless, concerns exist about exposing unhealthy individuals, particularly those who are immunocompromised, to mold. Visual inspection and regular maintenance to prevent water leaks can help prevent mold growth. Additional measures may be necessary to find mold in hidden areas, such as behind walls or in air-handling systems. Cleaning mold from a healthcare environment involves finding and controlling the moisture source, planning the remediation, and then implementing the remediation plan. An infection control risk assessment and other construction-project methods can be used to plan remediation. Special precautions and techniques are required when mold is caused by contaminated water, such as after a flood or hurricane. Mold sampling is not required and should be performed only with a clear goal, such as to locate a hidden moisture source. During mold remediation, mold is removed from materials that can be cleaned and materials that cannot be cleaned are discarded. Depending on the capabilities of facility staff, outside contractors may be required for mold remediation projects, particularly those that are large or complex. Only individuals experienced in mold remediation in heating, ventilating, and air-conditioning systems should be employed to clean mold from these systems because these systems have the potential to spread mold throughout a facility.

Whether a link exists between mold exposure and human illness in the general population remains a subject of debate in the medical literature. The Centers for Disease Control and Prevention (CDC) has stated that in most healthy individuals, “left undisturbed, mold is generally not a hazard, and most persons will not be adversely affected by a moderate exposure to mold.” On the other hand, the results of an Institute of Medicine literature review of the evidence base linked certain human health effects to the presence of mold or other agents in a damp indoor environment. (See “‘Sufficient Evidence’ for Some Human Health Effects of Mold Exposure.”)

Issues about the human health effects of mold exposure that are under debate include the following:

- Whether exposure to environmental mold poses a hazard to human health
- How much exposure is required for mold to cause an adverse health event, if in fact mold can cause such an effect
- Whether it is ever possible to establish a link between any individual’s ill health and any specific instance of mold contamination
- Which, if any, symptoms may result from exposure to mold

The issues are different for hospitalized and sick populations. CDC, for example, has said that individuals with certain health conditions should limit their exposure to mold. (See “Health Reasons to Restrict Mold Exposure.”) Concerns exist that mold exposure in unhealthy individuals, particularly those who are immunocompromised, may be harmful.

At present, no regulations, healthcare industry accreditation standards, or other national requirements restrict human exposure to mold. (Whether some state or local authorities have imposed requirements is beyond the scope of this Analysis.) An appropriate course of action for healthcare facilities is to plan to remediate any visible mold. This policy is likely to be the best path for most healthcare organizations for several reasons, including the following. It is better to

For more information about this topic and other related topics, go to HHC Members’ Web site at http://www.ecri.org.
“Sufficient Evidence” for Some Human Health Effects of Mold Exposure

An Institute of Medicine (IOM) literature review found “sufficient evidence of an association” between the “presence of mold or other agents in [a] damp indoor environment” and several symptoms of human illness, as listed below. IOM states that the term “sufficient evidence of an association” indicates that the reviewed studies “document an association between the agent and disease and that chance, bias, and confounding factors were ruled out with reasonable confidence.” These symptoms include the following:

- Upper respiratory tract symptoms
- Cough
- Wheeze
- Asthma symptoms in sensitized individuals with asthma
- Hypersensitivity pneumonitis (i.e., farmer’s lung) in susceptible people
- Severe respiratory infections in individuals whose immune system is severely compromised
- Fungus-related illness in individuals whose immune system is severely compromised and who have chronic obstructive pulmonary disease
- Colonization and potential lung infection in individuals with some chronic pulmonary disorders

IOM found “limited or suggestive evidence” of a link between the “presence of mold or other agents in [a] damp indoor environment” and respiratory illness in otherwise healthy adults.

IOM found “inadequate or insufficient evidence” of a link between the “presence of mold or other agents in [a] damp indoor environment” and the following symptoms:

- Mucous membrane irritation syndrome
- Asthma development
- Airflow obstruction in otherwise healthy individuals
- Chronic obstructive pulmonary disease
- Shortness of breath (dyspnea)
- Respiratory illness in otherwise healthy adults
- Acute idiopathic pulmonary hemorrhage in infants
- Skin symptoms, gastrointestinal problems, fatigue, neuropsychiatric symptoms, cancer, reproductive effects, and rheumatologic and other immune conditions

Last, IOM found that “no specific studies” associated fungal sinusitis with “damp or moldy indoor spaces.”


Preremediation

Molds are present in virtually all indoor and outdoor environments but are normally invisible except when conditions are right to encourage their growth. The main factor restricting mold growth is lack of moisture. If moisture becomes available, molds can grow on—and damage—many porous or organic materials, including carpet, concrete, cinder block, upholstery, drapery fabrics, linoleum, ceramic tile, vinyl, wood, and drywall and gypsum wallboard. Molds “eat” the organic material on which they grow by secreting an enzyme that digests it externally and then absorbing the nutrients. If allowed to grow long enough, mold may even cause structural damage.

Moisture can come from several sources, including ambient humidity, leaks and condensation from building water systems, and flooding or other natural disasters. Dirty water (e.g., from flooding) poses a host of infection control and worker safety issues beyond the mold growth problems posed by clean water. Sources
of moisture that may lead to mold growth include the following (U.S. EPA):

- Humidity greater than 60% for prolonged periods
- Leaks in roofs or fire sprinkler systems
- Leaks in or condensation on water pipes
- Landscaping, gutters, and downspouts that direct water into or under a building

Areas where moisture may accumulate and mold growth may be hidden include the following (U.S. EPA):

- Combustion appliances (e.g., clothes dryers) that are not vented to the outside air
- Pipe chases and utility tunnels that have been built into walls to provide a pathway for pipes and wires
- Areas where furniture is arranged in ways that permit condensation to form
- Poorly draining condensate drain pans inside air-handling units
- Porous thermal or acoustic liners inside ductwork
- Roofing materials above ceiling tiles
- The backside of drywall, paneling, and wallpaper
- The underside of carpets and pads

Visual inspection for moisture and mold growth and regular maintenance to prevent moisture buildup and water leaks are the most reliable ways to prevent mold growth or to catch it in its early stages. If mold is found, it should not be disturbed except by workers wearing appropriate personal protective equipment and acting in accordance with mold remediation plans.

If moisture is found but not mold, drying the affected area quickly can prevent mold from growing. Guidance varies, but drying within 24 to 48 hours is generally thought sufficient to prevent mold growth or to catch it in its early stages. Water can be removed from undamaged materials with tools such as a wet or water-extraction vacuum, followed by appropriate cleaning. The air-drying process can be accelerated through the use of fans, dehumidifiers, and heaters.

Visible mold may be hidden in out-of-view places, such as those listed above. Visual inspection for mold in air-handling systems is particularly difficult, because mold may be hidden and will likely require the services of someone who knows how to access portions of the system that are normally hidden. Not everything that looks like mold is mold; for example, paint, soil, and carpet stains may look like mold.

Other signals that mold may be present include a musty, moldy smell or mold-related health complaints from patients, workers, or visitors. If such signals exist but mold is not visible, it may be prudent to take additional action, such as using a moisture meter to test materials (e.g., carpet, ceiling tiles) for water content or using a borescope to peer behind a wall through a small hole cut for this purpose.

Mold may also grow in medical devices and could affect the function of electrical, electronic, optical, or other systems. At particular risk are devices that have chambers where warmth and moisture can collect, such as pillow speakers on a nurse call system, which

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**Health Reasons to Restrict Mold Exposure**

Although the links between environmental mold exposure and human health effects in the general population remain under debate, individuals with certain health issues or other characteristics, as listed below, should limit their exposure to mold, according to the Centers for Disease Control and Prevention.

The following people should never enter an environment “where mold contamination is obvious”:

- Transplant recipients
- Individuals with neutropenia
- People with CD4+ lymphocyte counts <200/μL attributed to any cause, including HIV infection
- Other individuals diagnosed by their physicians as having profoundly impaired antifungal host defenses caused by congenital or acquired immunodeficiency

The following people might be able to tolerate limited mold exposure, especially to undisturbed mold, but should consult their physicians first:

- Individuals receiving chemotherapy or other immunosuppressive drug therapy, as long as neutropenia or CD4+ lymphopenia are not present
- Individuals with immunosuppressive diseases, such as leukemia, lymphoma, or HIV infection, as long as there is no marked impairment in immune function
- Pregnant women
- People aged >65 years
- Children aged <12 years, particularly infants
- People with chronic, obstructive, or allergic lung diseases

may collect moisture from sources such as a patient’s sweat or blood or spilled drinks. (David)

**Sampling**

If mold is found, the most appropriate action to take is remediation—not sampling. Sampling and laboratory analysis of mold can be expensive and is generally unnecessary for several reasons, including the following:

- If visible mold is present, the type of mold present or other sampling results generally make no practical difference in remediation efforts.
- It can be difficult to acquire a statistically meaningful sample of environmental mold that is representative of local conditions instead of just a measure of the mold that happened to be present in the air or on a surface at the moment when sampling took place.
- Interpretation of sampling results requires expertise because mold is always present in the environment and guidelines are not available to define safe or unsafe levels of mold exposure.

As with many other aspects of mold remediation, forgoing sampling in favor of immediate remediation is a rule of thumb, and another course of action may be advisable depending on the circumstances. If sampling is performed, it generally should have a specific goal, such as to determine the extent of the problem before remediation, particularly if the mold source is unclear, or to determine whether the problem has been solved and the area has been adequately cleaned and remediated. In such cases, appropriate surface or bulk sampling of mold along with air or surface moisture readings may be useful.

Sampling and analysis activities run from simple microscopic examinations of noncultured mold for identifying species to more complex analyses of cultured mold samples. Some facilities may have the capacity to perform sampling and mold identification. For instance, one facility with an active pathology laboratory reported routinely taking a sample of visible mold on a piece of cellophane tape before remediation; the lab staff put the tape under a microscope to identify mold species. Even with these efforts, the results made no practical difference in the types of precautions the facility’s workers took during remediation. The same facility routinely took samples after remediation to ensure that the cleanup had been successful. (Yeager)

As part of regular mold prevention plans, some facilities may want to sample in certain areas, such as bone marrow transplant units or other units housing severely immunosuppressed patients, on a regular basis. Such regular sampling may help keep the most at-risk patients safe but also provides evidence of patient safety efforts that may be helpful during surveys by the Joint Commission or other inspections. (Streifel)

**Remediation**

During remediation, mold is removed from materials that can be cleaned and materials that cannot be cleaned are discarded. An assessment should be performed and a mold remediation plan should be developed before any mold is disturbed. Some facilities handle mold remediation the way they would handle a construction project, starting an infection control risk assessment to determine the extent of infection control and worker safety precautions required. Mold remediation projects may fall under regulations governing construction under certain conditions, such as if a wall is cut to remove mold-infested materials. Additional related information can be found in “Infection Control during Construction,” located in the Basic Infection Control section of the Healthcare Hazard Control (HHC) System.

How mold is remediated will vary according to circumstances and common sense. However, the following general principles apply to mold remediation projects, according to guidelines from an industry-sponsored organization, the Institute of Inspection, Cleaning and Restoration Certification (IICRC):

1. Keep workers, patients, and other building occupants safe through the use of controlled demolition, containment, and air pressure control, as well as appropriate use of personal protective equipment.
2. Document mold and moisture before the remediation, remediation activities, and conditions immediately after remediation is complete.
3. Control the mold contaminant at its source by using proper controls and work practices to prevent the spread of mold and mold spores before and during remediation.
4. Physically remove the contamination. Do not just kill or encapsulate the mold.
5. Correct the moisture problem that led to the mold contamination.

Estimates vary, but generally, an area wet with clean water that is dried within 48 hours is considered at low risk of mold growth. However, after 72 hours, mold growth is a particular concern. Opinions vary as
to whether drying or both drying and mold remediation are required in the period between 48 and 72 hours. The U.S. Environmental Protection Agency (EPA) sets its cutoff at 48 hours and offers guidelines for different techniques to be used before and after that point. These guidelines, summarized in Appendix A and Appendix B, are not specific to healthcare facilities and are provided here for general reference. One approach that will differ in healthcare facilities is the approach to containment. While EPA’s recommendations for containment vary from “none required” to “full” depending on the surface area affected, healthcare facilities should generally contain the area being remediated—no matter how small.

After 48 hours, EPA recommends different types of remediation techniques depending on the extent of mold contamination. These are just rules of thumb and may vary depending on circumstances. For instance, a small area with a heavy concentration of mold may fall under EPA’s recommendations for a medium-size area, while a medium-size area with light contamination may fall under EPA’s recommendations for a small area. Depending on the capabilities of facility staff, it may be necessary or advisable to bring in outside remediators, particularly for larger or more complex projects (U.S. EPA). A detailed discussion of the types of language that it may be advisable to include in mold remediation contracts is found in IICRC’s Standard and Reference Guide for Professional Mold Remediation.

Two professional trade groups that might be able to help facilities locate companies with experience in water-damage restoration and mold remediation are the Association of Specialists in Cleaning and Restoration (http://www.ascr.org) and IICRC (http://www.iicrc.org). Facilities should check contractors’ references and ask the contractor to follow recommendations in the American Conference of Governmental Industrial Hygienists’ guideline document “Bioaerosols: Assessment and Control” (see “Resource List”) or other guidelines from professional organizations or state agencies. Information on state licensing requirements for contractors should be available from state health departments. (CDC)

Healthcare facilities may find it helpful to refer to guidelines published by some state or local authorities. For instance, facilities in Connecticut can consult “Connecticut Guidelines for Mold Abatement Contractors,” which offers advice specifically for healthcare facilities on selecting a mold remediation team, using third-party oversight when employing outside contractors, and determining the scope of work (Connecticut Department of Public Health).

If mold is found in a heating, ventilating, and air-conditioning (HVAC) system, EPA recommends shutting down the system to prevent it from spreading mold through the building, unless a professional with experience in these matters determines that the system will not increase exposure to mold among workers, patients, and other building occupants. Remediation should be done only by professionals experienced in remediating ventilation systems.

Mold remediation in confined spaces may require additional measures to ensure worker safety. For more on these restrictions, refer to the Analysis “Permit-Required Confined Space” and the Training Tool “Permit-Required Confined Space Training Program” in the Physical Plant section in the HHG System.

As shown in the appendixes, EPA encourages mold remediation with detergent, not bleach. In fact, EPA’s published guidance actively discourages the use of bleach, as follows:

- Sterilizing an area is “not possible or desirable” in most cases.
- Personal safety issues arise from inhalation of bleach fumes.
- Bleach mixed with another substance may release highly dangerous fumes.
- Mold must be removed and not just killed because even dead mold may trigger an allergic reaction.

Nevertheless, it is clear that diluted bleach solutions are being used to remediate mold in hospitals (Yeager). In response to a query about its position on bleach use in mold remediation in healthcare facilities, EPA stated that it recommends that the moisture source be identified and corrected and that surfaces be cleaned before any pesticide is applied. EPA also stated the following:

There are many products registered to control mold and mildew in hospitals and other indoor environments. Bleach is one of the many registered products used to control mold, and EPA does not endorse the use of any specific registered product over another product registered for the same use. According to the
latest Agency stamped approved label, bleach may be used as a disinfectant on hard non-porous surfaces in hospitals. When used in accordance with label instructions, the product is effective against mold, and may be used to control mold growth in hospitals. (Smith)

**Communicating with BuildingOccupants**

For medium- and large-size remediation projects, EPA recommends a formal communication process with building occupants that includes regular updates and meetings with occupants to communicate openly and to take questions on topics such as the extent of the problem, the remediation process, health risks, and whom to contact with questions or concerns about mold or the remediation process. Questions and concerns should be addressed clearly.

An alternative approach to communication is to explain during worker training how and why mold remediation is done but not to communicate unnecessarily about each mold remediation project as it is being undertaken. Under such an approach, the level of communication necessary will vary depending on the project but answers should be provided to direct questions and any concerns should be addressed. This approach may help prevent the spread of an unreasonable amount of panic related to mold projects. (Yeager) Such a strategy has risks of its own, however, particularly if patients’ and their families’ concerns regarding mold contamination are unsuspected or unacknowledged.

**Remediation after Flooding**

Although it follows a similar pattern—stop the water incursion, plan remediation, remediate—mold remediation after flooding or other incursions of potentially contaminated water presents infection control risks that mold remediation following clean-water buildup does not. In the wake of the Gulf Coast damage caused by Hurricanes Katrina and Rita in 2005, CDC released a set of recommendations to prevent
excessive exposures to mold during remediation activities after flooding with potentially contaminated water. These guidelines are summarized in Appendix C.

Facilities that have closed because of extensive water and wind damage will have to consider a number of issues besides mold remediation before reopening. CDC has published fact sheets on this process. (See "Resource List.")

To help prevent mold growth, as soon as possible after flooding, methods should be used to dry the affected area, such as positioning dehumidifiers and fans so that they blow toward open doors and windows and using chemical desiccants that absorb moisture. Materials exposed to moisture for 48 hours or longer must be assumed to have mold growth.

CDC recommends against using detergent for mold remediation after a contaminated-water incursion. Instead, hard surfaces contaminated with mold should be washed with a solution containing a mixture of one cup of bleach to one gallon of water, scrubbed with a stiff brush, rinsed with clean water, and dried or left to dry. Hard surfaces without mold growth should be washed with soap and water and then disinfected with a mixture of one cup of bleach to five gallons of water and allowed to air dry. When using bleach, workers should wear rubber boots, rubber gloves, and nonvented chemical splash goggles; open windows and doors to get fresh air; and remember never to mix bleach with ammonia because the resulting fumes can be fatal.

Items that cannot be disinfected, such as waterlogged materials, should be discarded (CDC). Contaminated devices (e.g., laundry machines) should be disinfected or sterilized before use. Facilities may wish to consider whether the cost of remediation and lost operational time is greater than that of discarding damaged items and replacing them. In most cases, discarding and replacing will be the far less expensive option, stated one building administrator involved in a flood cleanup at Texas Children’s Hospital, Houston, after Tropical Storm Allison in 2001 (Kenneday).

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Occupational Safety and Health Administration</strong></td>
<td><strong>Guidelines</strong></td>
</tr>
<tr>
<td>U.S. Department of Labor, Office of Communications</td>
<td></td>
</tr>
<tr>
<td>200 Constitution Avenue NW</td>
<td></td>
</tr>
<tr>
<td>Washington, DC 20210</td>
<td></td>
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<tr>
<td>(800) 321-6742</td>
<td></td>
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<tr>
<td><a href="http://www.osha.gov">http://www.osha.gov</a></td>
<td></td>
</tr>
<tr>
<td><strong>Guide</strong></td>
<td><strong>Guidelines</strong></td>
</tr>
<tr>
<td><strong>U.S. Centers for Disease Control and Prevention</strong></td>
<td></td>
</tr>
<tr>
<td>1600 Clifton Road</td>
<td></td>
</tr>
<tr>
<td>Atlanta, GA 30333</td>
<td></td>
</tr>
<tr>
<td>(404) 639-3311</td>
<td></td>
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<tr>
<td><a href="http://www.cdc.gov">http://www.cdc.gov</a></td>
<td></td>
</tr>
<tr>
<td><strong>Fact Sheets</strong></td>
<td><strong>Guidelines</strong></td>
</tr>
<tr>
<td>Check list for infection control concerns when reopening healthcare facilities closed due to extensive water and wind damage. 2005 Apr 12.</td>
<td></td>
</tr>
<tr>
<td>Remediation and infection control considerations for reopening healthcare facilities closed due to extensive water and wind damage. 2005 Apr 12.</td>
<td></td>
</tr>
</tbody>
</table>
HVAC systems, with their potential to spread mold and other contaminants, require thorough inspection, cleaning, and disinfection. This process should be applied in areas that were flooded as well as areas that were not submerged but where moisture may collect, such as air supply ducts above the water line. The National Institute for Occupational Safety and Health has released special recommendations on cleaning and remediation of flood-contaminated HVAC systems with specific instructions on steps to take before and during cleaning and remediation and how to resume HVAC operations. (See “Resource List.”)

**CHEM RECOMMENDATIONS**

- Adopt a strategy to prevent and control mold growth.
- Perform regular maintenance to prevent water leaks.
- Perform regular visual inspection for moisture and mold.
- Take appropriate additional measures to find out-of-sight mold.
- Leave visible mold undisturbed until a remediation plan is developed.
- Find and control the moisture source before starting remediation.
- Sample only if the sampling has a clear goal.
- Consider using an infection control risk assessment and other construction-project methods to govern mold remediation plans.
- Use containment and other controls in most areas undergoing mold remediation, as appropriate.
- Bring in outside remedicators if necessary, particularly for large or complex projects.
- Incorporate additional precautions into plans for remediating mold caused by contaminated water.
- Ask individuals experienced in mold remediation in HVAC systems to clean mold from these systems.
- Remediate to remove mold from materials, and discard materials from which mold cannot be removed.

**References**


Kennedy, Mark (Director of Building Care and Operations, M.D. Anderson Cancer Center, Houston, TX). Conversation with: ECRI. 2006 Oct.


# Appendix A

## Preventing Mold Growth 24 to 48 Hours after Clean-Water Damage*

<table>
<thead>
<tr>
<th>Water-Damaged Material**</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books and papers</td>
<td>For non-valuable items, discard books and papers. Photocopy valuable/important items, discard originals. Freeze (in frost-free freezer or meat locker) or freeze-dry.</td>
</tr>
<tr>
<td>Carpet and backing—dry within 24 to 48 hours***</td>
<td>Remove water with water extraction vacuum. Reduce ambient humidity levels with dehumidifier. Accelerate drying process with fans.</td>
</tr>
<tr>
<td>Ceiling tiles</td>
<td>Discard and replace.</td>
</tr>
<tr>
<td>Cellulose insulation</td>
<td>Discard and replace.</td>
</tr>
<tr>
<td>Concrete or cinder block surfaces</td>
<td>Remove water with water extraction vacuum. Accelerate drying process with dehumidifiers, fans, and/or heaters.</td>
</tr>
<tr>
<td>Fiberglass insulation</td>
<td>Discard and replace.</td>
</tr>
<tr>
<td>Hard surface, porous flooring (linoleum, ceramic tile, vinyl)***</td>
<td>Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary. Check to make sure underflooring is dry; dry underflooring if necessary.</td>
</tr>
<tr>
<td>Non-porous, hard surfaces (plastics, metals)</td>
<td>Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary.</td>
</tr>
<tr>
<td>Upholstered furniture</td>
<td>Remove water with water extraction vacuum. Accelerate drying process with dehumidifiers, fans, and/or heaters. May be difficult to completely dry within 48 hours. If the piece is valuable, you may wish to consult a restoration/water damage professional who specializes in furniture.</td>
</tr>
<tr>
<td>Wallboard (drywall and gypsum board)</td>
<td>May be dried in place if there is no obvious swelling and the seams are intact. If not, remove, discard, and replace. Ventilate the wall cavity, if possible.</td>
</tr>
<tr>
<td>Window drapes</td>
<td>Follow laundering or cleaning instruction recommended by the manufacturer.</td>
</tr>
<tr>
<td>Wood surfaces</td>
<td>Remove moisture immediately and use dehumidifiers, gentle heat, and fans for drying. (Use caution when applying heat to hardwood floors.) Treated or finished wood surfaces may be cleaned with mild detergent and clean water and allowed to dry. Wet paneling should be pried away from wall for drying.</td>
</tr>
</tbody>
</table>

*If mold growth has occurred or materials have been wet for more than 48 hours, consult “Appendix B. Remediating Building Materials with Mold Growth Caused by Clean Water.” Even if materials are dried within 48 hours, mold growth may have occurred. Items may be tested by professionals if there is doubt. Note that mold growth will not always occur after 48 hours; this is only a guideline. These guidelines are for damage caused by clean water. If you know or suspect that the water source is contaminated with sewage, or chemical or biological pollutants, then personal protective equipment and containment are required by the Occupational Safety and Health Administration. An experienced professional should be consulted if you and/or your remediators do not have expertise in remediating in contaminated-water situations. Do not use fans before determining that the water is clean or sanitary.

**If a particular item(s) has high monetary or sentimental value, you may wish to consult a restoration/water damage specialist.

***The subfloor under the carpet or other flooring material must also be cleaned and dried. See the appropriate section of this table for recommended actions depending on the composition of the subfloor.

## Appendix B

**Remediating Building Materials with Mold Growth Caused by Clean Water**

*Use professional judgment to determine prudent levels of PPE and containment for each situation, particularly as the remediation site size increases and the potential for exposure and health effects rises. Assess the need for increased PPE if, during the remediation, more extensive contamination is encountered than was expected. Consult “Appendix A. Preventing Mold Growth 24 to 48 Hours after Clean-Water Damage” if materials have been wet for less than 48 hours and mold growth is not apparent. These guidelines are for damage caused by clean water. If you know or suspect that the water source is contaminated with sewage, or chemical or biological pollutants, then the Occupational Safety and Health Administration (OSHA) requires PPE and containment. An experienced professional should be consulted if you and/or your remediators do not have expertise in remediating in contaminated-water situations.*

<table>
<thead>
<tr>
<th>Material or Furnishing Affected</th>
<th>Cleanup Methods**</th>
<th>Personal Protective Equipment (PPE)</th>
<th>Containment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SMALL — Total Surface Area Affected Less than 10 ft(^2)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Books and papers</td>
<td>3</td>
<td>Minimum N-95 respirator, gloves, and goggles</td>
<td>None required</td>
</tr>
<tr>
<td>Carpet and backing</td>
<td>1, 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete or cinder block</td>
<td>1, 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hard surface, porous flooring (linoleum, ceramic tile, vinyl)</td>
<td>1, 2, 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-porous, hard surfaces (plastics, metals)</td>
<td>1, 2, 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upholstered furniture and drapes</td>
<td>1, 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wallboard (drywall and gypsum board)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood surfaces</td>
<td>1, 2, 3</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Material or Furnishing Affected</th>
<th>Cleanup Methods**</th>
<th>PPE</th>
<th>Containment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MEDIUM — Total Surface Area Affected Between 10 and 100 ft(^2)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Books and papers</td>
<td>3</td>
<td>Limited or Full</td>
<td>Limited</td>
</tr>
<tr>
<td>Carpet and backing</td>
<td>1, 3, 4</td>
<td>Use professional judgment, consider potential for remediator exposure and size of contaminated area</td>
<td>Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area</td>
</tr>
<tr>
<td>Concrete or cinder block</td>
<td>1, 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hard surface, porous flooring (linoleum, ceramic tile, vinyl)</td>
<td>1, 2, 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-porous, hard surfaces (plastics, metals)</td>
<td>1, 2, 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upholstered furniture and drapes</td>
<td>1, 3, 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wallboard (drywall and gypsum board)</td>
<td>3, 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood surfaces</td>
<td>1, 2, 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material or Furnishing Affected</th>
<th>Cleanup Methods**</th>
<th>PPE</th>
<th>Containment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LARGE — Total Surface Area Affected Greater than 100 ft(^2) or Potential for Increased Occupant or Remediator Exposure During Remediation Estimated to Be Significant</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Books and papers</td>
<td>3</td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>Carpet and backing</td>
<td>1, 3, 4</td>
<td>Use professional judgment, consider potential for remediator exposure and size of contaminated area</td>
<td>Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area</td>
</tr>
<tr>
<td>Concrete or cinder block</td>
<td>1, 3</td>
<td></td>
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</tr>
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<td>Hard surface, porous flooring (linoleum, ceramic tile, vinyl)</td>
<td>1, 2, 3, 4</td>
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<td>1, 2, 3</td>
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<td></td>
</tr>
<tr>
<td>Wood surfaces</td>
<td>1, 2, 3, 4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Select method most appropriate to situation. Since molds gradually destroy the things they grow on, if mold growth is not addressed promptly, some items may be damaged such that cleaning will not restore their original appearance. If mold growth is heavy and items are valuable or important, you may wish to consult a restoration/water damage/remediation expert. Please note that these are guidelines; other cleaning methods may be preferred by some professionals.

**Cleanup Methods**

- **Method 1: Wet vacuum** (in the case of porous materials, some mold spores/fragments will remain in the material but will not grow if the material is completely dried). Steam cleaning may be an alternative for carpets and some upholstered furniture.
- **Method 2: Damp-wipe** surfaces with plain water or with water and detergent solution (except for wood, which should be damp-wiped with wood floor cleaner); scrub as needed.
- **Method 3: High-efficiency particulate-air (HEPA) vacuum** after the material has been thoroughly dried. Dispose of the content of the HEPA vacuum in well-sealed plastic bags.
- **Method 4: Discard**—remove water-damaged materials and seal in plastic bags while inside of containment, if present. Dispose of as normal waste. HEPA vacuum area after it is dried.

**Personal Protective Equipment (PPE)**

- Minimum: Gloves, N-95 respirator, goggles/eye protection
- Limited: Gloves, N-95 respirator or half-face respirator with HEPA filter, disposable overalls, goggles/eye protection
- Full: Gloves, disposable full body clothing, head gear, foot coverings, full-face respirator with HEPA filter

**Containment**

- Limited: Use polyethylene sheeting ceiling to floor around affected area with a slit entry and covering flap; maintain area under negative pressure with HEPA filtered fan unit. Block supply and return air vents within containment area.
- Full: Use two layers of fire-retardant polyethylene sheeting with one airlock chamber. Maintain area under full negative pressure with HEPA filtered fan exhausted outside of building. Block supply and return air vents within containment area.

Table developed from literature and remediation documents, including Bioaerosols: Assessment and Control (American Conference of Governmental Industrial Hygienists, 1999) and IICRC S500, Standard and Reference Guide for Professional Water Damage Restoration (Institute of Inspection, Cleaning and Restoration Certification, 1999).

## Appendix C

### Protection from Mold Exposure in Buildings after Hurricanes and Major Floods\(^a\)

<table>
<thead>
<tr>
<th>Exposure Activity(^b)</th>
<th>Risk Factor</th>
<th>Observing from Outside the Demolition Area (disturbs no dust)</th>
<th>Inspecting or Assessing Damage (disturbs little or no mold)</th>
<th>Recovering Moldy Personal Belongings (disturbs some dust or mold)</th>
<th>Sweeping, Light Cleaning, Removing Mold (disturbs much dust or mold)</th>
<th>Using Power Tools, Cleaning, Demolishing (disturbs all dust and mold)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>No special precautions needed</td>
<td>No special precautions needed</td>
<td>Respiratory protection (RP)(^c) and gloves and dermal protection (GDP)(^d)</td>
<td>RP, GDP, and occlusive eye protection (OEP)(^e)</td>
<td>RD, GDP, and OEP</td>
<td></td>
</tr>
<tr>
<td>Persons at high risk for infection or colonization</td>
<td>Profound immunosuppression(^f)</td>
<td>Avoid exposure</td>
<td>Avoid exposure</td>
<td>Avoid exposure</td>
<td>Avoid exposure</td>
<td>Avoid exposure</td>
</tr>
<tr>
<td>Immunosuppression(^g)</td>
<td>RP</td>
<td>RP, GDP, and OEP</td>
<td>Avoid exposure</td>
<td>Avoid exposure</td>
<td>Avoid exposure</td>
<td></td>
</tr>
<tr>
<td>Obstructive or cavitary lung disease(^h)</td>
<td>RP</td>
<td>RP</td>
<td>RP and GDP</td>
<td>RP, GDP, and OEP</td>
<td>Avoid exposure</td>
<td></td>
</tr>
<tr>
<td>Persons who have diseases with immune sensitization(^i)</td>
<td>Allergic rhinoconjunctivitis (exacerbated by moldy materials)</td>
<td>RP</td>
<td>RP</td>
<td>RP, GDP, and OEP</td>
<td>RP, GDP, and OEP</td>
<td>Avoid exposure</td>
</tr>
<tr>
<td>Asthma (exacerbated by moldy materials)</td>
<td>RP</td>
<td>RP</td>
<td>RP, GDP, and OEP</td>
<td>Avoid exposure</td>
<td>Avoid exposure</td>
<td></td>
</tr>
<tr>
<td>Hypersensitivity pneumonitis caused by moldy materials</td>
<td>RP</td>
<td>RP</td>
<td>RP, GDP, OEP</td>
<td>Avoid exposure</td>
<td>Avoid exposure</td>
<td></td>
</tr>
<tr>
<td>Persons with unknown risk(^j)</td>
<td>Aged &lt;12 years(^k)</td>
<td>Consult healthcare provider</td>
<td>Consult healthcare provider</td>
<td>Consult healthcare provider</td>
<td>Consult healthcare provider</td>
<td>Consult healthcare provider</td>
</tr>
<tr>
<td>Pregnant</td>
<td>RP</td>
<td>RP</td>
<td>RP, GDP, OEP</td>
<td>Avoid exposure</td>
<td>Avoid exposure</td>
<td></td>
</tr>
<tr>
<td>Aged &gt;65 years</td>
<td>RP</td>
<td>RP</td>
<td>RP, GDP, and OEP</td>
<td>Avoid exposure</td>
<td>Avoid exposure</td>
<td></td>
</tr>
</tbody>
</table>

\(a\) Extensive mold contamination is assumed if the building’s interior was saturated with water for >48 hours, extensive water damage is present, extensive mold growth is visible, or “mildew” odors are clearly stronger than before the hurricane or flood.

\(b\) A visible dust cloud suggests high potential for exposure. However, activities can be associated with high fungal exposure even without visible dust. Consider more protective interventions for activities of longer duration or greater frequency.

\(c\) Recommended respiratory protection for residents is a respirator at least as protective as an N-95 filtering facepiece. Respiratory protection for workers in isolated areas of mold contamination (100 ft\(^2\)) or small isolated areas of heating, ventilating, and air-conditioning (HVAC) systems (10 ft\(^2\)) where mold is disturbed is a respirator at least as protective as an N-95 filtering facepiece. For working in areas of extensive contamination (a contiguous area >100 ft\(^2\)) or HVAC systems with large areas of contamination (>10 ft\(^2\)) and substantial mold-containing dust, full facepiece respirators with N100, R100, P100 particulate filters (or for powered air-purifying respirators, HEPA filters) are recommended.
d. Gloves should extend to the middle of the forearm and be selected on the basis of the substance or chemical being handled. When using a biocide (e.g., chlorine bleach) or a strong cleaning solution, gloves made from natural rubber, neoprene, nitrile, polyurethane, or PVC are needed. When using a mild detergent or plain water, ordinary household gloves can be used. Latex or nonlatex medical examination gloves should be used if hands are likely to be in contact with infectious materials. Additionally, aprons and other protective clothing can also be used to protect the skin.

o. Occlusive eye protection includes safety goggles, not regular eyeglasses.

1. Transplant recipients, including organ or hematopoietic stem cell recipients within 6 months of transplant or during periods of substantial immunosuppression; neutropenia (neutrophil count <500/L) associated with any cause, including HIV infection. Affected persons should consult their physicians before entering the affected area.

9. Includes immunosuppressant drug therapy (e.g., cancer chemotherapy, corticosteroid, or other immunosuppressive drug therapy), and diseases impairing host defense such as leukemia or lymphoma. Affected persons should consult with their physicians before entering the affected area. Duration and frequency of exposures should be minimal.

h. Such diseases include chronic obstructive pulmonary disease, asthma not exacerbated by mold, cystic fibrosis, and cavitary tuberculosis. Risk for airway colonization and subsequent diseases following mold exposure is unknown. Recommendations are based on best professional judgment.

1. The optimal treatment for allergic rhinitis, allergic asthma, or hypersensitivity pneumonitis is avoidance of the sensitizing agent. If symptoms occur despite the recommended preventive measures, avoidance of exposure is indicated. In many cases, allergic etiology of rhinitis or asthma needs to be inferred from clinical information, since the available diagnostic reagents for documenting IgE sensitization to fungi are mostly unstandardized. Similarly, the precise antigenic agent causing hypersensitivity pneumonitis is often unclear.

f. The level of risk associated with exposure activities and the potential benefit of recommended personal protective equipment are unknown for these vulnerable populations.

a. Exposure-reducing behavior and respiratory protection can be difficult to achieve in children aged <12 years. Infants should avoid exposure at all activity levels.