MOLD: INVESTIGATION AND REMEDIATION PROCESS

By Russell S. Nassof

More than 100,000 identified species of fungi exist naturally in our environment today, some species of which have existed for millions of years. They are generally present throughout the world at ambient airborne levels and have limited negative impact on mankind. Germination or reproduction of fungi occurs when fungi, which are naturally present in building materials such as ceiling tiles, drywall, insulation, and the like, are exposed to moisture. Upon germination fungi become mold; as long as moisture is present, the fungi will continue to reproduce (grow), creating potentially serious human health issues.

Mold has become an important issue for the following reasons:

- As modernization erodes the open spaces in which we live, confining us to more and more enclosed spaces, the opportunity for exposure to airborne fungi increases. The amount of mold indoors is hundreds, thousands, or even millions of times greater than that in the outdoor environment, and is increasing substantially.
- General weakening of the human species, especially in the Western hemisphere
- Pot-of-gold opportunities created by litigation.
- Media attention.
- Decline of other environmental issues.
- Increased world temperatures resulting in an increase in the pollen and ambient mold levels.

Generally, building materials must remain wet for more than 24 to 48 hours for molds to develop. If mold is visible prior to that time, it is likely from a preexisting water problem and not from the immediate occurrence. It is therefore extremely important to respond quickly to issues of water incursion as soon as a leak is discovered, by repairing the source of the leak, thoroughly drying all wet materials, and removing moisture from the air. The most significant factor in a microbial contamination occurrence is *not* the quantity of water involved in a loss but rather the length of time water intrusion impacts a material that is a suitable food source for the fungi.

Once molds become visible, they must be removed. A visual inspection is an important first step in any microbial investigation. Unfortunately, molds thrive in environments where there is a lack of ventilation, such as in wall cavities and subfloors, beneath wall/floor coverings, and behind vapor barriers and ceiling tiles. When microbial growth is suspected, it is critical to investigate all areas thoroughly for any potential water impact.

Until the source of water intrusion is eliminated and all impacted materials dried, molds continue to grow and, eventually, become aerosolized (airborne). This occurs when fungus germinates and distributes millions of spores in hopes of reproduction. Generally, the longer the molds have been germinating, the higher the spore counts and the more likely the molds have become aerosolized. Drying out building materials and molds may stop mold growth, but it may also make the dead mold spores more likely to aerosolize. Therefore, a drying process performed in an area with existing mold should be undertaken only under carefully controlled conditions.

Mold Exposure and Health

We are constantly exposed to thousands of different types of fungi in our everyday lives. Certain types of fungi tend to exist naturally in our environment, in soils, plants, fruits, and textiles. Exposure to these fungi in typical everyday doses generally is not harmful to our health, but exposure at higher levels may be harmful. Therefore, when a microbial investigation is performed, the levels and types of fungi present in the internal environment should be compared with those existing naturally in the outside environment. Should the indoor composition significantly vary quantitatively or qualitatively

(in genus or species) from the outside composition, microbial magnification should be suspected.

There are no established safe exposure limits for any fungi; all may be potentially harmful. Individual health conditions and sensitivities will dictate on a unique basis both the impact (i.e., particular physical effect) and duration of illness that occurs as a result of exposure. Individuals who are immune-compromised, infants, and small children with immature immune systems may be more severely impacted by exposure and may experience long-term health effects. It is important to note, however, that not all immune-compromised deficiencies will render an individual more susceptible to mold and many of the historically high-risk groups (i.e., pregnant women, the elderly) are thought by most experts to be no more susceptible than anyone else.

It is tremendously difficult, legally and medically, to link severe illness to mold exposure. The difficulty centers on our inability to effectively measure mycotoxins (particulates given off by host molds) that are believed to be responsible for causing people's adverse reactions to molds. This inability to measure mycotoxins (except at extremely high levels), coupled with our lack of knowledge with respect to the process of causation (i.e.,what is the triggering mechanism that prompts the release of the mycotoxins), has made it difficult if not impossible to establish causation between exposure to mycotoxins and development of severe illness. In order to be able to make an association between mycotoxins and human disease, several issues must be resolved. These include whether or not mycotoxins are concentrated in the spores of suspected mycotoxin-producing fungi (it is not clear whether the mycotoxins are excreted from the hyphae or actually in the spore); the level of mycotoxin concentrated in the spore; the level of exposure required for symptoms to develop; and a clinical definition of the disease.

Some of the most common health effects that may result from exposure to high levels of mold include allergic responses, headaches, dermatitis, asthma, eye problems, diarrhea, vomiting, nausea, fever, respiratory illnesses, and ear infections. It is thought that exposure to specific fungi will develop specific illnesses; therefore, it is important to document specific complaints of ill health that can be traced back to exposure to a specific mold.

Stachybotrys

Stachybotrys is a fungus that recently has received a tremendous amount of media attention. It is a black, slimy mold that requires an ongoing water source and/or extremely high humidity to grow. Once the drying process begins, the stachybotrys mold, which is very fragile, is generally replaced by aspergillus or penicillium. The mold's "slimy" characteristic is an important factor in why it is not often found in an aerosolized form. Finding this mold in the air generally indicates that the water intrusion has existed for some time. The stachybotrys mold selects a host of cellulose building materials, as well as products containing wood, paper, or cotton. This is not the black mold in your shower or the green mold on your cheddar cheese.

Stachybotrys has gained notoriety because it produces mycotoxins that can cause adverse health effects to those exposed to it. Although most molds produce some form of mycotoxins, those produced by stachybotrys are suspected to be extremely toxic, carcinogenic, and immunosuppressive. At the present time, however, considerable debate continues about the harmful impact associated with stachybotrys exposure.

Although stachybotrys was first described more than 150 years ago, the current focus is the result of an occurrence of pulmonary hemosiderosis (bleeding lung disorder) responsible for the deaths of 16 infants living in Cleveland housing projects, the condition is believed to have been caused by exposure to stachybotrys. The Centers for Disease Control, however, which conducted the investigation, recently indicated that linking this illness to stachybotrys exposure may have been premature. What is certain is that exposure to high levels of mold can be harmful, even though the actual ill effects and the amount of toxic exposure necessary to produce them will vary from individual to individual

Conducting a Microbial Investigation

Performing a microbial investigation is not always necessary. Each case must be evaluated on its own facts. In considering whether to perform an investigation, the following risk factors should be evaluated:

- Is there current or past water damage, particularly to building materials (cellulose, drywall, wood) that have been wet more than 24 to 48 hours?
- Is visible mold present?
- Do occupants complain of

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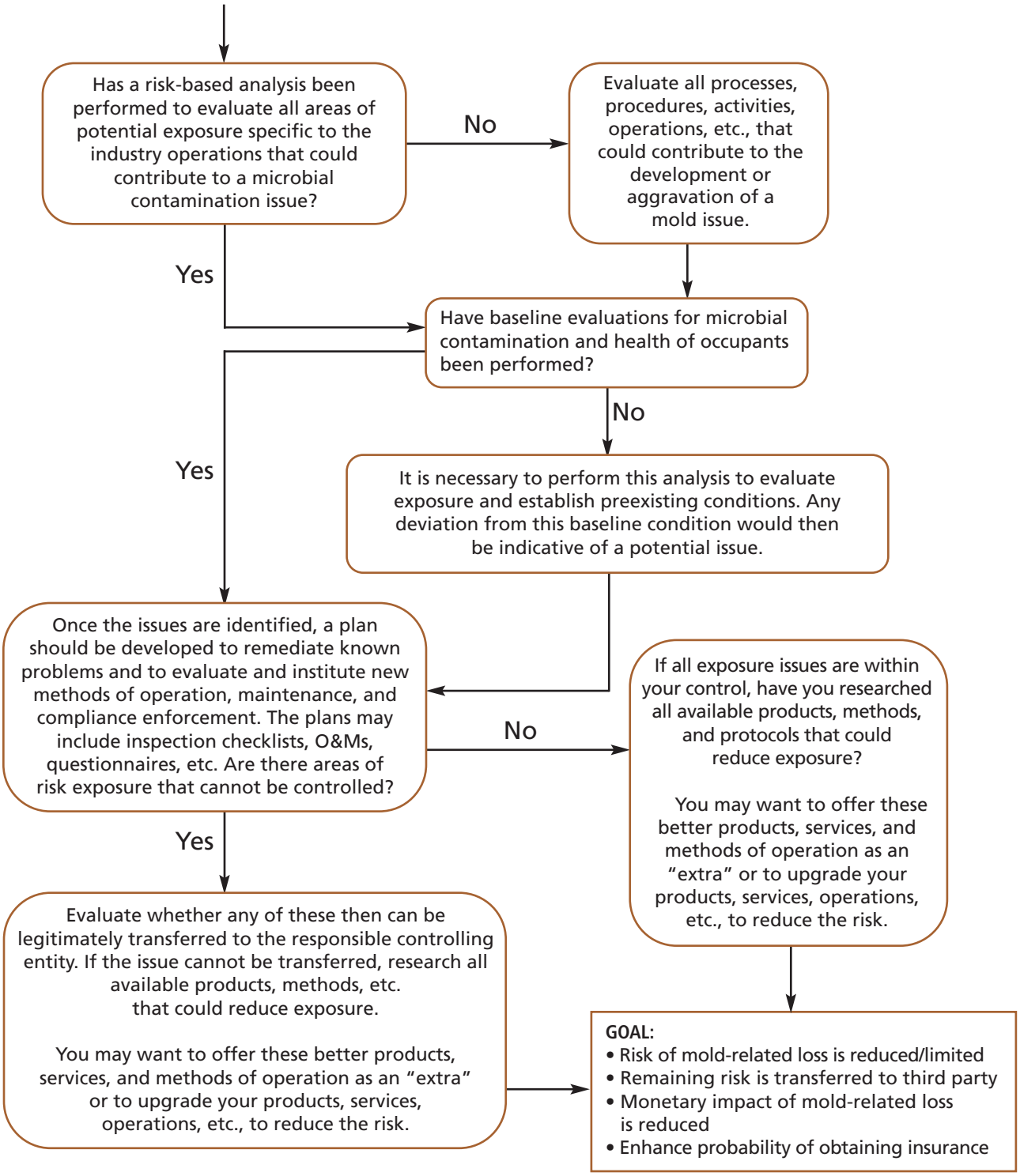

health issues that coincide with the presence of water damage?
- Are immune-compromised individuals or infants located in close proximity to areas of impact?
- Is there evidence of hidden microbial growth (i.e., odors) and/or of past moisture problems?
- Are ambient moisture levels high?
- Is there visible microbial evidence in the HVAC system and/or wet filters, standing water, dirty surfaces?
- Is the time and cause of loss known? Might there be multiple causes of loss?
- Is the extent of damage clearly defined?
- Is gray/dirty water involved?
- Does the affected area include a high-risk environment?
- Is the insured hostile, or is a P.A. involved?
- Does the building have conditions conducive to microbial growth: perimeter berms, sprinklers in close proximity to the building, roof issues, planters, crawl spaces, drainage/foundation issues, etc.?
- All information is discoverable in court. If the only information that can be generated by conducting an investigation is information that will hurt your client, you may not want to perform the testing.

Sampling

If, after evaluating the risks assessed with each particular case, a microbial investigation is advisable, the first step should be to examine the building layout and HVAC system. Next, after discussing the location and cause of water intrusion with knowledgeable personnel, perform a thorough visual observation of the building. Knowing the date of the event and the duration of the water intrusion may be important.

Sampling always should include a variety of sampling methodologies because it produces a "snapshot" of conditions at the time of the investigation; varying the types of samples and sample locations and times ensures a more representative picture of the actual conditions. Sampling a variety of surfaces, for example, may prevent missing certain areas of impact. Air sampling should take place outside as well as inside the structure, so that a comparison can be made of the internal quantity and type of mold/bacteria and the external. In addition, if the water impact is the result of a sewer or other "dirty water" problem, be sure to take samples for bacteria, which may exist along with fungi to produce additional health issues.

Air Sampling Data Interpretation

- Generally, two methods (Air-O-Cell spore trap sampler and single stage bioaerosol sampler with culture media) are used to identify fungal contaminants in the air; no one method can detect all microbial contaminants. Spore trap samplers identify the fungal contaminants only to the genus level; they cannot identify to the species level nor differentiate between aspergillus and penicillium genera. Where health issues are alleged, it is important to identify contaminants to the species level. In addition, sporetrap analysis cannot identify the producing organisms for ascospores and basidiospores, produced by many fungi and mushrooms, respectively.
- Microbial air sampling is highly variable; temperature, relative humidity, air movement/activity, outdoor air, time, and other factors affect the fungal structure and the dispersion of fungal spores. Thus noticing the weather on the date of sampling is important. Snow cover, for example, may eliminate all outside mold counts.
- To evaluate air sample results, multiple outdoor samples are taken; and the highest values of mycelia fragments, pollen, and total fungal spores are used for comparison with indoor air. Many times samples taken at different areas at different times vary. For this reason, a minimum of two outside samples should be taken, one at the beginning of the survey (preferably in the front yard) and one at the end (preferably in the back).
- Total spore counts of environmental fungi for each indoor sampling location are compared directly to the highest total spore count found in the outdoor air. Total spore counts should be the same or lower than the total spore counts measured in the highest outdoor sample. This is the *quantitative* comparison.
- Elevated levels of mycelial fragments may indicate that the fungi have been damaged or "broken" and fungal spores may be aerosolized.
- Individual spore counts of each type of environmental taxa identified in the indoor samples are compared to the highest individual spore count of the same taxa measured in the outdoor samples. This is the *qualitative* comparison.

The types of fungal species should be similar to that of outdoor air.

- Elevated airborne levels of environmental fungi drive the determination for contents cleaning, HVAC cleaning, and HEPA-vacuuming of carpeting.
- Air samples are collected from each problem area as well as one or two areas in the residence that are expected to be free of aerosolized fungal contamination. Typically, if the sampling shows aerosolization of fungal contaminats only in the problem areas, we recommend cleaning only in the problem areas. If the "nonaffected" area(s) samples also indicate aerosolized fungal contamination, cleaning of the entire residence is recommended.

Surface Sampling Data Interpretation

- If no surface is sterile, the question is, are the fungi growing on the surface?
- Surface sampling can consist of swab sampling, bulk sampling, tape sampling, or dust-collection sampling (e.g., carpet sampling).
- Surface sampling has its limits. Tape samples cannot be cultured and do not travel as well as other types of surface sampling. Swab samples remove only a portion of the visible fungal growth and may damage the structures, rendering them unidentifiable at the laboratory.
- Surface sampling is only a picture of one small area.

Wall Cavity Sampling

- Air samples may be taken inside a wall cavity to get a reading on what is going on in a wall cavity. Although building materials are expected to have fungal spores present on the surfaces, excessive fungal growth inside a wall cavity is not desirable.
- This sampling can be thought of as a qualitative sampling method to identify whether excessive fungal spores are present in a wall cavity. This methodology has its limitations, however; it does not check the "length" of the wall and therefore may generate both false positives and negative results. Dirty construction and lumberyard mold also can affect these samples, as can excessive debris and drywall dust in the wall cavities. If the reading is excessive, the laboratory cannot count and identify the fungal spores.
- Alternatives include conducting visual inspections of wall cavities by removing a portion of drywall (stud to stud) to "look" into the wall cavity, although the consultant cannot "see" the entire length and height of the wall and the potential for aerosolizing fungal contaminants exists. Using a Boroscope also allows visual inspection, but this method is limited because not all of the wall cavity can be viewed from one hole in the wall, and is awkward in actual field operation. These methods, of course, are much more invasive, and residents typically do not like having patches on walls afterward.
- Visual inspections of wall cavities on adjacent walls are generally recommended if there are questions regarding how far the water extended from the loss origin.

It should be noted that there still is considerable debate about what constitutes "contamination." Parameters of significance with respect to "contamination levels" can be developed based on historical data and visual inspection. Development of this data for each sampling methodology is currently in process.

Findings

After laboratory sample results are received, a report of findings should be issued that details the factors:

- Causes of loss as identified by fungal amplification sites
- Extent of microbial contamination
- Whether water intrusion issues appear to be ongoing
- Types of molds present and whether growth is evident
- Whether visually confirmed microbial growth also is the source of airborne contamination
- CAD drawing showing sample locations and results
- Photographs
- Weather conditions during sampling

Qualification of Experts

No credential requirements must be met to perform a microbial investigation. Engaging an individual with microbial investigation experience therefore makes good sense, preferably an industrial hygienist with microbiology or toxicology experience or a certified industrial hygienist (CIH).

The complexity of a typical mold case, especially one with impending litigation, usually requires the following team:

- Certified industrial hygienist (CIH): Performs sampling; knowledgeable with respect to indoor air quality issues
- Microbiologist (MS/Ph.D.):

Interprets lab data (microbial analysis)
- Toxicologist (MS or Ph.D.): Interprets exposure potential if health complaints have been alleged
- Medical doctor (M.D., environmental, occupational health, pulmonary specialist): Performs IME and gives diagnosis of health complaint
- Engineer (PE/forensic architect): May be needed to determine cause of loss if unknown

Relevant samples should be analyzed by an independent microbial laboratory that regularly performs this type of analysis. The laboratory should participate in the American Industrial Hygiene Association Microbiology PAT (Proficiency Analytical Testing) Program and/or be accredited in microbiology. Of course, the laboratory, your experts, and the remediation contractor always should be completely independent of one another.

Remediation

Once mold is identified, the following steps should be taken:

- Fix or stop the cause of moisture
- React promptly—dry and clean impacted areas
- Hire appropriate professionals
- Document all actions
- Run dehumidification
- Contain areas of visible mold and set up negative pressure enclosure
- Begin remediation if necessary

Remediation is the cleanup and removal of mold and spores in the structure and in the personal property to return them to background levels.

- Background levels are those that exist naturally in the outside environment.
- Remediation has been successfully completed when both the levels and types of molds found inside are comparable to the levels naturally occurring outside the residence/building in which the remediation has taken place.
- In general, items (furniture, clothing, toys, books, etc.) that have sustained microbial impact growth should not be moved into a clean environment until they have been remediated. Failure to follow this guideline could result in the contamination of previously nonimpacted areas and could affect the health of individuals in contact with the damaged items.
- Microbial waste can be disposed of at regular (nonhazardous) landfills; however, all workers should be notified of the contents and should be appropriately trained to handle a bag rupture should one occur.

The current trend with respect to remediation is that it is possible to clean most personal property. The exception to this appears to be soft goods that have been visually impacted by microbial growth, which should be discarded. Removal of impacted drywall/cellulose building materials should include all visually impacted areas *plus* one to two feet beyond the outer boundary of contamination.

New Trends

Protection for the Residential Buyer/Seller

Both the buyer and seller can perform a microbial self-evaluation to determine whether there is a likelihood of an issue's being present. Among issues the buyer and seller should consider and address are the following:

Buyer

1. Did it feel unusually humid in the residence?
2. Were there sprinklers in close proximity to the house?
3. Were there built-up areas around the perimeter of the building?
4. Were there stains on floors/walls/ceilings/widows?
5. Were carpet tack strips black?
6. Is there a history of prior roof/plumbing leaks?
7. Were there any unusual odors?
8. Was the HVAC system in good condition (wet filters, etc.)?
9. Was it too cold in the structure?
10. Were there stains in the sink cabinetry from water leaks?
11. Were there many houseplants, indoor terrariums, etc.?
12. Did all vapor barriers seem appropriate for the climate?
13. Were repairs to the building poorly made, or were surfaces painted over to hide problems?
14. Was there carpet in bathrooms?
15. Were there improper drainage conditions?
16. Is visible mold or water damage present?
17. Are crawl spaces damp or musty, and/or is excessive debris or other evidence of potential environmental problems visible in these areas?

Seller

1. Fix all water or moisture problems promptly.
2. Clean and/or remove all moldy materials
3. Check for return of moisture or mold problems.
4. Assess size of problem and note type of damaged materials.

5. Determine whether remediation is needed.
6. Test
7. Replace old washing machine and icemaker hoses.
8. Check property routinely for leaks, especially dishwasher, refrigerators, water heater, sinks, roofs, areas around windows.
9. Maintain low-level humidity through use of dehumidifiers or air conditioning.
10. Keep condensation pans clean and dry.
11. Check for moldy/musty odors.

As a buyer, you may want to have the current owner remediate the problem. Postremediation sampling should be performed after the project is complete to demonstrate that the issues have been successfully addressed. As a seller, it may be necessary to comply with certain state requirements, where applicable, with respect to disclosure and remediation. If your jurisdiction has

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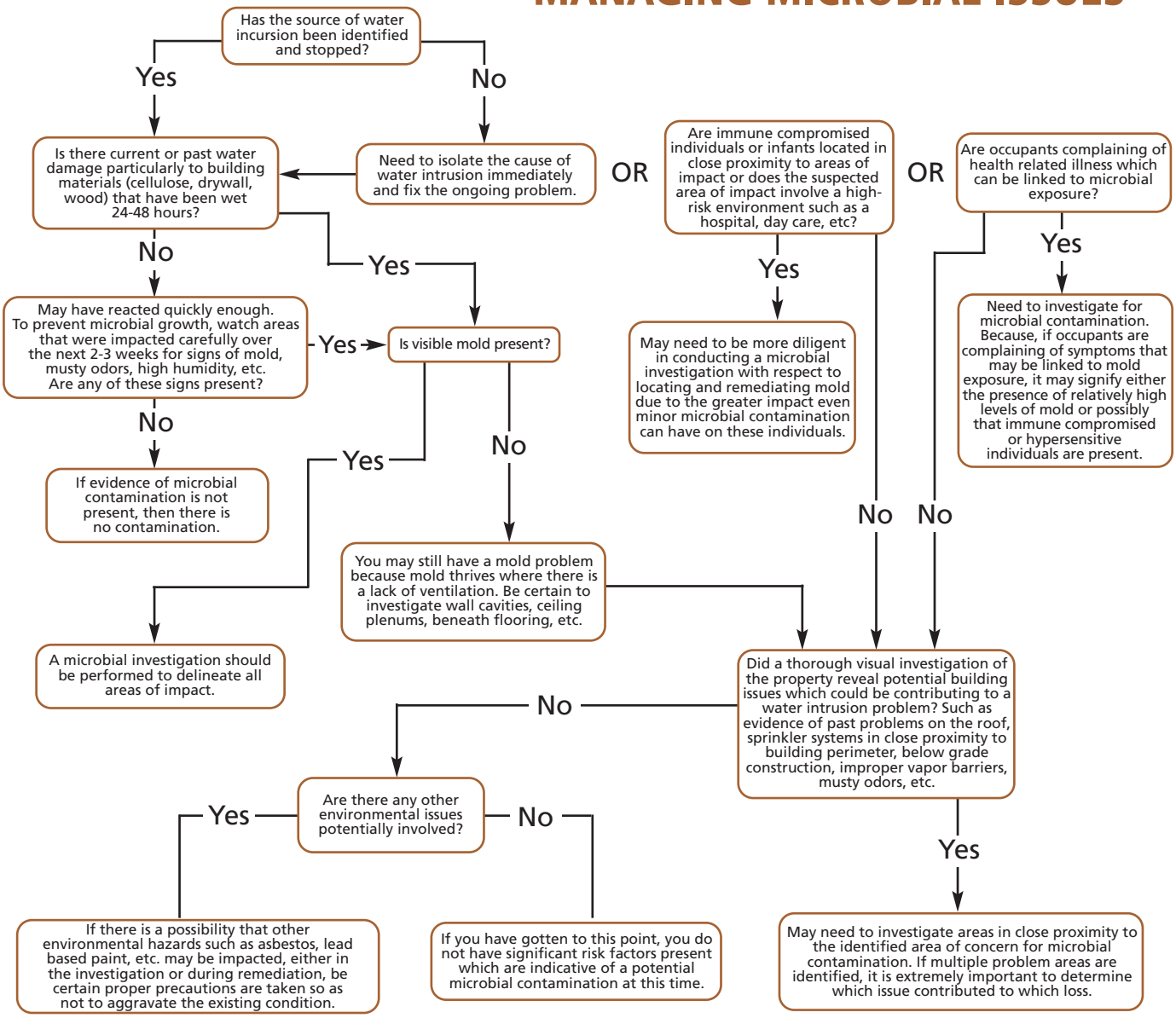

no particular requirements, it would be prudent to investigate known areas with past water intrusion issues and/or conditions that could be indicative of mold growth (i.e., high humidity levels, musty odors, improperly ventilated spaces, etc.). These areas should be remediated promptly, and postremediation sampling should be performed to guarantee successful remediation.

Liabilities for residential sellers may vary based on the particular state laws at issue. However, there is a clear potential for liability if a seller conceals or fails to disclose an unresolved issue. Liabilities for the buyer could involve tremendous repair and cleaning costs, especially if the issue was not identified soon after closing.

Protection for Commercial Industry

Obtaining coverage for microbial contamination will involve the following stages: prevention and maintenance plans, investigation and remediation plans, contractual risk transfer, and claim advocacy and management.

The process generally begins with performance of a risk-based analysis to determine risk potential for microbial contamination exposure. Once all applicable risk exposures for the particular company are identified, the environmental/microbial consultant works in conjunction with the appropriate company personnel to assign different values to the identified risks. Should the sum of the identified risk factors exceed relevant threshold levels (also established by the company and consultant), a variety of exposure response actions are triggered.

The next step is to develop and implement the following steps:

- protocol to reduce existing exposure
- proactive inspections to reduce existing and future risks of mold exposure
- contractual risk transfer

Successfully implementing these steps usually results in an enhanced likelihood of obtaining insurance because the risk of mold-related loss has been reduced or eliminated, remaining risk has been transferred to a third party, and the monetary impact of mold-related loss has been reduced. ■