Global Indoor Health Network

Common Toxins in Our Homes, Schools and Workplaces

Global Indoor Health Network, Inc.
PO Box 777308
Henderson, NV 89077-7308
contact@globalindoorhealthnetwork.com

globalindoorhealthnetwork.com

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Global Indoor Health Network (GIHN)

"Working Together for Healthy Indoor Environments"

PREFACE

The Global Indoor Health Network (GIHN) is a nonprofit organization dedicated to providing education and awareness of the health effects of mold and other indoor contaminants. GIHN's worldwide network of scientists, physicians, researchers, building engineers, indoor air quality experts, attorneys, teachers, injured workers, healthy indoor environment advocates and others are working together to promote healthy indoor environments in our homes, schools and businesses. GIHN has members throughout the United States and in seven other countries who have united to share our collective knowledge, expertise and life experiences to advance the understanding and awareness of this very important public health issue.

Indoor air pollutants cause 50% of illnesses globally. Poor indoor air quality affects people from all walks of life. Affected persons include both genders, all ages, those unborn and soon-to-be born, homemakers, stay-at-home moms, teachers and school children, veterans, retirees, disabled individuals, workers of all levels and skills, farmers, professionals, owners of businesses large and small, and all degrees of affluence. In short, anyone who spends time indoors is at risk.

This paper is dedicated to the individuals, families, teachers, employees and school children throughout the world who have been harmed by exposure to indoor contaminants...and to the countless advocates, doctors, scientists and others who have been working tirelessly for years to bring this very important public health issue to the forefront. It is our hope that this paper will help to further advance this cause.

Authors:

Scott W. McMahon, M.D.
Janette Hope, M.D.
Jack Dwayne Thrasher, Ph.D.
William J. Rea, M.D.
Alan R. Vinitsky, M.D.
Michael R. Gray, M.D., MPH

For a brief biography and conflict of interest statement for each author, see page 41. Any questions regarding this paper may be forwarded to Dr. Scott McMahon at (575) 627-5571.

EXECUTIVE SUMMARY

Astute physicians and healers have been aware of the existence of environmental toxins for over a thousand years. The list of substances, both naturally occurring and manmade, which may cause harm to the human organism, is continually growing. Curiously, while heart disease, cancers and rare exotic illnesses frequently grab headlines, illness due to environmental sources, though incredibly common, often receive little or no media coverage. Typically, little education is offered to allopathic physicians in their medical training on this subject. Hence, there is poor understanding of, and by many even contempt for, the concept that our environment is capable of slowly poisoning its inhabitants. However, according to a United States (U.S.) Environmental Protection Agency (EPA) spokesman, **indoor air pollution causes 50% of illnesses globally**. That's more than all the cancers and all the heart disease combined. It is time we started to pay more attention to the indoor air we breathe.

Occasionally, an environmental illness becomes national news overnight. Legionnaire's Disease, caused by the *Legionella* bacteria, became a media superstar in the summer of 1976 as hundreds of people became ill at the American Legion convention in Philadelphia, Pennsylvania. This is the exception for most environmental poisons, however. More typically, a few individuals discover the toxic potential of a substance, such as asbestos, publish, and yet it may take 3-4 **decades** for public and Western medical acceptance of the danger.

This delay in widespread awareness of novel science is not new and was certainly around in the times of Copernicus, Galileo and others, whose theories and proofs were opposed by powerful controlling bodies. In time, however, the truths of their works prevailed.

This paper highlights a number of environmental toxins, most of which have already been accepted as capable of causing significant disease. Studying their individual histories of usage and poison potential discoveries confirms that we, as people and as physicians, are usually slow to accept that these substances—found in most homes, schools and workplaces—are capable of harming us and our children.

Radon, asbestos, products of combustion (such as carbon monoxide and cigarette smoke), volatile organic compounds (such as formaldehyde, benzene, pesticides and some personal care products), particulate matter, lead and a number of known and emerging disease-causing microbiological agents are discussed in this paper. However, the most space is reserved for the discussion regarding the secondary metabolic products of molds and bacteria released into the air of water-damaged buildings as these potentially may harm the most people and because of the disinformation war currently being waged suggesting that human disease from these toxins cannot exist.

Indeed, the 2010 Policyholders of America (POA) position statement documents the previously published literature of more than 50,000 patients (a staggering number) displaying aspects of this disease. Yet, some individuals and organizations continue to author reports claiming there is no human data, no credible evidence and no way this disease can even exist. Interestingly, the American College of Occupational and Environmental Medicine's (ACOEM) 2011 position paper cites no study published after 2002 and does not reference the General

Accounting Office's (GAO) report of 2008 or the World Health Organization's (WHO) report of 2009—both of which summarize the existing scientific data and flatly contradict the opinions of the ACOEM's naysayer paper. Naysayer articles also spend valuable print space suggesting that disease from mold can only occur after ingestion, or can only occur in the presence of large amounts of aerosolized toxin, or can only occur in an acute exposure. In light of the overwhelming peer-reviewed and journal-published evidence to the contrary, it is unimaginable that such papers are still being inked, are still being used in courts as "evidence" and are still considered relevant in any way. It's the "Big Lie" all over again—say something long enough and loud enough and many will believe the lie.

"Big Business" has been shown repeatedly to use this tactic regarding the dangers of their products, and the histories of such substances as radium, asbestos and coal are evidence of the same. Workers in these industries, and other industries, were exposed to dangerous materials **for decades** while those making the profits knew the potential harmful health effects. Perhaps the tobacco industry is the most glaring and current example of corporate hubris, claiming, also for decades, that there was no evidence linking smoking to cancer and producing its own studies revealing that cigarette smoking was "safe". Hence, the era of junk science was not born, but was merely revealed.

Many additional examples of industry's use of the "Big Lie" strategy are highlighted in David Michaels' book "Doubt is Their Product."[148] Ironically, the name for the book came from the following statement written by one of the tobacco industry executives: "*Doubt is our product* since it is the best means of competing with the 'body of fact' that exists in the minds of the general public. It is also the means of establishing a controversy." Michaels provides an excellent summary:

> *The practices perfected (by the tobacco industry) are alive and well and ubiquitous today. We see this growing trend that disingenuously demands proof over precaution in the realm of public health. In field after field, year after year, conclusions that might support regulation are always disputed. Animal data are deemed not relevant, human data not representative, and exposure data not reliable. Whatever the story—global warming, sugar and obesity, secondhand smoke—scientists in what I call the ''product defense industry'' prepare for the release of unfavorable studies even before the studies are published. Public relations experts feed these for-hire scientists contrarian sound bites that play well with reporters, who are mired in the trap of believing there must be two sides to every story. Maybe there are two sides—and maybe one has been bought and paid for.*

"Big Business" has been aware of the mold issue for more than a decade too. At stake, who will pay for the cost of remediating water-damaged buildings? Since the U.S. EPA estimates that up to ½ of all U.S. buildings are water-damaged, the bill to correct all these spaces is enormous. State and Federal governments do not want to pay this price, nor do school districts or other employers. Building insurers have quietly exempted themselves via the addition of mold riders in their policies (non-existent 20 years ago). Meanwhile, more and more people are getting sick in the buildings where they live, attend school and work. By keeping the issue hushed, "Big Business" is attempting to delay paying the price, or if possible, push the costs of problem

solution onto the "little guy", i.e., the individual homeowner. Also at stake are 1) who pays for the medical care for injured workers and students and 2) who pays for the lost livelihoods of injured employees who are now disabled from their work environment related condition?

If you look at the other side of the equation, billions of dollars could be saved if we implemented specific steps aimed at improving indoor air quality. According to a 2011 report by Fisk et al, there is a potential annual economic savings of $20 billion if we would implement specific scenarios to improve indoor environmental quality in the stock of U.S. office buildings. Imagine how big those savings would be if we also made these changes in schools, homes and other structures around the world.

Literally, hundreds of billions of dollars are in the balance. Since widespread understanding in the lay and allopathic medical communities has yet to be achieved, these decisions are being made one by one in the courts. Hence, the emergence of junk science and the Big Lie to obfuscate the obvious—our environments can possess substances dangerous to human health—and some companies are making large profits by not addressing the dangers, insurance companies have revised their policies to exclude coverage for mold, some construction firms improve their bottom line by using poor construction techniques, and some schools are poisoning our children.

Mold illness, mold-related illness and biotoxin–related illness are euphemisms which are collectively referred to as Multi-system Exposure Related Illness (MERI) in this paper. Likely millions of individuals with MERI exist in the U.S. alone. In fact, as noted above, indoor air pollutants cause 50% of illnesses globally. Most physicians will not recognize the illness because of unawareness and the variable multi-systemic presentations of MERI.

While a massive acute exposure can lead to MERI, the most common mechanism is chronic exposure to low level toxins leading to an inflammatory response in the body. Inflammation is not caused by the typical path seen with infecting agents—antigen presentation to dendritic cells leading eventually to antibody production—presumably because the respective HLA-DR abnormalities do not enable the antigen presenting cells (APC) to recognize the offending toxin(s) as foreign. The toxin(s) are thought to bind to Toll-like (adipose cells) and non-Toll receptors acting as pattern-recognition receptors, then activate the innate immune system in the form of the mannose binding lectin pathway (MBL) of the complement system through a secondary messenger scheme. This leads to continuous stimulation of the MBL pathway without an effective "turn-off switch" (since no foreign particle was presented to APCs to be cleared). Direct neurotoxicity of some mycotoxins has also been demonstrated.

Currently, our detection and testing methods are not sensitive enough to determine which individual toxin, or group of toxins, causes illness for each individual patient. Different patients likely will have individualized susceptibilities and each water-damaged building has its own unique set of pathogenic, toxin-producing microbes. What is clear from re-exposure studies, however, is that certain buildings will cause a rapid reproduction of symptoms (and abnormal lab studies) in patients when re-exposed off therapy. Should the medical community wait 20 or 30 years to develop the technology to determine which individual toxin(s) is (are) causing MERI, or

should buildings be remediated and patients be treated now? The question is rhetorical; the answer is obvious.

The diagnosis of MERI is usually straightforward although a consensus of the exact definition of the disease has not been established since the disease is in the process of being defined. There are numerous objective biological indicators found in patients suffering from MERI. Dr. Ritchie Shoemaker *et al* have proposed a three-tiered case definition. He and his group use an extensive history, physical exam findings, and results of Visual Contrast Sensitivity testing, Magnetic Resonance Spectroscopy, nasal culture and blood tests to look at 10 different bio-markers for this illness.

Other treating physicians use additional testing modalities. Dr. Michael Gray *et al* also look for evidence of fungal colonization in nasal passages, sputum and stool, evaluate potential pesticide exposures and measure urine mycotoxins as proof of exposure. His group also looks at Nerve Conduction Velocities, neurobehavioral testing developed by Dr. Kaye Kilburn and QEEG (Quantitative Electroencephalograms) as part of their evaluation. In addition, Dr. Janette Hope uses detoxigenomic studies which look at various single nucleotide polymorphisms and assesses for nutritional deficiencies frequently found in those with long-term toxic exposures. Dr. Alan Vinitsky assesses for autonomic nervous system (ANS) dysfunction via the Autonomic Nervous System And Respiration (ANSAR) testing system. Dr. William Rea has developed a multi-disciplinary approach to diagnosis (which includes intradermal provocation of mycotoxins) in a facility using state of the art construction techniques to create a "less polluted environment". As more researchers and treating physicians publish on MERI, a consensus definition and diagnostic approach will be developed.

Treatment protocols also vary and to date there have been no head-to-head trials on the efficacy or superiority of any one regimen. However, each listed practitioner will relate extraordinary results (even up to 90%) of patients who are compliant with the prescribed therapy. The two basic principles of most approaches include 1) toxin avoidance and 2) removal of toxin from the body, usually via sequestering agents.

In summary, MERI is a multi-symptom, multi-system disease occurring in many people due usually to long-term exposure to the interior of WDB. While there are differing opinions on the best diagnostic and therapeutic approaches, it is clear from the literature and from practice that this disease exists and significant relief can be obtained by most sufferers with avoidance of further exposure and appropriate treatment.

Indoor air pollutants cause 50% of illnesses globally. This statistic should catch the attention of every physician, every lawmaker and every layperson reading this paper. It is staggering to comprehend the enormous impact on our global society as literally millions of individuals and families are harmed by contaminants inside our homes, schools and workplaces. Changes over the years in building philosophy, construction materials, pesticides, usage patterns, etc., along with new awareness and improved testing capabilities, have brought us to the understanding that some buildings are sick and can make their occupants sick. Shoddy construction practices and environmental disasters also contribute. Americans spend, on average, 22 hours a day indoors. As such, it is a disconcerting thought that the structures we live in, work

at and where we educate our children might lead to significant and even deadly health problems. As a society, we trust and even cherish many of these edifices. Yet some harbor hidden and harmful dangers. Imagine how different things could be if the truth came to light and all vested parties worked together to improve our indoor air.

- Medical costs would drop significantly.
- Doctors would have accurate, reliable information and be able to provide proper medical diagnosis and treatment.
- We could reverse the huge increase in asthma rates and reduce the billions of dollars being spent on asthma-related illnesses.
- Builders and construction firms would have the information they need to create safe and healthy homes, schools and workplaces.
- Teachers and children would teach and learn in schools with healthy indoor air, thusly increasing scores on educational achievement tests and reducing absenteeism, sick days and drop-out rates.
- Employees could work in buildings with healthy indoor air, increasing worker productivity and decreasing sick days and workers' compensation claims.
- Disability claims would drop significantly, reducing the cost and administrative burden of the rapidly increasing number of social security and private employer disability cases.
- Poor indoor air quality situations would be handled correctly, enabling business owners and landlords to properly remediate and remove contaminants, and prevent homeowners, tenants and employees from losing their homes and jobs as well as their lifetimes of achievements.

In other words, we would create a healthier, more productive society worldwide.

As stated above, the purpose of this paper is to highlight the main threats to human health hidden in our structures. Some agents are radioactive and some are toxins, while others are outright poisons. The list includes mold, bacteria, mycotoxins, endotoxins, microbial particulates, radon, lead, asbestos, chemicals, pesticides, Volatile Organic Compounds (VOCs) and other contaminants. Many of these contaminants occur in the interior of water-damaged buildings (WDB), but some of these exist in buildings without water damage. Some sick buildings lead to slowly deteriorating disease while others can bring death quickly.

The published roots of toxicology extend back over a millennium, yet thorough understanding of many toxins—exposure to which impair human health—is not nearly as prevalent as one would expect in our modern medical society. The intent of this paper is to summarize some of the most common and important toxic exposures found in the home, school and workplace.

Call to Action

This position paper is the first step of our **CALL TO ACTION**. Indoor air pollutants cause 50% of illnesses globally. It is time to move beyond the focus of "establishing the fact of mold disease," because it has already been established in numerous research papers and in the treatment of thousands of patients. It is time for our national and world leaders to develop a comprehensive public health response to this devastating epidemic that has the potential to cripple our individual and collective futures. We have highlighted the extensive research which clearly demonstrates many of these principles and look forward to collaborative efforts in this search for better health and safer living and working conditions. The Global Indoor Health Network puts forth an initial list of recommendations on page 35 of this report.

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Some Common Fungi, Mycotoxins, and Health Effects from Ingestion, Dermal, or Inhalation Exposure

Introduction

Indoor air pollutants cause 50% of illnesses globally.[1] This statistic should catch the attention of every physician, every lawmaker and every layperson reading this paper. It is staggering to comprehend the enormous impact on our global society as literally millions of individuals and families are harmed[2] by contaminants inside our homes, schools and workplaces. Changes over the years in building philosophy, construction materials, pesticides, usage patterns, etc., along with new awareness and improved testing capabilities, have brought us to the understanding that some buildings are sick and can make their occupants sick. Shoddy construction practices and environmental disasters also contribute. Americans spend, on average, 22 hours a day indoors. As such, it is a disconcerting thought that the structures we live in, work at and where we educate our children might lead to significant and even deadly health problems. As a society, we trust and even cherish many of these edifices. Yet some harbor hidden and harmful dangers. Imagine how different things could be if the truth came to light and all vested parties worked together to improve our indoor air.

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In other words, we would create a healthier, more productive society worldwide.[5]

Changes over the years in building philosophy, construction materials, pesticides, usage patterns, etc., along with new awareness and improved testing capabilities have brought us to the understanding that some buildings are sick—and can make their occupants sick. Shoddy construction practices and environmental disasters also contribute. The purpose of this paper is to highlight the main threats to human health hidden in our structures. Some agents are radioactive and some are toxins, while others are outright poisons (toxins = poisons). The list includes mold, bacteria, mycotoxins, endotoxins, microbial particulates, radon, lead, asbestos, chemicals,

pesticides, volatile organic compounds (VOCs) and other contaminants. The list is by no means exhaustive. Many of these contaminants occur in the interior of water-damaged buildings (WDB), but some of these exist in buildings without water damage. Some sick buildings lead to slowly deteriorating disease while others can bring death quickly.

The published roots of toxicology extend back over a millennium[6], yet thorough understanding of many toxins, exposure to which impair human health, is not nearly as prevalent as one would expect in our modern medical society. The intent of this paper is to summarize some of the most common and important toxic exposures found in the home, school and workplace.

Background

Astute physicians and healers have been aware of the existence of environmental toxins for over a thousand years. The list of substances, both naturally occurring and manmade, which may cause harm to the human organism, is continually growing. Curiously, while heart disease, cancers and rare exotic illnesses frequently grab headlines, illness due to environmental sources, though incredibly common, often receive little or no media coverage. Typically, little education is offered to allopathic physicians in their medical training on this subject. Hence, there is poor understanding of, and by many even contempt for, the concept that our environment is capable of slowly poisoning its inhabitants. However, according to a United States (U.S.) Environmental Protection Agency (EPA) spokesman, **indoor air pollution causes over half of all disease globally**. That's more than all the cancers and all the heart disease combined. It is time we started to pay more attention to the indoor air we breathe.

This report was written to meet the needs of a diverse, global audience and includes a discussion of numerous indoor contaminants that will be helpful to experts and laypersons. It also includes information on the pathophysiology and diagnosis of MERI, as well as details regarding the treatment protocols used by some of the leading physicians in this field. We hope this detailed information will be helpful to medical organizations, government agencies and physicians, nurses and others in the health care field.

Research Methods

Our research methods included an extensive search of the peer-reviewed, scientific literature, as well as other relevant sources, and communications with some of the experts in this field.

Findings

Our findings consist of facts and statistics derived from the research materials. They include specific details, observations and insights. We have also included key facts and statistics presented within the report and in tables included in Appendix A and B.

The purpose of this paper is to highlight the main threats to human health hidden in our homes, schools and workplaces. Some agents are radioactive and some are toxins, while others are outright poisons (toxins = poisons). The list includes mold, bacteria, mycotoxins, endotoxins, microbial particulates, radon, lead, asbestos, chemicals, pesticides, volatile organic compounds (VOCs) and other contaminants. This list is not exhaustive. Part I discusses indoor contaminants (other than mold). Part II focuses on mold and its related components.

The findings in this paper will help to further the mission and vision of the Global Indoor Health Network and will be used to help raise awareness of this important public health issue that is affecting individuals and families around the globe.

Common Toxins in Our Homes, Schools and Workplaces

PART I

Indoor Contaminants—other than mold

Part I focuses on indoor contaminants (other than mold and its related components). The list of indoor contaminants included in this section are radon, asbestos, products of combustion (such as carbon monoxide and cigarette smoke), volatile organic compounds (such as formaldehyde, benzene, pesticides and some personal care products), particulate matter, lead and a number of other known and emerging disease-causing microbiological agents (such as legionella, actinobacteria and bacillus). This list is not exhaustive, but it discusses some of the major types of indoor contaminants that affect the air we breathe.

Radon

Radon is a naturally occurring radioactive decay product of uranium and is found in the soil throughout the earth.[7] It is a tasteless, colorless and odorless gas. As a dense inert gas, once released from the dirt, it tends to accumulate in basements and on the ground floor of buildings.[8]

Radon is radioactive and accounts for the majority of background radiation humans receive. The ionizing radiation emitted is carcinogenic.[9] After smoking, radon exposure is the primary cause of lung cancer[10] and is credited with the death of 21,000 people per year in the United States (U.S.) alone.[11] Smoking, with radon exposure, increases the likelihood[12] of lung cancer by a factor of 4.

Radon is radioactive and accounts for the majority of background radiation humans receive. After smoking, radon exposure is the primary cause of lung cancer.

Typical exposure levels in homes[8] are around 100 Bq/m^3 (Becquerel/meter^3) with a toxic range over 160 Bq/m^3 (4 picocuries/Liter air or pCi/L), per the Environmental Protection Agency (EPA).[12] European authorities have set higher tolerable limits for radon. Of note, the "Working Levels"[6] noted in uranium mines exceed 7000 Bq/m^3.

Radon decays through alpha and beta particle emission through a variety of substances which include ^{214}Pb, ^{214}Bi, ^{210}Pb, and ^{210}Bi [isotopes of lead (Pb) and bismuth (Bi)].[13] The final product is the stable lead isotope ^{206}Pb. As such, simultaneously elevated levels of lead and bismuth, i.e., in hair analyses, should trigger an evaluation for radon in the patient's home.

Home testing for radon is simple and inexpensive. Short-term testing gathers radioactivity data over 90 days or less while long-term testing can last up to a year. Numerous inexpensive and effective mitigation techniques are available as are qualified testers.[12]

Excessive radon exposure should be totally avoidable.

Asbestos

Asbestos has been used by humans for over 4500 years.[14] Its chemical make-up makes[15] it an effective fire retardant and electrical insulator even at high temperatures.[16] As such, it has been very desirable for use in construction. Six different fibers[15] from two subgroups (amphibole and serpentine) are classified as asbestos, each differing in chemical formula and physical properties[17,18], but all forms share the property of mutagenicity[10]: being able to induce malignant transformations in the deoxyribonucleic acid (DNA) of exposed cells. Over 3000 asbestos containing products[19] were used, most extensively as fire retardants and to insulate wiring and plumbing in homes, schools, offices and industrial plants. In the late 1970s, it was discovered that the industry had been aware, for more than 40 years, of the many health hazards of asbestos.[20]

Crocidolite and amosite asbestos have the greatest potential for human health damage. According to the U.S. EPA Asbestos Building Inspectors Manual, chrysotile (the only serpentine asbestos) accounts for approximately 95% of asbestos found in buildings in the United States, but it often has amphibole contamination. Chrysotile is capable of inducing multiple malignancies in persons exposed. While most exposure occurs with those who mine, fashion or use asbestos professionally, exposure from buildings can also occur. Asbestos fibers remain in the materials in which they are used but aging can cause these materials to become friable and release respirable fibers into the air. Remodeling further disrupts these materials and allows asbestos fibers to infiltrate the air of indoor spaces. The most common diseases associated with chronic exposure to asbestos are asbestosis and pleural abnormalities (mesothelioma, lung cancer).[21] Cancers associated with asbestos exposure affect the lungs, gastrointestinal (GI) tract and multiple other organs.

Asbestosis is caused by inhaled asbestos fibers instigating chronic inflammation and scarring or fibrosis in the lungs, typically after long term exposure such as with mining or asbestos manufacturing.[22] Amphibole forms of asbestos predominate as they are able to penetrate deeper into the lung. A chronic foreign body reaction develops with resultant interstitial fibrosis due to a chronic inflammatory response. Asbestosis typically presents as dyspnea, usually with exertion,[23] and can progress to cor pulmonale [irreversible right-sided heart failure associated with pulmonary hypertension (increased blood pressure in the blood vessels of the lungs)]. Patients are at much higher risk for lung cancer and mesothelioma.[24] Supportive measures[25] such as oxygen form the only treatment options and there is no cure.

Several malignancies such as lung cancer, gastrointestinal (GI) cancers and mesothelioma are caused by long-term asbestos exposure. Concomitant smoking increases the risk of all except mesothelioma[26] by a factor of 50 to 84.[27] Mesothelioma is a cancer of the pleural lining of the lungs and other organs. While there is overwhelming evidence that asbestos exposure is the

cause of mesothelioma, there have been some cases where only indirect or low level acute exposure could be documented.[28] One third of all mesothelioma victims have been found to have tissue asbestos fiber counts that did not exceed the levels associated with ambient background exposure suggesting that there is no "safe level" of exposure. In fact, regarding mesothelioma and exposure to asbestos, according to the EPA, if there is a safe level of the latter, it is currently below science's ability to detect it.[29] This cancer presents as dyspnea, chest pain and weight loss. It may occur decades after exposure with an average latency of 35 - 40 years.[30] Surgical and radiation interventions are relatively ineffective while newer chemotherapeutic agents[31] offer some possibility for improvement. There is no cure for mesothelioma and survival rarely exceeds two years from diagnosis.

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Cross contamination[32] has occurred in laundries where exposed asbestos and power plant workers' uniforms were washed. Secondhand exposure has led to asbestosis in family members of exposed employees. Similar cross contamination is found with other environmental toxins.

Products of Combustion

Carbon monoxide (CO) is a colorless, odorless and tasteless gas which is responsible for the most common type of fatal indoor air poisoning in many countries.[33] Derived as a product of incomplete combustion, CO is released from auto exhausts, cigarettes, malfunctioning gas appliances (water heaters, furnaces, ranges etc.), fireplaces and indoor solid fuel burning devices such as wood stoves.[34]

CO competes effectively with oxygen for hemoglobin binding sites thusly reducing oxygen delivery to the tissues.[35] Exposure to 100 parts per million (ppm) can be hazardous to human health.[36] The American Association of Poison Control Centers reported 15,769 cases of carbon monoxide poisoning resulting in 39 deaths in 2007.[37]

CO poisoning may cause acute and chronic poisoning syndromes. Acute toxicity[38] starts as lightheadedness, confusion, headaches, vertigo and flu-like effects. As exposure progresses, significant cardiovascular and central nervous system (CNS) problems occur which can lead to death. Long-term sequelae are frequent and damage to an exposed fetus may also occur. Chronic low level exposure[39] can cause depression, confusion, memory loss and frank dementia. Chronic CO poisoning can cause Parkinsonian symptoms,[40] Chemical Sensitivity (CS) and chronic fatigue.[41] The easily inducible action of hemeoxygenase (HO-1) produces ferrous iron, CO and biliverdin from free heme.[42] Some chronic conditions increase free heme levels, potentially creating difficulty distinguishing increased endogenous production from chronic CO exposure.

Diagnosis of acute poisoning is by a simple arterial blood test found at most hospitals, but one must have a high level of suspicion to order it. Treatment includes hyperbaric[43] or 100% oxygen[36] given over time. Low-level chronic CO poisoning is treated by some with high dose oxygen.[41]

Tobacco smoking has been shown to produce over 4000 chemical compounds,[44] which are subsequently inhaled into the smoker's lungs and many of which are subsequently exhaled in the form of secondhand smoke. Nearly 600 compounds may be added to cigarettes—all are approved in the U.S. as additives to food but have not been tested by burning. Many countries include warnings on the label with the United States being the first[45] in 1966.[46] It is important to note that the tobacco industry knew of the dangers of tobacco beginning in 1953,[47] but they did not allow this information to become public knowledge until it was brought to light during the legal proceedings that occurred over the past decade.

Even with advertised awareness of the dangers of cigarette smoking, it was estimated in 2000 by the World Health Organization (WHO) that 35% of American males and 22% of females continue to smoke.[48] About 15 **BILLION** cigarettes are sold worldwide every day.[49] Indeed, "Cigarette smoking is the leading cause of preventable death in the United States, accounting for approximately 443,000 deaths, or 1 of every 5 deaths, in the United States each year."[50] Cigarettes are responsible for more than 20% of American deaths.[50]

There are many known health hazards of cigarette smoke. Nicotine is addictive[51] and the cause for many cancers,[52] including lung, bladder, oral, kidney, cervix and bone marrow. It is estimated that each cigarette smoked shortens the lifespan by 11 minutes[53] and that one-half of smokers die an average of 14 years early from tobacco-related disease.[54] Smoking is also known to cause harmful effects on nearly every organ in the body and contributes to cataracts and osteoporosis, reduces general health,[49] affects birth weight of unborn babies and promotes emphysema and chronic obstructive pulmonary disease.

It is estimated that each cigarette smoked shortens the lifespan by 11 minutes and that one-half of smokers die an average of 14 years early from tobacco-related disease.

Secondhand smoke, also known as environmental tobacco smoke, is generated by the incineration of tobacco products. It is a complex mixture of gases and particles[55] which contain at least 250 known toxins including more than 50 carcinogens.[56] More than 126 million nonsmoking Americans continue to be exposed to secondhand smoke in homes, vehicles, businesses, and public places. Most exposure to tobacco smoke occurs in homes and workplaces. Secondhand smoke causes heart disease and lung cancer in nonsmoking adults.[57]

Almost 60% of U.S. children aged 3 to11 years - or almost 22 million children - are exposed to secondhand smoke.[57] Several health conditions, including sudden infant death syndrome (SIDS), respiratory infections,[57] low birth weight infants and increased incidence of ear infections and developing asthma, are attributable to secondhand smoke. It is also a potent lung irritant and trigger of asthma exacerbations.

Thirdhand smoke is the result of smoke gases and particles which linger in clothing, on furniture, in hair, etc. Researchers are beginning to look at the possibility of health effects from these residues.

Volatile Organic Compounds

Molecules of substances with high vapor pressure tend to flow from the liquid (or solid) state to a gaseous or evaporated state. Substances with a high vapor pressure at normal temperatures are said to be "volatile." Volatile organic compounds (VOCs) are organic compounds (carbon based) which come out of their liquid (or solid) phase in significant degree to become gaseous, and hence, part of the air people breathe. Plants are responsible for 90% of all VOCs while anthropogenic VOCs (those produced by humans) make up around 10%.[58] The latter 10% result primarily from solvents, paints, protective coatings, new furniture, copying and printing devices, cleaning supplies and other sources. Evaporation of organic compounds from these sources indoors is called off-gassing. Other volatile chemicals, such as hydrogen sulfide (H_2S) in solution (as in sewer water), are also toxic and may come from the breakdown of organic materials.

Americans spend 22 hours per day indoors, on average.[59] Long-term exposure to indoor VOCs can contribute to Sick Building Syndrome (SBS)[60] and Building Related Illness (BRI). Illness is usually not acute—but due to chronic exposures. VOC levels can be from 5-1000 times outdoor levels.[61] Leukemia and lymphoma incidences increase as a result of prolonged exposures.[62]

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Examples of toxic VOCs include butanol, hexane, formaldehyde, terpenes, xylene, styrene, toluene, chlorofluorocarbons, aliphatic hydrocarbons, CO, carbon dioxide (CO_2), acetone, methane and hundreds of others. Well-designed heating, cooling and ventilation (HVAC) systems can help lower indoor concentrations of VOCs.[60]

Formaldehyde is known to irritate mucous membranes and is released from paints, adhesives, sheetrock, ceiling tiles[60] and wood materials.[63] Formaldehyde has also been shown to have high sympathetic activity,[64] increase the heart rate,[65] alter the immune system, cause headaches, affect cognitive function and stimulate reproductive problems and possibly cause birth defects.[66] In June 2011, the U.S. Department of Health and Human Services added eight new substances, including formaldehyde, to its list of known human carcinogens.[67]

Low level VOCs from cleaning products, cosmetics, fragrances and perfumes, laundry products, air fresheners, glues, etc. can cause chest pains, rashes, asthma symptoms, headaches, brain fog, gastrointestinal problems, anxiety, visual disturbances, chronic fatigue and many more symptoms[68] in those who suffer from chemical sensitivities.[69]

Pesticides are chemicals used to kill or limit the growth of numerous types of pests and their usage can create VOCs. Included in this grouping are herbicides (kill plants), fungicides (kill fungi), insecticides (kill insects) and numerous other classes. They are designed to disrupt biological systems.[70] Ten of the twelve most dangerous organic chemicals are pesticides.[71] Pesticides have been used to control mosquitoes and thusly reduce the spread of diseases such as malaria and yellow fever; however, approaches to treatment of mosquitoes and other health

threats often has included excessive and injudicious use of pesticides rather than appropriate vector control. Pesticides are also used extensively in farming. Over 98% of sprayed insecticides reach the air, water or soil.[72] Exposure has been linked to non-Hodgkins lymphoma and leukemia[73] as well as fetal death, birth defects[74] and neurodevelopmental disorders.[75] Recently, after reviewing thousands of published articles, The Endocrine Disruption Exchange released a list of over 1300 potential endocrine disruptors – 269 were pesticides.[76] The WHO estimates that 3 million agricultural workers, mostly in developing countries, suffer exposure so greatly that severe poisoning ensues and that about 18,000 die[73] each year. Integrated Pest Management (IPM) is an ecological approach using multiple strategies of pest control while minimizing the use of potentially toxic pesticides.[77] The term "safe" pesticides is used, typically to distinguish chemicals derived from natural sources (such as pyrethrum from chrysanthemums) from their synthetic counterparts (such as dichlorodiphenyltrichloroethane, known as DDT), however, no pesticide is free of danger.[78]

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The U.S. **Centers for Disease Control and Prevention's (CDC)** approach to indoor air quality follows its own **Indoor Environmental Quality Policy** which is used to govern practices at the CDC and buildings they own and lease.[79] While not specifically addressing the topics of chemical sensitivities or the dangers of VOCs, included are some of the policy's provisions which their employees are expected to follow:

> "Pest management, for both buildings and lawn care, will emphasize non-chemical management strategies whenever practical, and the least-toxic chemical controls when pesticides are needed. Integrated Pest Management practices must be utilized."
>
> "CDC will ensure that products used in the workplace, such as soaps, cleaning products, paints, etc. are safe and odor-free or emit low levels of volatile organic compounds (VOCs) to the fullest extent feasible. Only green cleaning products shall be specified and used within CDC facilities and leased spaces unless otherwise approved by the Office of Health and Safety."
>
> "Scented or fragranced products are prohibited at all times in all interior space owned, rented, or leased by CDC. This includes the use of:
>
> - Incense, candles, or reed diffusers
> - Fragrance-emitting devices of any kind
> - Wall-mounted devices, similar to fragrance-emitting devices, that operate automatically or by pushing a button to dispense deodorizers or disinfectants
> - Potpourri
> - Plug-in or spray air fresheners
> - Urinal or toilet blocks
> - Other fragranced deodorizer/re-odorizer products

Personal care products (e.g., colognes, perfumes, essential oils, scented skin and hair products) should not be applied at or near actual workstations, restrooms, or anywhere in CDC owned or leased buildings. In addition, CDC encourages employees to be as fragrance-free as possible when they arrive in the workplace. Fragrance is not appropriate for a professional work environment, and the use of some products with fragrance may be detrimental to the health of workers with chemical sensitivities, allergies, asthma and chronic headaches/migraines. Employees should avoid using scented detergents and fabric softeners on clothes worn to the office. Many fragrance-free personal care and laundry products are easily available and provide safer alternatives."

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Employers have a responsibility to provide safe working conditions for their staffs. The CDC's Indoor Environmental Quality Policy is a tremendous step forward with the recognition that VOCs such as pesticides, cleaning products and even personal care products can harm the health of personnel. Guidelines such as these are as important in protecting the health of all workers and similar policies should be implemented in all buildings.

Particulate Matter

Solid matter which is suspended in a gas or liquid is called particulate matter (PM) and also is known as particulates, fine particles and soot. PM can be natural, such as ash from volcanoes,[80] or manmade, as from combustion of solid fossil fuels like coal.[81] PM can be dissolved into water or suspended in the air. Spherical particles 5 microns in diameter and smaller are called "respirable" and can reach the air sacs, or alveoli, of exposed persons' lungs. PM often carry toxic agents on their surface—thereby delivering poisons to the surface of the deepest and most delicate structures of the lung. Normal human red blood cells (RBC) average 5 to 7 microns in diameter and are comparable in size to the largest respirable PM. To understand how small these particles are, typically 3.5 to 5.3 million RBC are present in a single cubic centimeter (1 cc or 1 ml) of blood. Sixty years of research by the National Institute for Occupational Safety and Health (NIOSH) has repeatedly demonstrated that respirable particles are invisible and unfilterable using any passive filtering device. Only self-contained breathing devices, such as SCUBA gear, can adequately protect from respirable particulates.

Somewhere between 22,000 and 52,000 deaths per year[82] in the U.S. are attributed to PM pollution, while in Europe[83] around 200,000 deaths per year are suspected. Inhaled particulates are classified by their size as this indicates where in the respiratory tract they can travel. Particles with an aerodynamic diameter of 10 microns or greater are filtered in the mouth and nose. Particles of 5 microns diameter and less can reach the alveoli, whereas particles < 0.1 micron can translocate[84] through cell membranes and gain access to other organs in the body.[84] Mold spores, pet dander and dust mites are all PM and can cause allergy problems[85] and trigger asthma

attacks. Silica, asbestos and coal dust cause not only chronic lung damage but can lead to lung cancer. Tobacco smoke contains PM. Inhaled lead particulates can contribute to lead poisoning.[86]

Filtering can be effective to remove water-borne PM[84] while controlling source exposure and optimizing ventilation may lessen airborne PM exposures.[86] PM often contain "mycotoxins, endotoxins, antigens, haemolysin", etc. from molds and bacteria which are immunogenic[87] and may be responsible for neurocognitive damage.[86]

Lead

The 82nd element on the periodic table is lead. Considered a heavy metal, lead has been used for thousands of years because it is quite malleable and melts at a relatively low temperature.[88] Lead has also been used in construction, batteries, pewter and solders and as radiation shields.[89] In the U.S., lead was used as shotgun shot and as an additive of interior paints,[90] pesticides and gasoline[91] for many years until banned due to health risks. It is still used in polyvinyl chloride (PVC) plastic,[92] lead glass,[93] semiconductors[94] and some glazes[94] for painting ceramics.

Poisoning from lead has been documented in several ancient civilizations. Exposures have occurred via inhalation, ingestion and even through skin contact.[90] Ingestions can come from produce grown in contaminated soils and some home remedies.[95] The primary source of ingested lead in children is from interior paints used before lead was banned. Most of inhaled lead is absorbed[96] while a smaller percentage of ingested toxin is absorbed. Inhalation is much less of a concern since almost all countries have now banned tetraethyl lead from gasoline.

Lead is primarily stored in the blood, soft tissue and bones.[96] Serum lead levels, erythrocyte protoporphyrin levels, appearance of RBC smears and physical exam findings can all detect or infer the acute presence of lead. Bone X-rays can be used as a measure of cumulative exposure. No safe level of lead exposure has been determined.

Lead creates free radicals, interferes with DNA transcription,[97] indirectly affects the integrity of cell membranes (RBC especially),[98] decreases activity of certain white blood cells (WBC) and interferes with the metabolism of Vitamin D, bones,[99] collagen[100] and calcium.[101] It may also cause excessive production of inflammatory proteins.[102]

Symptoms of lead poisoning vary based on the chronicity of exposure[103] and age of the patient.[104] Adult acute poisoning may display muscle weakness, pain, headache, occasional encephalitis and memory loss.[105] Children with acute lead exposure exhibit weight loss, constipation, kidney failure, abdominal pain with vomiting, lethargy and learning disabilities.[106] Chronic exposure in children[106] and adults often shows very subtle symptoms which may gradually become pronounced. Typically, short-term memory loss, concentration deficits, stupor, abdominal pain, loss of coordination and numbness or tingling in the extremities,[107] as well as fatigue, headaches,

Children with acute lead exposure exhibit weight loss, constipation, kidney failure, abdominal pain with vomiting, lethargy and learning disabilities.

anemia and sleep disturbances,[106] are found in chronically exposed adults. Similarly exposed children often refuse play, become excessively active or develop behavior problems.[106] Hearing loss and tooth decay are also seen.[108] Studies have shown that greater incremental loss in intelligence quotient (IQ) points in children occurs at lower levels[109,110] than for adults.

Prevention is the best treatment and most cases of poisoning are preventable. Screening programs exist for U.S. children.[107] Treatment of acute lead poisoning (increased blood lead and significant symptomatology) is by chelation with correction of other associated mineral deficiencies.[107] The longer a person has been exposed, the less likely central nervous system deficits will correct.

Legionella

Bacteria are ubiquitous and even live on the skin, in the mouth and in the GI tract of humans. Commensal bacteria such as these in the gut can be of aid in digesting certain food products. Many bacteria, however, are pathogenic to human hosts. A new genus, *Legionella*, was identified in 1977 after an outbreak months earlier had killed 34 people,[111] mostly associated with the American Legion convention in Philadelphia.

Legionella is a Gram negative bacteria[112] found in contaminated hot water of natural and manmade sources which can include HVAC systems and spas. The ideal temperature range for the bacterium is 32 – 42 ^{o}C (90-108 ^{o}F).[113] Growth requires cysteine so it will not be detected on standard blood agar plates[112] and culture methods can take 10 days. A urine antigen test takes only a few hours but detects only one species of *Legionella.*[114] Spread is through droplet inhalation, and there is no documented person to person communication.[115]

There may be as many as 10,000 – 50,000[116] cases of Legionnaire's disease in the U.S. each year, and the vast majority are caused by *Legionella pneumophila.* After a 2-10 day incubation period, symptoms begin with fever, chills and cough. Additional symptoms include "muscle aches, headache, tiredness, loss of appetite, loss of coordination (ataxia) and occasionally diarrhea and vomiting."[117] Kidney and liver functions may be abnormal and chest X-rays typically show bibasilar consolidation consistent with pneumonia.[118] Mortality rates vary from < 5% - 50% based on how quickly antibiotics are started and where the disease is acquired.[118] Quinolones and the newer macrolides are the drugs of choice. Rifampin has been used in combination. Pontiac fever is a lesser form of Legionnaire's disease and usually resolves within 2 days.[119]

Large eruptions of illness have occurred in Philadelphia, New York and Los Angeles (U.S.), London and Essex (England), Paris and Lorquin (France), Amsterdam (the Netherlands), the Urals (Russia), Barcelona, Pamplona and Madrid (Spain), Fredrikstad and Sarpsborg (Norway)[119,120] and Melbourne, New South Wales and Sydney (Australia). Many other outbreaks of varying sizes have been reported around the world. The sources of infection were typically drinking water systems, hot tubs or cooling towers. Control of *Legionella* may be accomplished by use of chlorine, chlorine dioxide or superheating water frequently to greater[118] than 60 ^{o}C (140 ^{o}F).

Actinobacteria

Many bacteria live in our indoor spaces and some are clearly more pathogenic than others. *Actinomycetes, Streptomyces, Mycobacterium* and *Nocardia*, all genera of the Gram positive phylum Actinobacteria, are gathering attention for their ability to cause human health problems. All of these pathogens may be found in WDB and many are capable of releasing toxins into indoor air. Some of these secondary metabolites have been used in medical practice as antimicrobials (neomycin, chloramphenicol,[119] etc.) and chemotherapeutic agents (daunorubicin and doxorubicin[88]).

Actinomyces are anaerobic and are not acid-fast. Actinomycosis is caused by *Actinomyces israelii* forming very large abscesses at the jaw's angle that can spread to the thorax and abdomen.[121] Farmer's lung and bagassosis are usually caused by *Actinomyces* as well as endocarditis and other valve abnormalities.

All of these pathogens may be found in water-damaged buildings and many are capable of releasing toxins into indoor air.

Nocardia are aerobic and acid-fast. Nocardiosis can present as abscesses in the brain, chest and skin or as pulmonary disease.[122] Infections are usually opportunistic,[122] and trimethoprim-sulfamethoxazole is the treatment of choice.[123]

Streptomyces are aerobic and not acid-fast. At least 11 antibiotics have been derived from this genus.[119] Streptomycosis, also known as mycetoma, is a subcutaneous infection which can invade the bone.[122] Spores from *S. californicus* have been shown to cause "lung inflammation and systemic immunotoxic effects"[88] and appear to harm human health synergistically with components of *Stachybotrys chartarum.*[88]

Mycobacterium are aerobic and acid-fast.[124] Known diseases include tuberculosis (*M. tuberculosis*) and leprosy or Hansen's disease (*M. leprae*). Other mycobacteria also cause pulmonary disease similar to tuberculosis, lymphadenitis, skin and disseminated disease.[125] "Hot tub lung" is associated with *Mycobacterium* in undrained sources[126] of water. *Mycobacteria* have thick cell walls and natural resistance to many antibiotics. Thusly, they are notoriously difficult to treat. Of note, Mycobacterium Avium Intracellulare (MAI) has been linked on at least some occasions to exposure to water-damaged buildings.[127]

Bacillus

The Gram positive rods in the genus *Bacillus* test catalase positive[128] and when stressed produce endospores.[129] *Bacillus* is ubiquitous in nature. *Bacillus subtilis* is used extensively in molecular biology research.[130]

Anthrax, a toxin-based illness,[131] is caused by exposures to the spores of *B. anthracis*. Spores are able to survive in soil for decades. Though typically an animal disease and though most livestock have been immunized for over a century, the name "anthrax" strikes terror in the hearts of many since the "white powder postal attacks" of 2001. Inhaled spores make their way

to lung macrophages. Once inside, they are transported eventually to lymph nodes. The spores germinate and multiply destroying the macrophage host. Once in the blood stream, three proteins are released: lethal factor, edema factor and protective antigen.[132] The combination of the three substances makes up what is known as anthrax toxin. Lethal factor causes release of Tumor Necrosis Factor-alpha (TNF-alpha) and Interleukin-1 beta (IL-1B) which ultimately leads to septic shock and death. Antibiotic treatment is successful if initiated early.

B. cereus is a well-known grain contaminant which causes a form of food poisoning.[132]

Conclusion of Part I

In Part I, we provided an overview of some of the common indoor contaminants that affect the air we breathe in our homes, schools and workplaces. See Appendix A for a table that was included in a report on *The Green Building Debate.* The table provides a pictorial representation of some of the contaminants that affect indoor air quality and the related health effects.

In 2010, the World Health Organization (WHO) issued a report titled "Guidelines for Indoor Air Quality: Selected Pollutants"[133] which addresses some additional substances and also provides exposure guidelines. The WHO report opens with the following statement regarding the importance of good indoor air quality:

> *Clean air is a basic requirement of life. The quality of air inside homes, offices, schools, day care centres, public buildings, health care facilities or other private and public buildings where people spend a large part of their life is an essential determinant of healthy life and people's well-being. Hazardous substances emitted from buildings, construction materials and indoor equipment or due to human activities indoors, such as combustion of fuels for cooking or heating, lead to a broad range of health problems and may even be fatal.*
>
> *Indoor exposure to air pollutants causes very significant damage to health globally–especially in developing countries. The chemicals reviewed in this volume are common indoor air pollutants in all regions of the world. Despite this, public health awareness on indoor air pollution has lagged behind that on outdoor air pollution.*[133]

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This 2010 report by the WHO was the second in a series. The first report in 2009 was titled "Guidelines for Indoor Air Quality: Dampness and Mould" which leads us into Part II of this paper where we focus on indoor mold and its related components.

PART II

Indoor Mold

What More Than 50,000 Mold Patients in the Literature have Taught Us

Historically, much controversy has arisen in the courts and in medical arenas regarding the supposition that exposure to the interior of water-damaged buildings (WDB), and the molds and other contaminants within them, can cause serious illness in humans. Fortunately, the tide is turning and the naysayers are being defeated. Opinion is losing to data and ignorance to information. The war is not over and dispute still exists, but the truth will prevail. "Mycotoxins are secondary metabolites produced by microfungi that are capable of causing disease and death in humans and other animals."[134]

*Opinion is losing to data and ignorance to information. The war is not over and dispute still exists, but **THE TRUTH WILL PREVAIL**.*

The naysayers cling to some serious misbeliefs and continue to publish them. One such false belief is that ingestion[135] is the primary mechanism by which human mold illness can occur. Another incorrect concept is that there must be a very large amount of mycotoxin or mold spores in the air to harm humans.[136] Yet another misconception is that disease related to mold must be from an acute exposure and that this would cause greater harm to the human host than repeated, chronic exposure to lower levels of toxin(s)[137]. **There is no published human or animal evidence to prove that any of these suppositions are necessary for the mold-related illness argument to be accurate.** Further, none of these mechanisms are even proposed by the pro-mold illness research community.

The naysayer community, in their writings, ignores all human data published[138] in peer-reviewed journals by treating physicians of mold illness patients as well as the most recent reports by the U.S. Government Accounting Office (GAO)[139] in 2008 and the WHO[2] in 2009. In the latter, the WHO reversed their previous position due to the absolute onslaught of published data supporting the existence of mold-related illness over the last 10 years. Indeed, the ACOEM (American College of Occupational and Environmental Medicine) naysayer report[140] from 2011 does not reference any paper after 2002. In the world of medicine, this is seriously outdated

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and makes the paper's stand on mold-related illness completely irrelevant. Contrast that with the consensus statement offered by Policyholders of America (POA) in 2010, which contains over 550 unique citations including Institutional Review Board (IRB) approved prospective human experiments in peer-reviewed journals, animal, toxicological and mycological studies, building industry papers and reports regarding more than 50,000 patients worldwide.[138] (See Appendix B for a table that was included in a book published by the American Conference of Governmental Industrial Hygienists. The table provides a list of some molds/fungus and mycotoxins and their related health effects.) Even the ACOEM 2011 paper,[140] which overtly denies that indoor molds can cause serious illness, recommends proper remediation of all water-damaged spaces. **Why is there any controversy at all?**

The "Big Lie"

Enter the "Big Lie". It is a misinformation and propaganda tactic designed to deceive very large groups of people. The idea is to create a mistruth so large and grandiose that no one would attempt to disprove it, even if it were ridiculous. The lie needs to be repeated over and over and spoken authoritatively until people believe it. Many Germans were convinced via the Big Lie that the Jewish population was at fault for the loss of World War I. The Big Lie was used in China in 1989 and since to convince the populace that the government did not use tanks to mow down hundreds of citizens in Tiananmen Square to squelch pro-democracy protests (even though the carnage was televised live worldwide). Big Tobacco used the Big Lie for many years stating there were no scientific studies demonstrating that cigarette smoking caused lung cancer—even though they knew better and had studies that proved otherwise.

The Big Lie is a misinformation and propaganda tactic designed to deceive very large groups of people. The idea is to create a mistruth so large and grandiose that no one would attempt to disprove it, even if it were ridiculous.

How does the Big Lie relate to mold? It has been proven that water, added to many modern building materials, leads to amplification of mold and bacterial growth. It has been shown beyond a shadow of doubt that some species of molds and bacteria found in WDB are capable of making toxins. Some of these toxins have been clearly demonstrated in thousands of patients to cause human health effects beyond mere runny noses and sore throats. Indeed, more than 50,000 patients exist[138] in the literature (and impartial agencies, such as the GAO and the WHO, have summarized this data). Many of these patients have been treated successfully (using protocols like those highlighted below) with documented symptom resolution or marked reduction, and abnormal lab tests returning to normal. It is very easy to connect these dots, but… **enter the Big Lie**… that exposure to mold and bacterial toxins from the interior of water-damaged buildings CANNOT POSSIBLY cause serious human health effects and that there are NO DATA in the literature that support the claims of serious human health effects.

Many treating practitioners are sufferers too. They learned firsthand about the impact that exposure to mycotoxins, endotoxins, etc. can wreak on the human body. Because of a long-established, even cherished, tradition of delayed acceptance of new concepts in allopathic

medicine, these physician/patients had to search for fellow practitioners who possessed understanding. The Big Lie is a double slap in the face for these victims - first denying that their own personal illness exists, and then claiming the disease they treat successfully in others, as well as the data generated, are all figments of their collective medical imaginations.

The Big Lie regarding mold is no vague conspiracy theory. It is prudent to remind the reader that "Big Business" has not always kept the health concerns of its employees first. The Radium Girls,[141,142] the asbestos scandal[143,144] and the history of the coal mines[145,146] in the U.S. and elsewhere are just three instances in which owners, management and even some industry-employed physicians were well aware of occupational health dangers, **for decades**, while the workers were given the Big Lie. The very fact that the U.S. has unions, labor laws, a federally-mandated 40-hour work week and organizations such as the Occupational Safety and Health Administration (OSHA) are the result of some employers repeatedly being willing to make dollars at the health risk of those in need of a paycheck.

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In the "distant" past, some researchers and some occupational medicine doctors may have had conflicts of interest. Some received their pay from employers who desired a clean bill of health even though there were numerous health problems in the workplace. Rather than speak up, some remained quiet, or worse, agreed to spread the mistruths. That there were thousands of internal experiments showing how "safe" smoking tobacco was (all purchased by Big Tobacco) proved to everyone that research findings could be bought. Similarly, the naysayers attempt to disprove irrelevant models while concurrently ignoring the last 10 years of many significant published reports. A chilling 2010 report by White and Bero[147] documented six research manipulation strategies consistently used by five industries (tobacco, pharmaceutical, lead, vinyl chloride and silicosis-generating) to spawn and distribute "supportive research" and suppress "unfavorable research" regarding their respective products and manufacturing practices. That approach is the very essence of "junk science".

Many additional examples of industry's use of the "Big Lie" strategy are highlighted in David Michaels' book "Doubt is Their Product."[148] Ironically, the name for the book came from the following statement written by one of the tobacco industry executives: "*Doubt is our product* since it is the best means of competing with the 'body of fact' that exists in the minds of the general public. It is also the means of establishing a controversy." Michaels provides an excellent summary:

> *The practices perfected (by the tobacco industry) are alive and well and ubiquitous today. We see this growing trend that disingenuously demands proof over precaution in the realm of public health. In field after field, year after year, conclusions that might support regulation are always disputed. Animal data are deemed not relevant, human data not representative, and exposure data not reliable. Whatever the story—global warming, sugar and obesity, secondhand smoke—scientists in what I call the ''product*

defense industry'' prepare for the release of unfavorable studies even before the studies are published. Public relations experts feed these for-hire scientists contrarian sound bites that play well with reporters, who are mired in the trap of believing there must be two sides to every story. Maybe there are two sides—and maybe one has been bought and paid for.[148]

"Big Business" is involved in the mold issue too. Billions, if not hundreds of billions, of dollars are at stake, and as such, anyone reading any article claiming that chronic exposure to WDB cannot cause illness should take great care and consider the potential conflicts of interest the authors of such a paper might have. The reader need only review his/her homeowner insurance policy and note the rider, found in most, which excludes the insurer's liability for mold damage to the insured dwelling[149] to see the reality of the situation. These exclusions did not exist 20 years ago.[150] The insurance policy riders prove that the insurance companies have known about mold for some time, yet they have not been active in educating the public, or physicians, about the dangers of moldy structures. Instead, they have quietly passed the expense of remediation from themselves to homeowners while allowing this public health debacle to silently escalate. Landlords' and tenants' organizations[151,152] discuss mold-related illness on their websites. The same is true in the building and legal industries.[150,153] State and federal lawmakers are also contemplating what to do with moldy buildings as are their counterparts in other countries.[154,155] "Big Business" knows about mold and the sickness it can cause.[156] Allopathic medicine seems to be far behind in its understanding.

Mold illness, mold-related illness and biotoxin–related illness are euphemisms for the same disease. Some refer to this syndrome as Chronic Inflammatory Response Syndrome due to Water Damaged Buildings (CIRS-WDB). Others use the terms Mycotoxicosis or Mixed Mold Mycotoxicosis (of which, the users believe CIRS-WDB is a subset). Still others call it Indoor Mold Sensitivity and Toxicity. Each name has its pros and cons. It is the opinion of this paper that a single unifying name would benefit all the various vested communities (treating physicians, researchers and sufferers) and that those who publish should come together and agree upon or newly develop such a name that would be easily remembered by and resonate with lay people, media and scientific personnel. For purposes of this paper only, rather than favor one group's name or another's, the phrase Multi-system Exposure Related Illness (MERI) will be used to refer to the disease as it points to the multi-systemic nature and indoor environmental triggers which include, but are not limited to, toxins, microbial secondary metabolic products, particulates and the microbes themselves. MERI also recognizes that toxins other than mold or

It is the opinion of this paper that a single unifying name would benefit all the various vested communities (treating physicians, researchers and sufferers) and that those who publish should come together and agree upon or newly develop such a name that would be easily remembered by and resonate with lay people, media and scientific personnel. For purposes of this paper only, rather than favor one group's name or another's, the phrase ***Multi-system Exposure Related Illness (MERI)*** *will be used to refer to the disease.*

microbial secondary metabolic products may create comparable symptomatology, presumably through the same or similar pathways. The source of incitants may also include overflows of waste and sewage, leaks from combustible heating sources (chimneys, wood-burning stoves, oil and gas furnaces or steam-generating radiant units) and resultant odorless carbon monoxide. Poor ventilation can increase humidity and CO_2. Radon buildup, lead (and from paint) and copper from water pipes, well-water bearing contaminants, septic tank back-ups, oil tank leaks are additional examples of indoor toxic exposure that have nothing to do with WDB. Additional factors may include building renovations, painting with VOCs, synthetic off-gassing, pesticides, chemical cleaners, etc., and in the case of WDB, the degradation products of construction materials resulting from chronic water exposure.

Likely millions of individuals with MERI exist in the U.S. alone. In fact, as noted above, indoor air pollutants cause 50% of illnesses globally. Most physicians will not recognize the illness because they are uninformed about the variable multi-system presentations of MERI.[157] Typically, one or two systemic problems predominate while several other systems are involved. Those who complain most of fatigue are often lumped into chronic fatigue syndrome (CFS). Those with a chief complaint of severe and chronic muscular pains are wrongly diagnosed as having fibromyalgia. Those with recurrent abdominal pains, with or without diarrhea, are labeled with irritable bowel syndrome (IBS). When the primary concern relates to odd neurologic symptoms, the patient may be misdiagnosed as having multiple sclerosis (MS), etc. However, all these patients show multi-systemic symptomatology. Pidgeon-holing the sufferer into a single system diagnosis requires ignoring or minimizing many other symptoms and systemic clues. Patients are frequently told they are depressed, anxious and need psychiatric medications, while the central environmental history of home and work was never explored. Others are told they are somaticizing (or worse – malingering), that they need to "learn to live with it", or that it's "all in their head."[158] On occasion, the patient will be told honestly by the practitioner that (s)he doesn't know what is wrong. MERI is usually the diagnosis that answers all the enigmatic multi-systemic, multi-symptom patients' questions. It also gives sufferers precious hope (that the misdiagnoses do not offer) by accurately identifying the composite causes of their symptoms.

Pathophysiology

Mold and bacteria are ubiquitous, inside and outside of buildings. Construction materials offer a great amount of food resources in the form of sheetrock,[159] wood, etc. for indoor molds and bacteria. Building interiors themselves provide a location of relatively low competition for such nutrients due to decreased airflow within them. Buildings become water-damaged when water intrudes via numerous pathways including leaking roofs, inadequate vapor barriers,[160] indoor plumbing leaks, faulty HVAC condensation drainage[161] and intrusions into basements and crawl spaces through several mechanisms. Adding water provides the missing ingredient needed for the explosive microbial growth, known as amplification, found in WDB. In an amplified system, there is unchecked expansion of numerous species of molds, bacteria, actinomycetes and mycobacteria, and unfettered production of spores and secondary metabolites such as endotoxins, β-D-glucans,[162] spirocyclic drimanes, trichothecenes,[163] aflatoxin, ochratoxin, satratoxins, galactomannans, hemolysins, fine particulates, etc., as well as VOCs from the building materials and microbial VOCs[164] which are released from damp cavities,[165] through sheetrock, into the air the inhabitants breathe. Illness due to exposure in WDB buildings likely

results from a combination of these factors and includes the direct effects of toxins, chronic inflammation and colonization and infection of microbial agents.

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The literature provides ample evidence that exposure to the interior of WDB leads to increases in upper respiratory syndromes, allergies and increased incidence of asthma with further triggering of asthma flares.[166,167,168,169] These symptoms and diseases have a relative risk of 1.4 to 2.2 due solely to exposure to damp buildings.[170] Risk is affected by genetic factors - including variations in cytochrome p450 detox pathways, glutathione pathways[171] and HLA (human leukocyte antigen) genotype which may affect an individual's ability to detoxify - as well as response to presenting antigens.

While a massive acute exposure can lead to MERI, the most common mechanism is chronic exposure to low level toxins leading to an inflammatory response in the body. Inflammation is not caused by the typical path seen with infecting agents. The MERI inflammatory mechanism is unlike the typical infectious agent that presents antigens to dendritic cells, and antibodies result. Rather, HLA-DR (DR portion of the HLA genome) does not facilitate antigen presenting cell (APC) recognition of antigens as foreign. In this model, the toxin(s) bind to Toll-like (adipose cells) and non-Toll receptors acting as pattern-recognition receptors, then activate the innate immune system in the form of the mannose binding lectin pathway (MBL) of the complement system[172,173,174] through a secondary messenger scheme. This leads to continuous stimulation of the MBL pathway without an effective "turn-off switch" (since no foreign particle was presented to APCs to be cleared). As such, the MBL runs smoothly and efficiently around the clock for weeks, months, years and even decades, all the while producing pro-inflammatory cytokines[175] with the ultimate intent of destroying "something". Since there is no foreign target being presented or opsonized for destruction, eventually those cytokines will cause damage to the host. Innate immune abnormalities are often demonstrated in patients by elevated TGF-β1 (transforming growth factor, beta 1), C4a (the activation product of the complement protein C4) and/or MMP-9 (matrix metallopeptidase 9) levels.[172]

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Of note, it does not matter which toxin is offending.[2,139] In the primordial milieus found in WDB, many toxins, particles, fragments, spores, etc. are being released,[88] and each building will be different. The number of cell wall or desiccated colony fragments released into the air will be many hundreds of times greater than spores.[176,177] Different and multiple species of molds, mycobacteria, actinomycetes and bacteria[178] will be found—many releasing different secondary metabolites including mycotoxins and endotoxins. Unlike animal cells, which digest nutrients in their interior, fungi - including yeasts and molds - actively secrete their digestive enzymes onto their surface in a process called exodigestion. Exodigestive enzymes are proteins that coat the surface of desiccated fungal particulates making them extreme antigens, or immune system stimulants. VOCs and MVOCs may also be released. "At present we know very little about interactions among low-level irritants. It is possible that, in the case of some compounds at subthreshold concentrations, a summation or potentiation takes place, causing sensory reactions to the mixtures of pollutants. It is also possible that chemical reactions take place, converting less irritating compounds to more irritating ones."[179] This excerpt from the SBS portion of the 1982 WHO Meeting on indoor air pollutants and exposures makes it clear that there may be multiple low-level toxins working in concert to affect human health and that dose response to a single agent may not apply. It is often difficult (and not essential) to discern which toxin or combination of toxins cause harm. That there are one or more toxins causing harm to the exposed human host is the crucial matter.

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Put another way, Dr. John Snow, the "Father of Modern Epidemiology," noted in 1854 that a cholera outbreak centered around the common use of the Broad Street public well.[180] He removed the pump's handle and the outbreak dissipated. *Vibrio cholerae*, the organism responsible for cholera, was coincidentally discovered the same year but was not widely known for another 30 years.[181] **Would it have been wise for Dr. Snow to withhold his actions for 30 years until the precise bacterial agent could be identified?** Likewise, Ignaz Semmelweis postulated the theory of hand washing between medical procedures in 1847.[182] He published several works on the subject and was widely criticized. However, Louis Pasteur and his microscope proved the existence of bacteria and refuted the idea of spontaneous generation in the 1860s.[183] Several years later, in 1867, Sir Joseph Lister published on the use of "antiseptic principles"[184] (like hand washing). After 28 years, antiseptic practice finally became the standard of care. Should the medical community wait 28 or 30 years to

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In the CIRS-WDB model, toxins from the interiors of WDB are inhaled, transported to the blood and lymph-bile systems, and ultimately find their way to adipose cells to trigger the mannose binding lectin pathway of the complement system. More and more pro-inflammatory cytokines are released into the bloodstream. Initially, neuroregulatory and immune peptides[185,186,187,188,189] such as Vasoactive Intestinal Polypeptide (VIP) and Melanocyte Stimulating Hormone (MSH) exert control on the immune system to mitigate the damage. However, in an epic tug of war, constant cytokine production eventually outruns overproduction of VIP, MSH and others (ADH or Anti-diuretic hormone included). When the production of these hormones is overwhelmed, it is possible that low levels ensue similar to insulin production in a patient becoming a Type II diabetic. Pro-inflammatory cytokine production becomes relatively unopposed leading to multisystem damage likely mitigated by T_h17 lymphocytes (T helper 17). Chronic systemic inflammation leads to localized degradation of the blood brain barrier (BBB) allowing T_h17 cells access to the cerebral blood supply and the parenchyma itself. TGF-β1 (an anti-inflammatory cytokine) appears to play an important role. Normal CD4+ (cluster of differentiation 4) cells in the presence of normal or elevated TGF-β1 promote commitment to CD4+CD25+ (T_h3 regulatory or T_{REG}) lymphocytes which decrease auto-immunity. However, low levels of TGF-β1 in the presence of pro-inflammatory interleukins (IL-6, IL-21 or IL-23) push naïve CD4+ cells' commitment to T_h17 cells,[190,191] known to promote auto-immunity and numerous well-described autoimmune diseases. Summing up, the WHO 2009 report states (p. 85), "Many of the health effects may result from recurrent activation of immune defence, leading to exaggerated immune responses and prolonged production of inflammatory mediators. Overproduction of these compounds damages the surrounding tissues and may manifest itself as chronic inflammation and inflammation-related diseases, such as asthma (Martin, Frevert, 2005)."[2]

In addition, there are degenerative neurologic changes because some mycotoxins are directly neurotoxic[164] causing global neurologic injury manifesting as visual contrast deficits, balance problems, cognitive deficits, abnormal pain patterns, recurrent numbness and tingling, extraordinary skin sensitivity (even on the order of that seen in chronic regional pain syndrome), etc. Cognitive deficits and behavioral issues have been shown in persons with systemic inflammation as well as in those exposed to mold and mycotoxins in water-damaged buildings.[192,193,194,195] IgG and IgM (immunoglobulin G and M) antibodies to several neuronal peptides have also been demonstrated in persons with documented mycotoxin[164] exposure and neurologic dysfunction. Bacterial endotoxins have been shown to induce neurotoxicity.[196] Magnetic Resonance (MR) Spectroscopy[197] in MERI patients shows reproducible deficits consistent with brain hypoperfusion[172] which reverse after therapy. Some of these patients, without a positive myelin basic protein from cerebrospinal fluid, may be incorrectly diagnosed as having multiple sclerosis.

Treating physicians have observed there is an over-representation of patients with midbrain movement disorders—choreas, obsessive compulsive disorder and Tourette's syndrome—among MERI patients.[198] Basal ganglion lesions found on CT (computerized

tomography) were predictive of movement disorders in people from 13 Chinese provinces who ingested sugar cane contaminated with *Arthrinium sp.*[199]

MERI often reflects endocrine disruption. It is important to understand that the hypothalamus and pituitary are very much affected by MERI. The hypothalamus, as seat of control over the autonomic nervous system, many of the body's "set points" (such as temperature control) and the endocrine system via the pituitary, is the structure of most ultimate importance in homeostasis of nearly all body functions. As such, almost every system of the body can be affected by MERI and the multiple and varied presentations stem from the fact that different patients, while having many symptoms crossing many systems, tend to have 1 or 2 predominating systemic difficulties. As above, if a practitioner focuses attentions primarily on those 1 or 2 systems (s)he is likely to neglect the larger picture which is the many system involvement known as MERI.

Looking again at the CIRS-WDB model regarding the hypothalamus and pituitary, abnormalities are frequently detected which are believed to be the result of decreased production of MSH. Stimulation of leptin receptors activates the proopiomelanocortin[200] (POMC) pathway. Weight gain is frequently seen in those exposed to water-damaged buildings. This could be in part due to leptin resistance which often develops as a result of pro-inflammatory cytokine action, pathway overusage due to increased need of MSH, and/or as a response to increased adiposity in those already overweight.[201] Increasing leptin resistance with subsequent decreased MSH alters the point of satiation.[202] Patients often gain significant weight which is not responsive to diet and exercise.[203,204] MSH modulates mucous membrane immune responses which work against nasal carriage of biofilm forming multiply antibiotic resistant forms of coagulase negative staph (MARCoNS).[172] In turn, MARCoNS produce hemolysin which cleaves MSH. β-endorphins, adrenocorticotropic hormone (ACTH) and MSH are all produced in the POMC pathway.[205] Reduction of this pathway's use means less of the body's most potent pain reliever is made. Many patients suffer chronic pain. MSH may also be critical for restorative sleep. Some MERI patients can sleep 10-12 hours but not feel rested upon waking. Many have much more trouble falling asleep and with early awakening.

Low MSH also affects pituitary function. Functional and/or laboratory dysregulation in patients diagnosed with MERI can be documented with 6 of the 9 pituitary hormones including abnormal levels of ADH, ACTH and MSH as well as disproportionate rates of patients on thyroid replacement (thyroid stimulating hormone, or TSH) and/or with extraordinary dysmenorrhea (LH, or luteinizing hormone and FSH, or follicle stimulating hormone). Almost all patients are fatigued and most have some combination of polydipsia/polyuria/nocturia. Abnormalities in ADH/osmolality and ACTH/cortisol feedback loops are also usually demonstrated. Histamine is a known messenger of dehydration, signaling ADH to correct the problem. The symptoms of sneezing, itching, and runny nose are often assumed by patients—not to mention healthcare providers—to be allergy, but with the depletion of ADH, there is a never-ending failure to end dehydration, and many patients suffer from fungal rhinitis, sinusitis, or rhinosinusitis. Since histamine is also alerting, there is a never ending stimulus toward agitation and anxiety. Further, histamine is methylated to its inactivated state. Depleted methylation resources then result in a series of symptom presentations that resemble depression.[206] MSH is an infundibular pituitary hormone and levels are low in roughly 90% of cases.

Chronic production of pro-inflammatory cytokines with decreased β-endorphins and rare restorative sleep lead to recurrent diffuse debilitating myalgias in many patients. These symptoms are identical to those in many patients diagnosed with fibromyalgia.[207] There are no biomarkers for fibromyalgia but 10 for MERI. As such, all patients diagnosed with fibromyalgia should be evaluated for MERI as a treatable cause of the myalgias.

Multiple derangements in regulation and the immune system can lead to autoantibody production and multi-system dysfunction. MERI patients often develop anticardiolipin antibodies[208] and can look very much like those diagnosed with systemic lupus erythematosus (SLE). In fact, MERI should be in the differential diagnosis of all patients previously labeled as SLE who do not demonstrate a positive anti-double stranded DNA antibody. Clinician's treating MERI patients have also observed a high rate of ANA positivity without diagnosable rheumatologic disease. There is a further connection here, in that the inability to recycle homocysteine to methionine and around, results in reduced production of SAMe. The effect is not only on methylation, but on the failure of SAMe (S-adenosylmethionine) to donate methionine to putrescine, which is derived from ornithine. Putresicine levels are elevated in Lupus. Putrescine + SAMe = Spermadine + SAMe = Spermine, which is the precursor to polyamines which encourage nerve healing.

Small vessel dysfunction is commonly seen in persons with MERI. There is also microvascular sludging, which is further associated with the hypercoaguable phenomena already described, capillary shunting, and increased venous oxygen, and excess intrinsic production of carbon monoxide due to the action of hemoxygenase on hemoglobin. This could be the result of persistent triggering of the innate immune system leading to white cell demargination which congests distal small arterioles and chronically decreases red blood cell delivery of oxygen to peripheral capillary beds as well as autonomic nervous system disturbance resulting from long term exposure to toxins. Very cold hands and feet are frequent in sufferers of MERI and some patients report transient blue and even green color changes to appendages not consistent with Reynaud's phenomenon. Increased blood levels of erythropoietin and/or Vascular Endothelial Growth Factor (VEGF) abnormalities document the peripheral hypoperfusion[209] as does MR spectroscopy of the brain.[209]

Shortness of breath is seen frequently in those exposed to water-damaged buildings. This can result from a variety of factors, including reactive airway disease, with evidence of small airway obstruction frequently noted in pulmonary function testing. The most common abnormalities are seen in markers of small airway obstruction such as $FEF_{25-75\%}$ (forced expiratory flow between 25 and 75% of forced vital capacity) and $FEF_{75\%}$. There is sometimes a restrictive component – which the pulmonologists will call "idiopathic." When Autonomic Nervous System And Respiration (ANSAR) testing of heart rate variability is simultaneously assessed, this restrictive component is associated with decreased parasympathetic nervous system (PSNS) activity. Since PSNS (vagus) regulates diaphragm contraction, there is typically an attempt at increased sympathetic nervous system (SNS) activity (chest wall expansion), to compensate for the decreased air entry. There is sometimes a net result of decreased FVC (forced vital capacity).

Additionally, pulmonary infections such as chronic mycobacteria, including *Mycobacterium Avium Intracellulare* infections, can result from exposure to water-damaged buildings resulting in a variety of chronic pulmonary symptoms including shortness of breath. Hypersensitivity pneumonitis, allergic bronchopulmonary aspergillosis, bronchiectasis and, in severe cases, pulmonary fibrosis can result from exposure to water-damaged buildings[210] and mold. Low VEGF has also been demonstrated by some researchers to be associated with shortness of breath (even in well-conditioned athletes).

Neurologic and cognitive symptoms are some of the most frequent complaints, and typically is the most upsetting complex of symptoms experienced, in those exposed to water-damaged buildings.[211] Direct neurotoxic affects from mycotoxins and other toxins found in WDB, vascular hypoperfusion, cytokines and immune system inflammation after T_h17 driven breach of the blood brain barrier[212] can all contribute to these phenomena. What is not in dispute is that brain fog, disturbances in memory, concentration, balance, word finding difficulties and other cognitive symptoms are frequently seen in those exposed to water-damaged buildings,, and a dose response relationship has been confirmed by Crago, et. al.[213]

Renal effects have also been seen with exposure to water damaged buildings. Ochratoxin A has been associated with Balkan Endemic Nephropathy in humans, urinary tract cancers in animals and humans and focal segmental glomerulosclerosis.[214]

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Chronic fatigue is the overriding symptom which unites almost every patient with MERI, although about 5% of patients do not describe fatigue as a recurrent symptom. Fatigue most likely results from chronic non-restorative sleep, low cortisol with dysregulation of the Hypothalamic-Pituitary Axis (HPA), peripheral hypoperfusion and mitochondrial injury resulting from exposure to the many toxins, such as mycotoxins, found in water-damaged buildings.

Diagnosis

Diagnosis of MERI is usually straightforward although a consensus of the exact definition of the disease has not been established since the disease is in the process of being defined. There are numerous objective biological indicators found in patients suffering from MERI. Lack of consensus regarding definition does not mean a particular disease does not exist—rather that more discussion is needed until consensus is reached. Further, there is no single pathognomonic test which rules CIRS-WDB in or out. The process of establishing a unique constellation of symptoms and lab findings is commonly used in medicine to delineate a diagnosis. The Jones criteria for Rheumatic Fever and the diagnoses of SLE and Kawasaki Syndrome are just three such examples.

Dr. Ritchie Shoemaker *et al* coined the term "CIRS-WDB" and have proposed a three-tiered case definition. He and his group use history, physical exam findings, and results of Visual

Contrast Sensitivity (VCS) testing[215], MR Spectroscopy, nasal culture and blood tests to look at ten different bio-markers for CIRS-WDB. Healthy persons should have, on average, 5% of these markers positive (0-1 per patient) whereas cases usually manifest at least 5-6 (50-60%) abnormal values.

Currently, a CIRS-WDB patient should meet all of the following criteria:[216]

1) Evidence of exposure (historical,[217] lab and/or objective testing such as ERMI[218] (Environmental Relative Moldiness Index)

2) 3 of the 6 following criteria:
   - VCS deficits
   - Decreased MSH
   - Elevated MMP-9
   - Abnormal or dysregulated ADH/osmolality
   - Abnormal or dysregulated ACTH/cortisol
   - HLA genotype noted to have a relative risk of 2 or greater to mold exposure

3) 2 of the 3 following criteria:
   - Improvement of symptoms and resolution of VCS deficit with cholestyramine (CSM) therapy
   - Reduction of leptin with therapy (if elevated)
   - Reduction of MMP-9 with therapy (if elevated). Note: In the case of normal leptin and MMP-9 at the institution of therapy, fulfilling the first of these three criteria is sufficient.

It is expected that most CIRS-WDB patients will also demonstrate abnormal TGF-β1, VIP and/or C4a and the presence of MARCoNS. Many will show altered von Willebrand's, iron and/or androgen studies, and often reveal antibodies to cardiolipin and/or gluten (with negative tissue transglutaminase or TTG). MR Spectroscopy often reveals specific abnormalities such as increased glutamate to glutamine ratios. Careful attention to confounding diagnoses is also required.

Other treating physicians use additional testing modalities. Dr. Michael Gray *et al* use the term Mixed Mold Mycotoxicosis and also look for evidence of fungal colonization in nasal passages, sputum and stool, evaluate potential pesticide exposures and measure urine mycotoxins as proof of exposure. His group also looks at Nerve Conduction Velocities, neurobehavioral testing developed by Dr. Kaye Kilburn (found to demonstrate evidence of chemical brain injury in those exposed to environmental toxins including mycotoxins) and Quantitative Electroencephalograms (QEEG) as part of their evaluation. In addition to much of the testing used by Dr. Gray, Dr. Janette Hope uses detoxigenomic studies which look at various single nucleotide polymorphisms (SNP) and assesses for nutritional deficiencies and food allergies frequently found in those with long-term toxic exposures.

Dr. Alan Vinitsky assesses for autonomic nervous system (ANS) dysfunction via the Autonomic Nervous System And Respiration (ANSAR) testing system. He has developed a

working model of hypomethylation to account for some of the symptoms of ANS dysregulation, as they relate to stress. His treatments initiate recognition and correction of the dehydration patterns that relate to the ADH – Histamine reactions described above. In addition, he has identified a pattern of amino acid deficiencies that result in chronically ill individuals, such as those with MERI. Dr. William Rea, a pioneer in the field of environmental medicine, has developed a multi-disciplinary approach to diagnosis (which includes intradermal provocation of mycotoxins[219]) in a facility using state of the art construction techniques to create a "less polluted environment for patient evaluation, testing and treatment."[220] His group has suggested the moniker "Indoor Mold Sensitivity and Toxicity" for the disease. As more researchers and treating physicians publish on MERI, a consensus definition will be developed.

Treatment

Treatment protocols also vary and to date there have been no head-to-head trials on the efficacy or superiority of any one regimen. However, each listed practitioner will relate extraordinary results (even up to 90%) of patients who are compliant with the prescribed therapy. The two basic principles of most approaches include 1) toxin avoidance and 2) removal of toxin from the body—usually via sequestering agents. Some use glutathione and targeted nutritional support to promote detoxification, as well as exercise and sauna therapy when indicated.

Toxin avoidance can be taken to several levels. Dr. Shoemaker suggests testing suspected indoor spaces via ERMI which detects mold DNA from vacuumed carpet or flooring samples. The result is logarithmic and a score of 2.0 or less is considered acceptable unless the patient has low MSH or very high C4a lab values.[221] Unfortunately, there continues to be limits to most testing modalities and it is often necessary to evaluate indoor settings using historical information about the building, as well as signs of water damage and moisture excess, combined with judicious use of focused testing. Multiple testing modalities exist and most experts agree a combination of methods provides optimal results,[138] False-negative test results are easy to obtain, especially using the common 5-minute spore trap techniques. However, it is nearly impossible to obtain a false-positive test result; therefore, all positive results should be taken seriously. Making sure home and work are mold-free places is critical for adults. Schools are a more challenging locale to test as the school district usually must give permission. Indoor air quality testing alone is often not sensitive enough to detect the low levels required to cause illness, especially in genetically predisposed patients.

For spaces found to be "moldy" (i.e., water-damaged, regardless of the findings on testing, when used), remediation by certified personnel is recommended. Improper efforts can spread microbes (such as mold, bacteria and parasites), spores, fragments and toxins throughout the entire structure as water-damaged building materials are removed.[222,223] If remediation is attempted, proper containment procedures and personal protective equipment are critical, because disturbing or handling the contaminants can result in increased aerosolized spores and particles containing mycotoxins which can be dangerous to human health and destructive to property.

It is important to note: Although many products can easily kill mold, dead mold (if not removed) can be as dangerous as growing mold due to the continued presence of highly toxic

mycotoxins and viable spores which are often impervious to the effects of the agents used to kill the molds.

Serious disinformation has been popularized and reflected in the guidelines given healthcare workers and the public encouraging the use of bleach and other chlorinated products for cleaning the mold from damp indoor spaces. However, at least two species of concern—*chaetomium* and *stachybotrys*—propogate via spores that are unaffected by chlorine, acids, caustics or ozone. In addition, chlorinating carbon-based organic toxins increases their toxicity by increasing their mutagenticity and their lipid solubility which allows these poisons to enter the skin and accumulate in lipid rich tissue such as fat deposits and the brain.

There are significant health risks at play when patients and their personal effects are subjected to contamination in damp, rotting, moldy—whether visible to the eye or hidden in the wall cavities—conditions indoors. The combination of an infectious threat—the spores—and poisons riding into the occupants' lungs on the surface of respirable particulates coated with a variety of some of the most toxic substances—mycotoxins—known to humankind represents one of the most serious threats to our public's health and to the health of the individual occupants.

When patients find themselves ill after spending time in highly toxic, damp indoor environments, restoring their health depends on their removal from conditions of continued exposure—in addition to the implementation of appropriate treatment protocols. They should be evacuated from the contaminated space and separated from their personal effects including, but not limited to, clothing, bedding, furniture, books, papers, computers and other electronic devices—most have fans and all have electrostatic and magnetic fields that attract toxic respirable particulates and spores—as all of these items are vectors for cross contaminating other indoor environments into which they are brought.

A new study titled "Remediation of mould damaged building materials—efficiency of a broad spectrum of treatments" was published in January 2012 by Peitzsch, et al.[224] It states (in part):

> "We compared the efficiency of some commercially available products and methods used for remediation of mould-contaminated building materials. Samples of gypsum board and pinewood were artificially contaminated with toxin-producing isolates of Stachybotrys chartarum and Aspergillus versicolor, respectively, then, ten different remediation treatments were applied according to the manufacturers' instructions. Microbial and chemical analyses of the infested materials were carried out both immediately before and after treatment, after six weeks of drying at room temperature, and after another six weeks of remoistening. The aim of the study was to determine whether the investigated methods could inhibit the mould growth and destroy some selected mycotoxins produced by the moulds. None of the decontamination methods tested could completely eliminate viable moulds. No remediation treatment eliminated all the toxins from the damaged materials. These results emphasize the importance to work preventatively with moisture safety throughout the construction processes and management to prevent mould growth on building materials."[224]

It is also important to note that many published guidelines state that testing is not necessary or not recommended. However, it depends on the situation and many independent and inter-dependent factors including whether the parties are involved in litigation and the current health status, sensitivity, and/or genetic susceptibility of each individual. An additional factor that needs to be considered is that testing is not financially viable for all homeowners, due to the extent of the damage and the tremendous financial losses that families incur in these situations. If testing is used or needed, positive results are a guide to treating the occupants of the exposed site, but negative results do not rule out the need to appropriately remediate.

The processes involved in accomplishing effective mold remediation are dependent upon multiple factors as each water-damage situation presents its own unique set of circumstances and challenges. For example, because some water-damaged structures may produce a false negative test result based on sampling, remediation procedures should still be implemented. Additionally, there are some water-damage situations that cannot be resolved or corrected with remediation. As such, it is not practical to provide a detailed discussion of mold remediation in this paper. Building owners, homeowners and others responsible for the proper maintenance of structures are encouraged to contact experienced, knowledgeable and certified professionals for appropriate guidance.

Mycotoxins routinely travel with spores (alive or dead) and, even more concerning, travel with very small, even submicron sized particles capable of penetrating deep into the lungs. At this level, they are subjected to the effects of pulmonary surfactants which allow otherwise insoluble toxins to be absorbed into the bloodstream. Dr. Walter Hayhurst suggests creating a "safe room" in a moldy dwelling for those who cannot afford to properly remediate the entire space and also thoroughly cleansing pets and vehicles with some "natural" products his group has developed. As a reminder, in the recently published study by Peitzsch et al,[224] researchers tested ten commonly used agents purporting to be capable of neutralizing mycotoxins and/or suppressing mold growth; not one of them completely removed all mold and toxins. (None of Dr. Hayhurst's products were included in this report.)

Dr. Shoemaker's sequestration approach uses cholestyramine 3-4 times a day while Dr. Gray uses up to three sequestering agents (bentonite or zeolite clay, charcoal and cholestyramine) twice daily. The clay and cholestyramine are mixed together in a liter of water and drunk over the course of the morning/afternoon and then again after dinner. The charcoal is taken as pills or capsules. Dr. Gray also recommends the simultaneous use of Dr. Grace Ziem's oxidative stress reducing Neural Sensitization Protocol (NSP), targeting the increased oxidative stress associated with both inflammation and toxicity.

Beyond toxin avoidance and sequestration, Dr. Shoemaker, *et al,* follow a step-wise, pyramidal approach to therapy. As each step is cleared, more patients will be free of symptoms and have a return to the normal biologic regulation and lab work which healthy persons enjoy. This approach is summarized below. Note: Few patients will require every step, and steps are NEVER taken out of order.

Eradicate biofilm-forming agents (MARCoNS)
Correct elevated Anti Gliadin Antibody (after verifying no celiac disease)

Correct elevated MMP-9
Correct ADH/osmolality
Correct elevated C3a
Correct elevated C4a
Correct elevated TGF β-1
Replace low VIP
Verify patient stable off all meds

Dr. Gray also stresses the need for adequate upper respiratory and pulmonary care, uses supplements such as CoQ_{10} and, on occasion, enlists systemic anti-fungal agents. Glutathione is heavily emphasized in Dr. Gray's treatment protocol, being used in an oral liposomal form, nebulized and intranasally (Dr. Kaye Kilburn has demonstrated benefits in neurocognitive symptoms as this route allows crossing of the blood brain barrier). Additionally, Dr. Gray frequently uses nasal antifungal agents and Dr. Ziem's oxidative stress protocol (as noted above).

Dr. Hope, in addition to the use of sequestering agents (cholestyramine and charcoal), also prescribes glutathione via all of the above routes and nasal antifungals when indicated, treats detoxigenomics findings to specifically address genetic deficits (SNPs) and nutritional testing to assess for adequate presence of vitamin cofactors needed for proper detoxification. Treatment includes both avoidance of problematic medications, toxins, foods and hormones as well as supplementation of specific cofactors (magnesium, B vitamins, etc.)

Dr. Rea's approach is aimed at decreasing the "total body load"[225] of all toxins and toxic chemicals, injections to neutralize[226] mycotoxins, avoidance of foods and chemicals to which patients may have become sensitized, parenteral and oral nutrition (the latter includes spring water in glass bottles, organic foods and a rotary diet), sauna treatments, exercise and massage. Some patients require an autologous lymphocytic factor, developed at Dr. Rea's center, which modulates the patient's own immune system. In some others, anti-fungals, oxygen therapy and sequestration agents are used.[225]

Dr. Hayhurst and Dr. Dennis[227] suggest treating fungal infections in the sinuses aggressively and use "The Inflammation Free Diet Plan"[228] and recommend resveratrol,[229], a molecule shown in some studies to prolong the lifespan of worms, fruit flies[230] and short-lived fish.[231] It may also reduce the risk of certain cancers in rats.[232] Further study is underway to evaluate resveratrol's potential for neuroprotective, anti-inflammatory, cardioprotective, anti-diabetic and anti-viral effects.[231]

Dr. Vinitsky teaches that chronic overstimulation of the sympathetic nervous system (SNS) also contributes to "mold toxicity."[233] His therapies also include relaxation/meditation techniques, energy optimization, dietary changes, exercise, nutritional supplements, increasing purified water intake and development of a positive mental attitude to help the body heal itself of toxins and toxic stress as precursors to the inflammatory response.[234] The intent is to integrate the mind, body and spirit into the healing process. As a further metabolic basis of treatment, Hydroxocobalamin is a recognized scavenger of inflammation stress (nitric oxide) as described by Martin Pall. That is part of the basis of Dr. Ziem's protocol. Dr. Vinitsky has identified a patent-pending 5:2 ratio of sublingual/transbuccal Folate:Hydrocobalamin as a means of cleaning

up oxidative stress (aldehydes) and Nitric Oxide, first as a means of cleaning up stress, then replenishing sufficient doses on a patient-to-patient basis to correct methylation defects. He has defined the Methylation Priority Principle© as a relative ranking of the need for methylation processes, of which there are more than 50 in the body. Included in this ranking are Adrenalin−activation and inactivation; followed by Histamine, Metals and Estrogen; then neurotransmitters Norepinephrine, Dopamine, Serotonin, and Melatonin; next RNA synthesis and DNA, histone, and microRNA repair; and finally, creatine production. In a recent review of 8 years of using this open-label protocol for patients of all ages, a significant portion who have been mold-affected, more than 2.37 million doses have been administered. As a side note, Henry Wright, a faith healer, believes that chronic fear, worry and anxiety are the roots of SNS overload[235] which then causes chronic hypothalamic stress and eventual HPA and overall endocrine dysfunction.

Causation

Causation is the final issue to address. Differing levels of proof are required for different audiences. For example, some women received silicone gel breast implants and years later had ruptures or slow leakages. Many of these women subsequently developed tremendous symptomatology similar to that described in MERI. One report indicated that 97% of women had significant improvement in their auto-immune symptoms by simply removing the failed implant.[236] That level of evidence would be convincing for most persons, including most judges and jury members, however the scientific community demands an even higher level. Large, IRB approved, controlled, prospective, double-blinded and reproducible trials are considered the gold standard. Yet, with MERI it is very unlikely an IRB will ever approve a prospective study which exposes humans to aflatoxin, endotoxin, digestive enzymes, polysaccharides, lipoproteins or any of the other biological toxins found in WDB to further prove that they cause illness in exposed humans. Regardless, sufficient data is already present in the published literature.

The 2008 GAO report (page 8) addresses this issue and offers three criteria which, if all are met, credibly establish causation in the matter of MERI. These are:

1) epidemiologic associations,
2) experimental exposure in animals or humans that leads to the symptoms and signs of the disease in question, and
3) reduction in exposure that leads to reduction in the symptoms and signs of disease.[139]

In the case of MERI, these criteria have clearly been met, as follows: 1) There are a plethora of studies demonstrating epidemiologic associations between exposure to the interior of WDB (with the associated toxins) and the various symptoms and lab/imaging/neurobehavioral testing found in patients suffering from MERI. Literally tens of thousands of human patients[138] are also documented in the literature. 2) Many prospective animal studies have been performed which reveal that exposure to various mycotoxins, endotoxins and VOCs have harmful health effects. Re-exposure studies by Dr. Shoemaker *et al* further demonstrate directly that exposure changes symptom scores and lab findings in previously treated humans. In fact, it can be shown reproducibly that patients improve on treatment out of

In the case of MERI, these criteria have clearly been met.

exposure and get worse without treatment when re-exposed. 3) The same re-exposure studies prove also that humans removed from exposure do indeed improve.

For some individual patients, it is very difficult or impossible to demonstrate that they themselves improve with reduction of exposure because they are unable to limit their presence to certain exposures. An example would be a person made sick in the workplace. In an ideal world, the patient would take a month or so off work with pay while diagnostic and therapeutic efforts are underway and significant improvement is achieved. Re-exposure upon return to the water-damaged workspace with exacerbation of previous symptoms and lab work would essentially seal the deal. However, many patients will have already exhausted sick leave and vacation time because of previous symptomatology. They are unable financially to remove themselves from the workplace exposure adequately to optimally restore health. These patients will sometimes seek other employment but usually continue working in the environment that is making them ill. A few employers are sympathetic and offer testing, remediation and/or accommodations to relieve the problem. This scenario potentially allows the opportunity to prove that the exposure truly is reduced by re-testing after the employer's intervention is implemented with the patient's physician documenting changes in health status. However, many employers disbelieve that mold can cause illness, others may feel threatened by potential lawsuits and the hassles of workers' compensation insurance or disability procedures. Some will be more concerned by the potential cost of appropriate remediation than the costs to the employee's health. In these scenarios, where the patient continues to work (or go to school) in an unmodified space, causation can still be inferred by treating with a sequestering agent such as cholestyramine, charcoal and/or clay. Since their actions are to bind and remove bile acids and the ionically charged molecules attached to them (through the enterohepatic circulation), sequestering agents are intended to reduce total body loads of many substances including many toxins. Reduced body toxin loads can be monitored via VCS and other targeted diagnostic testing modalities including urine mycotoxin studies (available through RealTime Laboratories in Dallas, Texas).[237] Documented symptoms, reduced by severity, frequency and/or duration, reveal a positive patient response. Resolution of abnormal blood tests further displays disease improvement.

Of note, a common scenario for the persistence of symptoms, after escaping exposure from a water-damaged building, is caused by cross contamination, or the transport of materials which have been contaminated with mycotoxins and other toxic and microbial agents, from the previous water-damaged building to the new setting. This phenomenon results in an ongoing exposure, as there was never any practiced avoidance.

Dr. Shoemaker's group has developed and published a re-exposure trial known as the ABB´AB protocol.[238] The first "A" stands for a patient who is ill in an exposure. The first "B" represents the same patient—now improved on therapy and out of exposure. B´ refers to an improved patient who remains out of exposure and maintains improved health off of therapy. The second "A" indicates that the patient, off therapy, is re-exposed to the previous suspected environment for at least three days. The final "B" documents the patient once again on therapy after the re-exposure. Symptom logs, VCS testing and specific labs are obtained just prior to re-exposure and at 24, 48 and 72 hours after re-exposure. If the suspected environment is an exposure, and hence a health risk for this patient, symptom scores will increase, VCS scores will

decrease and certain lab tests will increase and/or decrease predictably in post-exposure levels compared to those obtained just prior to re-exposure.

While performing the ABB´AB protocol[238] may not be required to establish causation for a patient, successful administration of this trial is very powerful evidence, difficult to refute, and clearly meets all three GAO-suggested criteria for causation between a purported exposure and an individual. It is a prospective re-exposure trial with the only variable being re-introduction to the suspected sick building.

It is also helpful to test one or more suspected environments to document the presence of water damage. A WDB, by definition, will have multiple species of molds, bacteria, etc. There are a number of testing strategies and using a combination of methods is recommended by many.[138] Verifying the presence of water damage in the interior of a building proves the existence of potentially harmful microbial agents and the secondary metabolites they exude. As noted above, it is not possible, nor necessary, to identify the individual toxin(s) which is (are) harming the human host. That there is at least one toxin in the interior of a WDB causing disease is inferred by the presence of water damage (causation has already been established as above) and the patient's improvement on a sequestration protocol with/without removal from the exposure. In the words of the WHO 2009 report (Executive Summary, p. XV), "As the relations between dampness, microbial exposure and health effects cannot be quantified precisely, no quantitative health-based guideline values or thresholds can be recommended for acceptable levels of contamination with microorganisms. Instead, it is recommended that dampness and mould-related problems be prevented."[2]

When treating patients only (i.e., litigation is not involved), it is not necessary to prove that a school or place of employment is the only exposure implicated. The treating practitioner's recommendation will be to test and/or remediate all spaces with water damage to which the patient is exposed. However, those who administer schools and workplaces are mandated by various laws and agencies to provide safe facilities for their students and employees. As such, even if a school or business is not the only WDB to which the patient is exposed, proper testing, remediation as needed and re-testing of these places must be performed. Landlords have a similar duty. As a generality, lawsuits usually only occur when the responsible parties appear to shirk these responsibilities.

The practitioner should always keep in mind, however, the possibility of future (or current) litigation. As such, documentation is the most basic key to demonstrating causation. Documenting worsening of the condition with re-exposures is also important. Some physicians use standardized symptom scales as a way to document symptoms. Dr. Gray uses the Davidoff Inflammatory Symptom Frequency Profile.

Conclusion for Part II

In summary, MERI is a multi-symptom, multi-system disease occurring in many people due usually to long-term exposure to the interior of water-damaged buildings. While there are differing opinions on the best diagnostic and therapeutic approaches, it is clear from the literature

and from practice that this disease exists and significant relief can be obtained by most sufferers with avoidance of further exposure and appropriate treatment.

As stated throughout this paper, it is time to move beyond the focus of "establishing the fact of mold disease," because it has already been established in numerous research papers and in the treatment of thousands of patients. It is time for our national and world leaders to develop a comprehensive public health response to this devastating epidemic that has the potential to cripple our individual and collective futures.

MERI is a multi-symptom, multi-system disease occurring in many people due usually to long-term exposure to the interior of water-damaged buildings. It is clear from the literature and from practice that this disease exists and significant relief can be obtained by most sufferers with avoidance of further exposure and appropriate treatment.

Call to Action

This position paper is the first step of our **CALL TO ACTION**. It is time to move beyond the focus of "establishing the fact of mold disease," because it has already been established in numerous research papers and in the treatment of thousands of patients. It is time for our national and world leaders to develop a comprehensive public health response to this devastating epidemic that has the potential to cripple our individual and collective futures. We have highlighted the extensive research which clearly demonstrates many of these principles and look forward to collaborative efforts in this search for better health and safer living and working conditions. The Global Indoor Health Network puts forth the following recommendations:

Marketing and Education

1. Create educational programs for mass distribution to rapidly increase awareness of this illness (e.g., books, videos, pamphlets, announcements on TV/Internet/radio/social networking sites, blogs, webinars, etc.)
2. Collaborate with key stakeholders to reach consensus on a common name for this illness
3. Participate in the development of a marketing strategy to ensure accurate and consistent messaging

Promoting Safe Indoor Environments

4. Provide accurate information to architects, builders, construction firms and others associated with developing homes, schools and business in order to promote construction of safe indoor environments
5. Develop and disseminate a thorough and accurate set of guidelines regarding testing, evaluation and remediation of water-damaged buildings
6. Develop a specific message for remediation of schools (because a high percentage of schools have already been identified as having indoor air quality problems and it is imperative that those structures be remediated correctly and in a timely manner)
7. Join with other interested parties to develop and promote the design and construction of housing that eliminates and/or minimizes the impact of indoor contaminants (e.g., emphasize the importance of using materials that promote good indoor air quality)

Working with Government Agencies and Organizations

8. Participate in and encourage open and good faith collaboration with international, federal, state and local government agencies and private and public organizations to develop written materials, actionable plans, resources to help individuals locate safe housing and other initiatives to address this important public health issue
9. Recommend to the U.S. President and Congress that they allocate funds and appoint someone at the federal level to oversee this issue on a national level so there is a coordinated approach for dissemination of information and development of solutions for this important public health initiative

Developing Resources

10. Participate in the development of a website and telephone hotline where people can get accurate information and a list of resources
11. Identify funding sources in order to provide loans and grants to individuals and families who need emergency housing and personal supplies due to emergency situations that require them to leave their homes and apartments in order to protect their health because of mold, water damage and other environmental pollutants
12. Assist with the development of a handbook for physicians, hospitals and medical organizations to inform them about the health effects of indoor contaminants and the appropriate testing and treatment protocols
13. Create an international resource list of medical professionals, specialized services and products relevant to the diagnosis and management of this illness
14. Provide consistent information to global relief agencies regarding the importance of requiring their volunteers to use personal protective equipment when assisting in disaster areas where there is likely to be indoor contaminants in water-damaged buildings

Ongoing Research

15. Develop strategies to fund research to increase our understanding of the mechanisms involved in the development and treatment of this illness
16. Identify more comprehensively the epidemiological aspects of this disease
17. Participate in and initiate research projects to investigate the effectiveness of remediation methods and to identify new products that will aid in remediation efforts
18. Work with national labs to develop rapid screening tests that identify those individuals with the potential to develop this illness and to identify those who are already showing symptomatic evidence of exposure

Please join us in our mission to promote healthy indoor environments for everyone around the globe.

—Members of the Global Indoor Health Network—

APPENDIX A

Chemicals Often Found in Buildings and Their Health Effects

CHEMICAL	POTENTIAL INDOOR BUILDING SOURCES	POTENTIAL HEALTH RISKS
Asbestos	Deteriorating, damaged or disturbed insulation, fireproofing, acoustical materials and floor tiles.	Long-term risk of chest and abdominal cancers and lung diseases.
Arsenic	Pesticides, wood preservatives, paint; natural water; smoke from burning arsenic-treated wood; chromated copper arsenate (CCA)—a chemical wood preservative—in decks or playground sets. (*Non-organic chicken*)	Long-term exposure to high levels of inorganic arsenic in drinking water has been associated with skin disorders and risks for diabetes, high blood pressure, and several types of cancer.
BPA	Residential water supply lines, hoses and many other plastics. BPA is found in building conduits that distribute water and air.	Hormone-like effects on the developing reproductive system and neuro-behavioral changes in the offspring.
Bromated flame retardants	Furniture foam; consumer electronics; wire insulation; back coatings for draperies and upholstery; and plastics for television cabinets and small appliances.	Animal studies show effects on the thyroid and liver in doses much higher than people would encounter; EPA has classified certain PBDEs (polybrominated diphenyl ethers) as a possible carcinogen.
Formaldehyde	Pressed wood products, wood products. Urea-formaldehyde foam insulation (UFFI). Durable press drapes, other textiles, and glues. Average concentrations in older homes without UFFI are generally below 0.1 ppm; in homes with significant amounts of new pressed wood products, levels can be greater than 0.3 ppm	Respiratory irritation; fatigue; skin rash; severe allergic reactions; cancer.
Lead	Paints, enamels, surface coatings on furniture. (*Decay product of radon*)	Adverse health effects of lead on the nervous system are well-documented, and there is no “safe” level of exposure.

Mercury	Fluorescent lamps, high intensity discharge lamps, mercury-containing switches, mercury-containing thermostats, silent wall switches, commercial/industrial HVAC equipment, freezers, sensors, switches, meters, manometers and barometers, pipes, thermometers, rubber floors, sump pumps and septic tanks.	Tremors, emotional changes; insomnia; neuromuscular effects, sensory disturbances, headaches; devices can break and release mercury vapor to the air, particularly in warm or poorly ventilated indoor spaces. (*Impairs methionine to homocysteine looping in at least 6 pathways*)
Pesticides	75% of U.S. households used at least one pesticide product indoors during the past year.	Headaches, dizziness, muscle twitching, weakness, tingling sensations, and nausea; may cause long-term damage to the liver and the central nervous system, and increased risk of cancer.
Phthalates	Phthalates are added to soften and make PVC more pliable; also used in latex adhesives, vinyl tiles, carpet tiles, fragrances and air fresheners; widespread in indoor air.	Developmental and reproductive effects; infertility; sperm damage; childhood studies link phthalate exposure to risk of asthma and allergies. Prenatal exposure and reduced anogenital distance in boys.
Polyfluoroalkyl Chemicals (PFCs)	Produced since the 1950s to make products that resist oil, stains, heat, water and grease, including stain-resistant carpets and fabrics. (*Nonstick and Teflon coatings*)	Limited animal studies available; not all PFCs have been tested. Some studies show that some types of PFCs can cause tumors, damage to the liver and other organs, and developmental and reproductive effects.
Volatile Organic Compounds (VOCs)	Found in a wide variety of commercial, industrial and residential products, solvents, cleaners and degreasers and pesticides. Estimated that indoor air concentrations of VOCs are much higher than concentrations found outdoors.	Asthma, headaches, nausea, damage to liver, kidney and central nervous system. Some organics are suspected or known to cause cancer in humans.

Source: Environment & Human Health, Inc. 2010. *The Green Building Debate: LEED Certification—Where Energy Efficiency Collides with Human Health.*[239]

NOTE: This table was taken directly from the source indicated. It is presented here as a pictorial representation of some of the topics presented in this paper and is not intended to be all inclusive. A few select notes (shown in parentheses and italics) have been added by the authors of this paper.

APPENDIX B

Some Common Fungi, Mycotoxins, and Health Effects from Ingestion, Dermal, or Inhalation Exposure

Derived from Kendrick, 1992; Arafat and Musa, 1995; Osborne et al., 1996

CAVEAT: The entries in this table provide examples of the toxins and health effects that have been associated with some fungi. The listed fungi may also produce other toxins, fungi other than those listed may produce some of these toxins, and health effects other than those listed may also be associated with these toxins.

Fungus	Mycotoxin	Possible Health Effect
Acremonium spp.	Cephalosporin	Antibiotic
Alternaria alternata, Phoma sorghina	Tenuazoic acid	Nephrotoxic, hepatotoxic, hemorrhagic
Aspergillus clavatus	Cytochalasin E Patulin	Affects cell division, inhibits protein synthesis, nephrotoxic, carcinogenic
Aspergillus flavus, Aspergillus parasiticus	Aflatoxins	Mutagenic, carcinogenic, hepatotoxic
Aspergillus fumigatus	Fumitremorgens Gliotoxin	Tremorgenic Cytotoxic
Aspergillus nidulans, Aspergillus versicolor, Cochliobolus sativus	Sterigmatocystin	Hepatotoxic, carcinogenic
Aspergillus ochraceus, Penicillium verrucosum, Penicillium viridicatum	Ochratoxin A	Nephrotoxic, hepatotoxic, carcinogenic (*immunotoxic, neurotoxic*)
Cladosporium spp.	Epicladosporic acid	Immunosuppressive
Cladosporium cladosporioides	Cladosporin, Emodin	Antibiotics
Claviceps purpurea	Ergot alkaloids	Vasoactive (cause smooth muscles to constrict), hallucinogenic
Fusarium graminearum	Deoxynivalenol Zearalenone	Emetic Estrogenic

Fusarium moniliforme	Fumonisins	Neurotoxic, hepatotoxic, nephrotoxic, carcinogenic
Fusarium poae, Fusarium sporotrichoides	T-2 toxin	Hemorrhagic, immunosuppressive, causes nausea and vomiting
Penicillium chrysogenum	Penicillin	Antibiotic
Penicillium crustosum	Penitrem A, Roquefortine C	Tremorgenic Neurotoxic (tremorgenic)
Penicillium expansum	Citrinin, Patulin, Roquefortine C	Tremorgenic Neutrotoxic (tremorgenic)
Penicillium griseofulvum, Penicillium viridicatum	Griseofulvin	Tumorigenic, teratogenic, hepatotoxic
Pithomyces chartarum	Sporidesmin Phylloerythrin	Hepatotoxic Causes photosensitization and eczema
Stachybotrys chartarum (atra)	Satratoxins, Verrucarins, Roridins Stachybocins *(Trichothecenes)*	Inflammatory agents, immunosuppressive, cause dermatitis, hemotoxic, hemorrhagic
Tolypocladium inflatum	Cyclosporin	Immunosuppressive

Source: American Conference of Governmental Industrial Hygienists (ACGIH). 1999. *Bioaerosols: Assessment and Control.*[240]

NOTE: This table was taken directly from the source indicated. It is presented here as a pictorial representation of some of the topics presented in this paper and is not intended to be all inclusive. A few select notes (shown in parentheses and italics) have been added by the authors of this paper.

Biographies and Conflict of Interest Statements

Scott W. McMahon, M.D., is a board certified pediatrician, practicing for nearly 20 years in Roswell, New Mexico. His introduction to MERI came when 15 teenagers and adults, all sharing significant exposure to the same local school, were presented to him. Seeing the truth, he opened Whole World Health Care to evaluate and treat pediatric and adult MERI patients. Dr. McMahon received his M.D. at Creighton University and completed his pediatric residency at Duke University Medical Center. He reports receiving income from testimony in one case involving mold litigation. Dr. McMahon is a member of the Global Indoor Health Network and is on the Board of Directors for the organization and serves as the Treasurer.

Janette Hope, M.D., works in the field of environmental medicine in private practice in Santa Barbara, California. Dr. Hope completed her family practice residency at Santa Monica UCLA Medical Center and graduated from medical school at the University of Hawaii John A. Burns School of Medicine, with Alpha Omega Alpha honors, where she subsequently served as a Clinical Assistant Professor of Family Medicine. She is board certified in family practice, environmental medicine and integrative and holistic medicine and recently published an article in the Journal of Environmental and Public Health reviewing human health effects of inhalational exposure to ochratoxin A including kidney disease. Dr. Hope reports receiving income for a deposition in one case related to exposure to a water-damaged building and mold. Dr. Hope is a member of the Global Indoor Health Network and is on the Board of Directors for the organization where she serves as Secretary. She is also a member of the Board of the American Academy of Environmental Medicine.

Jack Dwayne Thrasher, Ph.D, is semiretired. He received his Ph.D. in human anatomy specializing in cell biology from UCLA. He has consulted to the practice of Dr. Michael Gray. He has been an expert witness in both defense and plaintiff cases regarding toxic exposures. Dr. Thrasher is a member of the Global Indoor Health Network.

William J. Rea, M.D., is a thoracic, cardiovascular and general surgeon with an added interest in the environmental aspects of health and disease. Founder of the Environmental Health Center - Dallas (EHC-D) in 1974, Dr. Rea is currently director of this highly specialized Dallas-based medical facility. He received his MD from Ohio State University College of Medicine in Columbus, Ohio. He is board certified in general surgery, thoracic surgery, and environmental medicine. Dr. Rea reports receiving income as an expert witness in both defense and plaintiff cases regarding toxic exposures. Dr. Rea is a member of the Global Indoor Health Network.

Alan R. Vinitsky, M.D., is a board-certified Internist and Pediatrician, who has been in private practice for 33 years. He has a special interest in environmental medicine, nutrition, and the autonomic nervous system. He graduated from the University of Pennsylvania School of Medicine. He has provided testimony for patients who were exposed to mold and other environmental exposures. He has not been asked to provide defense testimony but would do so if the opportunity presented itself. He is a member of the Global Indoor Health Network. During the writing and review of this paper, Dr. Vinitsky's office suffered extended water damage exposure, requiring him to seek a temporary alternative office location. The office status is in

litigation at the time of publication. Dr. Vinitsky did not compose any wording relative to litigation in this paper, nor did he seek advice or opinions from any of the co-authors concerning litigation.

Michael R. Gray, MD, MPH, has practiced Internal Medicine, Emergency Medicine, Occupational Medicine, and Clinical Toxicology for 38 years. Dr. Gray is the Medical Director of Progressive Healthcare Group which operates a state licensed Rural Health Clinic in Benson, Arizona, 50 miles southeast of Tucson, Arizona. Dr. Gray treated his first MERI patients in 1994 when a bank branch manager from Tucson presented to his office wheelchair bound from rheumatoid arthritis and reported that 9 out of 10 of her employees suffered from a strange illness that manifested itself with symptoms occurring on Monday morning, worsening through the week, and abating on weekends and vacations. A leak in a pipe chase in a wall between the restroom and the closet housing the air handler caused the wall cavity to fill with mold, and the air handler spread the toxic bioaerosols throughout the entire building causing the employees' illnesses. For the next 18 years, Dr. Gray's clinical research has focused on furthering our understanding of the complexity of MERI, and approaches to effectively treating and preventing this devastating illness. Dr. Gray is Board Certified in General Preventive and Occupational Medicine and is Board Prepared in Internal Medicine, Emergency Medicine and Toxicology. Dr. Gray completed his residencies in Internal and Occupational Medicine, with an emphasis in Toxicology, at Cook County Hospital in Chicago, Illinois, from 1974 to 1975. He has served as an expert witness in litigation involving illness associated with exposure to bioaerosols in water damaged buildings, asbestos, pesticides, radiation sources, silica dust, coal dust, solvents, and other toxins and infectious agents. Dr. Gray reports no conflicts of interest and has been retained by both defense and plaintiff's counsel. He is a member of the Global Indoor Health Network.

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