REPORTED

IN THE COURT OF SPECIAL APPEALS

OF MARYLAND

No. 2454

September Term, 2009

MONTGOMERY MUTUAL INSURANCE COMPANY

v.

JOSEPHINE CHESSON, ET AL.

Eyler, Deborah S.,
Graeff,
Hotten,

JJ.

Opinion by Hotten, J.

Filed: August 29, 2012

At the heart of this case is whether the theories and methodologies of Ritchie Shoemaker, M.D. ("Dr. Shoemaker") are generally accepted in the relevant scientific community. Namely, we must determine whether the Circuit Court for Howard County was correct in concluding that: (1) the differential diagnosis performed by Dr. Shoemaker was reliable and acceptable to establish general and specific causation, and (2) the differential diagnosis method is generally accepted in the medical community.[1] For the reasons that follow, we reverse the judgment of the circuit court.

BACKGROUND

Appellees, Josephine Chesson, Martha Knight, Carole Silberhorn, Linda Gamble, Kenneth Lyons, and Connie Collins, were employees of the Baltimore Washington Conference of the United Methodist Church ("BWCUMC"), located at 9720 Patuxent Woods Parkway, Columbia, Maryland. In late 2002, several employees complained that there was an odor emanating throughout the walls of the facility. A maintenance crew investigated the situation and discovered mold in the walls. Two types of mold were found: Aspergillus and Stachybotrys. As a result of the exposure, each appellee filed a claim against BWCUMC and its insurer, appellant, Montgomery Mutual Insurance Company, with the Maryland Worker's Compensation Commission ("the Commission"). The claims alleged that appellees suffered an accidental injury or occupational disease, known as sick building syndrome, as a result of the exposure. A hearing was held and the Commission disallowed two of appellees'

[1] Appellant's question on appeal is: "Whether the Circuit Court for Howard County erred and abused its discretion in finding that the Frye-Reed Doctrine was satisfied by Dr. Shoemaker's use of differential diagnosis."

claims and awarded the remaining appellees partial compensation.[2]

Each appellee noted an appeal and the cases were consolidated. Before trial, appellant filed a motion *in limine* to preclude the testimony of Dr. Shoemaker. Appellant argued that Dr. Shoemaker's testimony should be excluded because his methodologies and theories regarding the causal nexus between exposure to mold and human health effects were not generally accepted in the relevant scientific community. Recognizing that Dr. Shoemaker was a board certified physician, who devoted a significant portion of his practice to caring for individuals who were exposed to water damaged buildings, the court denied the motion. The court then noted that a *Frye-Reed* hearing was unnecessary.

The Commission's decisions were subsequently reversed and appellant noted an appeal. Among other things, on appeal, appellant argued that the circuit court committed error by not conducting a *Frye-Reed* hearing. *Montgomery Mut. Ins. Co. v. Chesson*, 170 Md. App. 551, 556 (2006). We held that the court correctly declined to conduct a *Frye-Reed* hearing because Dr. Shoemaker performed "certain tests" that were "not so unorthodox that would warrant subjecting them to a *Frye-Reed* analysis . . . ." *Id.* at 569. Specifically, we noted that a hearing was unnecessary because "expert opinions concerning the cause or origin of an individual's condition are not subject to *Frye-Reed* analysis." *Id.*

An appeal was noted and a petition for certiorari was granted. *See Montgomery Mut.*

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[2] The Commission concluded that neither Collins nor Lyons suffered an accidental injury or occupational disease as a result of exposure to mold. The Commission, however, determined that Chesson, Knight, and Silberhorn suffered an accidental injury, and that Gamble suffered an occupational disease.

Ins. Co. v. Chesson, 396 Md. 12 (2006). In reversing our decision, the Court of Appeals held that a *Frye-Reed* hearing should have been held "to determine whether the medical community generally accepts the theory that mold exposure causes the illnesses that [appellees] claimed to have suffered, and the propriety of the tests Dr. Shoemaker employed to reach his medical conclusions." *Montgomery Mut. Ins. Co. v. Chesson*, 399 Md. 314, 328 (2007). Noting that Dr. Shoemaker's testimony involved more than generally accepted medical opinion and diagnosis, the Court explained that "Dr. Shoemaker employs medical tests to reach a conclusion that is not so widely accepted as to be subject to judicial notice of reliability." *Id.* at 332 (footnote omitted). Indeed, because "Dr. Shoemaker's testimony was based on scientific opinion regarding the causal link between mold exposure and sick building syndrome . . . ," the Court of Appeals reasoned that "his theories regarding causation and the tests he employed to diagnose [appellees] were subject to *Frye-Reed* analysis." *Id.* at 329. Accordingly, the case was remanded for the limited purpose of determining "whether Dr. Shoemaker's methodologies used for diagnosis and theories regarding the causal connection between mold exposure and certain human health effects are generally accepted in the scientific community." *Id.* at 336.

At the *Frye-Reed* hearing, Dr. Shoemaker explained the genesis of his theories and methodologies. Dr. Shoemaker began a rural family practice in Pocomoke City in 1980. Around 1997, some of his patients began developing acute and chronic symptoms from exposure to the Pocomoke River, and tributaries adjacent to the Chesapeake Bay. One of the symptoms, diarrhea, was treated with Cholestyramine, a drug approved by the United States

Food and Drug Administration for treatment of elevated cholesterol. Cholestyramine was prescribed because it was commonly used "in primary care medicine to treat secretory diarrhea." As Dr. Shoemaker expected, the diarrhea reduced; but surprisingly, there was an improvement concerning issues associated with memory, headaches, coughing, and muscle aches. Based on this, Dr. Shoemaker published a paper in the Maryland Medical Journal reviewing other cases in which patients suffered memory loss, cognitive impairments, headaches, rashes, abdominal pain, diarrhea, redness of the eyes, and bronchial spasms that were caused by exposure to the Pocomoke River.

Soon thereafter, the Maryland Department of Health and Mental Hygiene appointed a committee to examine some of Dr. Shoemaker's patients. The Center for Disease Control Prevention ("CDC") worked with the committee and developed a case definition for the illness: Possible Estuary-Associated Syndrome ("PEAS").[3] In diagnosing patients that purportedly had PEAS, Dr. Shoemaker would review possible exposure, consider factors that could contribute to potential physical and cognitive issues, conduct a physical examination, order medical testing, and thereafter, develop a differential diagnosis.

In 1998, Kenneth Hudnell, Ph.D., published an article that explored the benefits of using visual contrast sensitivity testing as a biomarker for PEAS. Dr. Shoemaker started using the testing soon thereafter. According to Dr. Shoemaker, the test results indicated that there were distinguishable markers between people exposed to the Pocomoke River and those

[3] Dr. Shoemaker referred to the illness as pfiesteria. However, we shall refer to it as PEAS because the CDC states that exposure to pfiesteria can cause PEAS.

who were not. At this point, realizing that he was treating patients who were not exposed to pfiesteria, dinoflagellates, or algal blooms, Dr. Shoemaker believed that his patients must have been exposed to water damaged buildings that contained visible mold.

In treating the patients who were exposed to water damaged buildings, Dr. Shoemaker would initially remove samples of visible mold from a person's workplace or residence. Then he would remove the patient from the exposure and prescribe Cholestyramine. The person would remain on Cholestyramine and away from his or her workplace or residence for approximately two weeks. If the symptoms subsided, Dr. Shoemaker would remove the patient from Cholestyramine and instruct him or her to stay away from the exposure. The patient would then be evaluated approximately two to three days later. Assuming the patient was not exhibiting the previous symptoms, the patient, again, would be exposed to the mold. This exposure would occur without Cholestyramine being prescribed. If the symptoms arose again, the patient would be retreated with Cholestyramine.

Not long after, Dr. Shoemaker added blood tests to review whether the treatment was working. After that, he created a two-tiered case definition.[4] To satisfy the first tier, the following had to occur: (1) a patient had a potential for exposure to water damaged buildings, (2) there was the "presence of multiple health symptoms for multiple health systems," and (3) confounders were absent (i.e. untreated or uncontrolled medical conditions). If a patient satisfied these requirements, the results from the blood and visual contrast sensitivity tests

[4] Dr. Shoemaker stated that "the first tier was used to obtain reasonable medical probability and the second tier was used to increase restrictiveness . . . ."

would be reviewed to determine whether three of the following were present: (1) one of fifty-four kinds of immune response genotypes known as HLA, (2) reduced levels of melancyte stimulating hormone ("MSH"),(3) elevated levels of matrix metalproteinase-9 ("MMP9"), (4) deficits in visual contrast sensitivity, (5) dysregulation of ACTH and cortisol, and (6) dysregulation of ADH and osmolality.

According to Dr. Shoemaker, HLA is inspected because it is a genetic measure that reviews immune response genes that "help turn down innate immunity following exposure . . . ." When "HLA is working, . . . innate immune re-signals get converted into antibodies that then protect [a person] . . . ." Dr. Shoemaker next explained that the level of MSH is analyzed because it is a hormone that regulates innate immunity in the body. According to him, MSH deficiency is generally present in individuals exposed to water damaged buildings because innate immune responses are not being properly regulated. Dr. Shoemaker thereafter noted that levels of MMP9 are reviewed because "MMP9 looks directly at a unified presentation of a kind of innate immune element called a cytokine . . . ." As for the visual contrast sensitivity test, Dr. Shoemaker explained that this test is used because its results illustrate "inflammatory changes that cause reduction of blood flow in small blood vessels in the retina." Additionally, Dr. Shoemaker provided that ACTH and cortisol are examined to determine whether there is a "disruption of a secondary mechanism to compensate for original inflammation . . .," and ADH and osmolality are examined to review the hypothalamic center. All in all, these measurements are supposed to illustrate inflammation, which, according to Dr. Shoemaker, is a biomarker for illnesses related to exposure to water

damaged buildings.

Hung Cheung, M.D. ("Dr. Cheung"), a board certified physician in internal and occupational medicine, testified in opposition to Dr. Shoemaker. In his "health-based approach" to evaluating patients associated with exposure to mold, Dr. Cheung explained that he reviewed a patient's complaints and medical history, assessed environmental conditions, and then determined whether environmental conditions were the cause of a patient's complaints. To evaluate the environment exposure, Dr. Cheung used the four "P's": (1) pollution, which could range from the ozone to mold, to endotoxins, (2) pathway, simply meaning the method in which the pollutant travels throughout the building, (3) pressure, which explains the direction of flow of the pollutant, and (4) person, because exposure is not possible without a person. Because there are different types of exposure, Dr. Cheung explained that he had to determine which one caused a patient's symptoms.

Thereafter, recognizing that Dr. Shoemaker could render a diagnosis using the differential diagnosis method, Dr. Cheung testified that the issue of causation has "nothing to do with differential diagnosis." Instead, he merely believed that Dr. Shoemaker's differential diagnosis exposed the human health effects being suffered. Dr. Cheung then explained that the scientific literature does not support the notion that exposure to toxic mold by inhalation in water damaged buildings causes certain human health effects. Ultimately, Dr. Cheung explained that Dr. Shoemaker's methodology, treatment, and opinion regarding causation are controversial and not generally accepted in the scientific community.

Approximately fourteen months after the *Frye-Reed* hearing,[5] the circuit court issued findings of fact. In relevant part, the court made the following findings:

Dr. Shoemaker's Qualifications and Experience

1. Dr. Ritchie Shoemaker, M.D., is Board Certified in Family Practice.

2. Dr. Shoemaker has no advanced training or certification in toxicology, allergy, epidemiology, genetics, mycology, immunology, rheumatology, industrial hygiene, neuropsychology, pulmonology, endocrinology, or teratology.

3. Dr. Shoemaker employs each of these areas on a regular basis in the practice of medicine.

4. With respect to diagnosis and treatment of human health consequences of persons exposed to toxicity from water damaged buildings, Dr. Shoemaker has been primarily a diagnostician and treating physician. His approach has been that of a clinician in the practice of medicine.

5. Dr. Shoemaker's medical group has addressed the medical question of health consequences or illness as a result of exposure in water damaged buildings more than four thousand seven hundred (4700) times since starting this area of interest in his practice of medicine in 1998.

6. In the years following 1998, about seventy-five (75) percent of Dr. Shoemaker's medical practice was devoted to the diagnosis, care, and treatment of patients who had illness acquired following exposure to water damaged buildings. Now the portion of his practice devoted to this specialized area of medicine is about ninety-five (95) percent and has been since 2002, when he sold his family practice and moved into a new medical office and practice.

7. By 2005, Dr. Shoemaker had treated over three thousand (3000) patients with health problems from exposure to the complex chemical mix found in water damaged buildings.

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[5] The parties submitted additional memoranda proffering proposed findings of facts after the *Frye-Reed* hearing.

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9. In these cases, samples of visible mold were taken from the home or workplace and sent to a reference laboratory. Also, it was not uncommon to notice odors in areas of water damage.

10. About twenty-five (25) percent of the patients treated by Dr. Shoemaker for illness acquired following exposure to water damaged buildings were referred to him by other physicians.

Dr. Shoemaker's Use of Differential Diagnosis is with Patients Exposed to Water Damaged Buildings

31. A differential diagnosis is a preliminary or working diagnosis. The follow up treatment and testing is meant to rule in possible, likely causes and rule out other confounders, in order to arrive at a final diagnosis.

32. The use of this method is taught from the first day in medical school. For centuries, it has been a standard technique utilized by physicians in the diagnosis of illness and in the care and treatment of patients, and it continues to be a standard technique today.

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35. [The] method, which [Dr. Shoemaker] followed with each . . . [appellee], was to see the patient, take a medical history, perform a physical examination, order medical testing, and then start with a differential diagnosis.

36. In addition to Dr. Shoemaker's reliance on the history given by the patient and a physical examination, the results of certain blood tests and studies were used to show an absence of confounders, such as other diseases that could account for or contribute to inflammatory problems that patients may have.

Dr. Shoemaker's Repetitive Exposure Protocol and Treatment Protocol

37. In order to attempt to establish a causal relationship between the exposure and the health effects or illness, Dr. Shoemaker utilized a

repetitive exposure protocol, which is a five (5) step process.

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38. Step one (1) of the protocol is called Base, which stands for baseline.

39. Step two (2) is called AC1, which means after treatment (Cholestyramine), the first time around.

40. Step three (3) is called HOC, or alternatively, OROC. The acronym HOC stands for patient home off Cholestyramine, if the suspect building is a work place.

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41. Step four (4) is called BOC. The patient is placed back in the building for three (3) days and off the Cholestyramine. If the patient does not become ill, then there is no step five. If the patient does become ill again under BOC, only then does step five (5) occur.

42. Step five (5), called AC2, means after Cholestyramine, the second time around.

43. Based upon the findings of one hundred and one (101) patients in some forty (40) buildings, Dr. Shoemaker found that there was something in the exposure to the indoor air that was causing the illness. He did not find or conclude that it was exclusively mold itself which was the cause of the illness.

44. The technique of repetitive exposure protocol is an example of a component of differential diagnosis and has been routinely and regularly practiced by clinical physicians to prove prospective causation, *i.e.*, prospective acquisition, of illness.

45. The time honored goal of repetitive exposure analysis is to isolate that exposure, eliminate and rule out confounders, and confirm the cause of illness with diagnostic studies and tests.

46. Under this process, the patient becomes the control for his own health and the short term interventions of three (3) days of exposure and then three (3) days of no exposure is more reliable from a diagnostic

standpoint than a longer term period of time or study.

47. The essence of Dr. Shoemaker's treatment protocol is to eliminate the exposure to potential toxicity on the front end and lower or eliminate toxicity at the back end, through the binding action with Cholestyramine.

48. According to Dr. Shoemaker, Cholestyramine has a positive charge and the toxins have a negative charge, so that they attract one another and bind into a large compound, preventing its reabsorption into the system. The compound, including the toxins, is eliminated from the system and hence the patient's toxicity is lowered and their symptoms relieved.

49. The treatment protocol has proved effective in the acute phase illness in thousands of patients who have been treated by Dr. Shoemaker's group.

50. The results of a treatment protocol also serve as a diagnostic tool. The response to a given therapy or treatment can be an essential element of the ongoing refinement of a differential diagnosis process.

51. Over a ten (10) year period, Dr. Shoemaker's treatment protocol underwent eleven (11) refinements or changes, but the basic approach remained the same.

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54. Dr. Shoemaker published the treatment protocol as of 2005 in a book called *Mold Warriors*.

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The Two Tier Analysis Employed by Dr. Shoemaker after 2002

55. After 2002, Dr. Shoemaker stopped taking new patients unless they had a chronic fatigue illness. With a larger patient base in this new area of practice, Dr. Shoemaker was able to collect data and to rule out a variety of possible confounders. He utilized a Two Tier system in arriving at a common case definition of the illness suffered by his new patients.

56. By this time, the water damaged building cohort of Dr. Shoemaker's practice constituted about two-thirds of his practice.

57. Under the model, the Tier One criteria were to establish that all patients must have the potential for exposure to water damaged building(s) somewhere, and the absence of any untreated and uncontrolled medical conditions that could be a confounder.

58. The second Tier is much more restrictive and precise. To meet Tier Two of the case definition, a patient must meet at least three (3) of six (6) secondary criteria, to eliminate any false positives in the diagnosis.

59. Dr. Shoemaker is able to reach a diagnosis to a reasonable degree of medical certainty just from taking into account the Tier One factors. Under Tier One, there is (1) a finding of the potential for exposure; (2) the presence of multiple health symptoms; and (3) a ruling out the presence of confounders through the differential diagnosis analysis. This process involves employment of the repetitive exposure protocol . . . .

60. By mid-2003, the second Tier criteria were used to increase restrictiveness so that no false positives would be included in the diagnosis. The second Tier findings provided increased weight to the opinion, but was not necessary in order for Dr. Shoemaker to diagnose biotoxin or toxin illness from exposure to water damaged buildings to a reasonable degree of medical certainty.

61. The degree of certitude solely based on Tier One analysis is over fifty (50) percent. Dr. Shoemaker would not proceed with the Tier Two analysis if the patient does not pass the Tier One level. The degree of certitude increases to the high nineties (90) if the diagnosis is based on both Tiers.

62. The blood tests and studies in the Tier Two inquiry are attempting, first and foremost, to measure inflammation and, in the process of doing so, assist Dr. Shoemaker in isolating the potential cause of illness from other confounders.

63. There are six (6) secondary criteria in the Tier Two analysis. They are: 1) The presence of one of fifty-four (54) kinds of immune response gynotypes, call HLA, a genetic marker found on chromosome 6[;]

    2) A reduction of an inflammation preventing hormone, Melanocyte Stimulating Hormone, or MSH;

3) An elevated level of an inflammation representing enzyme called Matrix Metallic Proteinase Nine or MMP9;

4) An abnormal relationship of hormone pairs ACTH, a hormone that stimulates adrenals to cortisol;

5) An abnormal relationship of hormone pairs Antidiuretic hormone ADH to osmolality; and

6) A visual contrast test.

64. Criterion two (2) under the Tier Two analysis, the reduction of MSH, is found in over nine-two (92) percent of Dr. Shoemaker's patients. This MSH hormone is important in the regulation of innate immune responses and therefore the deficiency results in abnormalities of the innate immune responses.

65. The third criterion, elevated MMP9, is quite common in the biotoxin and toxin illnesses treated by Dr. Shoemaker. The list of illnesses for which MMP9 is elevated is quite small. An elevated level of MMP9 is an example of inflamation, which can also be found in a patient with acute lung disease, connective tissue problems, or multiple sclerosis.

66. Criterion number four (4), abnormal relationship of ACTH to cortisol, is something that Dr. Shoemaker has encountered in over four thousand (4000) patients.

67. The blood work and visual contrast, which is criterion six (6) in Tier Two are part of the later stages of the diagnostic protocol used by Dr. Shoemaker, but are not part of the treatment protocol.

68. Dr. Shoemaker's data base showed that where there were at least three (3) of the six (6) criteria found, all of those patients were in the exposed category and had already been diagnosed under the Tier One analysis as ill from exposure to a water damaged building.

69. The data base showed that where there were only one (1) or two (2) but less than three (3) of the criteria, all of those persons were in the control group, i.e., those who had not been exposed to a water damaged building.

70. The test for the presence or absence of these six (6) criteria were all standard blood tests that were performed by a commercial laboratory. The results were placed in the patient's medical file and became part of the data base that Dr. Shoemaker maintained for all of his new patients with exposure to water damaged buildings.

71. Dr. Shoemaker's patients who are diagnosed with a biotoxin or toxin illness have an innate immunity response and not acquired immunity, such as someone suffering allergy or asthma.

72. In the early years, up until 2003, the blood test results that were ordered were essentially normal. Then, starting in mid-2003, Dr. Shoemaker ordered the Tier Two blood studies and tests that looked at the markers for innate immune response activity. He found that results were now abnormal in many respects.

73. Under this newer approach the focus was on innate immunity and inflammation was consistently identified as the central and major problem.

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Dr. Cheung's Methodology

143. Dr. Cheung is conducting two epidemiology studies. One is in Maryland and involves seven thousand six hundred (7,600) participants. The study involves over three hundred (300) sites and there are air samplings for mold, surface swabs for mold in the air handling units, measurements for endotoxins, skin cells, and measurements for sixty-four (64) different compounds that are within indoor environments.

144. To assess whether the exposure to the chemical mix in the work environment is causing illness to the occupants, Dr. Cheung relies upon the concept of four (4) "Ps".

145. The first "P" is the pollutant, which could be anything: maybe the ozone, or the mold, or the endotoxin, or the odor, or various other things.

146. The second "P" is the pathway which is how the pollutant travels and

how it gets around in the exposed location or building. The ventilation system is often a major factor under the second "P".

147. The third "P" is pressure, which explains the direction or flow of the pollutants along the pathway.

148. The fourth "P" is the person. Without any person, for example, in a warehouse, there is no exposure to any human and hence there are no health problems.

149. The goal of building remediation is to eliminate at least one of the first three (3) "Ps" so that persons who have to work or live in water damaged buildings are no longer exposed.

150. In looking at the issues of association or causation in exposure to the combination of chemicals in water damaged buildings, the strength or potency and quantity of various chemicals is important in determining whether there [may be] a much higher synergistic affect [sic] based upon the particular mix.

151. In determining causation of adverse health effects from exposure to toxic mold in water damaged buildings, it is important that a diagnostician consider the synergistic effect from the combination of chemicals in any given building, and not simply consider strength or potency and quantity of toxic mold alone.

152. Most mold assessment exposures are subjective by their very nature. Even if scientific methods are used, an objective mold assessment is very difficult to obtain and rarely used without the subjective complaints. Testing techniques and methods are static by their nature. Exposures are ever-changing and therefore a static test cannot be an accurate measure. Each of the four (4) "Ps" is constantly changing.

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Dr. Cheung's Scientific Opinion on Causation in These Proceedings

155. Dr. Cheung has testified that, in his opinion, the use of differential diagnosis procedure and diagnosis of CBAI fails to establish general causation or specific causation and is therefore unreliable. It merely gets to what the health condition may be, but without the causation

analysis, it fails to prove causation.

156. General causation in environmental medicine and research, in Dr. Cheung's opinion, is the equivalent of scientific causation which is at the nine-five (95) percent level of probability. It must be proved to this degree of certainty, by a rigid research based standard, according to Dr. Cheung.

157. In Dr. Cheung's opinion, causation analysis and scientific or general causation really have nothing to do with differential diagnosis, the method followed by Dr. Shoemaker.

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159. Dr. Cheung rendered his opinion that Dr. Shoemaker's diagnosis of CBAI is not generally accepted . . .

160. Dr. Cheung testified that, in his expertise, water damage in buildings may be the cause of health consequences and human health illness. He breaks the human health consequences into three categories: First, is the allergic or hypersensitivity group. Second, it is classified as infection or infections. The third category is the toxic effects associated with mold. The toxic effects, in Dr. Cheung's opinion, are usually associated with ingestion and not inhalation.

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162. Dr. Cheung contends that the various studies do not support Dr. Shoemaker's conclusions. These studies do not show that exposure to toxic mold by inhalation in water damaged buildings are in high enough concentrations to show an association with fatigue, memory loss, join[t] pain, muscle aches, confusion, weakness, depression, or disorientation.

163. Dr. Cheung acknowledged that if forty (40) people are in a water damaged building where visible mold is present and can be smelled, that it would be a good indication of an exposure.

164. Dr. Cheung noted that the Maryland State Task force on Indoor Air Quality Trial Report of July 1, 2002, investigated a wide variety of biological agents present in indoor environments that could potentially cause health problems.

165. The report specifically stated that molds and fungi can cause significant human health effects, including allergies, hypersensitivity pneumonitis and other health effects.

166. The specific health effects depend both on the nature and extent of the exposure and the underlying health status of the exposed individuals. Mold growth in buildings can have adverse health consequences.

167. The Report concluded on page eleven (11) that there is an inadequate base of scientific knowledge to get health-based mold standards for buildings because of uncertainties about the levels of mold, the relationships between mold exposure and different health effects, and differences in susceptibility from person to person.

168. Finally, the Report stated that exposures to indoor mold contamination can and should be minimized, and mold growth and contamination in offices can and should be prevented.

169. Dr. Cheung's opinion is that Dr. Shoemaker's diagnosis, treatment methodology and opinion on the [causal] relationship between human health effects and water damaged buildings is not generally accepted by the scientific community.

170. Dr. Cheung does not have any problem with Dr. Shoemaker's use of Cholestyramine to treat patients for exposure to mycotoxins in water damaged buildings nor to his treatment regimen or ordering them to be removed from the workplace.

171. Although he has no criticism of these steps by Dr. Shoemaker in his treatment, he does not believe that Dr. Shoemaker's treatment protocol proves either general or specific causation.

172. Dr. Cheung's complaint is that Dr. Shoemaker does not have the field investigators investigate the building to determine scientifically what chemicals or toxins are actually present in the indoor air and, if any, whether they are of sufficient potency to cause, generally and specifically, adverse health consequences to any of the buildings occupants.

173. Dr. Cheung believes the physician should guide the investigation as

> well as the communication and resolution of the problem. He actually goes out to the building site himself and actually crawls around and does sampling himself, so that he knows what the persons are exposed to, at least at the time that he is there. . . . .
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> 174. Dr. Shoemaker testified that this hands-on sampling is not part of his job as a diagnosing physician. Dr. Cheung does not know whether Dr. Shoemaker actually does this hands-on investigation sampling himself or relies upon others.

An opinion was issued approximately six months after the findings of fact. In concluding that Dr. Shoemaker's differential diagnosis method was reliable and acceptable to establish general and specific causation, the circuit court indicated that the "question of admissibility of expert medical testimony to prove general or specific causation appears to be a case of first impression in Maryland." Indeed, noting that there was "no judicial consensus regarding admissibility," the court explained that there were two "distinct" approaches in toxic tort cases: (1) the toxicological approach[6] and (2) the clinical-medical approach.[7]

The circuit court explained that the toxicological approach recognizes that the

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[6] The toxicological approach was originated in *Moore v. Ashland Chem., Inc.*, 151 F.3d 269 (5th Cir. 1998). There, the United States Court of Appeals for the Fifth Circuit explained that "[i]n the absence of an established scientific connection between exposure and illness, or compelling circumstances . . . , the temporal connection between exposure to chemicals and an onset of symptoms, standing alone, is entitled to little weight in determining causation." *Id.* at 278 (footnote omitted)

[7] The clinical-medical approach stemmed from *Westberry v. Gislaved Gummi AB*, 178 F.3d 257 (4th Cir. 1999). There, the United States Court of Appeals for the Fourth Circuit stated that "depending on the circumstances, a temporal relationship between exposure to a substance and the onset of a disease or a worsening of symptoms can provide compelling evidence of causation." *Id.* at 265 (citation omitted).

differential diagnosis method was reliable. However, the court noted that a differential diagnosis alone was not sufficient to establish general or specific causation under the toxicological approach. Because of that, the circuit court explained that the toxicological approach "deemphasizes the temporal relationship between exposure to a toxin and the onset of symptoms, focusing on specific dose-response relationships for the toxins." Conversely, the court noted that the clinical-medical approach "acknowledges that differential diagnosis is the . . . generally accepted method by which a clinician diagnoses the various illnesses he or she encounters in a myriad of patients." Moreover, the circuit court explained that the clinical-medical approach permits "a clinical physician to express an opinion, derived from differential diagnosis, that a particular toxic substance caused the patient's symptoms."

Inferring that the toxicological approach was undesirable because it was "inflexible," the circuit court articulated:

> Even if scientific methods are used, an objective and accurate mold assessment is very difficult to obtain, and is rarely used without subjective complaints. Testing techniques and methods are static by their very nature. Exposures, on the other hand, are ever changing and therefore a static test or even a series of such tests cannot be an accurate measure of the levels of concentration of toxicity or the duration of an exposure in any particular area of a water damaged building. Nor do static tests truly reflect a person's exposure over an extended period of time.
>
> No government agency has yet established a standard to determine a safe range or a dangerous range of indoor mold or other mycotoxin levels. Strict adherence to the toxicological approach would thus require a plaintiff to present information that does not yet exist. Without such information, there is no redress for the serious health problems that he or she may have suffered. One can only hope that future plaintiffs may find their luck enhanced by further scientific research. Today's plaintiff, under the toxicological approach, must accept that mold cannot be the scientific or legal cause of his or her

> symptoms, despite general acknowledgment that molds and fungi can cause significant human effects and the standard practice of vacating and remediating water damaged buildings where molds and other toxins are present.

Noting that the clinical-medical approach would be used to determine the admissibility of Dr. Shoemaker's testimony, the court opined:

> An integral part of any differential diagnosis process is a determination by the clinician of the general and specific causation of the patient's illness. This Court finds that an expert medical opinion based upon a properly conducted differential diagnosis is reliable. Therefore, a medical opinion based upon this methodology is admissible to prove general and specific causation of illness from exposure to toxicity in a water damaged building.

After that, the circuit court concluded that Dr. Shoemaker's testimony was admissible because:

> (1) The medical community is the relevant scientific community to determine whether differential diagnosis is a well recognized and generally accepted procedure.
>
> (2) Differential diagnosis is well recognized and generally accepted in the medical community.
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> (3) Two of the well recognized methods to establish the presence of toxicity and an exposure are the presence of black or visible mold and an odor. Dr. Shoemaker verified the presence of visible mold and an odor in the building where [appellees] and other employees were exposed.
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> (4) There is no requirement that toxic mold alone be identified or determined to be in sufficient quantity to be the pollutant. In establishing an exposure, the medical doctor must consider the combination or chemical mix present in any particular water damaged building for a finding of general and specific causation.
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> (5) Dr. Shoemaker was aware of the exposure to microbial growth and proliferation before meeting with [appellees]. He . . . met with [appellees] for purposes of diagnosis and treatment rather than litigation. Dr. Shoemaker's

expertise in treating patients exposed to toxicity dates back to 1980, and is not litigation-driven.

(6) Dr. Shoemaker took a detailed medical history and conducted a physical examination of [appellees] as a part of his routine diagnostic process.

(7) Dr. Shoemaker determined that there was a cohort of fifty (50) employees who were exposed. Of that number, eleven (11) employees were determined not to be ill and therefore were not tested. Dr. Shoemaker found twenty-two (22) employees who showed evidence of illness that could be ascribed to the exposure. Seventeen (17) other employees were examined and tested by other health care providers. Where a number of people become ill following an exposure, the temporal relationship between the exposure and illnesses becomes stronger and furnishes compelling evidence of causation.

(8) Dr. Shoemaker relied upon strong evidence of the temporal relationship between the onset and exacerbation of symptoms upon treatment and removal from exposure. He also relied upon the reported relapse of symptoms in three (3) of [appellees] following their exposure to boxed files that had been removed from the vacated office building.

(9) Dr. Shoemaker, after performing a differential diagnosis, was able to reach a final diagnosis to a reasonable degree of medical certainty as to [appellees]. In doing [so], he relied upon evidence of an exposure, the presence of multiple health symptoms, and diagnostic studies and blood tests, to rule in probable causes and rule out alternative causes of [appellees'] illnesses. The Tier Two (2) studies confirmed the final diagnosis.

Because appellant noted a timely appeal, we must determine whether the circuit court was correct in its *Frye-Reed* determination.

DISCUSSION

The present case was remanded to determine whether the "methodologies used for diagnosis and theories regarding the causal connection between mold exposure and certain human health effects are generally accepted in the scientific community." *Chesson*, 399 Md. at 336. After the *Frye-Reed* hearing, the circuit court concluded that the differential

diagnosis performed by Dr. Shoemaker was reliable and acceptable to establish general and specific causation. On appeal, we must conduct a *de novo* review and independently determine whether Dr. Shoemaker's methodologies and theories are admissible under the *Frye-Reed* standard. *See Wilson v. State*, 370 Md. 191, 201 n. 5 (2002) ("Appellate review of a trial court's decision regarding admissibility under *Frye-Reed* is *de novo* . . . ."); *see also Clemons v. State*, 392 Md. 339, 364 (2006) ("If the trial court determines that the test is admissible, on appellate review, this Court must independently apply the *Frye-Reed* test to the scientific techniques at issue."); *Fleming v. State*, 194 Md. App. 76, 100 (2010) ("This Court reviews *de novo* the admission of expert evidence under *Frye-Reed*.") (emphasis added); *Wagner v. State*, 160 Md. App. 531, 547 (2005) ("Appellate courts apply a *de novo* standard when reviewing the trial court's *Frye-Reed* issues.").

I.

Dr. Shoemaker considers himself to be a physician who practices family medicine and uses a differential diagnosis to treat individuals exposed to water damaged buildings. Differential diagnosis "is a scientific method that laymen would refer to as the process of elimination." *CSX Transportation, Inc. v. Miller*, 159 Md. App. 123, 204 (2004). Stated another way, differential diagnosis "is a standard scientific technique of identifying the cause of a medical problem by eliminating the likely causes until the most probable one is isolated." *Westberry*, 178 F.3d at 262 (citing *Baker v. Dalkon Shield Claimants Trust*, 156 F.3d 248, 252-53 (1st Cir. 1998)).

In conducting his differential diagnosis, Dr. Shoemaker testified that he interviews a

patient to review his or her medical history, conducts the repetitive exposure protocol, and reviews the results of blood and visual contrast sensitivity tests. According to him, a patient's symptoms can be attributed to exposure to water damaged buildings if: (1) he or she had exposure to a water damaged building, (2) there were symptoms that were indicative of exposure, and (3) no confounders were present. Once this occurs, Dr. Shoemaker reviews the blood and visual contrast sensitivity tests for three of the following: (1) one of fifty-four kinds of immune response genotypes known as HLA, (2) reduced levels of MSH, (3) elevated levels of MMP9, (4) deficits in visual contrast sensitivity, (5) dysregulation of ACTH and cortisol, and (6) dysregulation of ADH and osmolality. If three are present, Dr. Shoemaker indicated that the diagnosis, in essence, is verified.

Appellant argues that repetitive exposure, blood testing, and visual contrast sensitivity testing are not generally accepted in diagnosing and treating illnesses from exposure to mold. Instead, appellant contends that the generally accepted method,

> is to interview the patient, examine the patient, and perform allergy testing and spirometry (airway) testing. Then the doctor attempts to rule out environmental causes, other than the building in which the mold was found. He or she also attempts to rule out other illnesses or conditions that cause similar symptoms through, for example, review of prior medical treatment records. Upon completion of the evaluation of the patient through history, testing and diagnostic analysis, a diagnosis is then provided and causal relationship can be addressed.

In *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923), the United States Court of Appeals for the District of Columbia reviewed the notion of general acceptance:

> Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this

> twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.

The "'general acceptance' rule" articulated above was adopted in *Reed v. State*, 283 Md. 374, 389 (1978). There, the Court of Appeals explained:

> On occasion, the validity and reliability of a scientific technique may be so broadly and generally accepted in the scientific community that a trial court may take judicial notice of its reliability.
>
> ***
>
> Similarly, a trial court might take judicial notice of the invalidity or unreliability of procedures widely recognized in the scientific community as bogus or experimental. However, if the reliability of a particular technique cannot be judicially noticed, it is necessary that the reliability be demonstrated before testimony based on the technique can be introduced into evidence. Although this demonstration will normally include testimony by witnesses, a court can and should also take notice of law journal articles, articles from reliable sources that appear in scientific journals, and other publications which bear on the degree of acceptance by recognized experts that a particular process has achieved.

Id. at 380. (citations omitted)

At bottom, the *Reed* Court explained that "before a scientific opinion will be received as evidence at trial, the basis of that opinion must be shown to be generally accepted as reliable within the expert's particular scientific field." *Id*. at 381. To be sure, "if a new scientific technique's validity is in controversy in the relevant scientific community, or if it is generally regarded as an experimental technique, then expert testimony based upon its validity cannot be admitted into evidence." *Id*.

Recently, the Court of Appeals in *Blackwell v. Wyeth*, 408 Md. 575 (2009), discussed the issue of general acceptance and the differential diagnosis. There, the plaintiffs filed suit against the defendants, arguing that administered vaccinations, which were thimerosal-laden, caused autism and mental retardation. *Id*. at 578-79. One of the plaintiffs' experts, Dr. Geier, used a differential diagnosis to establish "a genetic susceptibility thesis . . . ." *See id*. at 614. In doing so, he "performed urinary porphyrin, mercury toxicity, testosterone and genetic polymorphism tests . . . ." *Id*. at 615. (footnotes omitted). The circuit court concluded that none of these were "generally accepted by the medical community, including clinical geneticists and pediatricians, as appropriate tests for either the work-up of a patient with autism or to determine the underlying cause of autism." *Id*. (internal citations omitted). The court then noted that Dr. Geier failed to consider unknown genetics – the most important alleged cause of autism – when conducting the differential diagnosis. *Id*. Based on that, the circuit court concluded that the "causation opinions on the etiology of autism cannot be based on a differential diagnosis that includes thimerosal as a potential cause of autism because the science does not support the plaintiffs' purported theory of a causal connection between thimerosal-containing vaccines and autism . . . ." *Id*. (internal quotations omitted).

On appeal, the plaintiffs argued that the circuit court was incorrect in holding that Dr. Geier neglected to consider unknown genetics. *Id*. at 616. According to the plaintiffs, Dr. Geier considered genetics, and genetic interactions, but "unknown genetics account[ed] for less than 5% of autism cases, and he need not discount all possible causes." *Id*. Because there was significant authority suggesting that unknown genetics accounted for the majority

of autism cases, the Court of Appeals held that the court did not err in concluding that unknown genetics was the most prevalent cause of autism. *Id*. at 617. Moreover, the Court articulated:

> We agree that Dr. Geier did not sufficiently consider genetics in his differential diagnosis equation. This conclusion is similar to that reached in [*Wilson, supra*, 370 Md. at 191], in which we recognized that the State's expert, in applying the product rule, did not account for a genetic linkage between siblings, who may have died of SIDS, rather than been murdered by their father.
>
> Based on [the circuit court's] rejection of Dr. Geier's underlying hypothesis and methodology, i.e. the identification of specific genes and differential diagnosis, we hold that [its] ultimate determination – that Dr. Geier's genetic susceptibility theory is no more than hypothesis and conjecture, devoid of a generally accepted methodology to support it – should not be disturbed by us.

Id. at 617-18.

At the *Frye-Reed* hearing in the case *sub judice,* Dr. Shoemaker testified that he conducts a differential diagnosis by using the repetitive exposure protocol, blood testing, and the visual contrast testing, to conclude that exposure to water damaged buildings causes certain human health effects. These underlying methodologies have been recognized in scientific publications authored by Dr. Shoemaker. *See* Ritchie C. Shoemaker, Judith M. Rash, Elliott W. Simon, *Sick Building Syndrome in Water Damaged Buildings: Generalization of the Chronic Biotoxin-Associated Illness Paradigm to Indoor Toxigenic Fungi,* Health Effects II – Toxicology & Neurological Effects, at 52-63 (2006); Ritchie C. Shoemaker, Dennis E House, *A Time-Series Study of Sick Building Syndrome: Chronic, Biotoxin-Associated Illness from Exposure to Water Damaged Buildings*, Neurotoxicology

& Teratology, Vol. 27, No. 1, at 29-46 (2005). However, in *A Time-Series Study of Sick Building Syndrome: Chronic, Biotoxin-Associated illness from Exposure to Water-Damaged Buildings*, an article in which Dr. Shoemaker is an author, the abstract noted that the results of the study must be "tempered" because there were "several study limitations." *Id*. at 29. Specifically, the article highlighted the fact that "[e]xposure to specific agents was not demonstrated . . . ." *Id*. Considering that, we believe Dr. Shoemaker's admission that he does not account for exposure amounts when conducting his differential diagnosis, which Dr. Cheung testified was integral to diagnosing illnesses associated with exposure, is similar to the situation in *Blackwell* in which the doctor did not sufficiently consider genetics in his differential diagnosis. *See Blackwell*, 408 Md. at 617-18.

In *Young v. Burton*, 567 F. Supp. 2d 121 (D.C. 2008), the United States District Court for the District of Columbia examined the methodologies and theories of Dr. Shoemaker. However, because the Supreme Court in *Daubert v. Merrell Dow Pharmaceuticals, Inc*., 509 U.S. 579, 589 (1993), concluded that *Frye* was superseded by the Federal Rules of Evidence, the *Young* Court reviewed the methodologies and theories pursuant to *Daubert* rather than *Frye*.[8] Nevertheless, because Federal Rule of Evidence 702[9] – the rule that concerns expert

[8] Several states use *Daubert* to determine the admissibility of expert scientific testimony. *See Green v. Alpharma, Inc.*, 284 S.W.3d 29, 44-45 (Ark. 2008); *State v. Haughey*, 3 A.3d 980, 989-90 (Conn. 2010); *Gen. Motors Corp. v. Grenier*, 981 A.2d 531, 536 (Del. 2009); *Jenkins v. Commonwealth*, 308 S.W.3d 704, 709 (Ky. 2010); *In Re: Alford*, 977 So.2d 811, 836-37 (La. 2008); *Sanders v. Wiseman*, 29 So.3d 138, 141 (Miss.Ct.App. 2010); *State v. Casillas*, 782 N.W.2d 882, 895-96 (Neb. 2010); *Andrews v. United States Steel Corp.*, 250 P.3d 887, 891 (N.M. 2011); *Christian v. Gray*, 65 P.3d 591, 600 (Okla. (continued...)

testimony – addresses the notion of reliable principles and methods, we shall consider *Young* as it pertains to that issue. *See Blackwell*, 408 Md. at 604-07 (reviewed federal cases that use

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[8](...continued)
2003); *State v. Lemler*, 774 N.W.2d 272, 280 (S.D. 2009); *Nations v State*, 944 S.W.2d 795, 796-97 (Tex. App. 1997); *985 Assocs., Ltd.* v. *Daewoo Elecs. Am., Inc.*, 945 A.2d 381, 383 (Vt. 2008); *San Francisco v. Wendy's Int'l, Inc.*, 656 S.E.2d 485, 492-96 (W. Va. 2007); *Cooper v. State*, 174 P.3d 726, 728 (Wyo. 2008); *see also State v. Price*, 171 P.3d 293, 298 (Mont. 2007) (concluding that *Daubert* is applicable when considering novel scientific evidence). Other states declined to adopt *Daubert*, but recognize its principles are instructive. *See Weeks v. E. Idaho Health Serv.*'s, 153 P.3d 1180, 1184 (Idaho 2007); *Turner v. State*, 953 N.E.2d 1039, 1050 (Ind. 2011); *Ranes v. Adams Laboratories, Inc.*, 778 N.W.2d 677, 686 (Iowa 2010); *Higgs v. State*, 222 P.3d 648, 657-58 (Nev. 2010); *State v. Nemeth*, 694 N.E.2d 1332, 1338-39 (Ohio 1998); *State v. O'Key*, 899 P.2d 663, 680 (Or. 1995); *DiPetrillo v. The Dow Chem. Co.*, 729 A.2d 677, 686 (R.I. 1999); *McDaniel v. CSX Transportation, Inc.*, 955 S.W.2d 257, 265 (Tenn. 1997). Still, other states continue to use *Frye*. *See Swanstrom v. Teledyne Cont'l Motors, Inc.*, 43 So.3d 564, 580 (Ala. 2009); *Lear v. Fields*, 245 P.3d 911, 915 (Ariz. Ct. App. 2011); *People v. Wilkinson*, 94 P.3d 551, 564 (Cal. 2004); *Jones v. United States*, 27 A.3d 1130, 1136 (D.C. 2011); *Marsh v. Valyou*, 977 So.2d 543, 547 (Fla. 2007); *People v. Caballes*, 851 N.E.2d 26, 56 n. 1 (Ill. 2006); *In Re: Girard*, 257 P.3d 1256, 1258 (Kan. Ct. App. 2011); *State v. Hull*, 788 N.W.2d 91, 103 (Minn. 2010); *Giordano v. Market Am., Inc.*, 941 N.E.2d 727, 733 (N.Y. 2010); *Grady v. Frito-Lay, Inc.*, 839 A.2d 1038, 1044 (Pa. 2003); *see also State v. Chun*, 943 A.2d 114, 136 (N.J. 2008) (noting that the *Frye* standard is applicable in criminal cases); *Howerton v. Arai Helmet, Ltd.*, 597 S.E.2d 674, 687 (N.C. 2004) (explaining that *Frye* is not adhered to but is noteworthy with regard to established scientific theory); *Anderson v. Akzo Nobel Coatings, Inc.*, 260 P.3d 857, 861 (Wash. 2011) (stating that *Frye* is applicable with regard to the admission of scientific evidence in criminal cases); *State v. Pickens*, 332 S.W.3d 303, 325 (Mo. Ct. App. 2011) (reiterating that *Frye* is used to determine the admissibility of scientific evidence in criminal cases).

[9] Federal Rule of Evidence 702 states that "[a] witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if: (a) the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue; (b) the testimony is based on sufficient facts or data; (c) the testimony is the product of reliable principles and methods; and (d) the expert has reliably applied the principles and methods to the facts of the case."

the *Daubert* standard for the issue of reliability).

Young involved a review of whether Dr. Shoemaker's diagnosis and theories relating to general and specific causation were "sufficiently grounded in scientifically valid principles and methods . . . ." *See Young*, 567 F. Supp. 2d at 122. Most relevant to this case, the *Young* Court reviewed "whether it was generally accepted in the scientific community that exposure to a water[]damaged building causes [CBAI]." *Id*. at 138. Recognizing that there were scientific articles that suggested exposure to mold could cause upper and lower respiratory problems, the *Young* Court articulated that there was also literature that stated there was insufficient evidence to suggest that exposure to damp indoor environments caused other symptoms attributed to toxicity. *Id*. at 138-39. Based on that, the *Young* Court held that the scientific community did not agree that exposure to water damaged buildings caused the "wide-ranging effects" articulated by Dr. Shoemaker. *Id*. at 139.

Although *Young* is instructive, because it was decided under the umbrella of *Daubert*, it is necessary to review *Wilson*, 370 Md. at 191, a Maryland case that addressed relevant *Frye-Reed* issues, to determine whether Dr. Shoemaker's theories regarding causation are generally accepted in the scientific community. There, the defendant's wife gave birth to Brandi Jean Wilson ("Brandi"). *Id*. at 196. Brandi died not long after birth. *Id*. at 197. An autopsy suggested that the death was caused by Sudden Infant Death Syndrome ("SIDS"). *Id*. Several years later, the defendant's wife at the time, gave birth to Garrett Michael Wilson ("Garrett"). *Id*. Garrett died approximately five months later. *Id*. An autopsy indicated that the cause of death was SIDS. *Id*. Because the causes of death were changed to possible

suffocation and smothering, respectively, the defendant was indicted for the murder of Garrett. *See id*. at 197-99. At trial, Dr. Linda Norton ("Dr. Norton") stated that the statistical probability that Garrett died of SIDS was 1 in 4,000,000. *Id*. at 199-200. Using the product rule, she explained that the probability of two SIDS deaths in one family was 1 in 2,000 multiplied by 1 in 2,000. *Id*.

In addressing whether Dr. Norton's testimony should have been precluded, the Court of Appeals provided the following synopsis regarding the cause of SIDS:

> Approximately fifty years ago, the medical community began a search to understand and prevent SIDS. *See* Committee on Child Abuse and Neglect, *Distinguishing Sudden Infant Death Syndrome From Child Abuse Fatalities*, 107 PEDIATRICS 437 (2001). Today, understanding of the etiology of SIDS still is incomplete. SIDS remains a "diagnosis of exclusion," meaning that a "diagnosis of SIDS reflects the clear admission by medical professionals that an infant's death remains completely unexplained." *See id*.
>
> Medical studies consistently have identified the following risk factors for SIDS: prone sleep position, sleeping on a soft surface, maternal smoking during pregnancy, overheating, late or no prenatal care, young maternal age, prematurity and/or low birth weight, and male sex. *See* Task Force on Infant Positioning and SIDS, *Changing Concepts of Sudden Infant Death Syndrome: Implications for Infant Sleeping Environment and Sleep Position*, 105 PEDIATRICS 650 (2000). African Americans and American Indians have consistently higher rates, two to three times the national average. *Id*. Because the cause of SIDS remains unknown, none of those risk factors are of help in calculating the probability that a child will die of SIDS. Robert M. Reece, *Fatal Child Abuse and Sudden Infant Death Syndrome: A Critical Diagnostic Decision*, 91 PEDIATRICS 423 (1993).
>
> Beyond these commonly accepted risk factors, there is little agreement as to the causes of SIDS. This is particularly true with regard to the role of genetics. Some . . . argue that it is generally accepted that there is no genetic defect or condition that can be tied to SIDS. *See id*. (noting that "the issue of recurrent SIDS within a family raises the possibility of genetically determined conditions. . . . But when SIDS occurrences among siblings of SIDS cases

were compared with those among non-SIDS siblings in maternal age - and birth rank matched - control families, there was no statistically significant difference in SIDS rates . . . . Thus, the notion that having a SIDS baby makes having another more likely was dispelled.").

In contrast, a recent article in the Journal of the American Medical Association presents a study suggesting that SIDS may result from a genetic condition. *See* Michael J. Ackerman et al., *Postmortem Molecular Analysis of SCN5A Defects in Sudden Infant Death Syndrome,* 286 JAMA 2264 (2001). This study draws into question the assertion that SIDS deaths within a single family are independent or unrelated events. Similarly, in the March 2000 edition of *Pediatrics*, the Task Force on Infant Positioning and SIDS, chaired by John Kattwinkel, M.D., expressed uncertainty as to the risk of SIDS among siblings. The report noted:

"Several studies that have evaluated SIDS among siblings have found that having a sibling who died of SIDS is a significant risk factor. However, others have failed to find such a relationship or have shown that siblings of infants who have died of SIDS are at risk for all causes of infant death, not just SIDS. In addition, most of the studies reporting familial SIDS have the limitation of having been conducted during a period when case and scene investigations were not routine and assignment of the SIDS diagnosis may have been flawed. Thus, the true risk is unknown."

John Kattwinkel, et al., *Changing Concepts of Sudden Infant Death Syndrome: Implications for Infant Sleeping Environment and Sleep Position,* 105 PEDIATRICS 650 (2000). In addition, the recent discovery of a deficit in a serotonergic pathway in the brainstem has provided promising insight into the mechanisms responsible for SIDS. *Id*. *See also*, HC Kinney et al., *Medullary Serotonergic Nework Deficiency in the Sudden Infant Death Syndrome,* 60 J. NEUROPATHOL. EXP. NEUROL. 228 (2001); A. Panigraphy et al., *Decreased Serotonergic Recepter Binding in Rhombic Lipderived Regions of the Medulla Oblongata in the Sudden Infant Death Syndrome,* 59 J. NEUROPATHOL. EXP. NEUROL. 377 (2000).

Id. at 203-06.

Noting that the product rule is applicable when events are independent, *id*. at 206, the Court of Appeals held that Dr. Norton's testimony should have been excluded because:

> [A] condition necessary to the proper application of the product rule was lacking: there was inadequate proof of the independence of Brandi and Garrett's deaths. As evidenced by the authorities above cited, there is not general agreement in the scientific community as to the relationship between SIDS deaths within a single family. Stated another way, there is not general agreement in the medical community that multiple SIDS deaths in a single family are genetically unrelated. The literature continues to reflect a lively debate concerning the role of genetics in SIDS. Moreover, the recent study in the Journal of the American Medical Association suggests that there may well be a genetic component to SIDS. *See* Michael J. Ackerman et al., *Postmortem Molecular Analysis of SCN5A Defects in Sudden Infant Death Syndrome*, 286 JAMA 2264 (2001). If there is any consensus in the field, it is that more research into the question is necessary before general acceptance is reached.

Id. at 209.

At the *Frye-Reed* hearing in this case, the parties acknowledged that the primary issue was whether exposure to mold caused appellees' neurocognitive and musculoskeletal problems.[10] Dr. Shoemaker testified that there were scientific publications that supported the

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[10] Notwithstanding, the parties cited several sources that indicated exposure to water damaged buildings could cause respiratory issues. *See* Ju-Hyeong Park, Jean M. Cox-Ganser, Kathleen Kreiss, Sandra K. White, Carol Y. Rao, *Hydrophilic Fungi and Ergosterol Associated with Respiratory Illness in a Water-Damaged Building*, Environmental Health Perspectives, Vol. 116, No. 1, at 45-50 (2008) (demonstrating that mold levels affiliated with dust in indoor environments were associated with new-onset asthma); Stephen J. Vesper, Craig McKinstry, Chin Yang, Richard A. Haugland, Carolyn Kercsmar, Iwona Yike, Mark D. Schluchter, Lester H. Kirchner, John Sobolewski, Terrence M. Allan, Dorr G. Dearborn, *Specific Molds Associated with Asthma in Water-Damaged Buildings*, J. of Occupational & Environmental Medicine, Vol. 48, No. 8, at 852-58 (2006) (noting that there was a relative moldiness index developed to predict the development of asthma in individuals exposed to water damaged buildings); Dick Menzies, Paul Comtois, Joe Pasztor, Fatima Nunes, James A. Hanley, *Aeroallergens and Work-Related Respiratory Symptoms Among Office Workers*, J. of Allergy & Clinical Immunology, Vol. 101, No. 1, at 38-44 (1998) (concluding that avoiding the exposure of aeroallergens could prevent a small group of office workers from having work-related respiratory tract issues). Based on these articles, it is well settled that exposure to water damaged buildings can effect respiratory issues.

theory that exposure to water damaged buildings caused the human health effects at issue here. There were two publications that we believe were relevant: (1) Edmond D. Shenassa, Constantine Daskalakis, Allison Liebhaber, Matthias Braubach, and Mary Jean Brown, *Dampness and Mold in the Home and Depression: An Examination of Mold-Related Illness and Perceived Control of One's Home as Possible Depression Pathways*, Am. J. of Pub. Health, Vol. 97, No. 10, at 1893-99 (2007) (concluding that there was an independent association between exposure to indoor mold and depression); and (2) Luke Curtis, Allan Lieberman, Martha Stark, William Rea, Marsha Vetter, *Adverse Health Effects of Indoor [Molds]*, J. of Nutritional & Environmental Medicine, Vol. 23, No. 1, at 3-8 (2004)[11] (noting that exposure to airborne mold caused neurological dysfunction and cognitive defects).

Conversely, Dr. Cheung testified that there was scientific research that provided there was no association between exposure to mold and certain human health effects, or in the alternative, more research was necessary. *See* Clifford S. Mitchell, Junfeng Zhang, Torben Sigsgaard, Matti Jantunen, Paul J. Lioy, Robert Samson, Meryl H. Karol, *Current State of the Science: Health Effects and Indoor Environmental Quality*, Environmental Health Prospective, Vol. 115, No. 6, at 958-68 (2007) (noting that more dose measurement research was necessary before an association between exposure and human health effects could be established); (2) Institute of Medicine, *Damp Indoor Spaces & Health*, at 8-12 (2004) (concluding that there was inadequate or insufficient evidence to establish an association

[11] Our citation to *Adverse Health Effects of Indoor Molds* is slightly different than the original because we could only locate the reprint.

between exposure to damp indoor environments and skin symptoms, gastrointestinal tract problems, fatigue, neuropsychiatric symptoms, cancer, and reproductive effects); (3) Bryan D. Hardin, Bruce J. Kelman, Andrew Saxon, *Adverse Human Health Effects Associated with Molds in the Indoor Environment*, J. of Occupational & Environmental Medicine, Vol. 45, No. 5, at 470-78 (2003) (concluding that the current scientific landscape did not support the argument that there was a causal relationship between the inhalation of mycotoxins and human health effects); and (4) Elena H. Page, Douglas B. Trout, *The Role of Stachybotrys Mycotoxins in Building-Related Illness,* American Industrial Hygiene Association J., at 644-48 (2001) (commenting that a literature review indicated that there was inadequate evidence that would support a causal relationship between building occupants' illnesses and exposure to mycotoxins).

One of the first articles to address whether exposure to water damaged buildings caused human health effects relevant to the case *sub judice* was *The Role of Stachybotrys Mycotoxins in Building-Related Illness*. There, the authors reviewed several articles that concerned human illness and exposure to mycotoxins in indoor environments. *Id*. at 645-67. The relevant articles suggested that "there is inadequate evidence to support the conclusion that exposure to mycotoxins in the indoor (nonindustrial) environment is causally related to symptoms or illness among building occupants." *Id*. at 647. Additionally, the article stated that "[r]esearch involving the identification and isolation of specific fungal toxins in the environment and in humans is needed before a more definitive link between health outcomes and mycotoxins can be made." *Id*. All in all, the article concluded that "objective measures

of adverse health effects must be associated with some measure of mycotoxin exposure . . ." to support a hypothesis "regarding potential adverse health consequences of mycotoxin exposure in the nonindustrial environment . . . ." *Id*.

More than a year later, *Adverse Human Health Effects Associated with Molds in the Indoor Environment*[12] discussed "the state of scientific knowledge as to the nature of fungal-related illnesses while emphasizing the possible relationships to indoor environments." Hardin, Kelman, Saxon, *Adverse Human Health Effects Associated with Molds in the Indoor Environment*, J. of Occupational & Environmental Medicine, Vol. 45, No. 5, at 470. Focusing on the potential health effects from exposure to mycotoxins, the article concluded that the "[c]urrent scientific evidence does not support the proposition that human health has been adversely affected by inhaled mycotoxins in the home, school, or office environment." *Id*. Specifically, the piece noted that irrespective of the amount of literature on the subject, "the causal association remains weak and unproven, particularly with respect to causation by mycotoxins." *Id*. at 475. Additionally, the article provided that the amount of exposure in an indoor environment indicates "that delivery by the inhalation route of a toxic dose of mycotoxins in the indoor environment is highly unlikely at best . . . ." *Id*. at 475-76.

In 2004, the Institute of Medicine published *Damp Indoor Spaces & Health*. There, the Institute of Medicine extensively reviewed the issue of human health effects and exposure to mold. *See* Institute of Medicine, *Damp Indoor Spaces & Health*, at 1-329. Most notable

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[12] *Adverse Human Health Effects Associated with Molds in the Indoor Environment* was updated in 2011. Nothing noteworthy was changed.

to this case, the Institute of Medicine concluded that "there is inadequate or insufficient information to determine whether an association exists between [fatigue and neuropsychiatric issues] and exposure to a damp indoor environment or the presence of mold or other agents associated with damp indoor environments."[13] *Id*. at 252. Additionally, the piece declined to address the issue of sick building syndrome because there was a "lack of consistent diagnostic criteria . . . ." *Id*. at 250.

In June of 2007, *Current State of the Science: Health Effects and Indoor Environmental Quality* recognized that although there was an "absence of validated markers of exposure . . . ," there have been attempts "to understand the relationship between mold exposures and chronic nonallergic health effects." Mitchell, Zhang, Sigsgaard, Jantunen, Lioy, Samson, Karol, *Current State of the Science: Health Effects and Indoor Environmental Quality*, Environmental Health Prospective, Vol. 115, No. 6, at 962. Noting that Dr. Shoemaker has conducted "trials of empirical therapies for treating mold-exposed individuals . . . ," the piece indicated that there was "a lack of consensus regarding the systemic effects of mold exposures." *Id*. Additionally, the article provided that "[o]ne of the limiting factors in this research is reliable, validated markers of exposure to either molds or the putative mycotoxins." *Id*.

Taking somewhat of an opposite position, *Adverse Health Effects of Indoor [Molds]*

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[13] The authors of *The Medical Effects of Mold Exposure* recognized the Institute of Medicine's conclusions concerning mycotoxins. *See* Robert K. Bush, Jay M. Portnoy, Andrew Saxon, Abba I. Terr, and Robert A. Wood, *The Medical Effects of Mold Exposure*, J. of Allergy & Clinical Immunology, Vol. 117, No. 2, at 329 (2006).

concluded that "[i]ndoor airborne [mold] and/or mycotoxin exposures cause many multisystem adverse human health effects . . . ." Curtis, Lieberman, Stark, Rea, Vetter, *Adverse Health Effects of Indoor Molds*, J. of Nutritional & Environmental Medicine, Vol. 14, No. 3, at 4. Particularly notable to this case, the article recognized that there were studies that indicated indoor airborne mold exposure generates cognitive deficits and neurologic dysfunction. *Id.* at 3. Specifically, it was recognized that "[t]he large number of objective neuropsychological findings in symptomatic patients support the findings that exposure to indoor molds can have adverse health effects." *Id.*

In *Building-Associated Neurological Damage Modeled in Human Cells: A Mechanism of Neurotoxic Effects by Exposure to Mycotoxins in the Indoor Environment*, it was confirmed that damage to human neurological system cells could result from exposure to water damaged buildings. Enusha Karunasena, Michael D. Larrañaga, Jan S. Simoni, David R. Douglas, David C. Straus, *Building-Associated Neurological Damage Modeled in Human Cells: A Mechanism of Neurotoxic Effects by Exposure to Mycotoxins in the Indoor Environment*, Mycopathologia, Vol. 170, No. 6, at 377 (2010). However, the article also recognized that "[l]eading scientific organizations disagree about the ability of inhaled mycotoxins in the indoor environment to cause adverse human health effects." *Id.*

Keeping the different articles in mind, we note that "unanimity is not required [to establish] general acceptance." *Wilson*, 370 Md. 210 (citing *State v. Copeland*, 922 P.2d 1304, 1319 (Wash. 1996)). Nevertheless, as was the case in *Wilson*, we believe that the articles demonstrate that there is a genuine controversy within the scientific community with

regard to whether exposure to water damaged buildings causes the human health effects Dr. Shoemaker suggests are caused by exposure to water damaged buildings. Dr. Cheung cited articles that suggest more research is necessary, or that the majority of the illnesses suffered by appellees could not be obtained through inhalation. Dr. Shoemaker cited articles that indicate neurological symptoms – which appellees purportedly had – could be caused by exposure to water damaged buildings.[14] Neither party cited articles that concerned musculoskeletal symptoms and exposure to water damaged buildings. Thus, because there are sources that support and oppose Dr. Shoemaker's theories and methodologies, and at least one that recognizes the relevant scientific field is undecided, we must conclude that Dr. Shoemaker's theories and methodologies with regard to exposure to water damaged buildings, and the human health effects suffered by appellees, are not generally accepted in the relevant scientific community.

In the end, our decision boils down to the difference between applying the *Daubert* and *Frye-Reed* standard. *Frye-Reed* mandates that Dr. Shoemaker's theories regarding causation be generally accepted in the medical community. *See Reed*, 283 Md. at 380-81. Under *Daubert*, the court would have determined whether Dr. Shoemaker's theories regarding causation were reliable. *See Daubert*, 509 U.S. at 589 (The Federal Rules of

[14] Interestingly, Dr. Shoemaker acknowledged that there were "naysayers" who disagreed with his theory. However, he merely criticized these pieces on collateral issues. Dr. Shoemaker questioned *Adverse Human Health Effects Associated with Molds in the Indoor Environment* because of legislative activities associated with the American College of Occupational and Environmental Medicine, and *The Medical Effects of Mold Exposure* because of a purported conflict of interest.

Evidence state that a "trial judge must ensure that any and all scientific testimony or evidence admitted is not only relevant, but reliable."). If *Daubert* was controlling, we would have entertained the circuit court's invitation to chose the clinical-medical approach to determine the admissibility of expert medical testimony as it pertains to establishing general or specific causation. However, because Maryland follows the *Frye-Reed* standard, and there is no consensus in the relevant scientific community that exposure to mold causes the injuries at issue here, we must conclude that the circuit court erred in its *Frye-Reed* determination.[15]

JUDGMENT OF THE CIRCUIT COURT FOR HOWARD COUNTY REVERSED. COSTS TO BE PAID BY APPELLEES.

[15] At the *Frye-Reed* hearing, the parties discussed whether the circuit court should consider whether Dr. Shoemaker's theories and methodologies were generally accepted at the present time, or when the *Frye-Reed* hearing was supposed to have been held. Although it is an interesting issue, because Dr. Shoemaker's theories have never been generally accepted in the relevant scientific community, we need not address the issue.