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ADVANCE SHEET HEADNOTE

May 2, 2016

2016 CO 25

No. 12SC871, City of Littleton v. Indus. Claim Appeals Office – Workers' Compensation – Firefighters – Statutory Presumptions.

In this case, the supreme court addresses the presumption created in the “firefighter statute,” § 8-41-209, C.R.S. (2015), of the Workers' Compensation Act of Colorado, §§ 8-40-101 to -47-209, C.R.S. (2015). The court holds that the presumption in section 8-41-209(2)(a) relieves the claimant firefighter of the burden to prove that his cancer “result[ed] from his or her employment as a firefighter” for purposes of establishing under section 8-41-209(1) that his condition is a compensable “occupational disease” under the Workers' Compensation Act. However, section 8-41-209(2) does not establish a conclusive, or irrebuttable, presumption. Instead, the firefighter statute shifts the burden of persuasion to the firefighter's employer to show, by a preponderance of the medical evidence, that the firefighter's condition “did not occur on the job.” The supreme court holds that an employer can meet its burden by establishing the absence of either general or specific causation. Specifically, an employer can show, by a preponderance of the medical evidence, either: (1) that a firefighter's known or typical occupational exposures are not capable of causing the

type of cancer at issue; or (2) that the firefighter's employment did not cause the firefighter's particular cancer where, for example, the claimant firefighter was not exposed to the substance or substances that are known to cause the firefighter's condition or impairment, or where the medical evidence renders it more probable that the cause of the claimant's condition or impairment was not job-related.

The Supreme Court of the State of Colorado
2 East 14th Avenue • Denver, Colorado 80203

2016 CO 25

Supreme Court Case No. 12SC871
Certiorari to the Colorado Court of Appeals
Court of Appeals Case No. 10CA1494

Petitioners:

City of Littleton, Colorado; Littleton Fire Rescue; and CCMSI,

v.

Respondents:

Industrial Claim Appeals Office; Julie Christ, surviving spouse and Personal Representative of Jeffrey J. Christ, Deceased; and Michelle Parris, on behalf of Lauren Parris.

Judgment Reversed

en banc

May 2, 2016

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JUSTICE MÁRQUEZ delivered the Opinion of the Court.

¶1 Littleton firefighter Jeffrey J. Christ was diagnosed with glioblastoma multiforme (“GBM”), a type of brain cancer. After undergoing surgery, chemotherapy, and radiation, he returned to work, but ultimately succumbed to the disease. He (and later his widow and child) sought workers’ compensation benefits to cover his cancer treatment, asserting that his brain cancer qualified as a compensable occupational disease under the “firefighter statute,” § 8-41-209, C.R.S. (2015), of the Workers’ Compensation Act of Colorado, §§ 8-40-101 to -47-209, C.R.S. (2015). At issue here is whether Christ’s employer, the City of Littleton, and Littleton’s insurer, Cannon Cochran Management Services, Inc. (collectively “Littleton”), successfully overcame a statutory presumption in section 8-41-209(2)(a) that Christ’s condition resulted from his employment as a firefighter.

¶2 The firefighter statute applies to firefighters who have completed five or more years of employment as a firefighter. § 8-41-209(1). Section 8-41-209(1) provides that the death, disability, or health impairment of such a firefighter “caused by cancer of the brain, skin, digestive system, hematological system, or genitourinary system” shall be considered an “occupational disease” (thus entitling the firefighter to benefits under the Workers’ Compensation Act) if the cancer “result[ed] from his or her employment as a firefighter.” Section 8-41-209(2)(a) then creates a statutory presumption that the firefighter’s condition or health impairment caused by a listed type of cancer “result[ed] from [the] firefighter’s employment” if, at the time of becoming a firefighter or thereafter, the firefighter underwent a physical examination that failed to reveal substantial evidence of such condition or health impairment preexisting his or her

employment as a firefighter. Under section 8-41-209(2)(b), however, the firefighter's condition or impairment "[s]hall not be deemed to result from the firefighter's employment if the firefighter's employer or insurer shows by a preponderance of the medical evidence that such condition or impairment did not occur on the job." This case requires us to determine whether Littleton met its burden under subsection (2)(b) to show by a preponderance of the medical evidence that Christ's GBM condition "did not occur on the job."

¶3 We hold that the presumption in section 8-41-209(2) relieves a qualifying claimant firefighter of the burden to prove that his cancer "result[ed] from his employment as a firefighter" for purposes of establishing his claim to workers' compensation benefits. But the firefighter statute does not establish a conclusive (i.e., irrebuttable) presumption that firefighting duties cause cancers relating to the brain, skin, digestive system, hematological system, or genitourinary system, or that a firefighter's employment caused a particular claimant firefighter's condition. Rather, the statute shifts the burden of persuasion regarding the job-relatedness of the firefighter's condition to the employer. In other words, although the firefighter bears the burden of proving his claim for benefits, section 8-41-209(2) places the burden with the employer to show, by a preponderance of the medical evidence, that the firefighter's condition or health impairment caused by a listed cancer "did not occur on the job." We further hold that an employer can meet its burden by establishing the absence of either general or specific causation. Specifically, an employer can show, by a preponderance of the medical evidence, either: (1) that a firefighter's known or typical

occupational exposures are not capable of causing the type of cancer at issue; or (2) that the firefighter's employment did not cause the firefighter's particular cancer where, for example, the claimant firefighter was not exposed to the cancer-causing agent, or where the medical evidence renders it more probable that the cause of the claimant's cancer was not job-related.

¶4 In this case, the administrative law judge ("ALJ") applied the statutory presumption in section 8-41-209(2)(a) but ultimately found that Littleton had established by a preponderance of the medical evidence that Christ's GBM condition was not caused by his occupational exposures. A panel of the Industrial Claim Appeals Office ("Panel") reversed, concluding that Littleton's medical evidence was insufficient to overcome the presumption. In a split decision, a division of the court of appeals affirmed the Panel. City of Littleton v. Indus. Claim Appeals Office, 2012 COA 187, ___ P.3d ___. Because we disagree with the court of appeals' interpretation of the breadth of the statutory presumption in section 8-41-209(2)(a) and of the employer's burden to overcome the presumption, we conclude that the court of appeals erroneously evaluated the medical evidence presented by Littleton and erroneously failed to defer to the ALJ's findings of fact, which are supported by substantial evidence. We therefore reverse the judgment of the court of appeals and remand this case with directions to return the matter to the Panel for reinstatement of the ALJ's original findings of fact, conclusions of law, and order.

I. Facts and Procedural History

¶5 Littleton Fire Rescue hired Christ in 1987. Before starting his employment, Christ had a physical examination, which included blood work, chest x-rays, and a general health assessment, but did not include an MRI scan or a tissue biopsy. Christ began his career as an engineer, later became a captain, and then served as a battalion chief for over ten years before filing the claim in this case. As battalion chief, Christ spent twenty percent of his time directly involved with fire calls and eighty percent of his time involved with day-to-day operations. Between 2000 and 2007, he responded to 172 fires and 50 situations involving hazardous substances. In December 2007, Christ was diagnosed with GBM, a type of brain cancer that cannot be diagnosed in the absence of a brain scan or a tissue biopsy. Christ sought temporary total disability benefits under section 8-41-209 of the Workers' Compensation Act for the period of time between his diagnosis and his return to work in March 2008 following treatment.

A. ALJ Findings and Conclusions

¶6 In June 2009, the ALJ denied Christ's claim for workers' compensation benefits. The ALJ concluded that the statutory presumption in section 8-41-209(2)(a) applied because Christ had been employed as a firefighter for more than five years and a physical examination prior to his employment as a firefighter had not revealed brain cancer. However, the ALJ determined that Littleton established, by a preponderance of the medical evidence, that Christ's brain cancer was not caused by his occupational exposures. Littleton presented the testimony of three expert witnesses: Dr. Denise M. Damek (neuro-oncology); Dr. Patricia A. Buffler (epidemiology); and Dr. Javier C.

Waksman (toxicology). The ALJ concluded that, collectively, Littleton's expert witnesses established that the substances to which Christ's expert opined he was likely exposed as a firefighter do not target the brain and do not cause brain cancer.

B. Panel Order

¶7 Christ appealed the ALJ's decision to the Industrial Claim Appeals Office. The Panel reversed the ALJ, concluding that the presumption in section 8-41-209 "represents a legislatively adopted premise that the occupational exposure of firefighters causes cancer," and that this statutory presumption "cannot be rebutted by the opinions of medical experts that there is no causal connection between the occupation in general and the disease in question." The Panel reasoned that Littleton's evidence was insufficient to rebut the presumption in section 8-41-209 because it "merely denied the underlying legislative premise of a causal relationship between the firefighter's occupational exposure and the development of cancer." The Panel remanded the case to the ALJ to determine Christ's entitlement to specific benefits. On remand, the ALJ determined that Christ was entitled to medical benefits and temporary total disability benefits. Littleton appealed the ALJ's order on remand to the Panel, which affirmed the ALJ's determination.¹

¹ Christ passed away on December 30, 2009, while his benefits were being determined. His widow, Julie Christ, was substituted as the claimant, and Michelle Parris, the mother of Christ's biological child, joined the action as an additional claimant. City of Littleton, ¶ 6 n.1.

C. Court of Appeals Ruling

¶8 Littleton then appealed the Panel's final order to the court of appeals, arguing that the evidence it presented to the ALJ was sufficient to sustain its burden of proof under section 8-41-209(2). A division of the court of appeals disagreed and affirmed the Panel's ruling in a 2-1 decision. City of Littleton v. Indus. Claim Appeals Office, 2012 COA 187, ¶ 1, __ P.3d __, 2012 WL 5360912.

1. Majority Opinion

¶9 In a detailed opinion, the division majority examined the firefighter statute through the lens of causation in a toxic exposure case. Id. at ¶¶ 9-47. The division majority observed that courts traditionally evaluate a toxic tort plaintiff's proof of causation by examining both general and specific causation. Id. at ¶¶ 9, 12. To prove general causation, the plaintiff must show that the toxic substance is capable of causing a particular disease. Plaintiffs typically rely on toxicological evidence² or epidemiological studies³ to establish general causation. Id. at ¶¶ 13-14. To prove specific causation, the plaintiff must establish, by particularized evidence, that the alleged exposure caused his specific disease. Evidence about the plaintiff's medical

² Toxicology examines the capacity of chemicals or environmental agents to produce harmful effects in living organisms. Toxicologists study the interaction between chemicals and biological systems, attempt to identify the mechanism of action, and attempt to assess the relationship between doses of chemicals and responses in living systems. Gerald W. Boston, A Mass-Exposure Model of Toxic Causation: The Content of Scientific Proof and the Regulatory Experience, 18 Colum. J. Env'tl. L. 181, 214 (1993).

³ Epidemiology is the study of the distribution and determinants of disease in human populations; epidemiologists look for unusual incidences of human disease and endeavor to identify those factors that distinguish the affected population group from other groups. Boston, supra, at 231.

history and his particular exposure (including dose, frequency, and duration) will be important. Id. at ¶ 16.

¶10 Applying these general principles to the firefighter statute, the division majority construed section 8-41-209 to presume specific causation—i.e., that the firefighter’s occupational exposures caused his specific cancer—where the firefighter can show: (1) he has worked as a firefighter for at least five years; (2) he suffers from one of the listed types of cancer; and (3) after becoming a firefighter, he underwent a physical exam that revealed no evidence of the current disease. Id. at ¶¶ 21–22. The majority reasoned that, by necessary implication, the statute also presumes general causation—i.e., that a firefighter’s occupational exposures are capable of causing the listed types of cancer. Id. at ¶ 23 (“If one presumes that occupational exposures caused a particular cancer, one necessarily also presumes that those exposures could have caused that type of cancer.”).

¶11 The division majority concluded that this statutory presumption is not the type of rebuttable presumption that merely shifts the burden of going forward with evidence, but rather, “remains in the case as affirmative evidence, creating an inference that must be overcome by contrary evidence.” Id. at ¶ 24.

¶12 Critically, the division majority reasoned that “[t]he statute contains no text that would limit the ways in which a firefighter is presumed to have gotten his cancer,” but simply presumes the cancer “resulted from the firefighter’s employment somehow.” Id. at ¶ 26. Thus, the majority concluded, the presumption is broad in two ways. First, it contemplates a “wide range of potential exposures” and presumes that the listed cancers can be caused by exposure to some “unspecified substance or intangible agent”;

that the claimant was exposed to such unspecified substances or agents while working as a firefighter; and that those exposures caused the firefighter's particular cancer. *Id.* at ¶ 28. Second, it presumes that the unspecified exposure caused the cancer directly or in combination with other genetic or environmental factors, either causing or hastening the onset of a disease. *Id.* at ¶ 29.

¶13 Based on its view of the breadth and nature of the presumption, the division majority construed section 8-41-209 to place a formidable burden on the employer in two ways. *Id.* at ¶ 30. First, it reasoned that the employer cannot overcome the presumption by undermining general causation. *See id.* at ¶¶ 31-33 (noting that the "employer gains nothing by challenging the wisdom or the evidentiary foundation of the legislature's decision"). Rather than "attacking the statute," an employer must affirmatively prove, by a preponderance of the evidence, that the firefighter's cancer did not result from, arise out of, or arise in the course of the firefighter's employment. *Id.* at ¶ 34. Second, because it construed the statute to presume causation by "unspecified means," the division majority reasoned that the employer must exclude "the wide range of potential exposures and biological mechanisms that the statute contemplates" in order to sustain its burden of proof. *Id.* at ¶ 36. In short, the division majority concluded that section 8-41-209(2) requires the employer to prove that "the cancer was not, or could not have been, caused by anything that the firefighter encountered on the job." *Id.* (emphasis added).

¶14 The division majority observed that in some cases, employers may have evidence of alternative causation sufficient to disprove specific causation, but that in general,

employers may be unable to disprove specific causation because it can be difficult to establish which substances a firefighter encountered, let alone the dose, frequency, or duration of such exposures. Id. at ¶¶ 37-38. The division majority further observed that general causation evidence (such as epidemiological studies) is ill-suited to disprove specific causation, particularly given the employer's heavy burden to disprove causation by any of the wide range of substances (known and unknown) to which the statute presumes the firefighter was exposed. Id. at ¶¶ 40-47.

¶15 Turning to the facts of the case, the division majority discussed the expert witness testimony, the ALJ's findings, and the Panel's order. Id. at ¶¶ 48-77. It then concluded that, upon review of the record, Littleton's evidence was insufficient as a matter of law to meet its burden of proof under the statute. Id. at ¶¶ 78, 83, 99-101. Although Littleton's experts "amply undermined claimant's assertion of general causation," Littleton failed to overcome the broad, substantive presumption in section 8-41-209 by disproving either specific or general causation by a preponderance of the evidence. Id. at ¶¶ 82-83.

¶16 The majority observed that Littleton presented no evidence about Christ's workplace exposures; consequently, it did not disprove specific causation. Id. at ¶¶ 87-88. Littleton instead relied on general causation evidence showing that carcinogens commonly associated with firefighting cannot cause GBM or any form of brain cancer.

¶17 Notably, the division majority acknowledged that "Littleton's evidence supports a reasonable inference that claimant's brain cancer was not caused by any of the carcinogens commonly 'associated with firefighting.'" Id. at ¶ 90. Specifically,

Littleton's evidence supported a reasonable inference that if Christ encountered those substances, he probably absorbed them by inhalation or through the skin; that there is no plausible biological pathway by which those substances, so absorbed, could affect the brain; and that those substances do not cause brain cancer. Id. The division majority nevertheless reasoned that this evidence was insufficient to overcome the statutory presumption because "Littleton presented no evidence to support an inference that [Christ's] workplace exposures were limited to that group of substances." Id. at ¶¶ 89-91. A factfinder therefore could only speculate that Christ's exposures were limited to those substances commonly "associated with firefighting." Id. at 91. And such speculation, the division majority concluded, is insufficient to rebut the broad presumption that Christ, while acting as a firefighter, was exposed to some substance or agent that caused his particular cancer. Id. at ¶¶ 91, 95-96.

¶18 Littleton's experts acknowledged, for example, that brain cancer can be caused by exposure to ionizing radiation such as that from an atomic blast or therapeutic brain irradiation. Id. at ¶ 93. The evidence supported a reasonable inference that Christ was not exposed to an atomic blast or therapeutic brain irradiation; however, the division majority reasoned that the evidence did not rule out Christ's occupational exposure to other conceivable sources of ionizing radiation. Id. at ¶ 94. And although the ALJ found, on the basis of Littleton's expert testimony, that "no known or putative carcinogen has been definitely associated with brain tumor development in either humans or animals," the division majority reasoned that this finding did not permit the ALJ to conclude that no such link exists. Id. at ¶ 97. Finally, the division majority

reasoned that the statute also presumes that occupational exposures hastened the onset of a cancer that Christ would have developed later, and that Littleton did not attempt to refute this presumed theory of causation. Id. at ¶ 98. In sum, the division majority concluded that Littleton failed to disprove the “wide and unspecified range of potential causes” of Christ’s GBM. Id. at ¶ 100. Only by speculation, and not reasonable inference, could the ALJ find that the substances to which Christ was exposed did not target his brain or do not cause brain cancer. Id. at ¶ 99. Thus, it concluded that the ALJ’s ultimate findings were unsupported. Id.

2. Dissenting Opinion

¶19 In a similarly detailed dissent, Judge Carparelli applied a different analytic framework. Like the majority, he construed section 8-41-209 to create a presumption that the firefighter’s particular cancer resulted from, arose out of, or was sustained in the course of his or her employment. Id. at *17 (Carparelli, J., dissenting). In his view, the statute requires ALJs to presume that a firefighter’s employment was capable of causing the firefighter’s specific cancer and that the firefighter’s employment did cause that cancer. Id. at *16. Judge Carparelli rejected the view, however, that the statute establishes a broad and conclusive presumption of general causation. Id. at *17. He questioned the division majority’s reference to the “evidentiary” foundation of the legislature’s policy decision, noting that this statement implied that “the General Assembly decided that there is scientific proof that cancers of the brain, skin, digestive system, hematological system, or genitourinary system result from firefighting,” yet “the statute contains no such statement.” Id. at *19. Indeed, he noted, there is “no basis

to conclude that the General Assembly was presented with an evidentiary foundation supporting a conclusion that all variations of cancer of the listed organs result from employment as a firefighter.” Id. He also reasoned that the division majority’s description of the breadth of the statutory presumption implied that the employer has the burden to eliminate “all imaginable possibilities,” and in so doing, rendered “reasonable inferences impermissible and section 8-41-209(2)(b) meaningless.” Id.

¶20 In Judge Carparelli’s view, to overcome the statutory presumption in section 8-41-209(2)(a), an employer must prove that it is more likely that the firefighter’s employment was not capable of causing the firefighter’s specific cancer, or, if his employment was capable of causing the cancer, that it is nonetheless more likely that the firefighter’s employment did not cause that cancer. Id. at *16, *18. He reasoned that in meeting this burden, epidemiology is highly probative evidence “because it considers human physiology and the likelihood that a potential environmental factor is capable of entering the body, traveling to a particular organ, and interacting with that organ in a way that can cause a particular cancer.” Id. at *19.

¶21 Judge Carparelli concluded that the ALJ’s findings were supported by the record and that the Panel therefore erred when it reversed the ALJ’s initial order. Id. at *15, *16, *23. Specifically, he concluded that there was sufficient evidence in the record to support a finding that the only known environmental risk factor for GBM is ionizing radiation, and that the ALJ could reasonably infer that Christ was not exposed to such radiation in his employment. Id. at *21-*22, *23. In his view, the ALJ’s finding of the absence of general causation was sufficient to overcome the statutory presumption by a

preponderance of the evidence without additional proof of the absence of specific causation. Nonetheless, Judge Carparelli concluded that there was also sufficient evidence to overcome the presumption of specific causation. Specifically, the evidence was sufficient to support findings that known and putative carcinogens, as well as other chemicals to which Christ might have been exposed, do not cause GBM, and that no credible biological mechanism exists by which the chemicals to which Christ was likely exposed could target his brain and cause GBM. *Id.* at *23.

¶22 We granted Littleton’s petition for a writ of certiorari to review the court of appeals’ decision.⁴

II. Analysis

¶23 Littleton has asked us to determine whether the court of appeals erred in its interpretation of section 8-41-209; whether it erred in holding Littleton’s medical evidence insufficient as a matter of law; and whether it failed to defer to the ALJ’s

⁴ We granted certiorari review on the following issues:

1. Whether the court of appeals erred in holding petitioners’ medical evidence, while admittedly persuasive and credible, to be insufficient as a matter of law to rebut the statute’s presumption.
2. Whether the court of appeals erred in its interpretation of section 8-41-209, C.R.S., in determining that the statute is effectively irrebuttable, contrary to the intent of the General Assembly and the unambiguous wording of the statute.
3. Whether the court of appeals failed to defer to the Administrative Law Judge’s Findings of Fact, thereby committing reversible error in contravention of the mandates of appellate review.

findings of fact.⁵ We first discuss the Workers' Compensation Act of Colorado generally and interpret section 8-41-209. We then address the evidence presented and the ALJ's findings of fact, conclusions of law, and order.

¶24 We hold that section 8-41-209(2) relieves a qualifying claimant firefighter of the burden to prove that his cancer "result[ed] from his employment as a firefighter" for purposes of establishing his claim to workers' compensation benefits. The presumption in section 8-41-209(2) is substantive in that it remains in the case as a substitute for evidence. But section 8-41-209(2) does not establish a conclusive presumption that firefighting duties cause cancers relating to the brain, skin, digestive system, hematological system, or genitourinary system, or that a firefighter's employment caused a particular claimant firefighter's condition. Instead, the firefighter statute shifts the burden of persuasion regarding the job-relatedness of the firefighter's condition to the employer. Put differently, although the firefighter bears the burden of proving his claim for benefits, section 8-41-209(2) places the burden with the employer or insurer to show, by a preponderance of the medical evidence, that the firefighter's condition or health impairment caused by a listed cancer "did not occur on the job."

⁵ In its briefing to this court, the Industrial Claim Appeals Office ("ICAO") states that its interpretation of section 8-41-209 has evolved since the Panel issued its order in this case, which was the ICAO's first opportunity to consider the statute. Since that time, the ICAO has considered several other cases under this provision. Contrary to its order in this case, the Panel now takes the position that sufficient evidence supported the ALJ's original finding that Littleton successfully proved by a preponderance of the medical evidence that Christ's GBM was not caused by exposures occurring during the course of his employment as a firefighter.

¶25 We further hold that an employer can meet its burden to show that a firefighter's cancer is not job-related by establishing the absence of either general or specific causation. That is, the employer may establish, by a preponderance of the medical evidence, either: (1) that a firefighter's known or typical occupational exposures are not capable of causing the type of cancer at issue; or (2) that the firefighter's employment did not cause the firefighter's particular cancer where, for example, the claimant firefighter was not exposed to the cancer-causing agent, or where the medical evidence renders it more probable that the cause of the claimant's cancer was not job-related.

¶26 Because we disagree with the court of appeals' interpretation of the breadth of the statutory presumption in section 8-41-209(2)(a) and of the employer's burden to overcome the presumption, we conclude that the court of appeals erroneously evaluated Littleton's evidence and erroneously failed to defer to the ALJ's findings of fact, which are supported by the record. We therefore reverse the judgment of the court of appeals and remand this case with directions to return the matter to the Panel for reinstatement of the ALJ's original findings of fact, conclusions of law, and order.

A. Standard of Review

¶27 "We review de novo questions of law concerning the application and construction of statutes." Hickerson v. Vessels, 2014 CO 2, ¶ 10, 316 P.3d 620, 623. Our purpose in interpreting a statute is to give effect to the legislative intent. Concerned Parents of Pueblo, Inc. v. Gilmore, 47 P.3d 311, 313 (Colo. 2002). To discern the General Assembly's intent, we turn first to the statutory language. Id. A comprehensive regulatory scheme such as the Workers' Compensation Act must be construed as a

whole to give effect and meaning to all its parts, and we avoid interpretations that render provisions superfluous. Wolford v. Pinnacol Assurance, 107 P.3d 947, 951 (Colo. 2005). Where the statutory language is clear and unambiguous, we do not resort to legislative history or other interpretive rules of statutory construction. Smith v. Exec. Custom Homes, Inc., 230 P.3d 1186, 1189 (Colo. 2010).

B. Compensation for Occupational Diseases Under the Workers' Compensation Act of Colorado

¶28 Under the Workers' Compensation Act of Colorado, an employee has a right to compensation for injuries or occupational diseases that "arise out of and in the course of the employee's employment." § 8-41-301(1)(c), C.R.S. (2015). Compensability under the workers' compensation scheme is therefore grounded in establishing the work-relatedness of an employee's injury or occupational disease.

¶29 Before the adoption of the Colorado Occupational Disease Disability Act in 1945, occupational diseases were not compensable unless the disease was viewed as an accident—a condition caused by some unusual or excessive exposure on the job. Anderson v. Brinkhoff, 859 P.2d 819, 822 (Colo. 1993). The rationale for treating occupational diseases differently rested on the difficulty in ascertaining the cause of the claimed occupational disease. Id.

¶30 In 1945, the legislature passed the Colorado Occupational Disease Disability Act, which made certain occupational diseases compensable. Ch. 163, sec. 9, 1945 Colo. Sess. Laws 432, 434. But even for the listed compensable diseases, the employer was not liable unless there was a "direct causal connection" between the occupational disease

and the conditions under which the work was performed; the disease could be seen to have followed as a “natural incident of the work” and as a “result of the exposure occasioned by the nature of the employment”; and the disease could be “fairly traced to the employment as a proximate cause” and not “from a hazard to which workmen would have been equally exposed outside of the employment.” Ch. 163, sec. 10, 1945 Colo. Sess. Laws 432, 435; see also Anderson, 859 P.2d at 822.

¶31 In 1975, the legislature repealed the Colorado Occupational Disease Disability Act but incorporated several of its provisions into the Workers’ Compensation Act, including the definition of “occupational disease,” now codified at section 8-40-201(14), C.R.S. (2015). Drawing nearly verbatim from the original 1945 definition, the Act still defines “occupational disease” as a disease directly resulting from a worker’s employment or work conditions:

“Occupational disease” means a disease which results directly from the employment or the conditions under which work was performed, which can be seen to have followed as a natural incident of the work and as a result of the exposure occasioned by the nature of the employment, and which can be fairly traced to the employment as a proximate cause and which does not come from a hazard to which the worker would have been equally exposed outside of the employment.

§ 8-40-201(14).

¶32 As we observed in Anderson, by retaining the original test for occupational diseases, the legislature chose to subject occupational diseases to a more rigorous test than accidents or injuries. 859 P.2d at 822. To be compensable, an occupational disease must meet each part of the definition in section 8-40-201(14), which effectively operates as an additional causal limitation to ensure that the occupational disease “arise[s] out of

and in the course of the employment.” Id. at 822–23; see also § 8-41-301(1)(c) (providing for the right to compensation where an “injury or death is proximately caused by an . . . occupational disease arising out of and in the course of the employee’s employment and is not intentionally self-inflicted”). Importantly, the definitional requirements of section 8-40-201(14) serve to limit the scope of occupational diseases to those that “result from working conditions which are characteristic of the vocation.” Anderson, 859 P.2d at 823 & n.4 (citing 1B Larson’s Workmen’s Compensation Law § 41.32 (1993) (explaining that the “important boundary” is that boundary “separating occupational disease from diseases that are neither accidental nor occupational, but common to mankind and not distinctively associated with the employment”). It is this proof of causation – the job-relatedness of an occupational disease – that “ensures that the Workers’ Compensation Act will not become a general health insurance act.” Id. at 823.

C. Section 8-41-209

¶33 In a typical workers’ compensation case, the claimant has the burden of establishing his or her entitlement to benefits by a preponderance of the evidence. § 8-43-201(1); City of Boulder v. Streeb, 706 P.2d 786, 789 (Colo. 1985). However, in 2007, the legislature made it easier for certain firefighters to recover benefits by enacting section 8-41-209, which modifies the burden of proof in a narrow class of cases involving certain types of cancer:

(1) Death, disability, or impairment of health of a firefighter of any political subdivision who has completed five or more years of employment as a firefighter, caused by cancer of the brain, skin, digestive system, hematological system, or genitourinary system and resulting from

his or her employment as a firefighter, shall be considered an occupational disease.

(2) Any condition or impairment of health described in subsection (1) of this section:

(a) Shall be presumed to result from a firefighter's employment if, at the time of becoming a firefighter or thereafter, the firefighter underwent a physical examination that failed to reveal substantial evidence of such condition or impairment of health that preexisted his or her employment as a firefighter; and

(b) Shall not be deemed to result from the firefighter's employment if the firefighter's employer or insurer shows by a preponderance of the medical evidence that such condition or impairment did not occur on the job.

§ 8-41-209.

1. Key Features of Section 8-41-209

¶34 Section 8-41-209 has several key features. As an initial matter, the statute applies to individuals who have been employed as firefighters for five or more years.⁶ § 8-41-209(1). Next, section 8-41-209(1) provides that the death, disability, or health impairment of such a firefighter caused by cancer of the “brain, skin, digestive system, hematological system, or genitourinary system” shall be considered an “occupational disease,” if the condition or health impairment “result[ed] from his or her employment as a firefighter.” Id. The firefighter's obligation under section 8-41-209(1) to establish that his condition “result[ed] from his or her employment as a firefighter” reflects the

⁶ Firefighters seeking compensation for an occupational disease who do not meet the requirements of section 8-41-209(1)—i.e., those who have completed fewer than five years of employment as a firefighter, or who suffer a job-related condition or health impairment caused by something other than a listed cancer—may proceed under other provisions of the Workers' Compensation Act.

basic requirement in section 8-41-301(1)(c) that, to be compensable, an occupational disease must “aris[e] out of and in the course of the employee’s employment.”

¶35 Section 8-41-209(2)(a) then creates a statutory presumption that the firefighter’s condition or health impairment caused by a listed type of cancer “result[ed] from [the] firefighter’s employment” if, at the time of becoming a firefighter or thereafter, the firefighter underwent a physical examination that failed to reveal substantial evidence of such condition or health impairment preexisting his employment as a firefighter. Thus, if a firefighter who suffers from a listed cancer can show that he meets the requisite years of service and physical exam conditions, then the statute establishes an inference that his cancer “result[ed] from [his] employment.” In effect, the presumption in section 8-41-209(2)(a) relieves a qualifying claimant firefighter of the burden to prove that his cancer “result[ed] from his or her employment as a firefighter” for purposes of establishing under section 8-41-209(1) that his condition is a compensable “occupational disease” under the Act. This statutory presumption logically presumes both specific causation (i.e., that the firefighter’s employment actually caused the firefighter’s specific condition or health impairment), and general causation (i.e., that the firefighter’s employment is capable of causing the firefighter’s condition or health impairment).

¶36 Importantly, however, the presumption of job-relatedness in section 8-41-209(2)(a) is not conclusive, or irrebuttable. Indeed, the General Assembly has established a conclusive presumption in a neighboring provision of the Workers’ Compensation Act. See § 8-41-206, C.R.S. (2015) (providing that any disability beginning more than five years after the date of injury “shall be conclusively presumed

not to be due to the injury,” with certain exceptions (emphasis added)). But it has not done so in the firefighter statute. Rather, section 8-41-209(2)(b) provides that the firefighter’s condition or impairment “[s]hall not be deemed to result from the firefighter’s employment” if the firefighter’s employer or insurer shows by a “preponderance of the medical evidence” that such condition or impairment “did not occur on the job.” In other words, section 8-41-209(2)(b) allows the employer or insurer to overcome the presumption of job-relatedness in section 8-41-209(2)(a) by a preponderance of the medical evidence.

2. Nature of the Presumption in Section 8-41-209(2)

¶37 The language of section 8-41-209(2)(b) shows that the presumption in section 8-41-209(2)(a) is not a “Thayer-Wigmore”⁷ presumption that shifts only the burden of production, as described in CRE 301. See CRE 301 (“In all civil actions and proceedings not otherwise provided for by statute . . . , a presumption imposes . . . the burden of going forward with evidence . . . but does not shift . . . the burden of proof in the sense of the risk of non-persuasion, which remains throughout the trial upon the party on whom it was originally cast.”); see also *Krueger v. Ary*, 205 P.3d 1150, 1154 (Colo. 2009)

⁷ Professors Thayer and Wigmore viewed presumptions as merely devices of procedural convenience to allocate the burden of production. Under the Thayer-Wigmore approach, once the opponent of the presumption introduces evidence refuting the existence of the presumed fact, the presumption drops out of the case, and the issue proceeds before the trier of fact without the presumption. See James Bradley Thayer, *A Preliminary Treatise on Evidence at the Common Law* 313–89 (1898); 9 John Henry Wigmore, *A Treatise on the Anglo-American System of Evidence* §§ 2490–2491 (3d ed. 1940); see also 21B Charles Alan Wright & Kenneth W. Graham, Jr., *Federal Practice and Procedure* § 5122.1 (2d ed. 2005) (discussing the “Thayer-Wigmore” theory of presumptions).

(discussing presumptions that shift the burden of production but not the burden of proof). Instead, section 8-41-209(2) creates a substantive, “Morgan”-type presumption⁸ that shifts the burden of persuasion to the employer regarding the job-relatedness of the firefighter’s condition or health impairment. In short, although the firefighter bears the overall burden of proving his claim for benefits under the Act, section 8-41-209(2)(b) shifts the burden to the employer to show that the firefighter’s condition is not job-related. Put differently, section 8-41-209(2)(b) allows the employer or insurer to overcome the presumption of job-relatedness in section 8-41-209(2)(a) by showing, by a preponderance of the medical evidence, that the firefighter’s condition or health impairment caused by a listed cancer “did not occur on the job.”

3. Employer’s Burden to Overcome the Presumption

¶38 The employer’s burden does not require an especially high degree of proof. Proof “by a preponderance of the evidence” demands only that the evidence must “preponderate over, or outweigh, evidence to the contrary.” Mile High Cab, Inc. v. Colo. Pub. Utils. Comm’n, 2013 CO 26, ¶ 14, 302 P.3d 241, 246. Without imputing any technical or mathematical meaning to the term “probable,” the widely accepted formula for expressing this burden of persuasion is “more probable than not.” Id. (citing Page v. Clark, 592 P.2d 792, 800 (Colo. 1979); In re Winship, 397 U.S. 358, 371-72 (1970);

⁸ Professor Morgan viewed presumptions to shift the burden of persuasion. Under his view, the presumption does not drop out of the case but remains as affirmative evidence. See Edmund M. Morgan, Some Observations Concerning Presumptions, 44 Harv. L. Rev. 906, 906-27 (1931); Wright & Graham, supra, § 5122.1 (discussing Morgan view of presumptions).

2 McCormick on Evidence § 339 (Kenneth S. Broun ed., 6th ed. 2006)). Thus, to meet its burden under section 8-41-209(2)(b), the employer or insurer must show that it is “more probable than not” that the firefighter’s condition or impairment “did not occur on the job.”

¶39 The employer can meet this burden to show that the firefighter’s condition “did not occur on the job” by overcoming either the statute’s presumption that the firefighter’s employment caused the firefighter’s particular condition or health impairment (i.e., specific causation) or that the firefighter’s employment is capable of causing the firefighter’s condition or health impairment (i.e., general causation).⁹ To establish the lack of specific causation, an employer can seek to show, for example, that the firefighter was not exposed to the substance or substances that are known to cause the firefighter’s condition or impairment, or that the medical evidence renders it more probable that the cause of the claimant’s cancer was not job-related. But nothing in section 8-41-209(2)(b) prohibits the employer from seeking instead to establish the lack of general causation by showing, by a preponderance of the medical evidence, that the firefighter’s work exposures are not capable of causing the firefighter’s condition or health impairment.

¶40 Christ contends that an employer is precluded from challenging the presumption in section 8-41-209(2)(a) that a general causal relationship exists between firefighting

⁹ Logically, the absence of general causation forecloses the possibility of specific causation. City of Littleton v. Indus. Claim Appeals Office, 2012 COA 187, ___ P.3d ___, 2012 WL 5360912, at *18 (Carparelli, J., dissenting); see also Norris v. Baxter Healthcare Corp., 397 F.3d 878, 881 (10th Cir. 2005) (“[W]ithout general causation, there can be no specific causation.”).

and cancers of the brain, skin, digestive system, hematological system, or genitourinary system, suggesting that the statute represents a “legislative declaration,” the scientific validity of which cannot be undermined. Relying on a line of out-of-state case law, the division majority similarly remarked that an employer cannot “challeng[e] the wisdom or the evidentiary foundation of the legislature’s decision.” City of Littleton, ¶ 33 (citing City of Frederick v. Shankel, 785 A.2d 749, 755 (Md. 2001); Linnell v. City of St. Louis Park, 305 N.W.2d 599, 601 (Minn. 1981); Robertson v. N.D. Workers Comp. Bureau, 616 N.W.2d 844, 855 (N.D. 2000); Sperbeck v. Dep’t of Indus., Labor & Human Relations, 174 N.W.2d 546, 549 (Wis. 1970)). These out-of-state cases, most of which trace their analysis to Sperbeck, involved differently worded presumptions for firefighters.¹⁰ The Wisconsin statute at issue in Sperbeck provided that, where a

¹⁰ Many states have enacted statutes governing occupational diseases of firefighters and establishing some form of presumption that the particular disease is work-related. A leading commentator notes that, of these various firefighter statutes, “[n]o two are quite identical.” 4 Larson’s Workers’ Compensation Law § 52.07[2]. Many of these statutes apply to heart and respiratory diseases, but not to cancer. See, e.g., Conn. Gen. Stat. § 7-433c (2016). Some states are contemplating legislation to add certain types of cancer to existing statutes. See, e.g., H.B. 5075, 2016 Leg. (Conn. 2016). Some statutes require the firefighter to show he or she was exposed to a known carcinogen. See, e.g., Ala. Code § 11-43-144 (2016). Some statutes require the firefighter to inform the department of his or her exposure to the known carcinogen. See, e.g., Ariz. Rev. Stat. § 23-901.01(B) (2016). The statutes vary considerably with respect to the quantum and level of proof required to rebut or overcome the presumption. See, e.g., Cal. Labor Code § 3212.1 (2016) (“[The presumption] may be controverted by evidence . . . that the carcinogen . . . is not reasonably linked to the disabling cancer.”); Idaho Code § 72-438 (2016) (requiring “substantial evidence to the contrary”); La. Stat. Ann. § 2011 (2016) (“This presumption shall be rebuttable by evidence meeting judicial standards”); Mo. Rev. Stat. § 87.006 (2016) (requiring “competent evidence” to the contrary); Or. Rev. Stat. § 656.802(4) (2016) (requiring “clear and convincing medical evidence that the condition or

qualifying firefighter’s disability or death was found to be caused by heart or respiratory defect or disease, “such finding shall be presumptive evidence that such defect or disease was caused by employment.” 174 N.W.2d at 547 n.2.

¶41 Unlike Colorado’s firefighter statute, the statute in Sperbeck contained no language regarding whether or how the presumption could be rebutted. Although the court in Sperbeck described the presumption there as rebuttable, id. at 549, it nevertheless reasoned that the presumption could not be rebutted by evidence that challenged the presumed general causal relationship between firefighting and heart disease; indeed, it suggested that the presumption could be rebutted only by evidence of specific causation. Id. (“Evidence which only attacks the rationale of the statute, without exposing the cause of death of a particular claimant, does nothing more than question the wisdom of the legislature.”).

¶42 The language of Colorado’s firefighter statute leads us to view the presumption in section 8-41-209(2) differently.¹¹ Although the legislature has established a conclusive presumption in a neighboring provision of the Workers’ Compensation Act,

impairment was not caused or contributed to in material part by the firefighter’s employment”). Some states provide no guidance beyond noting that the presumption is “rebuttable.” See, e.g., 40 Ill. Comp. Stat. 5/4-110.1 (2016). Several states instruct that regular tobacco use will undermine any statutory presumption regarding the work-relatedness of respiratory diseases. See, e.g., Mich. Comp. Laws § 418.405 (2016).

¹¹ We recognize that other states have construed their firefighter statutes differently. But as the Maryland Court of Appeals noted in City of Frederick v. Shankle, 785 A.2d at 756, the statutes around the country vary in their details, and hence, so have the decisions interpreting them. Any detailed analysis of out-of-state cases would require careful explanation of those statutory differences, and thus would be of marginal utility. Id.

see, e.g., § 8-41-206 (“[A]ny disability beginning more than five years after the date of injury shall be conclusively presumed not to be due to the injury.” (emphasis added)), nothing in section 8-41-209 suggests that the legislature intended to establish a conclusive presumption that a general causal link exists between firefighting and the listed types of cancer. And although the legislature has made express findings and declarations in other provisions of the Act, see, e.g., § 8-43-602, C.R.S. (2015) (“The general assembly finds, determines, and declares that insurer performance programs are used in marketing, sales, and other efforts, and, as such, may impact an employer’s selection of an authorized health care provider.”), section 8-41-209 contains no legislative declaration or express finding that cancers of the brain, skin, digestive system, hematological system, or genitourinary system result from occupational exposures associated with firefighting.

¶43 Instead, the legislature expressly provided in section 8-41-209(2)(b) that the firefighter’s condition or impairment “[s]hall not be deemed to result from the firefighter’s employment if the firefighter’s employer or insurer shows by a preponderance of the medical evidence that such condition or impairment did not occur on the job.” Thus, the legislative policy judgment reflected in section 8-41-209 was to relieve the claimant firefighter of the burden of proving that his condition “result[ed] from his or her employment,” and to shift the difficulty and expense of that burden to the employer to show that the firefighter’s condition did not occur on the job. See City of Littleton, 2012 WL 5360912, at *24 (Carparelli, J., dissenting). But nothing in the statute precludes the employer from attempting to meet this burden through medical

evidence that establishes that the firefighter's occupational exposures are not capable of causing the firefighter's condition or health impairment.

¶44 In this regard, epidemiological evidence is "highly probative because it considers human physiology and the likelihood that a potential environmental factor is capable of entering the body, traveling to a particular organ, and interacting with that organ in a way that can cause a particular cancer." *Id.* at *19; see also *Norris v. Baxter Healthcare Corp.*, 397 F.3d 878, 882 (10th Cir. 2005) ("While the presence of epidemiology does not necessarily end the inquiry, where epidemiology is available, it cannot be ignored. As the best evidence of general causation, it must be addressed."). An epidemiological cohort study, for example, compares disease rates in a population exposed to a substance with disease rates in a population that has not been exposed. The comparison yields a relative risk ratio expressed as: $\text{Relative Risk} = R1/R2$, where $R1$ = the risk of disease in the exposed population and $R2$ = the risk of disease in a non-exposed population. Gerald W. Boston, A Mass-Exposure Model of Toxic Causation: The Content of Scientific Proof and the Regulatory Experience, 18 Colum. J. Envtl. L. 181, 234-35 (1993). If the relative risk is greater than 1.0, the risk in the exposed group is greater than in the nonexposed group, and there is a positive association between the exposure and the disease. *Id.* at 235. A relative risk greater than 1.0 reveals only an association between the exposure and the disease, and not necessarily a causal relationship, given that other factors may be at work. *Id.* To determine if an association is causal, epidemiologists have developed criteria that treat the statistical association as

the starting point of the analysis and apply additional, more particularistic, analytical and biological tests before concluding a causal relationship exists. See id.

¶45 We conclude that employers may rely on epidemiological evidence to show the lack of an association or general causal relationship between known or typical substances to which the firefighter is likely to be exposed on the job and the firefighter's particular condition or impairment. The ALJ may then determine whether that medical evidence shows, by a preponderance, that the claimant firefighter's cancer "did not occur on the job." To construe section 8-41-209 otherwise contravenes its plain language and improperly converts section 8-41-209(2)(a) into a conclusive, or irrebuttable, presumption.

¶46 Importantly, we disagree with the court of appeals' conclusion that to overcome the presumption in section 8-41-209(2)(a), the employer must "disprove a wide and unspecified range of potential causes." City of Littleton, ¶ 100. The statute does not require the employer to prove that the cancer "was not, or could not have been, caused by anything that the firefighter encountered on the job." Id. at ¶ 36 (emphasis added). The division majority drew this conclusion because it reasoned that "[t]he statute contains no text that would limit the ways in which a firefighter is presumed to have gotten his cancer," but simply presumes the cancer "resulted from the firefighter's employment somehow." Id. at ¶ 26. But as discussed above, the presumption of job-relatedness in section 8-41-209(2)(a) serves only to establish, for purposes of section 8-41-209(1), that the firefighter's condition qualifies as an "occupational disease" under the Workers' Compensation Act. Thus, the scope of the presumption must be viewed in

light of the statutory definition of “occupational disease” in section 8-40-201(14), which we have previously recognized “limit[s] the scope of occupational diseases to those diseases which result from working conditions which are characteristic of the vocation.” Anderson v. Brinkhoff, 859 P.2d 819, 823 (Colo. 1993) (emphasis added). In other words, to qualify as an “occupational” disease, as distinguished from a disease “not distinctively associated with the employment,” see id. at 823 n.4 (quoting 1B Larson’s Workmen’s Compensation Law § 41.32 (1993)), the employee’s condition or impairment must result from known or typical workplace exposures.

¶47 When viewed in light of the definition of “occupational disease,” we conclude that the presumption in section 8-41-209(2)(a) does not, as the court of appeals reasoned, broadly presume exposure to any “unspecified substance or intangible agent.” City of Littleton, ¶ 28. Consequently, section 8-41-209(2)(b) does not require the employer to disprove causation from every conceivable substance or, as Judge Carparelli phrased it, from “all imaginable possibilities.” Id. at *19 (Carparelli, J., dissenting). If a firefighter’s exposure to a substance is speculative, remote, or illogical, then it is not typical of the occupation. Because the division majority erred in its understanding of the breadth of the presumption, it erred in its conclusion that section 8-41-209(2) requires the employer to prove that “the cancer was not, or could not have been, caused by anything that the firefighter encountered on the job.” Id. at ¶ 36 (majority opinion).

¶48 The burden imposed on the employer remains a formidable one because the employer is tasked with proving a negative. But by erroneously requiring the employer to disprove causation from “anything” to which the firefighter might conceivably have

been exposed, the court of appeals set an impossible bar, and effectively construed section 8-41-209(2) to establish a conclusive presumption.

¶49 In sum, we conclude that an employer can meet its burden under section 8-41-209(2)(b) to show that a firefighter's condition or impairment "did not occur on the job" by establishing, by a preponderance of the medical evidence, either: (1) that a firefighter's known or typical occupational exposures are not capable of causing the type of cancer at issue; or (2) that the firefighter's employment did not cause the firefighter's particular cancer where, for example, the claimant firefighter was not exposed to the substance or substances that are known to cause the firefighter's condition or impairment, or the medical evidence renders it more probable that the cause of the claimant's condition or impairment was not job-related.

D. Sufficiency of the Evidence

¶50 Littleton alleges that the court of appeals erred by concluding that Littleton's medical evidence was insufficient as a matter of law to overcome the statutory presumption in section 8-41-209(2)(a) and failing to defer to the ALJ's findings of fact. We agree.

¶51 Causation is an issue of fact for determination by the ALJ. Univ. Park Care Ctr. v. Indus. Claim Appeals Office, 43 P.3d 637, 640 (Colo. App. 2001). The ALJ has discretion to determine the weight to be accorded an expert medical opinion. Rockwell Int'l v Turnbull, 802 P.2d 1182, 1183 (Colo. App. 1990). The ALJ is the sole arbiter of conflicting medical evidence, and the ALJ's factual findings are binding on appeal if they are supported by substantial evidence or plausible inferences from the record.

Davison v. Indus. Claim Appeals Office, 84 P.3d 1023, 1031 (Colo. 2004); see also § 8-43-308, C.R.S. (2015) (“If the findings of fact entered by the director or administrative law judge are supported by substantial evidence, they shall not be altered by the court of appeals.”).

¶52 “Substantial evidence” is evidence that is probative, credible, and competent, such that it warrants a reasonable belief in the existence of a particular fact without regard to contradictory testimony or inference. City of Loveland Police Dep’t v. Indus. Claim Appeals Office, 141 P.3d 943, 950 (Colo. App. 2006); see also Benuishis v. Indus. Claim Appeals Office, 195 P.3d 1142, 1145 (Colo. App. 2008) (“Substantial evidence is that quantum of probative evidence which a rational fact-finder would accept as adequate to support a conclusion, without regard to the existence of conflicting evidence.” (citation omitted)). In applying this standard, an appellate court “must view the evidence as a whole and in the light most favorable to the prevailing party, deferring to the ALJ’s credibility determinations and resolution of conflicting evidence.” Benuishis, 195 P.3d at 1145.

¶53 We conclude that the ALJ’s findings in this case are supported by substantial evidence. At the hearing before the ALJ, Christ testified that he had been a firefighter for over twenty-five years and had served as a battalion chief for Littleton Fire Rescue for over ten years. When he was hired by Littleton in 1987, he underwent a physical examination that included blood work and chest x-rays. Christ underwent additional blood testing as part of HAZMAT physicals, and additional checkups through the City of Littleton’s voluntary Fit for Life program. Christ testified he was not aware of any

finding that he was at risk for cancer. He was diagnosed with brain cancer in December 2007 after undergoing an MRI scan and biopsy.

¶54 The expert witness testimony focused on the alleged causal connection between Christ's brain cancer and his exposure to carcinogens commonly associated with employment as a firefighter.

¶55 Christ presented two expert witnesses. The first expert, Dr. Virginia Weaver, an assistant professor at Johns Hopkins University and a physician specializing in occupational and environmental medicine, reported that firefighters are exposed to numerous substances that the International Agency for Research on Cancer ("IARC") categorizes as Group 1 chemicals, known to cause cancer in humans: arsenic, asbestos, benzene, benzo[a]pyrene, formaldehyde, and soot. She reported that firefighters are also exposed to Group 2A chemicals that are probable human carcinogens: 1,3-butadiene, creosote, diesel engine exhaust, and combustion products of wood. Dr. Weaver opined that firefighters have an increased risk of brain cancer and that Christ's "brain cancer is, more likely than not, work-related as a result of the toxic exposures he had experienced during his occupational activities as a professional firefighter." To support her conclusion that a causal link exists between Christ's brain cancer and his employment as a firefighter, Dr. Weaver relied on the LeMasters study, a meta-analysis¹² of cancer risks in firefighters. See Grace K. LeMasters et al., Cancer Risk Among Firefighters: A Review and Meta-analysis of 32 Studies, 48 J. Occupational &

¹² The LeMasters meta-analysis is a study in which the authors compiled and consolidated the information contained in thirty-two other studies.

Envtl. Med. 1189 (2006). This study reported a “summary risk estimate” of 1.32 for brain cancers.

¶56 Dr. Edward Arenson, a neuro-oncologist, also testified on Christ’s behalf as one of his treating physicians. He opined that “it’s more likely than not—in fact, it’s highly probable that there is a relationship between [Christ’s] occupational exposure and the diagnosis of glioblastoma.” His opinion was also based on the LeMasters study, although he acknowledged that the study does not use language of “cause and effect.”

¶57 Littleton presented two expert witnesses at the hearing before the ALJ and submitted a written report by a third expert. All of Littleton’s experts assumed that Christ was exposed to the list of Group 1 and Group 2A chemicals identified by Dr. Weaver as commonly associated with firefighting. These experts testified regarding the extensive investigation and study of carcinogens, the means by which the body absorbs such chemicals, the pathways by which those chemicals target particular organs, and the effects of those chemicals on particular organs.

¶58 The first expert, Dr. Denise Damek, a neuro-oncologist, opined that the LeMasters study, which suggested a possible increased risk of brain tumors in firefighters, was not designed to examine causation, and that “increased risk does not equate to causality.” She testified that nothing in the LeMasters study supports the conclusion that a causal connection exists between firefighter exposures and the development of brain cancer, or that Christ’s occupational exposures caused his brain tumor. She reported that “[n]o known or putative carcinogen has been definitely associated with brain tumor development in either humans or animals.” Although she

acknowledged that firefighters are exposed to carcinogens, it remains unknown if the brain is a target organ for these carcinogens. Moreover, even if the brain was clearly identified as a target organ for the specific carcinogenic exposures common to firefighting, it is unknown whether exposure through inhalation or the skin could reasonably impact the brain. Dr. Damek stated that the two recognized factors for an increased risk in developing brain cancer are ionizing radiation and genetically inherited syndromes, and noted that even Dr. Weaver, Christ's expert, found that Christ "did not have a family history of a tumor syndrome associated with malignant brain tumors and did not have a history of prior radiation treatment to his brain."

¶59 Dr. Javier Waksman, a physician specializing in internal medicine and medical toxicology, testified that to determine causation, one must establish and identify source, exposure, dose, and health effect. He reported that the standard conceptual framework to determine whether an exposure caused a medical effect requires (1) the presence of an unbroken pathway between the source of the contaminant and the point of exposure; (2) a calculation or measurement of the concentration of the chemical(s) at the exposure point; (3) a calculation or measurement of the dose received by the individual at the exposure point; and (4) an analysis of the health effects of the chemicals at such doses and the dose-response relationship of the chemical(s) under investigation. In Christ's case, Dr. Waksman noted that Dr. Weaver did not attempt to determine the exposure pathway or characterize the potential dose to which Christ was purportedly exposed. He nevertheless presumed that the "source" of workplace carcinogens would be the Group 1 chemicals identified by Dr. Weaver as commonly associated with firefighting.

Dr. Waksman then testified that the LeMasters study on which Christ's experts relied was not designed to determine causation. He further opined that current published epidemiological literature does not support an association between these Group 1 chemicals and GBM; indeed, there is no study that shows an association between brain cancer and the duties of being a firefighter.

¶60 Lastly, Littleton presented a report by Dr. Patricia Buffler, a professor of epidemiology. Dr. Buffler evaluated the available epidemiological studies pertaining to occupational exposures associated with firefighting and the possible association of these exposures with brain cancer. She noted that the authors of the LeMasters study classified the likelihood of brain cancer risk among firefighters as "possible," not probable. In her view, available epidemiological data, including the comprehensive review by LeMasters, do not support a conclusion that occupational exposures to chemicals associated with firefighting are causally associated with GBM or any form of brain cancer. Dr. Buffler reported that "[t]o date, ionizing radiation is the only known modifiable or environmental risk factor for glioma," citing exposure to "radiation from the atomic bombs in Hiroshima and Nagasaki" or "therapeutic radiation directed at the cranium" as the level of radiation high enough to increase risk.

¶61 In her "Findings of Fact, Conclusions of Law, and Order," the ALJ reviewed at length the opinions of all the parties' experts. She found and concluded that the testimony and opinions of Littleton's experts were clear, reliable, and well-founded by scientific evidence, and that each expert performed his or her own independent literature search, the completeness of which was not challenged or controverted by

Christ or his experts. The ALJ concluded that collectively, Littleton's expert witnesses established that the substances to which Christ was exposed did not target his brain and do not cause brain cancer. The ALJ concluded that Littleton's experts' opinions supported the conclusion that Christ's GBM condition did not arise out of his employment as a firefighter.

¶62 The ALJ considered and reviewed the opinions of Christ's experts, Dr. Weaver and Dr. Arenson, and noted that both experts relied heavily on the LeMasters meta-analysis as support for their opinions that Christ's GBM was caused by his employment as a firefighter, and that the LeMasters study supports only a possible increased risk of brain cancer for firefighters. The ALJ concluded, based on the testimony of Littleton's experts, that the LeMasters study does not support a causal association between the carcinogens commonly associated with firefighting and GBM. Based on the opinions of Littleton's experts, the ALJ ultimately concluded that Littleton met its burden of proof to establish by a preponderance of the medical evidence that Christ's brain cancer was not related to his employment.

¶63 We conclude that the ALJ's findings are supported by substantial evidence in the record. As the court of appeals recognized, Littleton's evidence supports a reasonable inference that Christ's brain cancer was not caused by any of the carcinogens commonly associated with firefighting. City of Littleton, ¶ 90. Specifically, the ALJ reasonably could have found that, if Christ encountered those substances, he likely absorbed them through inhalation or his skin; that there is no plausible biological pathway by which those substances, so absorbed, could affect the brain; and that those substances do not

cause brain cancer. Id. Thus, Littleton established, by a preponderance of the medical evidence, that Christ's condition "did not occur on the job" because it is more probable than not that his known or typical occupational exposures do not cause GBM, and the record supports a reasonable inference that Christ was not exposed to ionizing radiation in an amount equivalent to an atomic blast or a therapeutic dose directed at his cranium.¹³ Littleton was not required to do more to meet its burden under section 8-41-209(2)(b).

III. Conclusion

¶64 Because we disagree with the court of appeals' interpretation of the breadth of the statutory presumption in section 8-41-209(2)(a) and of the employer's burden to overcome the presumption, we conclude that the court of appeals erroneously evaluated the medical evidence presented by Littleton and erroneously failed to defer to the ALJ's findings of fact, which are supported by substantial evidence in the record. We therefore reverse the judgment of the court of appeals and remand this case with directions to return the matter to the Panel for reinstatement of the ALJ's original findings of fact, conclusions of law, and order.

¹³ We note that Christ does not argue, nor is there any evidence in the record, that he had a preexisting condition that was aggravated by his occupational exposures as a firefighter.