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Using Statistics to Determine Whether Causation is Adequately Proven in Medical Malpractice Actions Involving Multiple Events Preceding the Injury

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To prove medical malpractice liability, the plaintiff must establish through competent expert testimony that, to a reasonable degree of medical certainty, the plaintiff's injury was probably caused by the defendant's negligence. To have evidentiary weight, an expert's medical causation opinion must be supported by an adequate foundation demonstrating why the expert is reasonably certain that probable causation exists. This article discusses what this standard of proof means, how statistical analysis helps to determine when the standard for proving medical causation has been met, and how causation can be properly established in situations where multiple events precede the injury and each event in the sequence is dependent on the preceding event.1

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Reasonable Medical Probability

Medical malpractice is a form of professional negligence. Like any plaintiff suing in negligence, a plaintiff seeking to recover damages for medical malpractice must prove causation by a preponderance of the evidence. This requires a "show[ing] that defendants' breach of the standard of care was the cause, within a reasonable medical probability, of his injury."2

Although numerous published cases describe expert witnesses as testifying to a reasonable degree of medical certainty, showing a "reasonable medical probability" does not require proof of causation "to a 'medical certainty.'"3 Rather, a "reasonable medical probability" means there is at least a 51% chance that the defendant's breach of duty caused the injury, because a "possible cause only becomes 'probable' when, in the absence of other reasonable causal explanations, it becomes more likely than not that the injury was a result of [the defendant's] action."4 Proof "that there is some theoretical possibility the negligent act *could have been* a cause-in-fact of a particular injury is insufficient to establish causation."5

Reasonable medical *certainty* refers to the *confidence* level of the expert who is opining on the issue of whether a causal nexus between the alleged malpractice and the ensuing injury *probably* exists. It is a statistical term of art. Where there is very little data supporting an expert's opinion, the expert cannot have a high level confidence (i.e., a reasonable degree of medical certainty) that the data supporting an opinion of *probable* causation is not a fluke. But where there is an abundance of data, test results, and studies supporting the expert's opinion, the expert can testify with a high degree of confidence (i.e., a reasonable degree of medical certainty) regarding an opinion about probable causation.

Since questions of medical causation generally exceed the common knowledge of lay jurors, "[t]he law is well settled that . . . causation must be proven within a reasonable medical probability based upon competent expert testimony."6 Of course, an expert witness "does not possess a carte blanche to express any opinion within the area of expertise."7 Experts must not assume facts lacking evidentiary support and must not unduly speculate or guess; instead, they must tether a case's "factual predicates" to their ultimate conclusion by "reasoned explanation," "because an 'expert opinion is worth no more than the reasons upon which it rests.'"8

It is vital to examine expert witnesses to determine whether their opinions regarding medical causation are supported by an adequate foundation. Given the legal requirement of proving causation by a reasonable medical probability, it is advisable for experts to testify about the *relative certainty* of their opinions. *See, e.g., Maxwell v. Powers*, 22 Cal. App. 4th 1596, 1601 (1994) ("[Dr.] Orloff opined there was a better than 90% probability, to a reasonable medical certainty, that the kidney could have been saved had kidney surgery been performed on the day Maxwell was admitted to Scripps Hospital."). If experts do not initially volunteer to state the relative certainty of their opinions when they testify, counsel should follow up with additional questions designed to elicit that information. If, for example, an expert were to testify that he is 100% certain that the negligent failure to administer a particular drug caused an adverse result--because the one time that drug had been administered previously no adverse result occurred--counsel could object to the testimony on the ground that an opinion premised on a single data point lacks adequate foundation.9 If the court sustains the objection, the defendant might then be entitled to summary judgment, nonsuit, or a directed verdict, since plaintiffs generally must prove their cases using expert testimony.

Distinguishing Medical Probability from Statistical Confidence

In statistical terms, "confidence" reflects the degree of certainty that a particular outcome can be accurately predicted. In one case, for example, a plaintiff who suffered a spinal injury sued her treating physician for failing to administer a particular steroid treatment that allegedly would have prevented her partially-transected spinal cord from becoming completely transected. The plaintiff alleged that she would not have been ventilatordependent (needing 24-hour nursing care) had the steroids been promptly administered. Citing a particular medical study, the plaintiff's medical expert testified he was "95% certain" that the spinal cord would not have completely transected if the steroids had been administered. But the medical study relied on by the expert actually showed, to a statistical *confidence* of 95% (i.e., two standard deviations), that there was a 53% likelihood that the steroid treatment would be effective for spinal injuries. The expert's testimony was highly misleading, since it suggested there was a 95% chance that steroids would have been helpful. In fact, there was only a 53% chance that steroids would have made a difference. Effective cross-examination could have clarified this testimony by forcing the expert to admit, based on the very study he cited, that he was only 95% "sure" that there was a 53% "likelihood" that steroids would have prevented the spinal cord from becoming completely transected.

Statistical analysis can be used to test the certainty of an expert's testimony. For example, suppose an expert testifies that he is 99% sure that there is at least a 75% chance that a particular test or therapy would have lead to a particular result. Statistical analysis--using a well-established formula for calculating the number of observations required for a 99% confidence interval (where there is only a small random sample of a large population)--suggests that the expert's testimony may not be credible if his or her opinion is based on fewer than 1,875 observed cases.10

Proving that an expert's causation opinion is not credible based on the foundation for that opinion may require the testimony of a statistician. That is especially likely in cases involving a series of sequential events linking the alleged malpractice and the plaintiff's injury, the topic discussed next.

Applying the Reasonable Medical Probability Standard in Situations Where Sequential Events Precede the Plaintiff's Injury

Many malpractice cases involve a series of sequential events. One example is a delayed diagnosis case, in which a plaintiff alleges that the defendant was negligent for failing to administer a test that could have prompted an earlier diagnosis of a disease, and the odds of successfully treating that disease are greater the earlier it is diagnosed. The event of "treatment" is statistically linked to the event of "diagnosis," since a patient receives no treatment for a disease until it has been diagnosed.11 In such a case, analyzing the joint probability of sequential events (diagnosis and treatment) is an important tool in proving (or countering) medical causation.

The science of statistics teaches us that the probability that events A and B will happen in succession is determined by multiplying the probability that event A will happen by the probability that event B will happen if event A has already happened.12

An example helps to illustrate these principles, and to focus on the role that effective counsel can play in alerting a court to deficiencies in expert testimony and proof of causation.

> Example: A patient alleges that he would have had a better outcome if the defendant physician had not negligently failed to diagnose his cancer at stage one. At trial, the patient's expert witness opines that the defendant "probably" would have diagnosed the patient's stage-one cancer if he had ordered additional chest x-rays, as the standard of care required. On cross-examination, the expert clarifies that it was 70% probable that the diagnosis would have been made. The expert separately testifies that, if the patient had received treatment when his cancer was in stage one, he had a 60% chance of living five years or more.

In this example, the patient has failed to prove that a better treatment outcome within five years was reasonably probable because, while each event was probable in isolation, the chance that these events would occur in succession was just 42% (70% times 60%).13 Once the patient's expert clarified his opinion about the percentage chance that each event would occur, the defendant's counsel could move to exclude the expert for failing to offer opinions capable of showing--to a reasonable medical probability--that the patient's injury was caused by the defendant. Alternatively, the defendant's counsel could move for nonsuit or directed verdict (depending on the stage of the case) because the record lacked substantial evidence that the defendant's negligence probably caused the injury. Because causation must be proved by a preponderance of the evidence--by at least 51%--this case should not reach a jury.

In this example, the key element allowing the defendant to defeat the plaintiff's claim was defense counsel's crossexamination question pinning down the percentage chance of the first event. The expert's answer to that question enabled the defendant (and the court) to calculate the joint probability of all necessary events tying the alleged negligence to the eventual injury occurring in succession by multiplying the probability of each such event.

If defense counsel had not asked that crossexamination question, and the jury later returned a verdict for the patient, it is uncertain whether the patient's evidence of causation would be deemed sufficient as a matter of law on appeal.

The defendant would argue that the plaintiff's expert did not establish ultimate causation by a preponderance because he opined only that the likelihood of diagnosis was probable (meaning at least 51%), and multiplying 51% by the 60% chance of successful treatment results in a figure less than 50%. The premise of the defendant's argument would be that the patient's expert needed to supply the jury with the opinion that there was at least an 85% chance of diagnosis--a figure which, if multiplied by the 60% chance of successful treatment, would establish a 51% chance of a better outcome. Opining merely that the *diagnosis* was "probable"--51%-- disabled the patient from satisfying its ultimate burden of showing that a *better outcome* was probable. *See Reese v. Smith*, 9 Cal. 2d 324, 328 (1937) ("If the existence of an essential fact upon which a party relies is left in doubt or uncertainty, the party upon whom the burden rests to establish that fact should suffer, and not his adversary. A judgment cannot be based on guesses or conjectures.") (citation omitted).

In contrast, the patient would argue that his expert's opinion presented the jury with a range--it was between 51% and 100% probable that the defendant would have made the diagnosis if the standard of care had not been breached. Because appellate courts view the evidence in the light most favorable to the patient (the verdictwinner), it might be possible for the patient to argue that the jury reasonably believed that the "probable" result identified by the patient's expert was closer to 100% than to 51%, and that the jury was free to accept a higher figure based on its evaluation of the full evidentiary record and the expert's credibility.14

There does not appear to be a California decision answering this question definitively. But the question may be a close one, especially in cases where admitted negligence preceded a bad outcome, so there are benefits to both plaintiffs and defendants in pursuing alternate strategies to avoid having to confront this question directly.

From the perspective of plaintiffs' counsel, an expert may be able to avoid the type of problem depicted in the example by giving an overarching opinion about the ultimate probability that a deviation from the standard of care caused the injury, rather than offering discrete opinions about the likelihood of each causal factor contributing to that injury. Borrowing from the example above, if the patient's expert had instead opined that it was probable that the patient would have avoided a premature death from cancer if the defendant physician had not negligently failed to diagnose his cancer at stage one, a trial judge would likely allow the case to go to the jury.

This alternative approach would not, however, eliminate the defendant's ability to contest proof of causation. If the patient's expert offered such a global opinion, defense counsel would be free to cross-examine the expert about the probabilities of each necessary event in the causal chain. Cross-examination questions might elicit answers from the expert undermining the strength of his opinion. If those answers elicited opinions like those supplied in the example (a 70% chance of diagnosis and a 60% chance of successful treatment), then the defendant would have established solid grounds for challenging the admissibility of the expert's ultimate opinion of probability, allowing the court to conclude that the expert's initial causation opinion proved only that he was not well versed in statistics (or basic math).

Conclusion

Medical causation issues are becoming more common. Medical institutions are becoming increasingly complex, and many different specialists and health care providers are commonly involved in patient care. System failures, where different participants in a patient's health care fail to communicate effectively or efficiently, are increasing as health care systems become more diversified. In addition, the cost of medical testing continues to increase, which reduces the likelihood of redundant and prophylactic tests. Together, these circumstances may result in an increase in cases presenting medical causation issues involving delayed diagnosis or other causallycomplicated situations. Counsel must be prepared to confront the statistical aspects of expert testimony when such cases arise.

Consequently, counsel presenting or defending against medical malpractice claims should consider doing some or all of the following:

- Elicit from experts separate opinions about the cause of the ultimate injury and the cause of each necessary event in the chain of causation leading to the injury.
- Ask experts to pinpoint (with percentages, if possible and appropriate) the likelihood that key events or omissions caused or contributed to plaintiff's injury.
- Test the foundation for the expert's testimony, and carefully review any studies, texts, or reports that the expert purports to rely upon as a basis for his or her opinion. This is especially important when the case concerns new drugs, devices, or treatments.
- Employ statistical experts to fully understand whether causation theories are medically, factually, and statistically sound, and possibly to seek judicial notice of key statistical concepts and formulae, and to provide testimony educating the jury on these issues.
- Consider moving to exclude the testimony of experts whose opinions are unable to satisfy medical, statistical, and legal standards, either through motions in limine, pretrial hearings, or dispositive motions.

Endnotes

1 Referring to the joint probability of sequential events that occur sequentially, preceding an injury, not situations where any one of multiple events may have jointly contributed to an injury and each event independently could have caused the injury. *See Espinosa v. Little Co. of Mary Hosp.*, 31 Cal. App. 4th 1304, 1317-18 (1995) ("[In evaluating multiple *independent* causes leading up to the injury, because] defendants' conduct was a substantial factor in bringing about the outcome, Dr. Gabriel's inability to pin down the exact extent to which defendants' conduct contributed to the outcome is immaterial for purposes of *causation*. Clearly, where a defendant's negligence is a concurring cause of an injury, the law regards it as a legal cause of the injury, *regardless of the extent to which it contributes to the injury*."). This often-overlooked distinction is critical. Back

2 *Bushling v. Fremont Med. Ctr.*, 117 Cal. App. 4th 493, 509 (2004). Back

3 *Nelson v. County of Los Angeles*, 113 Cal. App. 4th 783, 792 n.7 (2003). Back

4 *Williams v. Wraxall*, 33 Cal. App. 4th 120, 133 (1995). Back

5 *Jennings v. Palomar Pomerado Health Sys., Inc.*, 114 Cal. App. 4th 1108, 1118 (2003) (citing *Saelzler v. Advanced Grp.* 400, 25 Cal.

4th 763, 775-76 (2001)). Back

6 *Jameson v. Desta*, 215 Cal. App. 4th 1144, 1166 (2013) (internal quotation marks omitted). Back

7 *Jennings*, 114 Cal. App. 4th at 1118. Back

8 *Id.* at 1117. Back

9 *Id.; Cottle v. Superior Court*, 3 Cal. App. 4th 1367, 1383 (1992). Back

10 The formula for determining the standard error of a proportion (for a small random sample of a large population) is óp = (pq/n)1/2, where óp is the standard error of the population, p is the probability of a success, q is the probability of a failure, and n is the number of observations. Plugging this testimony into the above formula: 0.01 = (0.75*0.25/n)1/2 and solving for n yields 1,875 observations. This means that, if the expert has observed fewer than 1,875 cases, then his or her testimony about being 99% confident may not be credible--though a more precise statistical analysis (by an appropriate expert) is needed to determine the actual confidence level under the circumstances. Courts may take judicial notice of such mathematical and statistical formulae. *See People v. Collins*, 68 Cal. 2d 319, 328-35 (1968). Back

11 The above situation involving a sequence of events preceding an injury contrasts with situations where multiple independent events are causally related to an injury. Imagine the following example: a ventilator-dependent patient suffers brain damage due to oxygen deprivation, which occurred because a technician failed to activate an alarm that should have sounded when the ventilator malfunctioned, and the nurse responsible for checking on the patient failed to do so. In that example, the negligence of the technician and the nurse are separate, independent causes of the injury; neither negligent act was dependent on the other, and each may be a substantial factor causing the subsequent injury. Back

12 *See, e.g., Collins*, 68 Cal. 2d at 325 & n.8; Richard I. Levin & David S. Rubin, A Short Course in Business Statistics 106- 07 (1983); Aczel & Sounderpandian, Complete Business Statistics 66-67 (7th ed. 2009); *Brzoska v. Olson*, 668 A.2d 1355, 1361 n.6 (Del. 1995). Back

13 Stated differently, there was a 58% chance that the negligent act made no difference to the outcome: there was a 30% chance that no diagnosis would have been made, plus a 40% chance of no better outcome in the 70 percent of cases that are diagnosed. (0.3 + (0.4 x 0.7) = 0.58). Back

14 *Cf. Collins*, 68 Cal. 2d at 323-35 (cautioning against the use of misleading or inapplicable statistical evidence that tends to strip the jury of its fact-finding function). Back

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