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NOTE

DECIPHERING DAUBERT'S DILEMMA: USING PROBABILITY AND STATISTICS TO ASSIGN LIABILITY WHERE A DEFENDANT HAS NOT MORE THAN DOUBLED THE LIKELIHOOD OF A PLAINTIFF'S HARM

Christopher Collins[†]

I. INTRODUCTION

After thirty-eight weeks of anxiety and preparation, the time has finally arrived. “Ten fingers and ten toes is all I ask, Lord.” The doctor emerges from the delivery room. “It’s a boy!” he exclaims. Weeks go by and all appears well. Your son eventually becomes accustomed to sleeping through the night. You become accustomed to the new demands on your time that a new child represents. However, after a few months, it becomes apparent that something is wrong. While most children his age are babbling, attempting to mimic their parents’ facial expressions, and performing other age-appropriate actions, your son appears reclusive and unresponsive. A trip to the doctor reveals your son suffers from autism. The cause is unknown and treatment options are limited.

For millions of American families, this scenario has become all too real. The incidence of conditions such as autism and attention deficit disorder (“ADD”) have increased exponentially over the past twenty years.¹ While

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1. See *Attention-Deficit/Hyperactivity Disorder: Data & Statistics*, CTRS. FOR DISEASE CONTROL AND PREVENTION, <http://www.cdc.gov/ncbddd/adhd/data.html> (last updated July 8, 2015) (“Rates of ADHD diagnosis increased an average of 3% per year from 1997 to 2006 . . . and an average of approximately 5% per year from 2003 to 2011.”); *Autism Spectrum Disorder (ASD): Data & Statistics*, CTRS. FOR DISEASE CONTROL AND PREVENTION, <http://www.cdc.gov/ncbddd/autism/data.html> (last updated Aug. 12, 2015) (noting that the incidence of autism among eight year olds increased from 1 in 150 in 2000 to 1 in 68 in 2010); *Latest Autism Statistics*, TALK ABOUT CURING AUTISM (Apr. 17, 2012),

speculation abounds regarding the reasons for the increase, ranging from immunization shots to artificial sweeteners, no definitive cause has yet been established. Suppose, however, that sufficient evidence were to emerge linking a particular product to a significant increase in a condition such as autism, ADD, or an even more debilitating disorder. Suppose further that research showed that children who were exposed to that product had a greater chance of developing the condition than those who were not exposed. Imagine how you would feel if you were told by your state supreme court that the product's manufacturer would not have to pay anything for producing the product that harmed your child. That is exactly what the plaintiffs in *Daubert v. Merrell Dow Pharmaceutical, Inc.*, were told, despite the fact that multiple studies linked an increase in birth defects to use of Bendectin—a drug their mothers had taken to combat morning sickness.²

This Note focuses on the unjust results of allowing restrictive notions of causation to insulate negligent businesses from liability in cases such as *Daubert*.³ Once a statistically significant connection has been established linking a product to a particular harm, all efforts should be made to ensure that those harmed by the product are made whole, to the extent that it is possible to do so. Using statistics⁴ and principles of equity, this Note seeks to explain how a system could be implemented which would provide a remedy to plaintiffs, while holding manufacturers accountable for the exact amount of harm which their negligence produced—no more and no less. Finally, this Note will look at the practical consequences of awarding less than the amount necessary to fully compensate victims for the harm that they have suffered.

<http://www.tacanow.org/family-resources/latest-autism-statistics-2> (estimating that only 1 in 1000 children were diagnosed with autism in 1995).

2. *Daubert v. Merrell Dow Pharm., Inc.*, 43 F.3d 1311 (9th Cir. 1995).

3. Currently, the Ninth and Eleventh Circuits maintain the more than doubling requirement, in addition to several states, including California and Vermont. See Andrew Jurs, *Judicial Analysis of Complex & Cutting-Edge Science in the Daubert Era: Epidemiologic Risk Assessment as a Test Case for Reform Strategies*, 42 CONN. L. REV. 49, 60 (2009). See also *Blanchard v. Goodyear Tire & Rubber*, 30 A.3d 1271, 1277-78 (Vt. 2011); *In re Lockheed Litig. Cases*, 10 Cal. Rptr. 3d 34, 36 (Cal. Ct. App. 2004).

4. The author taught high school mathematics for nineteen years before attending law school.

II. BACKGROUND

A. *Purpose of Tort Liability*

For as long as mankind has interacted in a social setting, people have acted in ways that hurt others, either intentionally⁵ or accidentally.⁶ To keep individuals from “tak[ing] the law into their own hands,” governments have instituted methods to make the victims of these acts whole, or to compensate them for their loss in cases in which the person or property damaged or destroyed cannot be restored.⁷ Additional reasons for providing remedies for injured parties include: “deter[ing] wrongful conduct; . . . encourag[ing] socially responsible behavior; . . . [and] restor[ing] injured parties to their original condition.”⁸ These principles are so inherent in our collective consciousness that we can rightly conclude that they originate not from the government, which protects our right to enforce them, but from a source that pre-exists the institution of government. In the foundational case of *Marbury v. Madison*, the Court held that “[i]t is a settled and invariable principle, that every right, when withheld, must have a remedy, and every injury its proper redress.”⁹

But what happens when government does not provide a remedy when one party has obviously wronged another? Are not the purposes for which tort liability was instituted inevitably defeated? Not only is wrongful conduct not deterred, but socially irresponsible behavior is encouraged and injured parties are left to defend themselves in their own strength, or not at all. As these cannot be the proper goals of a government that defends the weak against the strong,¹⁰ our society should extend every possible

5. *Genesis* 4:8 (King James) (“And Cain talked with Abel his brother: and it came to pass, when they were in the field, that Cain rose up against Abel his brother, and slew him.”).

6. *Exodus* 21:33-34 (KJV) (“And if a man shall open a pit, or if a man shall dig a pit, and not cover it, and an ox or an ass fall therein; the owner of the pit shall make it good, and give money unto the owner of them; and the dead beast shall be his.”).

7. VICTOR E. SCHWARTZ, KATHRYN KELLY, & DAVID F. PARTLETT, PROSSER, WADE AND SCHWARTZ’S TORTS: CASES AND MATERIALS 1 (12th ed. 2010).

8. *Id.*

9. *Marbury v. Madison*, 5 U.S. (1 Cranch) 137, 147 (1803).

10. JOHN LOCKE, TWO TREATISES OF GOVERNMENT 179 (5th ed. 1728) (“[W]here there is no law there is no freedom. For Liberty is to be free from Restraint and Violence from others; which cannot be, where there is no law: But Freedom is not, as we are told, A Liberty for every Man to do what he lists, (for who could be free, when every other Man’s Humour might domineer over him?) . . .”) (italics in original).

opportunity to provide relief and demand accountability where it is reasonably practical to do so.¹¹

B. *Daubert v. Merrell Dow Pharmaceuticals, Inc.*

In studying Torts, many law students are left with a profound sense that justice was not achieved in *Daubert v. Merrell Dow Pharm., Inc.* In *Daubert*, the plaintiffs, who were minors, sought to recover for birth defects that might have been caused by Merrell Dow's drug, Bendectin.¹² Even though the plaintiffs were not able to demonstrate that their particular injuries were caused as a result of their mothers having taken Bendectin while the plaintiffs were in utero, they presented evidence that suggested that Bendectin increased the occurrence of birth defects similar to the ones that they experienced.¹³ The Ninth Circuit held that the plaintiffs were precluded from recovery for two reasons. First, the evidence they presented did not meet the scientific standards necessary to prove causation.¹⁴ Second, under California law, which the court applied, the plaintiffs were required to prove not only that Bendectin increased the occurrence of birth defects, but that it "more than doubled" their occurrence.¹⁵

While the U.S. Supreme Court and nearly all legal publications have focused on the first issue,¹⁶ there has been little analysis devoted to curing the obvious injustice that allowed a negligent company, whose product is known to increase the occurrence of injuries, to escape liability. The Ninth Circuit acknowledged as much when it noted, "No doubt, there will be unjust results under this substantive standard. . . . [S]ome plaintiffs whose

11. *Greenman v. Yuba Power Prods., Inc.*, 377 P.2d 897, 901 (Cal. 1963) ("The purpose of such liability is to insure that the costs of injuries resulting from defective products are borne by the manufacturers that put such products on the market rather than by the injured persons who are powerless to protect themselves.").

12. *Daubert v. Merrell Dow Pharm., Inc.*, 43 F.3d 1311, 1313 (9th Cir. 1995). Ironically, the increased incident of birth defects resulting from using Bendectin appears to be so small that the plaintiffs in *Daubert* would be precluded from recovery even under the system that this Note proposes. See *Turpin v. Merrell Dow Pharm., Inc.*, 959 F.2d 1349, 1354-56 (6th Cir. 1992).

13. *Daubert*, 43 F.3d at 1320 ("[S]tatistical studies show that Bendectin use increases the risk of birth defects.").

14. *Id.* at 1314.

15. *Id.* at 1320.

16. See, e.g., *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 588-89 (1993); Suedabeh Walker, *Drawing on Daubert: Bringing Reliability to the Forefront in the Admissibility of Eyewitness Identification Testimony*, 62 EMORY L.J. 1205 (2013); David Paul Horowitz, "Will the Gatekeeper Let *Daubert* in?", N.Y. ST. B.J., June 2006, at 18; Henry G. Miller, *The Daubert Debacle*, N.Y. ST. B.J., March/April 2005, at 24.

injuries are attributable to the drug will be unable to recover.”¹⁷ The court was unwilling to dispense with the “more than doubling” requirement, however, stating that “[t]here is a converse unfairness under a regime that allows recovery to everyone that *may* have been affected by the drug.”¹⁸

In other words, it would be just as unfair to force manufacturers to pay for injuries that their products did not cause (at least with respect to a particular plaintiff) as it would be to prevent injured parties from recovering, knowing that some un-quantified portion of them were, indeed, harmed by the company’s drug. Under traditional tort law, it is necessary to prove that a plaintiff’s injuries were “more likely than not” caused by a particular defendant.¹⁹ This requirement ensures that a defendant will not be held liable for an injury unless the evidence demonstrates that they were most likely the cause of a plaintiff’s injuries. This is a difficult enough task when only a single source of injury is alleged. When, as in *Daubert*, similar birth defects occur naturally, proving that one’s injuries were caused by a particular defendant and not via natural causes is impossible.²⁰

In attempting to find a middle ground, California law allows plaintiffs to collect when they are able to show that a drug causes injuries similar to their own, but insists that plaintiffs prove that the drug “more than doubles” the incidence of those injuries among those who are exposed to it.²¹ On the surface, this seems reasonable. It satisfies the “more likely than not” requirement of traditional tort law and protects manufacturers from paying for injuries for which they are not responsible. Upon closer inspection, however, three major injustices result.

First, manufacturers whose products are known to increase the incidence of injuries to unsuspecting consumers are not held responsible for their actions. Second, innocent consumers, some of whom were harmed by the manufacturer’s negligence, are prevented from recovering for those injuries. Third, manufacturers whose products more than double the risk of suffering an injury are forced to pay for all plaintiffs’ injuries, despite the fact that a significant portion of those injuries are naturally occurring and are not in any way attributable to the manufacturers’ negligence.²²

17. *Daubert*, 43 F.3d at 1320 n.13.

18. *Id.* at 1320 (emphasis included in original).

19. *Id.*

20. *Id.* (“In the case of birth defects, carrying this burden is made more difficult because we know that some defects . . . occur even when expectant mothers do not take Bendectin.”).

21. *Id.* at 1320-21.

22. To illustrate this point, suppose a certain birth defect occurs naturally in 3 out of 1000 live births among those who are not exposed to a particular drug. Suppose further that among those who take a particular drug, 5 out of 1000 are born with that defect. Under the

Unable to solve this problem in a way that provided justice for all, the Ninth Circuit denied any recovery by these or similarly situated plaintiffs.²³ However, the solution to overcoming the more likely than not standard lay in the California Supreme Court's own precedent. Utilizing the principles of equity, the court had already solved this problem twice before in *Summers v. Tice*²⁴ and *Sindell v. Abbot Labs.*²⁵ Whereas the law is consistent and inflexible, "equity jurisprudence evolved as a means of avoiding injustices when meritorious claims failed to fit the rigid causes of action known at law."²⁶ The purpose of tort law is to make victims whole.²⁷ The purpose of equity is to provide justice to those whose injuries the law cannot remedy.²⁸ Recognizing the power of equity to overcome inflexible notions of causation, the court had twice before provided a remedy for plaintiffs when it found a strong connection between their injuries and the defendants' negligence.

C. *Summers v. Tice*

In *Summers*, the court was faced with the problem of how to provide justice for a man who was injured when it could not determine which of two defendants had caused the plaintiff's injuries. The plaintiff and the two defendants were using shotguns to hunt for quail on November 20, 1945.²⁹ Before the parties began to hunt, the plaintiff instructed the defendants how to shoot safely and of the importance of remaining "in line."³⁰ After ensuring that the defendants had a clear view of his position, one of the defendants "flushed a quail . . . [which] flew between plaintiff and the

holding in *Daubert*, none of those who exhibit this defect will be able to collect from the drug's manufacturer, even though 2/5 of those affected were, in fact, harmed by the manufacturer's drug. Under the same holding, if 7 out of 1000 are born with the defect, all plaintiffs may hold the manufacturer liable, even though 3/7 would have been born with the defect without any negligence on the part of the manufacturer. In the first scenario, the manufacturer escapes liability entirely, whereas in the second it is held liable for even those injuries that it did not produce.

23. *Daubert*, 43 F.3d at 1320-21.

24. *Summers v. Tice*, 199 P.2d 1 (Cal. 1948).

25. *Sindell v. Abbott Labs*, 607 P.2d 924 (Cal. 1980).

26. *Estate of Murray v. Spiegle*, 58 A.3d 1228, 1232 n.4 (N.J. Super. Ct. App. Div. 2013).

27. SCHWARTZ, KELLY, & PARTLETT, *supra* note 7, at 535.

28. CHRISTINA L. KUNZ & CAROL L. CHOMSKY, *CONTRACTS: A CONTEMPORARY APPROACH* 162-63 (2d ed. 2013).

29. *Summers*, 199 P.2d at 2.

30. *Id.*

defendants.”³¹ In attempting to shoot the quail, both defendants fired in the direction of the plaintiff from seventy-five yards away, striking the plaintiff in the eye and lip.³²

The court had no trouble concluding that the defendants had been negligent. The problem was in determining how to hold either of them accountable, since each was equally likely to have caused the plaintiff's injuries.³³ Under California law, the plaintiff was required to prove that a particular defendant was “more likely than not” the party responsible for having caused the plaintiff's injuries.³⁴ Since there was insufficient evidence to prove which defendant had harmed the plaintiff, there was a fifty percent chance that each individual had produced the harm.³⁵ Because fifty percent is exactly half, and not more than half, it was not “more likely than not” that either defendant had produced the harm.

Unable to determine which of the defendants had produced the plaintiff's injuries, the court placed the burden of proving causation on the defendants.³⁶ Abandoning the “more than doubling” requirement, the court reasoned that since both defendants had been negligent, and they were in a better position to determine which of them was liable than was the injured plaintiff, it would be unjust to prevent the plaintiff from recovering.³⁷ The court reasoned that “[t]o hold otherwise would be to exonerate both from liability, although each was negligent, and the injury resulted from such negligence.”³⁸

D. *Sindell v. Abbott Labs*

Over thirty years later in *Sindell*, the court found a creative way to provide justice for a class of victims whose mothers had taken diethylstilbesterol (“DES”). The Food and Drug Administration (“FDA”) approved DES for experimental use in 1947.³⁹ The FDA ordered DES manufacturers to stop producing the drug in 1971 after it found an

31. *Id.*

32. *Id.*

33. *Id.*

34. *LaPorte v. Houston*, 199 P.2d 665, 666 (Cal. 1948).

35. *Summers*, 199 P.2d at 5 (“[W]here the matter of apportionment is incapable of proof, the innocent wronged party should not be deprived of his right to redress.”).

36. *Id.* at 5.

37. *Id.* at 6.

38. *Id.* at 3 (emphasis omitted) (quoting *Oliver v. Miles*, 110 So. 666, 668 (Miss. 1926)).

39. *Sindell v. Abbott Labs*, 607 P.2d 924, 925 (Cal. 1980).

increased incidence of cancer in the children of Bendectin users.⁴⁰ The plaintiffs in *Sindell* alleged that the defendant manufacturers had marketed the product without warning of its potentially harmful effects and without communicating that it was an experimental drug.⁴¹

Although the plaintiffs demonstrated that DES was responsible for their injuries, they were unable to determine which manufacturer had produced the particular pills that their mothers had ingested.⁴² The court allowed the plaintiffs to continue by treating all manufacturers of DES as a single source of injury and attributing liability to each individual manufacturer based on that company's share of the overall DES market.⁴³ The court went on to provide that a defendant could escape liability entirely if it could show that it could not possibly have produced the drug that caused that particular defendant's injuries.⁴⁴ In fact, "one of the original defendants was dismissed from the action upon proof that it did not manufacture DES until after plaintiff was born."⁴⁵

The court reasoned that its response could be "either to adhere rigidly to prior doctrine, denying recovery to those injured by such products, or to fashion remedies to meet [the] changing needs" of an industrial society.⁴⁶ The court went on to cite Justice Traynor's concurring opinion in *Escola*, stating that "the traditional standard of negligence was insufficient to govern the obligations of manufacturer to consumer,"⁴⁷ reasoning that "between an innocent plaintiff and negligent defendants, the latter should bear the cost of the injury."⁴⁸

The *Sindell* court accomplished what the Ninth Circuit was unable to do fifteen years later in *Daubert*. The court provided a remedy to all plaintiffs who suffered the type of injuries that the defendants' negligence had produced, while requiring the defendants to pay for only that portion of the defendants' injuries that its own negligence produced.⁴⁹ In contrast, the Ninth Circuit in *Daubert* was unwilling to apply this reasoning, since it

40. *Id.* at 925-26.

41. *Id.* at 926.

42. DES was produced by over a hundred manufacturers and "was produced from a common and mutually agreed upon formula as a fungible drug interchangeable with other brands of the same product." *Id.*

43. *Id.* at 937.

44. *Id.*

45. *Id.* at 930.

46. *Id.* at 936.

47. *Id.* (citing *Escola v. Coca Cola Bottling Co.*, 150 P.2d 436 (1944)).

48. *Id.*

49. *Id.* at 937.

could not be proven that all plaintiffs were injured by the defendants' negligence. This was not required in *Sindell*. In fact, the court required that only those manufacturers who were collectively responsible for producing "a substantial share" of the total DES market be joined.⁵⁰ The court rejected the figures of seventy-five to eighty percent,⁵¹ suggesting that liability could be assigned even where another party or parties had produced more than twenty-five percent of the harm for which the named defendants would be held accountable.⁵² Nonetheless, the court was satisfied that "[e]ach defendant will be held liable for the proportion of the judgment represented by its share of that market . . . Under this approach, *each manufacturer's liability would approximate its responsibility for the injuries caused by its own products.*"⁵³ The *Sindell* court explained why this is the most equitable solution:

[I]f X Manufacturer sold one-fifth of all the DES prescribed for pregnancy and identification could be made in all cases, X would be the sole defendant in approximately one-fifth of all cases and liable for all the damages in those cases. Under alternative liability, X would be joined in all cases in which identification could not be made, but liable for only one-fifth of the total damages in these cases. X would pay the same amount either way. Although the correlation is not, in practice, perfect . . . , it is close enough so that defendants' objections on the ground of fairness lose their value.⁵⁴

The court dispensed with the traditional requirement of proving that a particular defendant was more likely than not the cause of each plaintiff's individual injuries. By pooling the plaintiffs and defendants into groups and assigning liability for the plaintiffs' injuries collectively, the court fashioned a remedy that ensured that each defendant was held accountable for the amount of damage that its products caused to the group as a whole.

50. *Id.*

51. This figure was suggested by a law review comment: Naomi Sheiner, Comment, *DES and a Proposed Theory of Enterprise Liability*, 46 *FORDHAM L. REV.* 963, 996 (1978).

52. *Sindell*, 607 P.2d at 925.

53. *Id.* (emphasis added).

54. *Id.* n.28 (quoting Sheiner, Comment, *supra* note 51).

III. PROPOSED SOLUTION

A. *Determining Sufficient Statistical Correlation*

Before adopting a new system for determining causation, the first thing to decide is how great an increase in the occurrence of harm should be required before relative liability⁵⁵ can be assigned. This determination depends on a number of factors used to calculate the likelihood that the imputed cause is actually responsible for at least part of the harm that the plaintiffs suffered. These factors include: the number of studies conducted; the sample size of each study; whether the sampled population fairly represents the overall, affected population; and the level of impartiality of the party conducting the study. This Note will consider only empirically objective factors, such as sample size and number of studies. The fact finder will have to weigh subjective factors, such as diversity and impartiality, to determine whether an individual study is sufficiently representative and impartial to permit it to be considered in the analysis. Included below is a brief discussion of standard deviations which demonstrates that certain results deserve heightened scrutiny.

1 Historically Sufficient Levels of Causation

In determining a level that fairly represents the amount of increased incidence of defects necessary to assign liability, examining other cases that have already addressed the question of certainty can be helpful. In *Sindell*, the court only required that a substantial percentage of market share manufacturers be joined.⁵⁶ Therefore, with respect to any given plaintiff, there was a ten percent chance that none of the parties held accountable were actually responsible for that party's injuries. This would also be true with respect to the class of plaintiffs as a whole. To be sufficiently reliable, therefore, a method need not produce a 100% correlation between plaintiffs allowed to recover and parties actually harmed by the defendants.⁵⁷ In *Summers*, the court required both defendants to pay for the plaintiff's injuries, even though only one of them produced the harm. The court

55. "Relative liability" is the term the author is using to refer to this theory.

56. *Sindell v. Abbott Labs*, 607 P.2d 924, 937 (Cal. 1980).

57. For example, if 400 people are victims and the defendants, as a class, represent 90% of the market share for producing the drug that caused their harm, then most likely 360 (90% x 400) of them were harmed by the defendants. That means that it is likely that 40 of them were not harmed by the defendants. Using the approach in *Sindell*, these 40 plaintiffs would also be allowed to collect for their injuries despite the fact that the defendants may not have been responsible for their injuries. Under *Sindell*, 10% is apparently an acceptable margin of error.

assigned liability even though it knew that one of the defendants would be required to pay for half of a plaintiff's damages which he had not caused.

In each of these cases, the court was concerned with "the practical unfairness of denying the injured person redress simply because he cannot prove how much damage each [defendant] did" and concluded: "[L]et them be the ones to apportion it among themselves."⁵⁸ The court held this to be especially equitable in instances in which it is impossible to determine which negligent act produced the harm, stating "[s]ince, then, the difficulty of proof is the reason, *the rule should apply whenever the harm has plural causes*, and not merely when they acted in conscious concert."⁵⁹ This same rule should apply in cases in which natural or unknown sources are among the "plural causes."

2. Calculating Sufficient Mathematical Causality⁶⁰

A few formulae are particularly useful in determining the accuracy of statistical samples. Among these are the Small Population Formula, the Chi Square Test, and the calculation of standard deviations among samples. Using these techniques, it is possible to analyze data to determine how reliable it is and what insight, if any, the data provides when determining how many of the potential victims were harmed by the manufacturer's product.

a. Small Population Formula: Calculating Margin of Error

The small population formula is used to calculate the margin of error in a sample that is significantly smaller than the total population it seeks to represent.⁶¹ This same formula is used to compute the margin of error in political polls. A smaller margin of error means greater accuracy.⁶² Using this formula, the margin of error can be calculated as $.98\sqrt{[(N-n)/(Nn-n)]}$,

58. *Summers v. Tice*, 199 P.2d 1, 3-4 (Cal. 1948).

59. *Id.* at 4 (emphasis added).

60. For this Note, the author has chosen to place the mathematical calculations in the footnotes, thus allowing for greater readability while allowing anyone who wishes to verify the accuracy of the calculations the ability to do so easily.

61. *How to Compute the Margin of Error (3 Easy Methods)*, eHow, http://www.ehow.com/how_5276026_compute-margin-error-easy-methods.html (last visited Oct. 17, 2015).

62. *Id.*

with “N” representing the total population represented and “n” representing the size of the sample group.⁶³

Suppose that in a town of 10,000 people, forty should, on average, contract a particular disease. Suppose further that in a sample of 1000 people, seven contract the disease. Leaving the issue of the significance of the result (7) for the next section, how reliable is a sample size of 1000 in representing the overall population of 10,000? Applying the formula yields a margin of error of 2.94%.⁶⁴ This means that whatever level of significance the result of “7” represents, it will only need to be adjusted, at most, by 2.94%, up or down.

The next step in the analysis is to determine how unusual a result of “7” would be, given that the expected number of persons per thousand evidencing the disease is 4 (i.e., 40 per 10,000 = 4 per 1000). To calculate this, it is first necessary to define the variables that will be used in the formula. The first variable, “n,” represents the number of people being sampled: in this case, 1000. The second variable, “r,” represents the number of people exhibiting the particular trait: in this case, 7. The third variable, “m,” represents the expected number of people exhibiting the trait in question: in this case, four.

A third expression, “ ${}_n C_r$,” represents the number of ways that r (7) selections can be arranged out of a total of n (1000) sampled. For example, the only two possible outcomes of a coin flip are “heads” and “tails”—each equally likely to occur. If a coin is flipped five times, how many ways could the result include exactly two heads? Mathematically, this could be expressed as “ ${}_5 C_2$,” and the result is 10.⁶⁵ Using these three expressions, n, c, and ${}_n C_r$, the probability of a specific number of outcomes occurring when the expected number is known can be expressed using the formula: $P_r = ((1 - (m/n))^{n-r} (m/n)^r ({}_n C_r))$.

Applying this formula yields the expression: $P_7 = ((1 - (4/1000))^{1000-7} (4/1000)^7 (1000 C 7))$. This is approximately equal to six percent.⁶⁶ This

63. *Id.* (“For example, suppose a small college has 2,500 students and 800 of them answer a survey. With the formula above, we calculate the margin of error to be $0.98\sqrt{[1700/2000000-800]} = .0286$ ”).

64. $MOE = .98\sqrt{[(N-n)/(Nn-n)]}$. Since “N”=10,000 and “n”=1000, $MOE=0.98\sqrt{[(10,000-1000)/((10,000)(1000)-1000)]}$. Simplifying yields $MOE = 0.98\sqrt{(9,000/9,999,000)} \approx .0294$ or 2.94%.

65. ${}_5 C_2 = (5!)/((5-2)!(2!)) = ((5 \bullet 4 \bullet 3 \bullet 2)/(3 \bullet 2)(2)) = 120/12=10$. The ten possible arrangements are: TTTHH, TTHTH, TTHHT, THTTH, THTHT, THHTT, HTTTH, HTTHT, HTHTT, and HHTTT. See ASHLEY SAUNDERS LIPSON, MATHEMATICS, PHYSICS AND FINANCE FOR THE LEGAL PROFESSION 163 (2011).

66. $(1-.004)^{993}(.004)^7(1000C7) = (.996^{993})(.004^7)(194,280,608,456,793,000) \approx .0595$.

means that in a sampling of 1000 people, with each person possessing a 4/1000 chance of exhibiting the trait, there is only a six percent chance that seven of those people would possess the trait. This is only the probability that *exactly* seven people will possess the trait; it does not account for the chances that more than seven people will possess the trait. To calculate the probability that *at least* seven people will possess the trait, it is necessary to calculate each of those possibilities separately and then add them all together. Each step farther away from the expected value (8, 9, 10 ...) yields a much smaller probability of that result occurring. In this case, the total probability of at least seven people showing signs of this disease out of a sample size of 1000 is approximately eleven percent.⁶⁷

This means that in a study of 1000 people, there is only an 8-14% likelihood ($11\% \pm 2.94$) that at least seven people would exhibit signs of this condition. Therefore, it is approximately 86-92% likely that this result signifies that this sample represents a deviation from the norm, suggesting that there are more people in the overall population carrying this condition than were expected. Since the only known difference between this sample of people and those among the general population is exposure to the drug in question, it is very likely that the drug is responsible for this increase.

While this does not provide absolute certainty that a drug has increased the incidence of an occurrence, this conclusion is far more likely than not to be correct. While it is *not* more likely than not that the manufacturer's product harmed any *individual* plaintiff, it *has* more likely than not contributed to the increase in occurrence of the specified disease or illness. It should be noted that the law has never demanded certainty before assigning liability. "More likely than not" allows for recovery in cases in which there is as much as a 49% chance that the defendant did not cause a plaintiff's injuries.

b. Chi Square Test

A second way of determining causality is by using the Chi Square Test (also referred to as the "Pearson test"). Statisticians often use this test to compare actual and expected values to determine if there is a significant statistical aberration between the two.⁶⁸ Among other things, the Chi Square Test can be used to evaluate: the existence of bias in jury selection; divergent treatment involving race or gender; the effects of drugs on humans and animals; and the significance of disparities in achievement.⁶⁹ Using the

67. $P_8 \approx .0297$, $P_9 \approx .0131$, $P_{10} \approx .0052$, $P_{1000} \approx .0019$.
 $\sum_7^{1000} ((.996)^{(1000-n)})(.004)^n (1000Cn) \approx .11$, or 11%.

68. *Bazile v. City of Houston*, 858 F. Supp. 2d 718, 738-39 (S.D. Tex. 2012).

69. *N.A.A.C.P. v. City of Mansfield*, 866 F.2d 162, 167-68 (6th Cir. 1989).

hypothetical example that was referenced in the previous section—with 40 out of 10,000 in the general population contracting the disease while 7 out of 1000 who are exposed contract it—the following table can be constructed.⁷⁰

	With Disease	Without Disease
General Population	“a” 40	“b” 9960
Exposed Population	“c” 7	“d” 993

Using this information, the formula for the Chi Square test is: $((ad-bc)^2(a+b+c+d)) / ((a+b)(c+d)(b+d)(a+c))$.⁷¹ This yields a Chi Square of approximately 1.923.⁷² By referencing a Chi Square distribution table, this means that a result as divergent as this should be expected to occur in between 10-20% of random samples.⁷³ This correlates very strongly to the result that was obtained in the earlier calculation of (11±2.94)%. Under Chi Square methodology, an arbitrary value of 5% is used to express the maximum value (called the alpha level) that represents a sufficient statistical aberration to signify a conclusive link between cause and effect.⁷⁴ Hence, in this hypothetical, the value of 8-14% would fail the test.

On the surface, it may appear that the result obtained depends upon which method is used. While this may be true in terms of the ultimate conclusion (pass/fail), the value obtained using either method is the same in terms of the likelihood that the drug is responsible for causing the disease. Both methods produced values between 10-20%. The only difference between the two methods is the significance attached to the outcomes. The Chi Square method requires a value that is no larger than 5%. The Small Population Formula has no such arbitrary minimum value. While the Chi Square Method is easier to calculate, the Small Population Formula yields a

70. The table is the author's own creation and has been constructed to provide an easy means of identifying the variables used in the Chi Square formula.

71. *Chi Square Statistics*, MATHBEANS PROJECT, <http://math.hws.edu/javamath/ryan/ChiSquare.html> (last visited Oct. 17, 2015).

72. $((40*993)-(9,960*7))^2(40+9,960+7+993)/((40+9,960)(7+993)(9,960+993)(40+7)) = ((39,720-69,720)^2(11,000))/((10,000)(1000)(10,953)(47)) = ((-30,000)^2(11,000))/(5,147,910,000,000) = (9,900,000,000,000)/(5,147,910,000,000) \approx 1.923$.

73. *Values of the Chi-squared Distribution Table*, MEDCALC, <http://www.medcalc.org/manual/chi-square-table.php> (last visited Oct. 17, 2015).

74. *Bazile v. City of Houston*, 858 F. Supp. 2d 718, 738-39 (S.D. Tex. 2012). See *Chi Square Statistics*, *supra* note 71.

more precise value (as opposed to a range of values). To illustrate the difference required to meet the Chi Square 5%, consider the following scenarios.

Instead of 7 out of 1000 people showing signs of the disease, suppose that 9 were affected. That would produce a Chi Square of 5.125,⁷⁵ which correlates to a likelihood of just under 5%,⁷⁶ a value that would meet the test. Another way to reach a sufficient level would be to increase the sample size. If, for example, 2000 people had been sampled and the same ratio of people showed symptoms, then there would be 14 people affected.⁷⁷ This would yield a Chi Square of 5.381,⁷⁸ representing a likelihood of just over 2%.⁷⁹ This drastic effect on probabilities shows how much the outcome is affected by sample size.

c. Standard Deviation: Calculating Consistency Between Samples

Of course, additional testing would also increase certainty. Not only would additional testing provide more samples, it would also provide a means by which the samples could be compared with one another to determine the consistency of results. The concept of consistency between repeated samples is referred to as “standard deviation.”⁸⁰

Samples whose results are highly consistent provide evidence that the results are trustworthy; conversely, samples with widely divergent outcomes cast doubt on the reliability of the results.⁸¹ Sometimes, the results of a single sample may be so far outside the mainstream of collected data as to increase suspicion of its validity. Such a result is called an “outlier.”⁸² Existence of an outlier could indicate that the sample was not chosen entirely at random, or that some form of bias or even human error entered

75. $\frac{((40 \cdot 991) - (9,960 \cdot 9))^2 (40 + 9,960 + 9 + 991)}{((40 + 9,960)(9 + 991)(9,960 + 991)(40 + 9))} = \frac{((39,640 - 89,640)^2 (11,000)) / ((10,000)(1000)(10,951)(49))}{(5,365,990,000,000)} = \frac{((-50,000)^2 (11,000)) / (27,500,000,000,000)}{(5,365,990,000,000)} \approx 5.125$.

76. See Values, *supra* note 73.

77. $7/1000 = .007$; $14/2000 = .007$.

78. $\frac{((40 \cdot 1,986) - (9,960 \cdot 14))^2 (40 + 9,960 + 14 + 1,986)}{((40 + 9,960)(14 + 1,986)(9,960 + 1,986)(40 + 14))} = \frac{((79,440 - 139,440)^2 (11,000)) / ((10,000)(1000)(11,946)(56))}{(7,358,736,000,000)} = \frac{((-60,000)^2 (11,000)) / (39,600,000,000,000)}{(7,358,736,000,000)} \approx 5.381$.

79. See Values, *supra* note 73.

80. Equal Emp't Opportunity Comm'n v. Am. Nat. Bank, 652 F.2d 1176, 1191 (4th Cir. 1981) (“As standard deviations increase numerically, the probability of chance as the cause of revealed underrepresentation of course diminishes.”).

81. LIPSON, *supra* note 65 at 220.

82. Kennerson v. Astrue, No. 10-CV-6591 MAT, 2012 WL 3204055, at *9 (W.D.N.Y. Aug. 3, 2012).

into the gathering and recording of the data.⁸³ The existence of an outlier could also merely indicate that the population sampled contained an unusually heavy or light concentration of people exhibiting the specific trait being tested.

Assume that in addition to the sample utilized above, nine more samples consisting of 1000 people each are taken. If the results of those samples were especially consistent it would lend confidence to the results. Suppose that the results were as follows: 67, 68, 73, 72, 50, 79, 100, 70, and 51. The average of the results would be “7” per thousand, the same as in the calculations of the previous sample.⁸⁴ By comparing the data from the ten groups, the consistency of the results can be calculated as the standard deviation.

Using the results in the previous paragraph, the standard deviation is approximately 13.3.⁸⁵ Since 68.26% of data is expected to fall within one standard deviation of the mean⁸⁶, or average (70), we should expect that the samples would return seven results⁸⁷ between 56.7⁸⁸ and 83.3.⁸⁹ In fact, there are exactly seven results in that range, with only “50,” “51,” and “100” lying outside it. To see how unusual these results are, we look to see if they are within two standard deviations of the mean. 95.44% of data typically fall within two standard deviations.⁹⁰ Here, that range is 43.4 to 96.6.⁹¹ It is expected that there would be either one or zero results lying outside that range.⁹² In this case, only “100” lies outside two standard deviations.

As is illustrated above, by calculating the standard deviation of a series of data samples, it is possible to express how consistent samples are and outliers can be identified. Deciding whether to include or discard outliers is an important decision since this decision affects both the mean and the standard deviation. For example, if the value of “100” is deemed to be too

83. LIPSON, *supra* note 65 at 219.

84. $(70+67+68+73+72+50+79+100+70+51)/9 = 700/10 = 70$.

85. $\sqrt{(\Sigma(X-M)^2/n)} = \sqrt{((02+32+22+32+22+202+92+302+02+192)/10)} = \sqrt{((0+9+4+9+4+400+81+900+0+361)/10)} = \sqrt{(1768/10)} = \sqrt{176.8} \approx 13.3$.

86. *Lesson 2: The Standard Deviation*, NOVA SOUTHEASTERN UNIV., <http://www.fgse.nova.edu/edl/secure/stats/lesson2.htm> (last visited Oct. 17, 2015); see LIPSON, *supra* note 65 at 182.

87. $68.26\% \times 10 \text{ samples} = 6.826$ (which rounds to 7).

88. $70-13.3$.

89. $70+13.3$.

90. See NOVA, *supra* note 86. See also LIPSON, *supra* note 65, p.182.

91. $2 \times 13.3 = 26.6$. $70-26.6 = 43.4$. $70+26.6 = 96.6$.

92. $100\% - 95.44\% = 4.56\%$. $4.56\% \times 10 \text{ samples} = .456$ which rounds to 0, but is very close to rounding up to 1.

far outside the mainstream of data (it lies more than two standard deviations outside the norm), the mean becomes 66.7⁹³ and the standard deviation becomes 9.24.⁹⁴ The new range of values that are within two standard deviations of the mean is 48.22 to 85.18.⁹⁵ The remaining nine samples are all within this range. Unless there is a compelling justification that explains why a value that lies outside two standard deviation of the mean should be included, it should be discarded as suspect.

B. Calculating Total Damages

Once a sufficient statistical correlation is established linking the drug to an increase in illness or disability, the next step is to determine the amount of the total harm for which the manufacturer is responsible. To do this, it is necessary to calculate the relative increase in harm, the total population that has potentially been effected, and the total amount of damage that those plaintiffs have suffered. Using these figures, a value can be assessed which represents the total amount of actual harm which the manufacturer's drug caused.

1. Determine The Relative Increase In Harm

Calculating the relative increase in harm is accomplished by comparing the presence of the disease or disability in the general population that has not been exposed to the manufacturer's product with its presence among those groups that have been exposed to it. In the main example above, after discarding the outlier of "100" for being too far outside the mainstream of data, the expected value is 40 per thousand and the measured value is 66.7.⁹⁶ This represents a relative increase of 26.7 per thousand.⁹⁷ Statistically speaking, that means that out of every 1000 people who were exposed to the manufacturer's product, approximately 26.7 of them became ill as a result of exposure.

2. Determine the Total Population Potentially Affected

Once the relative increase has been calculated, it is necessary to identify how many people have potentially been exposed to the product. This can be

93. $(70+67+68+73+72+50+79+70+51)/9 = 600/9 \approx 66.7$.

94. $\sqrt{(\sum(X-M)^2)/n} = \sqrt{((3.3^2+.3^2+1.3^2+6.3^2+5.3^2+16.7^2+12.3^2+3.3^2+15.7^2)/9)} = \sqrt{((10.89+.09+1.69+39.69+28.09+278.89+151.29+10.89+246.49)/9)} = \sqrt{(768.01/9)} \approx \sqrt{85.33} \approx 9.24$.

95. $66.7 - 2(9.24) = 66.7 - 18.48 = 48.22$. $66.7 + 2(9.24) = 66.7 + 18.48 = 85.18$.

96. See *supra* notes 70 and 82 with accompanying text.

97. $66.7-40 = 26.7$.

established in a number of ways, depending upon the nature of the contaminant and the manner in which it was delivered or distributed. For our purposes, we will assume that only the population of one small city (80,000) has been effected, perhaps as a result of pollution that reached the municipal water supply. We will further assume that all people have been equally exposed. Of course, the manufacturer will always have the opportunity to reduce the size of the class of potential plaintiffs by showing that it is impossible for groups or individuals to have been exposed.⁹⁸

3. Multiply The Increase By The Total Population Potentially Affected

If, as in the example above, an average of 26.7 out of every 1000 people in the city (of 80,000) have been exposed to a manufacturer's drug or other defective product, then approximately 2136 people will contract the disease or illness as a result the exposure.⁹⁹ Of course, it is highly unlikely that *exactly* 2136 people were directly harmed by the product. It is, however, the best estimate which is able to be calculated statistically given the data provided, and it is equally likely that this number is too low as it is that it is too high. As such, it represents a fair figure to be used for the purposes of calculating damages.

4. Determine the Average Harm Suffered per Person

Once the number of people who have actually suffered harm as a result of using a manufacturer's drug or other product, the next step is to determine the amount of harm that those individuals suffered. Since it is impossible to determine precisely which individuals were harmed, we must examine the total group that was affected in calculating damages. Taking this group as a whole, it will be necessary to calculate the total amount of harm which all of those individuals have suffered and will suffer in the future. This can be calculated according to traditional tort liability calculation methods, including compensatory and even punitive damages.¹⁰⁰ Once that total has been calculated, divide this figure by the total number of people in the group to determine the average harm suffered per person.

Using the hypothetical scenario referenced earlier, if there are 80,000 people in the town and 66.7 per thousand have contracted the illness or disease, then the total group size to be used for calculating damages is

98. *Sindell v. Abbott Labs*, 607 P.2d 924, 937 (Cal. 1980) (“[O]ne DES manufacturer was dismissed from the action upon filing a declaration that it had not manufactured DES until after plaintiff was born.”).

99. $26.7/1000 * 80,000 = 2,136$.

100. *State Farm Mut. Auto. Ins. Co. v. Campbell*, 538 U.S. 408, 416 (2003).

5336.¹⁰¹ Assuming that the total damages suffered by that group equals \$50,000,000, this figure is then divided by 5336 to determine the average harm suffered per person. This yields a value of \$9,370.31.¹⁰²

5. Multiply the Number of People Harmed by the Average Harm Suffered per Person

After determining the average harm suffered per person, that figure must then be multiplied by the number of those who have been harmed by the manufacturer's product. Since it has been determined that 2136 of that group were harmed by the manufacturer's defective product or negligent action, this would yield a total of \$20,014,982.16 which is directly traceable to the manufacturer's negligence.¹⁰³ This represents the manufacturer's total liability.

This total liability is less than half of the amount of total harm suffered because more than half of those affected were damaged by natural or unexplained sources. In a jurisdiction that requires a "more than doubling" of the occurrence of disease, the manufacturer would escape liability completely. As a result, none of those affected would receive anything to compensate them for their injuries. However, this raises another problem. If \$50,000,000 worth of harm is suffered and only \$20,014,982.16 collected, there is insufficient money to pay for all of the harm suffered by the entire group that has been affected. This means that each person in the group can be compensated for only a portion of the harm that the person has suffered. It must be kept in mind, however, that unless relative liability is used, these plaintiffs will receive no compensation at all.

C. *Apportioning Damages to Individual Plaintiffs*

Since the amount of damage suffered is greater than the money available to compensate those who have been injured, some organized system must be used to determine who receives how much of the total award. If all of the people exposed to the product who show signs of the disease file suit to recover for their injuries, distribution simply becomes a matter of assigning each plaintiff an amount equal to their individual damages, multiplied by the number of people injured by the defendant, and divided by the number of people in the class. Using the previous example, if an individual suffered \$38,000 in damages, then that person's share would be \$15,211.39.¹⁰⁴ If

101. $66.7/1000 * 80,000 = 5,336$.

102. $\$50,000,000 / 5,336 = \$9,370.31$.

103. $2,136 * \$9,370.31 = \$20,014,982.16$.

104. $\$38,000 * 2,136 / 5,336 = \$15,211.39$.

another person's injuries amounted to \$5,000, that person would receive \$2,001.50.¹⁰⁵ Each individual plaintiff will receive approximately 40% of his or her total injury, since that is the portion of the total group's injuries that has been attributed to the manufacturer.¹⁰⁶

In many cases, however, fewer than the total number of plaintiffs available to seek compensation for their injuries avail themselves of that opportunity.¹⁰⁷ Many decide that it is not worth the effort,¹⁰⁸ considering the cost of litigation¹⁰⁹ and the length of time between filing suit and collecting any potential award.¹¹⁰ Others are intimidated by the prospect of filing suit due to their lack of familiarity with the legal system.¹¹¹ Still others are completely unaware that a link has been established between their injury and a product with which they have come in contact.¹¹² For this reason, it is entirely possible that as few as 10% of those entitled to collect damages will choose to do so.¹¹³

Regardless of how many people ultimately sue, or whether they choose to do so individually, through joinder as an aggregate claim, or via a class action lawsuit, the amount paid to that group of people will be based on their total injury. For example, if only one person in the hypothetical chose to sue for his or her injuries, the amount of recovery would be based only on that person's damages. Whatever the individual's damages were calculated to be, he or she would be awarded just over 40%¹¹⁴ of that total. If ten people chose to join their claims together for greater efficiency,¹¹⁵ then the value of that group of ten would be calculated and the total would be multiplied by 40%, with each individual in the group receiving his or her share according to the value of his or her individual injury.

105. $\$5,000 * 2,136 / 5,336 = \$2,001.50$.

106. $2,136 / 5,336 = .4003$ or 40.03%.

107. Catherine R. Hecker, Note, *Wal-Mart Stores, Inc. v. Dukes: Taming "Too Big to Fail" Classes in the Battle Against Blackmail Actions And Frivolous Litigation*, 7 LIBERTY U. L. REV 49, 50 (2012).

108. DEBORAH R. HENSLER ET AL., CLASS ACTION DILEMMAS: PURSUING PUBLIC GOALS FOR PRIVATE GAIN 68 (RAND Institute for Civil Justice 2000).

109. STEFAN WRBKA ET AL., COLLECTIVE ACTIONS 3 (Cambridge Univ. Press 2012).

110. *Id.* at 6.

111. *Id.* at 4-5.

112. BRIAN ANDERSON & ANDREW TRASK, THE CLASS ACTION PLAYBOOK 194 (Oxford Univ. Press 2d ed. 2012).

113. Jay Tidmarsh, *Living in Cafa's World*, 32 REV. LITIG. 691, 708 n.67 (2013) ("Only about 10% of people with viable tort claims seek a lawyer's assistance.")

114. 40.02998%, to be exact.

115. See HENSLER ET AL., *supra* note 108, at 49.

If the number of potential plaintiffs is small and the amount to be awarded is large, individual suits may be profitable.¹¹⁶ But in situations where there is a large number of plaintiffs whose individual awards would be relatively small, the class action lawsuit is the most efficient mechanism for providing a means of holding manufacturers liable and providing relief for those affected by their negligence.¹¹⁷ Among its other virtues, class action lawsuits provide the best method of incorporating all potential plaintiffs whose claims enjoy a high degree of commonality into one cause of action.¹¹⁸ Such a system would ensure that no one is left out¹¹⁹ and that the negligent manufacturer will be held accountable for all injuries for which it is responsible.

If the plaintiff is seeking to recover as part of a class action lawsuit, then “both the representative plaintiffs and the counsel they have chosen owe absent class members a fiduciary duty to protect the absentees’ interests throughout the litigation.”¹²⁰ This includes trying to find all of those who might potentially have a claim and working to receive the largest award or settlement possible.¹²¹ Of course, all of this takes time and that time takes the form of legal fees, which amounts to less money available to distribute to the class. “Often class action litigation means only a big paycheck for lawyers, and little satisfaction for the injured clients.”¹²²

IV. PRACTICAL CONSEQUENCES OF ADOPTION

This section analyzes the effect relative liability will have on consumers, manufacturers and the legal system in general if it is adopted. Among the issues that will be addressed are the types of cases for which relative liability is best suited, the level of statistical correlation that will produce an adequate remedy, and the effect of only receiving partial compensation for victims. Finally, a case will be made that this method of computing and

116. Laura J. Hines, *The Dangerous Allure of the Issue Class Action*, 79 IND. L.J. 567, 572 (2004).

117. Natalie C. Scott, *Don't Forget Me! The Client In A Class Action Lawsuit*, 15 GEO. J. LEGAL ETHICS 561, 563-64 (2002).

118. See ANDERSON & TRASK, *supra* note 112, at 28.

119. See HENSLER ET AL., *supra* note 108, at 50.

120. *Barboza v. W. Coast Digital GSM, Inc.*, 102 Cal. Rptr. 3d 295, 299 (Cal. Ct. App. 2009).

121. *Eisen v. Carlisle & Jacquelin*, 417 U.S. 156, 175 (1974) (“[T]he express language and intent of Rule 23(c)(2) leave no doubt that individual notice must be provided to those class members who are identifiable through reasonable effort.”).

122. Scott, *supra* note 117, at 565.

assigning liability is the most just method for both consumers and manufacturers alike.

A. *Scenarios For Which Relative Liability is Best Suited*

In theory, relative liability could be used to assign liability to a manufacturer in instances in which there is only a 2% or 3% increase in the occurrence of illness or disease. While this indicates that at least some of those who are injured contracted the illness as a result of the manufacturer's product, the causal link is so slight and the amount of recovery is so small in comparison to the legal fees required to produce a recovery that it would be practically of no value to pursue these "negative-value" or 'small-stakes' class action suits."¹²³ Only in instances in which the number of people affected is vast or the amount of harm produced per person is very large would relative liability prove useful with only small increases linked to manufacturer negligence.

1. Cases In Which Multiple Studies Involving Large Sample Sizes Have Been Performed

Because of the injustice which would result from requiring defendants to pay for damages for which they are not responsible, it is important that enough data be collected to provide a high degree of certainty that the plaintiffs' injuries resulted from the defendant's negligence. Larger sample sizes yield smaller margins of error,¹²⁴ and multiple studies allow for the results of those studies to be compared in order to determine if any individual result is so far outside the mainstream that it should be discarded.¹²⁵

2. Class Action Lawsuits

Without question, the best use of relative liability is the class action lawsuit. The fact that the accuracy of the calculations depends upon aggregating large groups of potential claimants suggests that relative liability is particularly well adapted to class action suits. Larger numbers from a wide variety of people groups generates greater confidence in the results, a lower margin of error, and the opportunity to compare results to see if any of the samples are so far outside the rest of the data that they deserve additional scrutiny. All of this leads to greater certainty that the

123. Tidmarsh, *supra* note 113, at 719.

124. *See supra* Part III.A and note 61.

125. *See supra* Part III.A.

amount attributed to the manufacturer's negligence is an accurate representation of the harm for which that manufacturer is responsible.

Perhaps equally important is the opportunity it provides for alerting all potential claimants that such a link has been established. Federal Rule of Civil Procedure 23(c)(2)¹²⁶ requires that "the court must direct to class members the best notice that is practicable under the circumstances, including individual notice to all members who can be identified through reasonable effort."¹²⁷ Furthermore, Rule 23(a)(4) requires that "the representative parties will fairly and adequately protect the interests of the class."¹²⁸ At least in theory, this should ensure that all of those who have been harmed by being exposed to a product or contaminant will have the opportunity to receive appropriate compensation for that harm and that those claims will be pursued by someone with both the incentive and the ability to recover that compensation.¹²⁹

Responsibilities of the class representative include first and foremost a fiduciary duty of loyalty to the members of the entire class.¹³⁰ Because the success or failure of the action filed and pursued by the class representative will determine the ability of all members of the class to recover, it is essential that such a representative have no competing interests that might call into question his or her judgment. "If the class representative is not adequate, class members may find their valid claims barred by *res judicata*, or settled for less than their full value by a plaintiff with a weak claim or a clear conflict of interest."¹³¹

Such an individual must also have "the personal characteristics that class members would look for in a representative."¹³² Relevant factors include the class representative's knowledge of the case, his or her credibility and personal integrity, and whether the representative advocates remedies that

126. ADMINISTRATIVE OFFICE OF THE COURTS, *Class Certification in California* (2010), <http://www.courts.ca.gov/documents/classaction-certification.pdf> (noting that while FRCP Rules are not binding on state courts, "California certification standards and procedures have evolved to include substantial parallels to those of the federal jurisdiction, with the exception of the option for interlocutory appeal of the certification decision that is available in the federal court.").

127. FED. R. CIV. P. 23(c)(2)(B).

128. FED. R. CIV. P. 23(a)(4).

129. See ANDERSON & TRASK, *supra* note 112, at 33-34.

130. *Id.* at 34.

131. *Id.* at 33.

132. See *id.* at 34; see also *In re WorldCom, Inc.*, 358 B.R. 585, 604 (Bankr. S.D.N.Y. 2006).

would benefit the class as a whole or primarily the class counsel.¹³³ Anyone claiming the right to serve as class representative may be disqualified by the court upon motion of the defendant.

These precautions provide an excellent means of ensuring that as many people as possible will have the opportunity to collect for their injuries, and that the person leading that effort is both competent and loyal. In the process, it ensures that manufacturers will be held accountable for the total harm that their products cause. Establishing an accurate level of compensation is not only just, but it is essential to establishing the correct level of deterrence.¹³⁴

Another advantage of the class action lawsuit is its ability to produce consistency of outcomes.¹³⁵ Without it, the potential exists for plaintiffs to be awarded varying levels of compensation for their injuries, with some likely receiving no compensation at all.¹³⁶ By standardizing the process, and consolidating all potential claims for consideration, more resources may be invested in the process of determining the true proportion of the harm for which the manufacturer is responsible, and all plaintiffs' awards will be based on this determination.¹³⁷

Having stated this, there are a few disadvantages associated with the class action format. In particular, class action suits allow trivial or highly speculative injuries to be compounded by the specter of "huge financial exposure associated with these mega-lawsuits [to the point that] manufacturers feel forced to settle these claims rather than contest them."¹³⁸ In so doing, many good products are forced out of the market because of the fear of incurring litigation expenses.¹³⁹ Adopting relative liability may allow lawsuits to go forward in which only small increases in relative risk are alleged to have occurred since plaintiffs will not have to demonstrate that their risk of harm was not more than doubled by exposure to the manufacturer's product. While this is true, it is a price that must be weighed in the balance between enabling plaintiffs and promoting efficiency.¹⁴⁰ Of course, this concern could be greatly alleviated by implementing a minimum level of increased risk of harm required to bring a claim.

133. ANDERSON & TRASK, *supra* note 112, at 35-36.

134. See WRBKA ET AL., *supra* note 109, at 3.

135. See ANDERSON & TRASK, *supra* note 112, at 15-16.

136. *Id.* at 16.

137. *Id.* at 14-15.

138. See HENSLER ET AL., *supra* note 108, at 50.

139. *Id.*

140. *Id.*

3. Cases in Which The Increased Occurrence Is At Least 25%

Since manufacturers will only be held accountable for the amount of harm that they actually cause, situations will arise in which there is far more harm suffered than money collected to compensate all injuries suffered by those affected. In fact, if relative liability is used exclusively in cases in which the increase in occurrence is less than 100% (thus failing to meet the “more than doubling” requirement), the amount available will always be less than 50% of what would be required to fully compensate the victims.¹⁴¹ However, limiting application to these scenarios would be as equally unjust as is the current “more than doubling” requirement utilized in some jurisdictions, which allows for no recovery at all.

Nonetheless, there are practical considerations that make applying relative liability less attractive in certain situations, particularly those in which there is only a small increased occurrence. Although 25% is an arbitrary figure, suits involving less than this amount of increase would be difficult to pursue when applying relative liability. Not only is proving causation more difficult, but the amount ultimately awarded may be so small that it is not worth pursuing after all expenses are accounted for.¹⁴² This should not be viewed as a bright line rule, however, as it is conceivable that in cases with large individual damages such a suit may be economically feasible.

Another practical limitation involves cases in which nearly all of the increased occurrence of harm can be linked to the manufacturer. In such instances, it is practically certain that the plaintiff's harm developed as a result of being exposed to the manufacturer's product. Since causation is virtually certain, the somewhat reduced individual award may be viewed as an unwelcome complication that stands in the way of the plaintiff's complete restoration. The decision to impose either a floor or a ceiling is

141. The amount available, expressed as a ratio, will be equal to $P/(100+P)$, where P =the percentage of increase. For example, if exposure to a certain drug raises one's chances of contracting an illness by 20%, then the manufacturer is responsible for $1/6$ of the total harm suffered, because $(20/(100+20)) = 20/120 = 1/6$. If the drug resulted in a 50% increase in occurrence, then the manufacturer would be responsible for $1/3$ of the damages, because $(50/(100+50)) = 50/150 = 1/3$. At a 100% level of increased occurrence, representing an exact doubling, a person chosen at random who both consumed the drug and contracted the illness would be equally likely to have received his injuries from natural causes or from taking the drug. At this level, the manufacturer would be liable for $1/2$ of the harm suffered, because $(100/(100+100)) = 100/200 = 1/2$.

142. See HENSLER ET AL., *supra* note 108, at 463.

inherently a prudential decision that is best left for the legislature, not the courts.¹⁴³

Where relative liability clearly demonstrates its value is in cases between these extremes, particularly those in which causation is very nearly split between natural causes and the negligence of the defendant. Currently, a manufacturer that produces a drug which increases a patient's likelihood of developing an illness by 100% or less is subject to no liability in jurisdictions which have adopted the "more than doubling" requirement.¹⁴⁴ But if the drug increases the occurrence by just over 100%, the manufacturer is required to pay for all of the damages of those who took the drug and developed the illness. This policy lends itself to absurd possibilities.

Consider, for example, a manufacturer who markets and distributes a drug that is later found to cause skin cancer. Many people who did not take this drug also develop the same cancer. After many years and numerous studies, it is determined that taking the drug results in a 95% increase in the occurrence of this type of skin cancer. Furthermore, due to the length of time during which the drug was marketed, approximately 20 million people took the drug, with 300,000 of those developing this variety of cancer. In a jurisdiction which insists upon a finding that the cancer is "more likely than not" the result of taking the drug, the manufacturer would pay nothing.¹⁴⁵ Thus, despite the fact that it is readily demonstrable that over 146,000 people¹⁴⁶ contracted skin cancer due to using this drug, the manufacturer will not be required to pay anything toward their injuries.

Equally absurd is the fact that if the drug had been shown to be responsible for a 105% increase in skin cancer occurrence, the manufacturer would be responsible for paying for the injuries of all of the victims, despite the fact that over 146,000¹⁴⁷ of them contracted cancer through no fault of the manufacturer at all. Assuming an average award of \$50,000 per person, this would yield a judgment of \$15 billion dollars.¹⁴⁸ In this scenario, the

143. Jeffrey C. Tuomala, *Marbury v. Madison and the Foundation of Law*, 4 LIBERTY U. L. REV. 297, 329-30 (2010).

144. *Daubert v. Merrell Dow Pharm., Inc.*, 43 F.3d 1311, 1320 (9th Cir. 1995).

145. A 95% increase equates to a relative risk of only 1.95. Jurisdictions which adhere to "more likely than not" require a relative risk exceeding 2.0.

146. The ratio of cancer victims for which the manufacturer is responsible equals $(95/100+95) = 95/195 = 19/39$. Multiplying this by the total number of people who have skin cancer among those who took the drug yields $(19/39) * 300,000 = 146,153.846153847$.

147. In this case, the formula used to calculate the ratio of victims who were *not* harmed by the drug is $(100/(100+P))$, where P=the percentage of increased occurrence. $(100/(100+105)) = 100/205 = 20/41$. $(20/41) * 300,000 = 146,341.463414634$.

148. $300,000 \text{ victims} * \$50,000/\text{victim} = \$15,000,000,000$.

addition of fewer than 8,000 victims produced a result in which the manufacturer became responsible for all 300,000 victims.

Had relative liability been applied to these scenarios, this massive disparity of outcomes would have been avoided. In the first instance, the drug manufacturer would have been responsible for the injuries of the 146,154 victims that its drug was estimated to have produced. Using an average award of \$50,000 per victim, this would yield a judgment of \$7,307,700,000.¹⁴⁹ In the second scenario, the manufacturer would have been responsible for paying for the 153,659 victims¹⁵⁰ whose cancer was caused by using this drug. This would result in a judgment of \$7,682,950,000.¹⁵¹

By using relative liability, the increase of 7,505 victims¹⁵² resulted in an increased award of \$375,250,000,¹⁵³ the exact value that those claims should produce at \$50,000 each.¹⁵⁴ This is far more sensible and equitable to both the victims and the manufacturer than a shift from nothing at all to \$15,000,000,000. Of course, assigning less than 100% of the victim's harm to the manufacturer comes with its own problems. The primary drawback is that a victim may not have enough money available to completely pay for the treatment necessary to remedy his or her illness, assuming that such a remedy is available. However, this is not unlike the remedies produced in "comparative fault" jurisdictions when the plaintiff is determined to be at least partly responsible for his own harm.

B. Similarities to "Comparative Fault"

In fact, the practical application of relative liability bears a striking similarity to that of comparative fault. The use of "comparative negligence" developed from the abandonment of the doctrine of contributory negligence by most jurisdictions.¹⁵⁵ As of this writing, only Virginia, Maryland, North Carolina, Alabama, and the District of Columbia still hold

149. 146,154 victims * \$50,000/victim = \$7,307,700,000.

150. The ratio equals $(105/(100+105)) = 105/205 = 21/41$. $(21/41) * 300,000 = 153,658.536585366$.

151. 153,659 victims * \$50,000/victim = \$7,682,950,000.

152. 153,659 - 146,154 = 7,505.

153. 7,682,950,000 - \$7,307,700,000 = \$375,250,000.

154. 7,505 victims * \$50,000/victim = \$375,250,000.

155. *Williams v. Delta Int'l Mach. Corp.*, 619 So. 2d 1330, 1334 (Ala. 1993) ("[A]most every common law jurisdiction in the world and forty-six American states have replaced the outmoded doctrine of contributory negligence with some form of the doctrine of comparative negligence.").

to the contributory negligence doctrine.¹⁵⁶ In jurisdictions that still employ contributory negligence, a plaintiff who in any way contributes to his own injury is completely prevented from receiving any recovery.¹⁵⁷

By contrast, comparative fault assigns liability based upon the percentage of harm for which each party is responsible.¹⁵⁸ For example, if the plaintiff is 10% liable for his injury (perhaps due to speeding) and the defendant is responsible for the remaining 90% (due to running a stop light, for example), the defendant will be forced to pay for 90% of the plaintiff's injuries.¹⁵⁹ Some jurisdictions have placed limitations on the amount of fault that the plaintiff may be responsible for and still be allowed to recover.¹⁶⁰ Ironically, California has chosen to adopt pure comparative fault,¹⁶¹ yet it still clings to the "more than doubling" requirement. This logical inconsistency allows plaintiffs in California to recover even when they are primarily responsible for their own injury, yet absolves negligent manufacturers from liability unless the manufacturer's actions produced a majority of the harm. Each of these versions of comparative fault shares two things in common with relative liability. In both systems, plaintiffs receive less in damages than the total harm that they suffered. Also, in each system someone (or something) other than the defendant is at least partly to blame for the plaintiff's harm.

1. Plaintiffs Are Awarded Less Than 100% of The Harm Suffered

A fair concern about applying relative liability is that it may leave the injured plaintiff with less than the amount required to remedy the injury that he or she suffered. In fact, a person suffering \$100,000 in damages may

156. *Coleman v. Soccer Ass'n of Columbia*, 69 A.3d 1149, 1158 (Md. 2013) (Harrell, J., dissenting) ("A dinosaur roams yet the landscape of Maryland (and Virginia, Alabama, North Carolina and the District of Columbia), feeding on the claims of persons injured by the negligence of another, but who contributed proximately in some way to the occasion of his or her injuries, however slight their culpability. The name of that dinosaur is the doctrine of contributory negligence.").

157. *McIntyre v. Balentine*, 833 S.W.2d 52, 54 (Tenn. 1992) ("[I]f a party, by his own gross negligence, brings an injury upon himself, or contributes to such injury, he cannot recover; for, in such cases, the party 'must be regarded as the author of his own misfortune.'" (quoting *Whirley v. Whiteman*, 38 Tenn. 610, 619 (1858))).

158. 18 S.C. JUR. NEGLIGENCE § 30.

159. Donald G. Gifford & Christopher J. Robinette, *Apportioning Liability in Maryland Tort Cases: Time to End Contributory Negligence and Joint and Several Liability*, 73 MD. L. REV. 701, 709 (2014).

160. 18 S.C. JUR. NEGLIGENCE § 30.

161. 2 CAL. AFFIRMATIVE DEF. § 48:1 (2d ed.) ("California followed an all or nothing contributory negligence standard until 1975 when the Supreme Court adopted pure comparative negligence as the standard in *Liv. Yellow Cab Co.*").

only recover \$25,000 if the increased occurrence of the injury is only 25%.¹⁶² After taking into account the portion paid in attorneys' fees and court costs, this recovery will be even smaller. But this same concern is present when applying comparative fault, particularly in a jurisdiction that employs pure comparative fault.¹⁶³ From the plaintiffs' perspective, any amount available to help them recover is better than no recovery at all. From the defendants' perspective, knowing that they will be held accountable for even a small increase in harm to others will encourage more responsible behavior.

2. At Least Part Of The Harm Is Produced By A Source Other Than The Defendant

As is the case in comparative fault jurisdictions, defendants in relative liability cases are only responsible for the portion of the plaintiff's harm the defendant caused. With respect to relative liability, however, the other contributing source of harm is natural or unexplained as opposed to the plaintiff's own negligence. In both cases, liability is assigned in direct proportion to the total amount of harm actually produced by the defendant.

C. Effect on Business and the Public

Considering the similarity to comparative fault, the financial effects of implementing relative liability would likely be similar. Opponents of comparative fault suggest that adoption leads to an increase in lawsuits, costlier trials, and more numerous awards of damages.¹⁶⁴ This could lead to increased liability insurance premiums that may harm the state's economy.¹⁶⁵

1. Effect on the Court System

If the 25% minimum increase level is adopted,¹⁶⁶ the concern about frivolous lawsuits being filed solely for the purpose of promoting settlement will be greatly alleviated.¹⁶⁷ While it is almost certain that the number of

162. Ratio = $(25/100+25) = 25/125 = 1/5$. $1/5 * \$100,000 = \$20,000$.

163. Comparative Negligence/Fault, 2015 Prod. Liab. Rep. (CCH) ¶ 3030 (2009 WL 4034547) ("Under pure comparative fault, a plaintiff will not be barred from recovery, no matter how great his fault in causing his injuries, unless his conduct is the sole proximate cause of the harm. For example, if a plaintiff is 80 percent at fault and his total damages are determined to be \$100,000, the plaintiff will recover only \$20,000.").

164. See Gifford & Robinette, *supra* note 159, at 731.

165. *Id.*

166. See *supra* Part IV.A.

167. See Gifford & Robinette, *supra* note 159, at 734 ("Victor Schwartz, the leading commentator on comparative fault and, on most issues, the nation's leading proponent of

lawsuits will increase in jurisdictions which adopt relative liability, there is no reason to believe that the administrative costs per trial would be any different. In addition, the instances in which plaintiffs will be able to collect in cases in which they are currently barred will be offset by the reduced awards in cases in which the defendant's negligence accounts for only slightly more than half of the increased occurrence of harm. In some cases, defendants will pay substantially less if relative fault is adopted.¹⁶⁸

2. Effect on the Economy

Since the number of suits being filed will not increase substantially, the net effect on businesses will be driven primarily by the overall increase or decrease in awards that they are forced to pay. Overall, the amount paid out in damages will only increase if there are many more cases in which the increased risk is less than 100% than there are cases in which it is greater than that level.¹⁶⁹ In fact, the aggregate of payments will probably be less than that currently paid if a minimum threshold for the manufacturer's percentage of increase is adopted, similar to that employed in "slight/gross" and modified comparative fault jurisdictions.¹⁷⁰

If a 25% minimum increase requirement is imposed,¹⁷¹ using relative liability will only generate additional lawsuits when the increased harm is between 25-100%.¹⁷² This will produce recoveries between 25-50% of the total harm.¹⁷³ Meanwhile, manufacturers who are currently required to pay the entire expense of remedying the harm will experience a reduction in nearly half of future cases.¹⁷⁴ Among those whose damages are reduced, the

tort reform, states that the contention that comparative fault would create a greater flood of litigation or discourage settlement has been refuted.").

168. See *supra* Part IV.A and notes 148-52.

169. Cases in which the increased risk is less than 100% will generate at most a 50% recovery. Likewise, cases in which it is greater than that level will generate as much as a 50% savings.

170. In "slight/gross" comparative fault jurisdictions, the plaintiff may only collect if his own negligence is slight. In modified comparative fault jurisdictions, the plaintiff's negligence may be no more than that of the defendant. See Harrison Ford Hagg, *Slightly-Gross: South Dakota's Addiction to A Bad Comparative Negligence Law and the Need for Change*, 59 S.D. L. REV. 139, 146-47 (2014).

171. See *supra* Part IV.A.

172. Suits in which the relative increase is more than 100% are already allowed in all jurisdictions. If a 25% floor is employed, this would lower this requirement to that level.

173. $(25/(25+100)) = 25/125 = 1/5 = 20\%$. $(100/(100+100)) = 100/200 = 1/2 = 50\%$.

174. Any case in which the manufacturer's portion of the harm exceeds 50% will be eligible for a reduction in liability if relative liability is adopted. The amount of reduction will

amount of that reduction will be as high as 50%.¹⁷⁵ Because of these offsetting savings and expenses, the overall effect on the economy should be neutral.

3. Effect on Victims

The greatest effect of adopting relative liability will be felt by victims who are currently deprived of the opportunity to be made whole: those plaintiffs who receive no compensation for injuries which are clearly traceable to the actions of negligent manufacturers. Even a partial award will allow them to receive some help in recovering from the harm that they have suffered. While it may be insufficient to compensate them for their pain and suffering, it will help with medical treatment and possible lost wages.¹⁷⁶

4. Effect on Defendant Businesses

The greatest concern raised by those opposed to adopting relative liability and comparative fault is that imposing liability in cases in which suit is currently barred would drive up liability insurance premiums and that those costs would be passed along to consumers in the form of higher prices.¹⁷⁷ This concern has already been addressed previously and is only one of the factors to be considered in determining whether implementation of relative liability is appropriate. Perhaps the greatest effect to be weighed is what changes businesses will make in response to its adoption.

Some products will undoubtedly be driven from the market, just as they are today, but to an even greater extent.¹⁷⁸ However, this should only apply to those products that can be traced to at least some increase in consumer illness or injury. If the product is only marginally profitable before taking litigation expenses and possible payouts into consideration, it is probably not worth the offsetting harm that its use causes to society and to those who use it. Relative fault, then, will serve to cull products from the market that should not have been introduced in the first place.

More importantly, the ability to bring suit keeps manufacturers honest. Whether state or federal, most government agencies simply do not have the resources to monitor every product or service being offered within their

be equal to the amount of harm which occurs through natural or otherwise unexplained causes.

175. Since the manufacturer's savings will be equal to the amount produced by other sources it could approach 50%, since savings will only occur in cases in which the manufacturer is currently liable for more than 50% of the harm.

176. *United States v. Burke*, 504 U.S. 229, 235 (1992).

177. See HENSLER ET AL., *supra* note 108, at 50.

178. *Id.*

jurisdictions.¹⁷⁹ “Whereas *public* attorneys generally may be reluctant to bring meritorious suits because of financial or political constraint, *private* attorneys generally” are more than willing due to the prospect of financial gain.¹⁸⁰ As such, manufacturer liability suits act as a private regulatory agency.¹⁸¹

Finally, there is the moral imperative to hold those responsible who injure others through their actions, intentionally or otherwise. Allowing those who injure others to escape accountability for their actions promotes irresponsible corporate behavior.¹⁸²

The essence of corrective justice is that a party who wrongfully injures another must correct the wrong to restore the moral balance between the parties. Injurers cannot literally correct the wrong by healing the injury; liability is therefore imposed as a substitute for the previous bodily health and autonomy. Under contributory negligence, an injurer can be relieved of the burden of correcting her moral wrong.¹⁸³

Those who are only responsible for a small harm will only be assessed a small judgment. Efforts that reduce the harmful effects of products will be reflected in a reduction of liability imposed upon those who manufacture them.

Currently, there is no financial incentive for a manufacturer to take steps to lower the proportion of harm that its products cause unless it crosses the 50% threshold. For example, if the manufacturer’s proportion of harm is reduced from 45% to 25%, the manufacturer will still pay nothing. Likewise, if its percentage of harm is reduced from 90% to 55%, it will still pay for the entire harm. Either way, there is no financial incentive to make its products safer. If a jurisdiction adopted relative liability, each measure taken to make a product safer would be matched by a corresponding reduction in liability.

V. CONCLUSION

This Note has demonstrated how to prove with a fair degree of accuracy the portion of increased harm that a manufacturer’s product has produced in a class of victims. By adopting a minimum level of increased causation of

179. *Id.* at 72.

180. *Id.* (emphasis added).

181. *Id.*

182. See Gifford & Robinette, *supra* note 159, at 725-26.

183. *Id.*

25%, the concern of a flood of frivolous lawsuits may be avoided. Equity demands, and common sense dictates, that plaintiffs be compensated for the loss that they have sustained. By holding manufacturers responsible for the exact amount of harm that their products cause, they will be incentivized to employ safety measures which reduce the risk associated with use of their products, regardless of whether they cross the arbitrary 50% threshold. The time has come for courts to adopt relative liability and provide justice for those to whom it is currently denied.

