Title

Lost Chance of a Better Medical Outcome: New Tort, New Type of Compensable Injury, or New Causation Rule?

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Lost Chance of a Better Medical Outcome: New Tort, New Type of Compensable Injury, or New Causation Rule?[*]

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Abstract:

In an important category of medical negligence cases, such as cases of doctors negligently failing to diagnose a potentially fatal disease, the defendant significantly increases the risk of harm to the plaintiff, but that increase in risk is insufficient to satisfy the preponderance test of factual causation, which requires proof that but for the defendant's negligence, the plaintiff would not have suffered harm. For example, suppose a doctor's delayed diagnosis of cancer increased the risk of death to the patient from 30% (if the doctor had not been negligent) to 45%, and further suppose that there is no feasible way to determine whether the patient is within the group who would have died apart from that negligence or within the group who died because of the negligence. If the patient dies of cancer, the preponderance test of causation cannot be satisfied, because the doctor's negligence only increased the risk of death by 15 percentage points, and the patient is more likely to be in the 30% group of patients who would have died apart from that negligence.

Most courts that have addressed this issue have permitted partial damages in these cases, and I agree. But I disagree with the "subtraction" computation method that courts almost uniformly employ. In the example, they would award 15% of the damages that the plaintiff's estate would ordinarily receive if the plaintiff had been negligently killed in a fact pattern satisfying the preponderance test. In my view, the estate should receive 1/3 of ordinary damages, not 15%, because the chance that the doctor's negligence caused the death is more accurately computed by the ratio 15/45. The subtraction method, as compared to the ratio method, undercompensates plaintiffs.

My disagreement with the predominant judicial approach is not just a technical dispute about how to compute partial damages. The main reason that most courts give for endorsing the subtraction method is that the relevant legal injury that the plaintiff suffered was not the death itself, but the loss of a chance of avoiding the death. But this rationale is unpersuasive, because it relies on an ad hoc and unnecessary redefinition of the legal injury. Moreover, that redefinition has

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radical implications, potentially supporting tort liability whenever a negligent actor exposes people to harm, even if harm does not result.

The most persuasive justification for awarding partial damages in this special class of cases is that courts are fully justified in creating an exception here to the usual preponderance requirement for factual cause—just as they are justified in modifying that requirement in other well-accepted categories of cases, such as multiple sufficient tortious causes, uncertainty about which of two tortious defendants was the cause, and uncertainty about whether a plaintiff would have heeded a legally adequate warning. Thus, to answer the question posed by the title, recovery for a lost chance is best understood not as a new tort, and not as a new type of compensable injury, but as a new causation rule.

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I. Introduction and summary of argument

In an important category of medical negligence cases, such as cases of doctors negligently delaying diagnosis of a potentially fatal disease, the defendant significantly increases the risk of harm to the plaintiff, but that increase in risk is insufficient to satisfy the preponderance test of factual causation. Factual causation ordinarily requires proof that but for the defendant's negligence, the plaintiff probably would not have suffered harm. Consider the following two examples, which are identical except for the risk percentages:

> **Dr. Careless**[1] negligently fails to diagnose a patient's cancer. By the time the proper diagnosis is made six months later, the risk of death to the patient has increased from a 61% background risk of cancer to a 75% risk. Thus, Dr. Careless's negligence increased the risk of death by 14 percentage points, judged as of the time of his negligent misdiagnosis. The patient soon dies of cancer and the patient's family brings a lawsuit. There is no feasible way to determine whether the patient would have died anyway because of the background risk or instead died because of Dr. Careless's negligence.
>
> **Dr. Deficient** negligently fails to diagnose a patient's cancer. By the time the proper diagnosis is made six months later, the risk of death to the patient has increased from a 30% background risk of cancer to a 45% risk. Thus, Dr. Deficient's negligence increased the risk of death by 15 percentage points, judged as of the time of his negligent misdiagnosis. The patient soon dies of cancer and the patient's family brings a lawsuit. There is no feasible way to determine whether the patient would have died anyway because of the background risk or instead died because of Dr. Deficient's negligence.

In both cases, the family is unable to satisfy the preponderance test of factual causation, because they cannot show that if the doctor had not been negligent, the patient probably would not have died. This inability is easier to see in the Dr. Careless case. Here, the patient was likely to die quite apart from the doctor's negligence, for the simple reason that 61% > 50%. But plaintiff is also unable to satisfy the preponderance test in the Dr. Deficient case. Here, too, the family cannot show that Dr. Deficient's negligence was the probable cause of the patient's death. Why not? Because it is more likely that the patient was within the background risk group (30%) rather than the group (15%) that was made worse off because of Deficient's negligence, and because there is no feasible way to determine which group the patient belonged to.[2]

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[1] This example is based on one of the most-cited loss of chance cases, Herksovits v. Group Health Coop. of Pugent Sound, 664 P.2d 474 (Wash. 1983).

[2] If instead the delayed diagnosis increased the risk of death from 30% to more than 60%, the preponderance test *would* be satisfied. For example, if the negligence increased the risk from 30% to 70%, there is a 40/70 or 57% probability that the patient would not have died

Most courts that have addressed tort liability in these scenarios have departed from traditional tort law doctrine and have permitted the award of partial damages. But most courts have not permitted full damages—i.e, the full amount of damages that would be awarded in a more typical negligence case in which it was absolutely clear that the defendant's negligence was a factual cause of the death or other harm to the plaintiff. And a significant minority of courts have insisted that the traditional preponderance test should apply and have therefore denied any recovery. Under the traditional test, factual causation is an "all or nothing" issue, in the following sense: if it is more likely than not that plaintiff would not have been injured if defendant had not been negligent, plaintiff obtains full damages; but if this is not more likely than not, plaintiff obtains no damages.

Persuasive tort law policies support the solution that most courts have adopted in loss of chance cases[3] insofar as they award partial damages, rather than no damages or full damages. This paper will discuss these policies in greater detail, but for now, consider the following especially compelling justifications. The partial damage solution avoids the unfairness and inefficiency of permitting a pocket of legal immunity to exist in a significant and recurring category of cases—namely, cases in which (a) the doctor's negligence clearly increases the risk of harm to the patient, but does not increase that risk enough to be considered the probable cause of the ultimate harm the patient suffered, and (b) it is not feasible to determine whether or not the patient was within the class of individuals exposed to negligence who were actually harmed by that negligence. A strict application of the preponderance test would preclude any liability in all such cases.[4]

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but for the doctor's negligence. See Section IIe infra.

[3] Reference in this paper to "loss of chance" cases is meant as a shorthand, a neutral description of the types of medical malpractice cases in which plaintiff would not be able to prove the ultimate harm by a preponderance of the evidence and in which most courts award a partial damages remedy. Use of this terminology is not meant either to favor or to disfavor the view that the relevant legal injury is best understood, not as the ultimate harm that plaintiff might have suffered due to defendant's negligence, but as the loss of a chance of a better medical outcome. Further discussion will critique that specific view. See Section [] infra. Similarly, "loss of chance" is meant to embrace both cases in which the defendant's negligence reduces the chance of a better outcome and those in which it eliminates those chances. See Section [] infra. And this language includes judicial approaches that determine the relevant chance or probability both ex ante, as of the time of the defendant's negligence, and ex post, as of the time of trial. But as we will see, there are important differences between these subcategories and approaches.

[4] To be clear, in loss of a chance cases, either the background risk or the negligence of the defendant, but not both, caused the ultimate harm (such as the death of the patient). Very different policy considerations arise when a background risk and an actor's negligence have a *cumulative* effect. For example, environmental factors and a toxic agent might combine to cause a more serious harm than either the factors or the agent alone would have caused. Or a negligent driver might aggravate the plaintiff's preexisting back problem, causing greater pain. Or the tortious acts of *multiple actors* might have a cumulative effect. See Restatement Third, Torts: Liability for Physical and Emotional Harm § 28, Comment d (2010); Restatement Third, Torts: Medical Malpractice § 8, Comment h (Council Draft No. 1, 2023). Loss of a chance cases are more analogous to alternative-cause cases, in which either A's

Unfortunately, when courts specify a computation method for the factfinder to employ in determining the amount of partial damages, they require a particular method that is highly problematic. This standard method is what I will call **subtraction**.

Under the subtraction method, the factfinder first determines the patient's background risk of death from the disease if the defendant had not acted negligently (**B**), then compares this risk with the greater cumulative risk of death (**C**) that exists as a result of defendant acting negligently. By subtracting **B** from **C**, the factfinder arrives at the additional risk, as of the time of defendant's negligent conduct, that results from that negligence (**N**). The factfinder then computes the partial damage award by taking the following additional steps:

1. Determine the full damage amount **F**, which is the damages that the plaintiff's estate would ordinarily receive if the plaintiff had been negligently killed in a fact pattern clearly satisfying the preponderance test[5]; and
2. Multiply **F** by the percentage figure **N**.

In short, the partial award amount = **(C-B) x F**, or simply **N x F**

Thus, in the Dr. Deficient example, the factfinder would subtract B, or 30%, from C, or 45%, resulting in N, or 15%, the change in the risk due to the doctor's negligence (and determined as of the time of the doctor's negligence). Suppose full damages (F) would be $1 million. The actual damage award would then be:

$150,000 = 15% x $1 million = N x F

On first impression, this computation method and this result seem straightforward and plausible. But appearances can deceive.

This article will show that the subtraction computation method should not be used when the relevant ultimate harm (such as paralysis or death from cancer) has occurred as of the time of trial. And this scenario is very common. Thus, in the Dr. Deficient example, the patient's family should receive 1/3 or 33%[6] of ordinary damages, not 15%, because the chance that the doctor's negligence caused the death is 15/45. The proper analysis is to consider the ex post probability, *given the death of the patient*, that the doctor's negligence was the cause.

In this analysis, the factfinder should ignore the 55% chance, at the time of the doctor's negligence, that the patient would not die. Why ignore that chance? Because factual cause in tort negligence cases is an ex post determination of whether a defendant's negligence turned out to make a difference to whether plaintiff was harmed, and in the Dr. Deficient example, we know at the time of trial that the patient did die. Therefore, when awarding partial damages *at the time of*

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negligence or B's negligence caused the harm but it is not possible to determine which. See id., § 28(b), Comments f through l.

[5] Suppose, for example, that the factfinder was certain that a driver's negligence caused the death of the plaintiff.

[6] For ease of exposition, percentages have been rounded to the nearest whole number.

trial, the factfinder should ignore the ex ante chance, as of the time when the defendant acted negligently, that that negligence would *not* cause the death of the patient.

Generalizing from this example, the factfinder should employ what I call the **ratio method** instead of the subtraction method. The initial steps under both methods are the same. Under the ratio method, the factfinder again considers the background risk of death from the disease if the defendant had not acted negligently (**B**), and again compares this with the greater cumulative risk of death (**C**) that exists as a result of defendant acting negligently. And once again, the factfinder arrives at the additional risk due to negligence (**N**), which is determined as of the time of defendant's negligent conduct.

Under the ratio method, the factfinder then computes the partial damage award by taking the following steps:

1. Determine the full damage amount F (in the same manner as before); but then
2. Multiply **F** by the ratio **N/C**.

In short, the partial award amount = **(C-B)/C x F**, or simply **N/C x F**

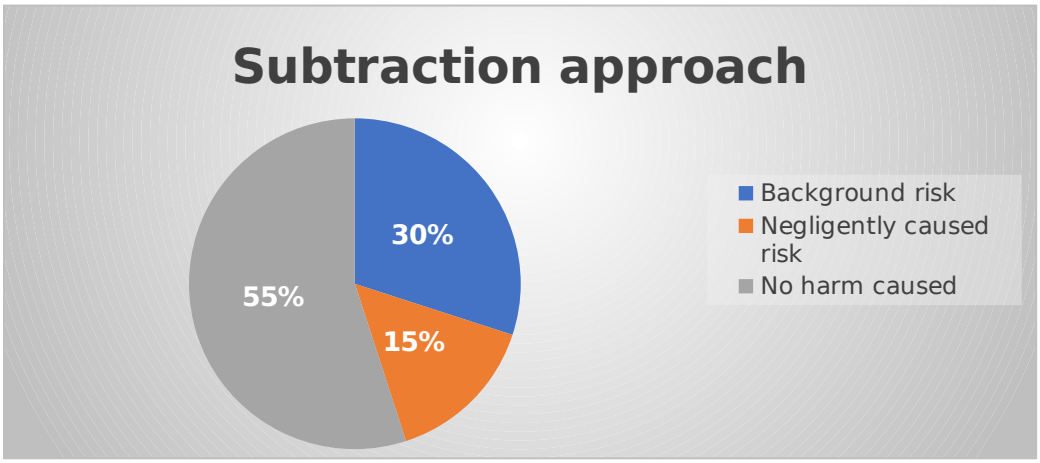
Crucially, step two of the ratio method differs from step two of the subtraction method, as the highlighted text reveals. I call this the ratio method because the partial damage award depends on the ratio N/C. By contrast, the partial award under the subtraction method depends only on N, which is the arithmetic result of subtracting B from C. The only difference between the two methods is in step two of the analysis.

Using the same $1 million figure for F as above, the ratio method would result in a substantially greater award than the subtraction method:

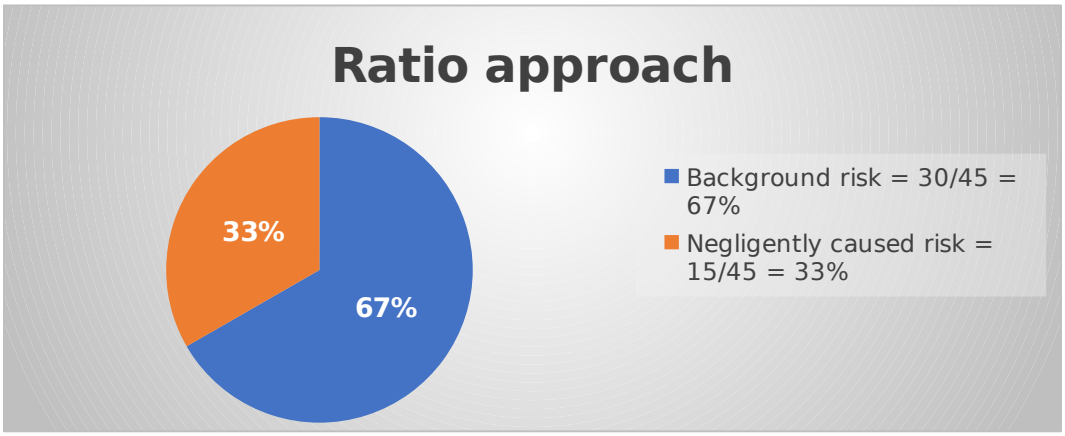
$333,333 = 15/45 x $1 million

By contrast, the subtraction method would result in a $150,000 award, as explained above.

Another way to grasp the difference between the subtraction and ratio methods is to consider the following charts, which illustrate the Dr. Deficient scenario.



The subtraction approach awards the patient's family 15% of full damages. This might initially seem plausible, but on reflection, it makes little sense. The factfinder should ignore the "no harm caused" grey portion of the graph (55%), because as of the time of trial, it is known that the patient is *not* in that segment, because the patient *has* suffered the ultimate harm. Instead, the chart should be resized to include only the relevant blue and orange segments, as follows:



The ratio approach awards the patient's family 33% of full damages, which is a much closer approximation than the subtraction approach of the harm that the negligent doctor caused.[7]

The damages awarded under the ratio method will always be at least as great as the damages awarded under the subtraction method, and they will sometimes be substantially greater. The mere fact that the ratio method is more generous to plaintiffs[8] is not, of course, a sufficient reason to favor the ratio approach. But I will

[7] Similar charts also help illuminate the way in which a medical practitioner's negligence affects the ex ante probability, determined at the time of that negligence, that the patient will suffer harm *in the future*. See Appendix B, section 1.

[8] This paper occasionally uses the term "plaintiff" not only for the plaintiff in the lawsuit but also, in a case where the patient has died, for the decedent. In the latter case, the actual plaintiff will be the estate or the family members of the decedent. This simplifying terminology permits a more concise analysis that embraces both cases in which the patient

argue in this paper that the ratio approach is far preferable to the subtraction approach because it requires compensation from negligent defendants in an amount that most closely approximates the harm that the defendant's negligence has caused, and is therefore more consistent with the fairness and efficiency principles underlying negligence law.

This paper thoroughly explores the relative merits of these two computation methods. My disagreement with the predominant judicial subtraction approach is not just a technical dispute about how to compute partial damages. It is also a substantive objection to how most courts adopting the subtraction approach conceive of the relevant legal injury. To appreciate these more fundamental issues, it is helpful to step back and consider why courts endorse a partial damages remedy for loss of chance cases in the first place.

Courts endorse a partial damage remedy in these cases for a variety of reasons. Among the most compelling reasons is the concern to avoid a pocket of legal immunity in a recurring category of cases. In the Dr. Careless example and similar cases, the patient's family will *never* be able to prove that the doctor's negligence was, more likely than not, the factual cause of the patient's death, because the background risk of death even in the absence of negligence was greater than 50%.[9]

Another (and related) reason why courts endorse a partial damage remedy is that negligent medical practitioners ought to pay for the harms that they cause, both as a matter of fairness and as a matter of incentivizing optimal levels of care. The best way of achieving this goal is to identify precisely those patients who were *in fact* made worse off by the defendant's negligence and then award them full damages. But in loss of chance cases, this solution is, by definition, not feasible. Accordingly, most courts justifiably turn to the second-best solution: award partial damages to all plaintiffs who *might* have been made worse off by defendant's negligence.

If courts are relying on these two rationales, avoiding pockets of immunity and requiring negligent defendants to pay compensation that most closely approximates the harm that they have caused, the ratio method is far superior to the subtraction method. The reason is straightforward: in many cases, the subtraction method significantly undercompensates plaintiffs and results in negligent defendants paying too little in compensation, as compared to the ratio method.

If I am correct that the subtraction method is clearly deficient in these ways, why have courts so widely employed it? Perhaps the most important reason, we shall see, is that they have not realized that the ratio method is a viable alternative,

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dies and those in which the patient suffers a nonfatal serious injury.

[9] The same point also applies, but less obviously, in the Dr. Deficient example, if doctors like Dr. Deficient repeatedly encounter similar probabilities (30% background risk, 15% risk due to negligence) at the time that they fail to act with reasonable care. So long as a doctor repeatedly faces scenarios in which failure to use reasonable care increases the risk of harm but does not increase the risk enough to satisfy the preponderance test, the problem of a pocket of legal immunity arises.

an alternative that more effectively furthers the policies and expresses the principles that underlie the decision to award partial damages in loss of chance cases.

But there is another possible explanation for why courts have employed the subtraction method. In permitting the award of partial damages even though the plaintiff is unable to satisfy the preponderance test for factual causation, courts are quite understandably worried about undermining traditional tort law proof requirements. Plaintiff ordinarily must prove all the elements of a tort by a preponderance of the evidence, and factual cause is one of those elements. If courts permit a partial damage remedy in cases of loss of a chance of a better medical outcome, it might seem that they are now committed to permitting this unusual remedy in *every* case where plaintiff can readily prove that the defendant was negligent and that that negligence increased the risk that plaintiff would suffer harm, but cannot prove factual causation by a preponderance.

To avoid this slippery slope, most courts that endorse partial damages employ a novel doctrinal strategy: they redefine the legal injury that plaintiffs have suffered in loss of chance cases. Specifically, they assert that the relevant legal harm or injury that the plaintiff suffered was not the death itself, but the loss of a chance of avoiding the death. On this view of the relevant injury, the defendant *did* cause the injury (the lost chance), and the plaintiff can prove *this* causal connection by a preponderance. And on this view, the lost chance should be valued as of the time of the doctor's negligent act, thus supporting the subtraction method.

However, on closer examination, this rationale for partial damages is unpersuasive. Although this strategy succeeds in preserving the traditional requirement that the plaintiff prove factual causation of the legal injury by a preponderance, it creates a serious new difficulty. For it relies on an ad hoc, unnecessary, and problematic redefinition of the legal injury suffered in loss of chance cases. If taken to its logical conclusion, the redefinition strategy would have radical consequences—for example, it would permit everyone endangered by a speeding driver to obtain partial damages for that risk exposure, even if the driver caused physical harm to none of those she endangered.

A far most persuasive justification for awarding partial damages in "lost chance of a better medical outcome" cases is that courts are fully justified in creating an exception here to the usual preponderance requirement for factual cause—just as they are justified in modifying that requirement in other special situations that courts widely recognize, such as: multiple sufficient concurrent tortious causes, uncertainty about which of two or more tortious defendants was the factual cause, and uncertainty about whether a plaintiff would have heeded a legally adequate warning. Courts should not rely on the fiction of redefining the nature of the legal injury but should instead invoke the types of arguments of policy and principle that justify departures from the strict preponderance rule in other exceptional categories of factual cause cases.

The subtraction approach is much more defensible, however, in one situation: when, as of the time of trial, the patient has not yet suffered the relevant ultimate harm (such as death or paralysis) but might suffer the harm in the future. For the

subtraction approach does accurately measure the risk of a future physical harm that has not yet come to pass. Thus, suppose that Dr. Deficient's patient is still alive at the time of trial. And suppose it is not then possible to determine whether the patient is a member of:

(a) the background risk group of those who will die in the future and would die even if defendant had not negligent (the 30%),

(b) the group who will die because of negligence (the 15%), or

(c) the group who will not die from the medical condition (the 55%).

In this situation, a small number of courts would permit a partial damages remedy for being exposed to the risk of future harm that has not yet occurred. In such a jurisdiction, the subtraction method is indeed more appropriate than the ratio method. Even in this situation, however, a partial damages remedy is problematic, for it is in serious tension with tort law's general reluctance to permit a plaintiff to obtain any compensation from a tortious defendant merely because the defendant increased the risk that the plaintiff might suffer legally recognized harm in the future.

The issues addressed in this paper are both important and timely to address. Important, because courts have increasingly endorsed a partial damages remedy in lost chance cases, especially in medical malpractice cases. And timely to address, because the Reporters for two projects of the Restatement Third, Torts are now drafting provisions meant to guide courts in analyzing loss of a chance cases.[10]

This article focuses on cases involving lost or decreased chances of a better medical outcome (or, framed differently, increased risks of a worse outcome) due to medical malpractice. It does not address whether lost chance or increased risk doctrines should extend beyond this domain—for example, to lost chances due to legal malpractice, negligent failure to rescue, or negligent failure to warn. But the analysis in this paper undoubtedly has implications for these other doctrinal areas.

The paper is organized as follows. Section II clarifies the nature of the choice between the subtraction and ratio computation methods. Section III reviews the arguments supporting partial, as opposed to no, damages in loss of chance cases, and concludes that these arguments do not favor the subtraction approach over the ratio approach. Section IV carefully examines and critiques the argument that the legal injury should be viewed, not as the death or serious injury suffered by the patient, but as the loss of a chance of avoiding that ultimate injury. Section V addresses two complications that loss of a chance cases pose: the challenge of integrating probabilistic and individualized evidence, and the question whether a probability greater than 50% (but less than 100%) that defendant's negligence caused plaintiff's ultimate injury should receive partial rather than full damages. Section VI considers whether the most plausible argument for the subtraction approach—that a patient should obtain compensation for being exposed to a risk of harm even if the harm has yet to occur—is persuasive. The Conclusion answers the question in the title.

[10] See Appendix A for a review of these projects and my suggestions to the Reporters.

II. Clarifying the choice between the subtraction and the ratio methods

As courts ordinarily frame the loss of a chance problem, the question is whether a plaintiff who had less than a 50% chance of survival when defendant negligently misdiagnosed or negligently treated[11] plaintiff's medical condition can nevertheless recover full or at least partial damages when the defendant reduced or eliminated plaintiff's chance of survival. (We will see that this characterization of the question is problematic in some cases.[12])

Courts have responded to this problem with three different solutions. Most courts today endorse the award of partial damages. A minority apply the traditional preponderance test and award no damages. Another minority leave the question of damages to the jury with little guidance about how to compute those damages.[13]

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[11] Although many loss of chance cases involve negligent misdiagnosis of a fatal condition, other loss of chance cases involve different types of negligent treatment or nontreatment. For example, the court in Delaney v. Cade, 873 P.2d 175 (Kan. 1994) held that a plaintiff who suffered paralysis after automobile accident had a loss of chance claim against the doctor who allegedly was negligent in delaying transfer to a facility that was properly equipped to treat her injuries. See also Alberts v. Schultz, 975 P.2d 1279, 1282 (N.M. 1999) ("The negligence may be found in such misconduct as an incorrect diagnosis, the application of inappropriate treatments, or the failure to timely provide the proper treatment.").

[12] The Dr. Careless case from the introduction fits this characterization, but the Dr. Deficient case does not. However, partial damages are appropriate in both cases. See Section [] infra.

[13] Some courts that endorse this third solution rely on a "substantial factor" test of factual causation. See, e.g., Estate of Frey v. Mastroianni, 463 P.3d 1197 (Hawaii 2020). In Ehlinger by Ehlinger v. Sipes, 454 N.W.2d 754, 763 (Wisc. 1990), the court held that plaintiff 's burden of production in a medical malpractice loss of chance case is simply to prove that reasonable care *could* have lessened or avoided the ultimate harm.

> In a case such as this, the plaintiff need not show that proper treatment more probably than not *would* have been successful in lessening or avoiding the plaintiff's injuries as a prerequisite to satisfying his or her burden of production on the issue of causation. … [A]ll that is required is that the plaintiff establish that proper treatment *could* have lessened or avoided the plaintiff's harm. … If the defendant's negligence is found to have been a substantial factor in causing the harm, the trier of fact may also consider evidence of the likelihood of success of proper treatment in determining the amount of damages to be awarded. (emphasis original)

The substantial factor test is a problematic general criterion of factual cause. Accordingly, Restatement Third, Torts: Liability for Physical and Emotional Harm § 26, Comment j (2010) sensibly rejects the test. And as applied to loss of a chance cases, this test, unless further clarified, offers very little guidance to juries about how to compute damages, as the above excerpt from *Ehlinger* demonstrates. Similarly, the court in *Frey* rejects the view that the legal injury is the loss of a chance as an "incongruous approach," 463 P.3d at 1210, but then offers uncertain guidance about how factfinders should compute damages.

However, the question whether a court should employ a general "substantial factor" test of factual cause rather than a but-for test is a separate issue from whether a court

This article focuses on the first solution, partial damages, and how it should be implemented.

This section clarifies the choice between the subtraction and the ratio methods by addressing several points. It offers a more precise account of how the subtraction and ratio approaches differ; explains the difference between scenarios in which the defendant's negligence merely reduces and those in which it eliminates the chance of survival; provides a broader perspective on the subtraction/ratio choice by illustrating the aggregate effect of employing each method; describes problematic implications of using the subtraction approach in reduction scenarios; rejects the view that loss of chance should only apply when the background risk of death exceeds 50%; distinguishes the controversial loss of chance issue from the uncontroversial use of probabilistic analysis in valuing damages; notes that the subtraction probability *is* relevant to whether the defendant was negligent; and then considers whether loss of chance applies when the patient has not suffered the ultimate harm as of the time of trial.

The ultimate harm that the patient suffers or might suffer in a loss of chance case is typically a serious injury or illness such as death, paralysis, or blindness. In this paper, most of my examples involve an increased risk of death (or, equivalently, loss of a chance of survival), but courts have endorsed the loss of a chance partial damages remedy in other serious harm cases as well.[14] References to death or to survival in the ensuing discussion should be understood to apply also to other serious harms.[15]

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should support partial damages in lost chance cases and whether the computation method should be subtraction or ratio. Some courts (including *Ehlinger* and *Frey*) employ the substantial factor test and also endorse partial damages. It is then an open question which computation method best effectuates the court's factual cause test. Put differently, the question should not be whether a court, when endorsing the award of proportional damages in loss of chance cases, correctly understands the American Law Institute's position on the "substantial cause" test or on whether Restatement Second, Torts § 323 supports partial damages in loss of chance cases. (It does not; that section simply defines the scope of an actor's duty of care.) Rather, the important question is whether, as a matter of tort principles and policy, there are good reasons for redefining the injury in lost chance cases and for endorsing the subtraction over the ratio approach in such cases.

[14] See, e.g., Mohr v. Grantham, 262 P.3d 490 (Wash. 2011) (lost chance of avoiding permanent disability is compensable). See Restatement Third, Torts: Medical Malpractice), § 8, Reporters' Note to Comment f (Council Draft No. 1, 2023) (reviewing case law endorsing proportional damages when the ultimate harm is less than death and noting that many courts require a serious rather than trivial harm).

[15] When a plaintiff sues for loss of a chance of a better medical outcome or for increased risk, the plaintiff often has also suffered some harms unrelated to that chance or risk but caused by the negligence of the doctor who failed to diagnose the plaintiff's ailment. All courts, even if they reject partial or full damages for loss of a chance, support full compensation for harms that the tortious defendant probably caused. See David A. Fischer, Tort Recovery for Loss of a Chance, 36 Wake Forest L. Rev. 605, 620-621 (2001); Aagard, Note, Identifying and Valuing the Injury in Lost Chance Cases, 96 Mich. L. Rev. 1335 (1998).

For example, suppose doctor X negligently misdiagnoses a patient's cancer; doctor Y properly diagnoses it a year later when the risk of harm has greatly increased; after Y's

a. How the subtraction and ratio methods differ

The introduction to this paper provided a preliminary explanation of the difference between the subtraction and ratio methods. This section offers a fuller explanation.

The standard method employed by courts[16] that endorse partial damages in loss of a chance cases is "subtraction."[17] To be more precise, under that method, the factfinder proceeds as follows:

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correct diagnosis, the patient must undergo further tests and surgical procedures in order to minimize future risks of harm. Suppose that those tests and procedures would not have been necessary if X had not acted negligently a year early. X is liable in full for the financial cost of those tests and procedures and for any pain and suffering that they caused. See, e.g., Walter v. Bruhn, 40 Fed.Appx. 244 (7th Cir. 2002) (delayed diagnosis of breast cancer required plaintiff to undergo mastectomy rather than lumpectomy or partial masectomy).

Thus, the Supreme Judicial Court in Matsuyama v. Birnbaum, 890 N.E.2d 819, at n. 41 (Mass. 2008), overruled on other grounds, Doull v. Foster, 163 N.E.3d 976 (Mass. 2021), explains:

> We pause to clarify the issue of damages for pain and suffering, of which there are potentially two kinds. First, a jury could find, on appropriate evidence, that a physician's negligence caused pain and suffering quite apart from the loss of chance. Compensatory damages for this type of pain and suffering should be awarded in the same manner as in any malpractice case; they are not part of the proportional damages calculation.
>
> Second, a jury could find, on appropriate evidence, that the ultimate injury—in this case, dying of gastric cancer—involved pain and suffering. This second category of pain and suffering would more likely than not have occurred even absent the physician's negligent conduct. Thus, the physician may only be held liable for this pain and suffering to the extent that his negligent conduct diminished the decedent's likelihood of avoiding this outcome. Thus, this second category of pain and suffering is properly subject to the proportional damages calculation set out here.

Similarly, in Cohan v. Medical Imaging Consultants, 900 N.W.2d 732 (Neb. 2017), the court permitted mental distress damages notwithstanding its rejection of a loss of chance recovery, reasoning:

> [The patient] stated that she had incurred mental pain or anguish as a result of the delayed cancer diagnosis. Whether [her] damages for anxiety were directly related to the delay in diagnosis or a consequence of discovering the cancer would have been a question of fact for the jury to determine.

[16] The Restatement Third, Torts: Remedies § 11, Comment f, Reporters' Note helpfully summarizes the case law on this issue, explaining that almost all courts endorse the subtraction method, but noting that New Jersey might endorse what I call the ratio method. Another New Jersey case that is not cited in id. also provides some support for the ratio method. See Fischer v. Canario, 670 A.2d 516, 524 (N.J. 1996), citing Evers v. Dollinger, 471

Subtraction method:

1. Determine the following risk levels, as of the time of the defendant's negligent conduct:

B, which is the **background risk** (or pre-negligence risk) of death from the disease if the defendant had not acted negligently; and

C, which is the **cumulative risk** (or post-negligence risk) of such a death as a result of defendant acting negligently.

2. Subtract B from C, and call the difference N:

Mathematically, N = C-B. Substantively, **N is the negligently-created risk**.[18] It is the share of C, the cumulative risk, that results from defendant's negligent conduct, determined at the time of that conduct.

3. Compute partial damages as follows:

First determine **F**, the full-damage amount.[19]

A.2d 405 (N.J. 1984) ("[King's] illustrations reveal … that the harm for which he advocates redress is not the increased risk *per se,* but rather a harm such as death or bodily injury occasioned in part by the increased risk."). The reference is to Joseph King, *Causation, Valuation, and Chance in Personal Injury Torts Involving Preexisting Conditions and Future Consequences*, 90 Yale L.J. 1353 (1981).

[17] The Restatement Third, Torts: Remedies § 11 (Tent. Draft No. 2, 2023) uses the terminology "value of a chance" (rather than "subtraction") for this computation method. This terminology is potentially misleading for reasons described in Appendix A.

[18] Restatement Reporters, scholars, and courts have employed a variety of terms for B, N, and C. Thus, Joseph King characterizes B as one type of pre-existing risk or condition. King, supra note []. Elissa Gentry refers to B as "inevitable injuries" and to N as "avoidable injuries." Elissa Philip Gentry, Damned Causation, 54 Ariz. St. L. J. 419, [] (2022). Lars Noah refers to B as "doomed" and N as "excess." Lars Noah, *An Inventory of Mathematical Blunders in Applying the Loss-of-a-Chance Doctrine*, 24 Rev. Litig. 369, [] (2005).

The Restatement Third, Torts: Remedies § 11 (Tent. Draft No. 2, 2023) formulates the problem in terms of the loss of chance of avoiding death, rather than the increased risk of death, so it focuses on the probability 1-B rather than the probability B, and on the probability 1-C rather than the probability C. (See text at note [].) The Restatement then defines 1- B as "the percentage chance of avoiding … harms had defendant not engaged in tortious conduct," and it defines 1-C as "the percentage chance of avoiding those harms once the plaintiff or plaintiff's decedent discovered or reasonable should have discovered defendant's tortious conduct."

In a leading case, Matsuyama, supra, the court characterizes B as the patient's "chance of survival or cure immediately preceding ('but for') the medical malpractice" or "prior to the medical malpractice," and it characterizes C as "the chance of survival or cure that the patient had as a result of the medical malpractice." 890 N.E.2d at 840.

[19] The Restatement Third, Torts: Remedies, § 11(b)(1), defines F as "the full damages … for all the harms that might have been avoided had defendant not tortiously reduced the

Then award the following in compensation:
Partial damage award = **N** x **F**.[20]

By contrast, under the ratio method,[21] the factfinder takes the following steps:

Ratio method:

1. Determine the following risk levels, as of the time of the defendant's negligent conduct:

B, which is the **background risk** (or pre-negligence risk) of death from the disease if the defendant had not acted negligently; and

C, which is the **cumulative risk** (or post-negligence risk) of such a death as a result of defendant acting negligently.

2. Subtract B from C, and call the difference N:

Mathematically, N = C-B. Substantively, **N is the negligently-created risk**. It is the share of C, the cumulative risk, that results from defendant's negligent conduct, determined at the time of that conduct.

3. Compute partial damages as follows:

First determine **F**, the full-damage amount.
Then award the following in compensation:
Partial damage award = (**N**/**C**) x **F.**[22]

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chance of avoiding those harms."

[20] For a careful explanation of this computation method, see Matsuyama, supra.

[21] The Restatement Third, Torts: Remedies § 11 (Tent. Draft No. 2, 2023) uses the terminology "probability of causation" (rather than "ratio") for this computation method. Noah uses the language "attributable risk rate" for the ratio method, Noah, at [], and Gentry follows him in that usage, Gentry, at 434. Rhee refers to the ratio rule as a rule of "probabilistic causation" or simply as the "correct" method. Robert J. Rhee, *Loss of Chance, Probabilistic Cause, and Damage Calculations: The Error in* Matsuyama v. Birnbaum *and the Majority Rule of Damages in Many Jurisdictions More Generally*, 1 Suffolk U. L. Rev L. Online 39 (2013); Robert J. Rhee, *Probabilistic Causation in the Loss of Chance Doctrine: A Comment on Efficiency and Error Mitigation*, 55 Suffolk U. L. Rev. 513, 526 (2022). In Laurent Bieri and Pierre Marty, The Discontinuous Nature of the Loss of Chance System, 2 J. Euro. Tort L. 23 (2011), the authors use the phrase "proportional liability system" for what I call the ratio method; in a footnote, they characterize this as based on a defined ratio. Id. at 24 n. 6.

[22] The formulations of the subtraction and ratio methods in the text are quite consistent with Rhee's meticulous mathematical equations in his two articles, supra note [20]. However, my formulations have been crafted to make them more comprehensible to judges, lawyers, and academics who are less mathematically sophisticated than Rhee.

Consider how these two different computation methods would apply to perhaps the most famous case addressing loss of a chance in medical malpractice cases, Herskovits v. Group Health Coop. of Pugent Sound.[23] In this case, which was the basis of the Dr. Careless example in the introduction, the court allowed a loss of chance recovery when the doctor's negligence reduced the patient's chance of recovery from 39% to 25%.[24] The patient died. Relying on the analysis of Professor Joseph King,[25] the concurring opinion concluded that the plaintiff (decedent's estate) should obtain partial damages of 14% times full damages. Thus, the concurring opinion clearly employs the subtraction approach. That concurring opinion has been widely cited in subsequent cases that have awarded partial damages in loss of a chance cases.[26] And subsequent cases that have endorsed the remedy of partial damages have almost uniformly adopted the subtraction approach.

The ratio approach would award a slightly greater amount of damages in this fact pattern than the subtraction approach. In implementing the ratio approach, it is easier to use the figures for increased risk of death rather than the figures for reduction in the chance of survival that the concurring opinion in *Herskovits* employs. However, each formulation is mathematically identical.[27] Thus, instead of expressing loss of chance as a decrease in the chance of survival from 39% to 25%, it is more straightforward (if one is employing the ratio approach) to translate this into an increased risk of death from 61% to 75%. Or, returning to the symbols employed above:

> **B** (background risk *of death*) = **1 – $\mathbf{B_L}$**. B_L refers to the background *chance of life* or of survival.
>
> **C** (cumulative risk *of death*) = **1 - $\mathbf{C_L}$**. C_L refers to the cumulative *chance of life* or of survival.[28]

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[23] 664 P.2d 474 (Wash. 1983).

[24] Expert evidence supported the conclusion that the doctor's negligence reduced the patient's statistical chance of surviving five years from lung cancer from 39% to 25%. Id. at 480.

[25] King, supra note [].

[26] It is unclear whether the lead opinion in *Herskovits* agrees with the computation formula endorsed by the concurring opinion. But a later Washington Supreme Court opinion endorses the concurring opinion's approach. Mohr, supra at 496.

[27] Although the formulations are mathematically identical, it is possible that jurors would react differently if the damages question is framed as measuring the increase in the risk of death rather than the decrease in the chance of survival. Thus, jurors might be inclined to be more generous under the "increased risk of death" formulation. If further research suggests that this is the case and that the framing effect is substantial, it might be advisable for courts to give a clarifying jury instruction, explicitly stating that the two formulations are identical.

[28] One could use the notation $\mathbf{B_D}$ for background risk of *death*, and $\mathbf{C_D}$ for cumulative risk of *death*, to draw a more explicit contrast with $\mathbf{B_L}$ and $\mathbf{C_L}$. However, this article uses the terms **B** and **C** rather than $\mathbf{B_D}$ and $\mathbf{C_D}$ in order to keep the notations simpler.

N (the share of C that results from negligence) = **C – B.** C-B is equivalent to B_L - C_L.

In *Herskovits*, **B** = .61, while $\mathbf{B_L}$ = .39; and **C** = .75, while $\mathbf{C_L}$ = .25.
Thus, under the ratio method, **N/C** = .14/.75 = 19%.
Partial damage award = 19% x **F** (full damages)

In the introduction to this paper, in explaining the subtraction approach, I characterized the approach as comparing the background and cumulative (post-negligence) *risks of death*, rather than as comparing the background and cumulative (post-negligence) *chances of survival*. But again, these two characterizations are just flipsides of each other: a 30% risk of death is equivalent to a 70% chance of survival; and a 45% risk of death is equivalent to a 55% chance of survival.[29] However, the "risk of death" formulation is preferable because it makes the difference between the subtraction approach and the ratio approach easier to grasp, and it makes the ratio approach somewhat easier to apply.[30]

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[29] In mathematical terms, the percentage probability for the risk of death = 100% minus the probability for the chance of survival; and the percentage probability for the chance of survival = 100% minus the probability for the risk of death. Because the term "risk" typically is used to characterize the probability of a harm, but not of a benefit, this paper speaks of "risks" of death but "chances" of avoiding death.

It is possible to define these terms differently. For example, Sandy Steel stipulates that "increased risk" of a loss means that the bad outcome risked by the conduct has yet to occur, while "lost chance" means that there is now no chance of the bad outcome occurring. Sandy Steel, Proof of Causation in Tort Law 290-291 (Cambridge Univ. Press 2015). However, courts typically use the two terms interchangeably, and I will follow that usage. The distinction that Steel draws is nevertheless important and will be discussed later.

In theory, one might distinguish between negligence of a doctor that worsens the patient's current condition and negligence that fails to improve that condition. But insofar as a doctor's duty of care extends both to conduct that worsens and conduct that fails to improve a condition, tort law does and should treat the cases similarly. For a helpful discussion, see Restatement Third, Tort: Remedies § 11, Reporters' Note to Comment b:

> A gain that a tort prevents is just as much a damage item as a loss that a tort inflicts… If prompt diagnosis would have led to referring plaintiff to a rehabilitation program with a 40 percent chance of restoring the lost function of some atrophied or paralyzed body part, the lost chance for that gain is within the rule of this Section [awarding proportional damages].

[30] See Noah, at 395 ("Instead of asking about the loss of a chance for survival, courts should focus on the flip-side question framed as the increased risk of morbidity and mortality.").

Rhee's formulation of the two computation methods employs variables representing chance of survival rather than risk of death. See Rhee, supra note [22]. That is, he uses $\mathbf{B_L}$ and $\mathbf{C_L}$ rather than **B** and **C**. His formulation is accurate but might be more difficult for judges and lawyers to understand. Thus, using my notations from footnote [] and from the text, Rhee's formulation of the *subtraction* approach is as follows:

Subtraction partial damage award = ($\mathbf{B_L}$ - $\mathbf{C_L}$) x F

On the facts of *Herskovits*, there is relatively little difference between the subtraction approach (which provides partial damages of 14%) and the ratio approach (which provides 19%). The same is true of a fact pattern discussed at length by the Supreme Judicial Court of Massachusetts in *Matsuyama*.[31] But in other cases, such as the Dr. Deficient example in the introduction, the difference is quite substantial: 15% under the subtraction approach, but 33% under the ratio approach.

Strikingly, almost every scholar who has carefully explored the choice between the subtraction and ratio computation methods has concluded that the subtraction method is mistaken or unpersuasive when it is applied to the very common situation in which the relevant ultimate harm (such as death from cancer) has occurred as of the time of trial.[32] Why, then, have courts adopted the

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Rhee's formulation of the *ratio* approach is as follows:

Ratio partial damage award = $((\mathbf{B_L} - \mathbf{C_L})/(1 - \mathbf{C_L})) \times F$

By contrast, my formulation of the subtraction approach is no more complex than Rhee's:

Subtraction partial damage award = $(\mathbf{C} - \mathbf{B}) \times F$

But my formulation of the ratio approach is somewhat simpler than Rhee's:

Ratio partial damage award = $((\mathbf{C} - \mathbf{B})/ \mathbf{C}) \times F$

[31] In Matsuyama v. Birnbaum, 890 N.E.2d 819 (Mass. 2008), the court discussed an example in which the negligence increased the patient's probability of death from 55% to 85%. Thus, the subtraction approach would award 30%, while the ratio approach would award approximately 35% (=30/85). See Rhee, Loss of Chance, supra note [22], at 43-44.

[32] For the most thorough discussion, concluding that the ratio approach is correct and that the subtraction approach is erroneous, see Rhee, *Loss of Chance,* supra note [22]; Rhee, *Probabilistic Causation,* supra note [22]. Also supporting the ratio approach over the subtraction approach are the following: Aaron D. Twerski & Neil B. Cohen, *The Second Revolution in Informed Consent: Comparing Physicians to Each* 34 *Other*, 94 Nw. U. L. Rev. 1, 28 n.68 (1999); Ariel Porat & Alex Stein, Tort Liability Under Uncertainty 124 (Oxford 2001); Noah, supra, at 374-375 & n. 21, 382, 393-403; Ward Farnsworth & Mark Grady, Torts: Cases & Questions 283-284 (3d ed. 2019); Lauren Guest, David Schap & Thi Tran, *The "Loss of Chance" Rule as a Special Category of Damages in Medical Malpractice: A State-by-State Analysis*, 21 J. L. Econ. 53, 58 (2015); Richard Epstein, Torts § 10.4, pp 252-254 (Aspen 1999). I contributed to the material on loss of a chance in the Farnsworth & Grady casebook, supra.

See also Mark A. Geistfeld, Duty-Preserving Tort Rules as an "Old Category" for Justifying the Loss-of-Chance Doctrine in Medical Malpractice (forthcoming, 73 DePaul L.J. _) (endorsing the ratio approach as a viable alternative to the subtraction approach in some cases); Elissa Phillip Gentry, *Damned Causation*, 54 Ariz. St. L.J. 419, 434 (2022) (but Gentry urges caution in relying on probabilities alone to justify a remedy of partial compensation).

Laurent Bieri and Pierre Marty explain that the ratio approach (which they call the proportional approach) is preferable to the subtraction approach (which they call the loss of a chance approach) in their article, The Discontinuous Nature of the Loss of Chance System,

subtraction approach, given the powerful arguments favoring the ratio approach? There are several possible reasons, as we will see, including the following: on first inspection, the subtraction approach appears to be simpler; in many cases, the difference that the choice of methods makes to plaintiff's recovery is modest; when the chance of survival is eliminated and not merely reduced, the choice of methods makes no difference to plaintiff's recovery; when the ultimate harm has not been suffered as of the time of trial, the subtraction approach is the more persuasive computation method. But I believe that the most likely reason is that courts simply have not considered the choice between the methods.

b. Reduction vs. elimination of the chance of a better outcome

Thus far, I have discussed fact patterns in which the defendant's negligence reduced but did not eliminate the patient's chance of survival or of a better outcome. (Recall Dr. Careless and Dr. Deficient.) Put differently but equivalently, these are fact patterns in which the defendant's negligence increased the patient's risk of death (or other serious injury) but did not increase that risk to 100%. But in other fact patterns, the defendant's negligence eliminates or destroys, and does not merely reduce, the chance of survival.[33]

One such fact pattern is identified by Joseph King in the following passage in his article, a passage that numerous courts have cited:

> [C]onsider a patient who suffers a heart attack and dies as a result. Assume that the defendant-physician negligently misdiagnosed the patient's condition, but that the patient would have had only a 40% chance of survival even with a timely diagnosis and proper care. Regardless of whether it could be said that the defendant caused the decedent's death, he caused the loss

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supra note []. They plausibly argue that the subtraction approach creates significant problems of discontinuity if partial damages are awarded only up to a threshold of "certainty" in the neighborhood of 85% or 90%. I underscore a similar discontinuity problem with the subtraction approach when partial damages are awarded only up to the preponderance threshold of greater than 50%. See Section [] infra.

John Madkisi presupposes the ratio approach in his discussion of proportional damages examples, but he does not explicitly compare it to the subtraction approach. Proportional Liability: A Comprehensive Rule to Apportion Tort Damages Based on Probability, 67 N.C. L. Rev. 1063, 1088, & 1093 n. 123 (1989). Similarly, Steven Shavell presupposes that the ratio approach is the correct way to measure proportional damages in his important article, Uncertainty over Causation and the Determination of Civil Liability, 28 J. L. & Econ. 587, 589 (1985). Kenneth Abraham, in Forms and Functions of Tort Law, pages 141-143 (5th ed., 2017), notes the distinction between the subtraction and ratio approaches but does not endorse one view over the other.

The Restatement Third, Torts: Liability for Physical and Emotional Harm § 26, Comment n (2010) similarly recognizes the difference between the ratio and subtraction methods but does not endorse one over the other. See Appendix A.

[33] Equivalently, in these fact patterns, the defendant's negligence increases the risk of death to 100%.

> of a chance, and that chance-interest should be completely redressed in its own right. Under the proposed rule, the plaintiff's compensation for the loss of the victim's chance of surviving the heart attack would be 40% of the compensable value of the victim's life had he survived...[34]

Notice that in this fact pattern, the doctor's negligence eliminates, and does not merely reduce, the patient's chance of life. Equivalently, that negligence increases the risk of death to 100%.

Crucially, in this type of scenario, the subtraction and the ratio approaches reach precisely the same result.[35] The background risk of death is 60%, which the doctor increased to 100%. The subtraction method would analyze the fact pattern as follows:

> **Subtraction method:**
> Damage award = N x F = (C-B) x F = (100% - 60%) x F = **40% x F**

The ratio method would analyze the fact pattern in a different way but would result in an identical damage award:

> **Ratio method:**
> Damage award = N/C x F = (C-B)/C x F = (100% - 60%)/100% x F = **40% x F**

Why do I emphasize the equivalence of the subtraction and ratio methods in these scenarios where chance is eliminated and not merely reduced? For an important reason: it is quite possible that judges, beginning with the concurring opinion in *Herskovits*, have proceeded under the misimpression that the subtraction method is always the optimal approach for calculating partial damages because they have implicitly assumed that the appropriate calculation method for *elimination* of chance scenarios is also the appropriate method for *reduction* of chance scenarios. But this is simply not true. The ratio method is far more accurate than the subtraction method in determining the probability that the defendant's negligence caused the ultimate harm (such as death) in the many scenarios in which that negligence reduced but did not eliminate the patient's chance of survival or of avoiding a serious harm.

Unfortunately, King's article has contributed to this confusion. That article is a landmark piece of scholarship. King deserves significant credit for offering courts persuasive arguments to justify the award of partial damages in loss of a chance

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[34] King, at 1382 (footnote omitted). The passage continues:

> The value placed on the patient's life would reflect such factors as his age, health, and earning potential,
> including the fact that he had suffered the heart attack and the assumption that he had survived it. The 40% computation would be applied to that base figure.

[35] See Rhee, Probabilistic Causation, at 518.

cases, notwithstanding traditional rules of proof of factual cause that would deny any recovery. But the article has a fatal flaw: *it does not address how partial damages ought to be computed when the defendant's negligence reduces but does not eliminate the chance of survival.*[36] Accordingly, it does not offer guidance in this frequent scenario. Courts have quite understandably interpreted King's analysis and examples (especially the 40% chance of survival example quoted above) as justifying the subtraction approach in all circumstances. In what follows, I will try to explain why applying the subtraction method this broadly is unwarranted.

c. The subtraction and ratio methods often have very different aggregate effects

An important and related point is that the subtraction and ratio methods of calculating partial damages differ greatly in their aggregate effects, with respect to both how much compensation the negligent actor pays and how that compensation is distributed among those who were exposed to the risk of that negligence. The subtraction method, as compared to the ratio method, systematically undercompensates plaintiffs and systematically results in defendants paying much less in damages than they actually caused.[37] These points might be easier to grasp by a stylized thought experiment, based on the Dr. Deficient example in the introduction.[38]

Suppose that the defendant makes the identical negligent misdiagnosis with 100 patients, and suppose that each patient would be entitled to full damages of $1

[36] In a single footnote, King discusses a reduction rather than elimination of chance scenario, but his analysis is difficult to understand. See King, at 1378 n. 85, discussed in Noah, at 374 n. 21 (observing that "King seems to have hinted at the correct calculation"); id. at 382 n. 47 (describing the footnote as "somewhat confusing"). I have found no cases that discuss this footnote.

King's later article on loss of a chance repeatedly observes that a chance might either be destroyed or reduced, but he does not address the question whether, in reduction cases, the ratio computation method is a viable alternative to the subtraction method. Joseph King, *"Reduction of Likelihood" Reformulation and Other Retrofitting of the Loss-of-a-Chance Doctrine*, 28 U. Mem. L. Rev. 491 (1998).

It is also revealing that King opposes the award of partial damages in cases in which the patient has not suffered the ultimate injury as of trial. King, Reduction of Likelihood, at 499. Yet that scenario is the only one in which the subtraction approach is plausible. As Makdisi notes: "Requiring the loss of the benefit itself [i.e., the benefit of avoiding injury, as King advocates] is an indication that the real injury is not the loss of the chance; it is the loss of the benefit." Madkisi, supra note [], at 1093.

[37] See Rhee, Probabilistic Causation, emphasizing this point. We will see below, in the discussion of Subtraction method 2, that one can imagine another version of the subtraction method that does not have this problem, because it results in negligent actors paying compensation for approximately the amount of harm that they have caused. But this second version creates new difficulties.

[38] Others have employed this type of thought experiment. See Twerski & Cohen, supra, at 29 n. 68; Rhee, Probabilistic Causation, supra note [20]; Gentry, supra note []; Restatement Third, Torts: Remedies § 11, Comment d (Tentative Draft. No. 2, 2023).

million (e.g. the damages that would be owed if a negligent driver had immediately killed the patient). 30 of those patients will die from cancer whether or not defendant was negligent. 55 of the patients will not die. 15 of the patients will die from cancer only because of defendant's negligence. (Recall the pie charts from the introduction.)

Under the subtraction approach, the individual compensation, total compensation, and total harm caused are as follows:

Subtraction method 1: Assume all who suffer harm sue negligent D

$150,000	**Individual compensation** for each of the 45 patients who dies = 15/100 x $1 million
$6.75 million	**Total compensation** paid by D = 45 x $150,000
$15 million	**Total actual harm** caused by D's negligence = 15 x $1 million

By contrast, under the ratio approach, the analogous figures are:

Ratio method: Assume all who suffer harm sue negligent D

$333,333	**Individual compensation** for each of the 45 patients who dies = 15/45 x $1 million
$15 million	**Total compensation** paid by D = 45 x $333,333
$15 million	**Total actual harm** caused by D's negligence = 15 x $1 million

These number are stylized, of course. Nevertheless, the ratio approach, as compared to the subtraction approach, is much more likely to impose damages on a negligent defendant that approximate the actual harm that the defendant has caused. Accordingly, both fairness and efficient deterrence favor the ratio approach.[39]

However, there is indeed a way for the subtraction approach to impose on the defendant an aggregate liability that approximates the actual harm the defendant caused (and that approximates it just as well as the ratio approach). Suppose, in a case where the patient has died, the subtraction approach is interpreted as permitting *all* of the 100 patients whom the defendant negligently

[39] Notice that both the subtraction and ratio methods provide an "incorrect" amount of compensation to every successful plaintiff. If we were omniscient, we would provide full damages only to the 15% who actually were made worse off by the defendant's negligence. Instead, in the absence of any basis for determining which individuals are in the 15% category or in the 30% category, the ratio method gives everyone in both categories a portion of the damages, thus undercompensating those who were actually made worse off by the defendant's negligence but overcompensating those were not made worse off. This issue is further discussed below.

misdiagnosed (and thus exposed to an increased risk of harm) to obtain 15/100 of their full damages. On this approach, compensation would be awarded, not just to the estate of each of the patients who died, but also to each of the 55 patients who did not die.[40] We would then have the following result, with differences from the earlier Subtraction method 1 indicated by ***bold italics***:

Subtraction method 2: Assume all who suffer harm *or who are exposed to risk* sue D

$150,000	Individual compensation for each of the 45 patients who dies ***and for each of the 55 patients who does not die*** = 15/100 x $1 million
$15 million	Total compensation paid by D = ***100*** x $150,000
$15 million	Total actual harm caused by D's negligence = 15 x $1 million

But this approach has a significant disadvantage relative to the ratio approach: It awards the same risk-exposure damages to the 55 who have not actually been harmed as to the 45 who have been harmed. Yet we know that the defendant's negligence did not actually harm any of the 55. Why should they receive any compensation? More pointedly, why should they receive compensation at the expense of those who did suffer the relevant harm (death)?[41]

Courts have compelling reasons, grounded in both fairness and efficiency, to require the negligent defendant in loss of chance cases to pay damages that approximate the harm he has caused. (I will elaborate upon these reasons below.) But tort law can give effect to these reasons, and at the same time avoid the award

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[40] In referring to the patients "who did not die," I am assuming that those who have not died as of the time of trial have no chance of later dying of the disease. But if there is a chance that the disease will recur and cause premature death or other serious harm, the case is more complicated and might be analyzed differently. See Section [], infra: "What remedy if the patient has not suffered the ultimate harm as of the time of trial?"

[41] Anticipating this objection, The Restatement Third, Torts: Remedies § 11, Comment f, Reporters' Note states:

> The … patients who survive are less likely to sue and less likely to recover if they do; … juries may be less sympathetic or have difficulty understanding the harm. Compensating only the value of the lost chance, and recognizing the survivors' losses as part of the total social loss, thus aggravates the problem of underdeterrence. But the families of many of the patients who die are also unlikely to sue.

These are not the strongest arguments. Juries would probably have difficulty understanding the harm precisely because patients who survive have not actually suffered the ultimate harm that doctors have a duty of care to prevent. And although not all injured victims of medical malpractice sue, both fairness and deterrence principles support prioritizing the compensation of those who do suffer the ultimate harm.

of compensation to persons whom we know the defendant did not harm, simply by adopting the ratio approach.

d. The subtraction method has problematic implications in many reduction scenarios

In a reduction scenario, if a court employs the subtraction approach and thus pays no attention to the proportion of patients who do not suffer the ultimate harm, all of the following cases would be treated identically, because in each case, the proportional damage award would be 25% of full damages.[42]

1. B = 10%, C = 35%
2. B = 20%, C = 45%
3. B = 30%, C = 55%
4. B = 40%, C = 65%
5. B = 50%, C = 75%

But it is highly problematic to provide exactly the same damage award in each of these cases.[43] Notice that in cases 1 and 2, it is more likely than not that defendant's negligence was the factual cause under the traditional preponderance standard. Courts would therefore ordinarily award full damages. Yet a literal application of the subtraction approach would provide only 25% of the damages. This reveals a serious tension between the subtraction approach and the preponderance standard itself.

To be sure, this result could be avoided by applying the subtraction rule only after the factfinder has determined that the risk created by defendant's negligence (C-B) is no greater than the background risk (B). But the ratio approach more clearly illustrates why courts have reason to treat cases 1 and 2 differently than cases 3, 4 and 5: the ratio method, unlike the subtraction approach, unambiguously reveals that negligence is the probable cause of the harm in case 1 (56% probability) and case 2 (71% probability):

[42] Recall that B refers to the background risk apart from negligence, and C refers to the cumulative risk, i.e., the risk resulting from the background risk and from the additional negligently-created risk.
[43] See Noah, at 399.

Cases	Pure subtraction proportional damages	Pure ratio proportional damages	Is preponderance satisfied?
1. B = 10%, C = 35%	**25%** x F	**71%** = 25/35	Yes
2. B = 20%, C = 45%	**25%**	**56%** = 25/45	Yes
3. B = 30%, C = 55%	**25%**	**45%** = 25/55	No
4. B = 40%, C = 65%	**25%**	**38%** = 25/65	No
5. B = 50%, C = 75%	**25%**	**33%** = 25/75	No

Notice that the *pure* version of the ratio approach described above is symmetrical, awarding proportional rather than full damages even when defendant's negligence is more likely than not the cause of the harm. In case 1, for example, a pure ratio approach would award 71% of full damages. However, courts that endorse a partial remedy in loss of a chance cases almost always treat cases such as 1 and 2 *asymmetrically*, awarding full damages. This is why the preponderance approach is often characterized as an "all-or-nothing" rule. Whether courts *should* treat cases 1 and 2 symmetrically to cases 3, 4, and 5, or instead asymmetrically, is discussed below.[44] For now, the point is that the ratio approach illustrates, much more clearly than the subtraction approach, that scenarios 3, 4, and 5 are the scenarios in which the reasons for providing a partial remedy are most compelling.

These lessons can also be grasped from a different perspective. Instead of holding constant the percentage generated by the subtraction approach over five cases, we could hold constant the percentage generated by the ratio approach. Appendix B, part 2, contains a chart setting forth this alternative perspective.

e. Loss of chance liability should not require a background risk of death exceeding 50%

Courts and commentators often emphasize that loss of chance liability is warranted when the background risk of death exceeds 50% (or, equivalently, when the background chance of life is less than 50%).[45] They point out, correctly, that in

[44] See Section V.b, infra.

[45] See, e.g., Mayhue v. Sparkman, 653 N.E.2d 1384, 1387 (Ind. 1995) ("Where a patient's illness or injury already results in a probability of dying greater than 50 percent, an obvious problem appears. No matter how negligent the doctor's performance, it can never be the proximate cause of the patient's death."); Herskovits, supra, at 475 (framing the question as whether a plaintiff with less than a 50% chance of survival has a loss of chance claim and answering affirmatively, stating: "To decide otherwise would be a blanket release from liability for doctors and hospitals any time there was less than a 50 percent chance of survival, regardless of how flagrant the negligence"); Koch, Whose Life Is It Anyway? Effects

such a case, the preponderance test of factual cause can *never* be satisfied, regardless of whether the defendant's negligence increased the risk of death to 90% or to 100% (or equivalently, regardless of whether that negligence decreased the chance of life to 10% or to zero). For if the background risk of death is more than 50%, the additional risk created by the defendant's negligence must be less than 50%, and the plaintiff will be unable to prove that the death was more likely than not caused by the negligence.

Another way of expressing this point is that the defendant's negligence *must at least double the background risk* in order to satisfy the preponderance test.[46] For only in that case can we conclude that if the death occurs, it is probably due to the negligence, not to the background risk. Thus, if the background risk of death is 51%, it is impossible for the additional negligent risk to be the more probable cause of death, while if the background risk is 49%, and if the defendant's negligence increases the cumulative risk to 100%, negligence indeed is the more probable cause.

But courts should be careful not to overgeneralize from this point. It is true that the preponderance test of factual cause *cannot* be satisfied when the background risk of death exceeds 50%. This fact makes the scenario an especially strong one for permitting partial rather than no recovery. But it does not follow that the preponderance test always *can* be satisfied whenever the background risk of death is *less* than 50%.[47] Accordingly, even when the background risk is less than 50%, partial recovery is sometimes warranted, depending on the level of the negligently-created risk.[48] This general point holds regardless of whether the subtraction or ratio method of computation is used. For the sake of brevity, the discussion in the rest of this section will address only the ratio method.

Consider some examples demonstrating why courts should not require, as a condition of applying the partial damages loss of chance remedy, that the background risk of death exceeds 50%. Recall the Dr. Deficient example: the doctor's negligence increased the patient's 30% background risk of death from cancer to 45%, and the patient died of cancer. There is no obvious reason why a

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of the Lost-Chance Doctrine on Civil Litigation and Medical Malpractice Insurance, 88 N.C. L. Rev. 595, 604 (2010).

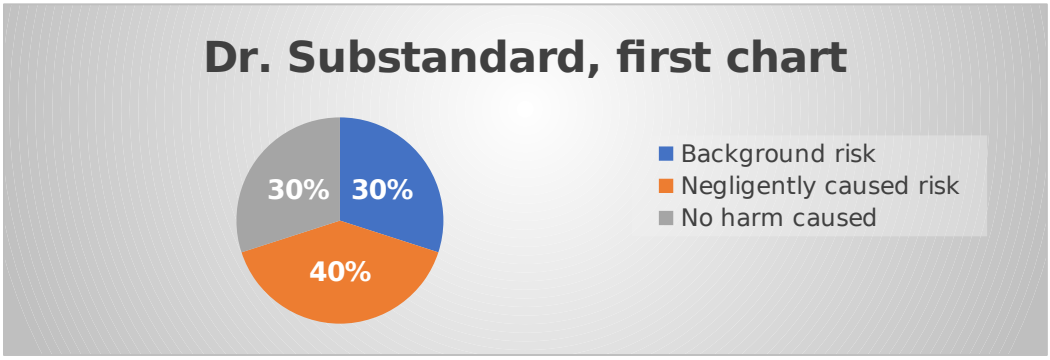
[46] See, e.g., Theofanis v. Sarrafi, 791 N.E.2d 38, 48-49 (Ill. App. 2003). In the analogous but distinct context of toxic torts, courts are often justified in concluding that a doubling of the background risk helps establish causation. See Restatement Third, Torts: Liability for Physical and Emotional Harm § 28, Comment c (2010) (discussing the relevance of a doubling of risk to general causation and specific causation).

[47] The Restatement Third, Torts: Remedies § 11, Comment c (Tent. Draft No. 2, 2023) recognizes, and clearly explains, this point.

[48] See Renzi v Paredes, 890 N.E. 2d 806, 813 (Mass. 2008) ("It would defy logic, to say nothing of fairness, to absolve a physician from liability when his or her malpractice reduces a plaintiff's chances of survival from greater than even to less than even."); Alberts, supra, at 1282. For a thorough explanation of potential judicial confusion about this point, see Gentry, at 432-437. See also Dobbs, et al, § 197, at note 41 (arguing that it is arbitrary and unjustifiable to condition the loss of a chance partial recovery on whether the chance that was lost was "improbable to begin with").

partial damages recovery should be precluded here simply because the background risk of death was less than 50%, and many courts have so held.[49]

But now suppose a variation of the example, in which the negligence increased the 30% risk of death to 70%, and in which the patient died. In this variation, which I will call Dr. Substandard, the defendant's negligence more than doubles the background risk, and a court is very likely to simply apply the preponderance test and award full damages. The following charts might help the reader to visualize this point:



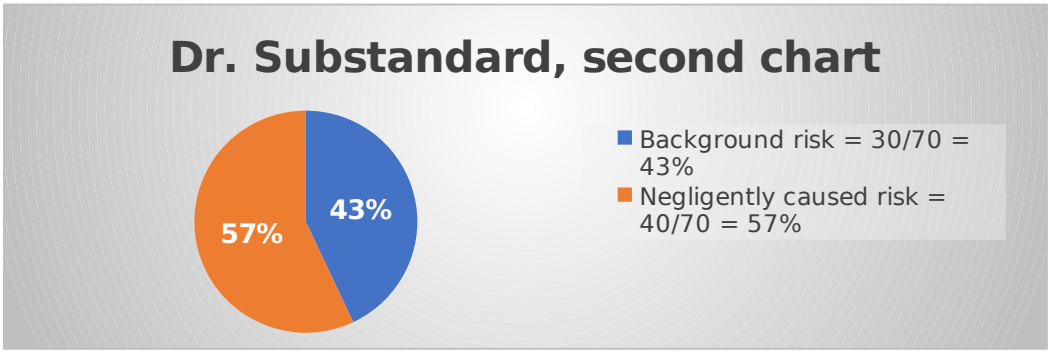
Under a literal application of the subtraction approach, the plaintiff in this scenario would obtain 40% of full damages. But even courts that currently adopt the subtraction approach are likely to be more generous, rejecting the logic of the subtraction approach, because in this scenario, the plaintiff satisfies the preponderance test, and would therefore recover full damages.

Once again, it is useful to resize the chart to include only the relevant blue and orange segments, and to exclude the "no harm caused" grey segment:

[49] See, e.g., Renzi v. Paredes, 890 N.E.2d 806 (Mass. 2008); Dickhoff ex rel. Dickhoff v. Green, 836 N.W.2d 321, 330 at 330 n. 7 (Minn. 2013). The Dickhoff court also states, at 337:

> The troubling consequence of [the lower court's view that liability exists so long as the patient's chance of death moved from unlikely to likely] is tha t a plaintiff whose odds of survival drop from 51 percent to 49 percent has a cognizable medical malpractice claim, while a patient whose odds of survival are reduced from 49 percent to 0 percent as a result of a physician's negligence is unable to ever establish, as a matter of law, that the physician caused any harm. We conclude that such an approach is unreasonable.

To be sure, when B is greater than or equal to 50%, we can be certain that the preponderance test cannot be satisfied, while if B is less than 50%, we cannot be certain until we determine C or N. But in both scenarios, if the factfinder is presented with sufficiently reliable data about B and about C or N, the factfinder can determine not only whether the preponderance test is satisfied but also what proportional share the negligent defendant should pay, under either the subtraction or ratio approach.



In this chart, the orange segment is greater than the blue segment, clearly illustrating that, more likely than not, the plaintiff's death resulted from the doctor's negligence, not from the background risk. Thus, the preponderance test is satisfied.[50]

These charts also underscore that the subtraction approach is in serious tension with the widely accepted rule that, absent specific causal evidence to the contrary, the preponderance test is satisfied if the defendant's negligence *more than doubles* the background risk of the type of injury plaintiff suffered. The tension arises because the doubling rule relies only on a ratio. Specifically, the rule provides that factual causation is proven by a preponderance if the ratio (N+B)/N exceeds 2. By contrast, the subtraction rule looks only at the *absolute* value of N. As the tables above reveal, a literal application of the subtraction method would therefore entail only a partial recovery, while the ratio method would entail a full recovery because the defendant's negligence was the more probable cause. Courts frequently allow plaintiffs a recovery of full damages when defendant's negligence more than doubled the risk of the plaintiff's injury, even if the absolute difference under the subtraction method was less than 50% and thus, on a literal application of that method, would justify only partial damages.[51] This problematic result of the

[50] Some scholars advocate a symmetrical legal rule in this scenario that would award proportional but not full damages to the plaintiff even though the probability that negligence caused his death is greater than 50%. Thus, they would award the plaintiff 57% rather than 100% of full damages. For discussion, see Section Vb infra.

[51] See Aagard, supra, at 1336; Gentry, at 430. Consider two cases cited by Noah, at 395, n. 87: McBride v. United States, 462 F.2d 72 (9th Cir. 1972) (sufficient evidence of factual cause under preponderance test based on expert testimony that mortality rate for coronary patients increased from 15% to 30-35% if patient is treated outside rather than inside hospital); Bradshaw v. Daniel, 854 S.W.2d 865 (Tenn. 1993) (sufficient evidence of factual cause based on expert testimony that mortality rate for disease was 4% with early treatment but 40% if left untreated). See also Noah, at 397 (noting that epidemiological evidence that suffices to prove causation by a preponderance in toxic tort or product liability cases would often be insufficient under the subtraction test).

However, courts have not always recognized the point that if defendant's negligence more than doubles the preexisting risk of death, recovery should be available under the traditional preponderance test of factual cause. In Cohan v. Medical Imaging Consultants, 900 N.W.2d 732 (Neb. 2017), plaintiffs' experts testified that defendant's negligence increased the risk of recurrence of cancer from 30% to 75%. This should have sufficed to

subtraction method is some evidence that actual judicial practice implicitly favors the ratio approach over the subtraction approach.

The analysis thus far might seem to entail a reductio ad absurdum, because it seems to suggest that courts should apply the loss of a chance partial damages remedy even in a case in which the background and negligently created risks are very small in absolute terms. Suppose the background risk is merely 3% and the additional negligently-created risk is 1%. On the ratio approach, the plaintiff would obtain 25% of full damages (=1% / (3% + 1%)), even though the defendant's negligence only created a miniscule absolute increase in the risk of harm. But this result is not absurd. In principle, partial damages are justifiable here as well—just as it is justifiable for a regulator to prohibit a business from adopting a workplace practice that would increase the risk of injury by only 1% but offered no social benefits. On the other hand, when the absolute percentages are very small in a loss of chance case, the statistical evidence that produces these probabilities might be much less reliable. If that is so, it would be justifiable for courts not to permit even a partial recovery.

f. Loss of chance is distinguishable from probabilistic analysis in valuing damages

Although courts are sharply divided on whether to award partial damages in loss of a chance scenarios, they are united on the question whether to take probabilities about future events into account in measuring the amount of damages, once it is clear that the defendant's tortious conduct did cause some harm to the plaintiff. And those future probabilities need not exceed 50% in order to be relevant to the damage assessment.[52]

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permit the jury to find factual cause under the traditional factual cause preponderance test, because if a recurrence occurred, it is more likely that it was due to negligence (45%) than due to background risk (30%). But the court held that because Nebraska does not recognize loss of chance recovery, there was no liability. However, the court also noted that plaintiff had not yet suffered a recurrence of cancer, and that there was no evidence of her chance of survival if the cancer returned.

[52] See David Carl Minneman, Annotation, Future Disease or Condition, or Anxiety Relating Thereto, As Element of Recovery, 50 A.L.R. 4th 13 (orig. published 1986); Steel, supra note [], at 299-302 (characterizing the distinct valuation of damages inquiry as a question of "quantification"). In U.S. v. Anderson, 669 A.2d 73, 78 (Del. 1995), the court reasoned:

> Increased risk can be viewed … as merely one element of damages when negligence has caused harm. … [D]efendant's negligence caused the cancer to spread. But for the missed diagnosis, accepted treatments would, almost to a certainty, have stopped the cancer. The missed diagnosis caused the cancer to spread, and Plaintiff suffered surgery and chemotherapy. One additional element of his damages is the increased risk of a recurrence. In view of the risk of recurrence, he certainly has suffered an injury which is significantly greater than that which he would have suffered in the absence of negligence.

Thus, if a negligent driver speeds, and if not for his speed, he would have avoided killing a pedestrian, the compensation award will take into account the extent to which the driver has decreased the life expectancy and work expectancy of the victim. Such expectancies are, of course, a mathematical product of a range of estimated probabilities. A person with a life expectancy of 30 years has a relatively low chance of living exactly 30 years, but the person most likely has a lower chance of living 29 or 31 years, a still lower chance of living 28 or 32 years, and so forth. Yet it is not problematic to employ life expectancy tables in awarding damages.[53] In the speeding driver case, we know that the driver's negligence was a but-for cause of the death of the pedestrian. What is uncertain is not causation but the extent and proper valuation of the damages. Courts do not depart from traditional tort principles when they take account of probabilities (even if the probabilities are less than 50%) in assessing how much harm the driver caused—for example, in the form of lost wages and lost companionship.

Similarly, if defendant causes immediate physical harm to the plaintiff and as a consequence, plaintiff is at risk of future harm from that initial trauma, many courts will also permit compensation for the increased risk that the trauma will result in future injury or disease, and many courts will not require proof that that risk exceeds 50%.[54] (Suppose defendant's negligence damages plaintiff's heart, creating a risk of future heart failure.)

Furthermore, preexisting medical conditions are routinely considered in assessing damages. Suppose a negligent driver kills a pedestrian. At the time of her death, the pedestrian had cancer, and the driver's expert testifies that she had a 30% risk of dying from that cancer but a 70% chance of surviving the cancer with a normal life expectancy. A court will instruct the fact-finder that if it is persuaded by the expert testimony, it should reduce the damage award by taking into account the 30% risk that the pedestrian would have a shorter life expectancy. It does not matter that that risk is less than 50%.

The traditional rule that valuations of the extent of the harm need not be proven by a preponderance is supported by several fundamental tort principles:

- A plaintiff is not entitled to any compensation if the plaintiff has not satisfied all of the elements of the tort (including, in almost all negligence cases, the causation of physical harm);

[53] At least this is so if the tables are statistically reliable and do not embed or reinforce impermissible bias. See Kimberly Yuracko & Ronen Avraham, Valuing Black Lives: A Constitutional Challenge to the Use of Race-Based Tables in Calculating Tort Damages, 106 Cal. L. Rev. 325 (2018).

[54] See 2 Stein on Personal Injury Damages Treatise § 9:16 (3d ed., Oct. 2023 update); Minneman, supra note []; Berry v. City of Chicago, 181 N.E.3d 679, 689 (Ill. 2020) ("A plaintiff who suffers bodily harm caused by a negligent defendant may recover for an increased risk of future harm as an element of damages, but the plaintiff may not recover solely for the defendant's creation of an increased risk of harm"), discussed in Dan B. Dobbs, Paul T. Hayden and Ellen M. Bublick, The Law of Torts § 197, note 31 (2d ed. May 2023 update); Dillon v. Evanston Hospital, 771 N.E.2d 357, 370 (Ill. 2002) ("A plaintiff can obtain compensation for a future injury that is not reasonably certain to occur, but the compensation would reflect the low probability of occurrence.").

- Once those elements are satisfied, a lower burden of proof applies to determining the precise extent of the harm[55]; and
- Damages in tort cases are almost always awarded in a lump sum at the time of final judgment.

As we will see, advocates of the subtraction method for computing loss of chance damages often reframe the issue as involving only the extent of damages, not causation. That reframing, if appropriate, might indeed support a partial damages award, just as the driver in the previous example need only pay partial damages, taking into account the plaintiff's preexisting medical condition. However, it is highly problematic to reframe the loss of chance problem as a problem only of damages, not of causation, for reasons explained in section IV below.[56]

g. The subtraction probability is relevant to whether the defendant was negligent

The primary function of the subtraction computation method is to guide factfinders in computing partial damages in loss of chance cases. This paper raises serious doubts about the use of the method for this purpose. But the probability that the subtraction method generates is often relevant to a very different issue: whether the defendant's failure to take a precaution was negligent in the first place.

Suppose that a doctor could choose a particular treatment to improve the chance that a patient will survive a preexisting medical condition. The preexisting condition is sufficiently serious that the patient probably will not survive regardless of whether the treatment is given. But now suppose that the suggested treatment is not terribly effective: it only increases the probability of survival by 1%. At the same time, the treatment has a very substantial risk of causing the patient to die of a heart attack. The fact that the treatment has only a very small chance of being effective is certainly relevant to whether it is negligent for the doctor not to employ the treatment. On these facts, that low probability of effectiveness suggests that not employing the treatment is not negligent. Conversely, if the treatment would be quite effective and does not carry serious risks, the greater probability that the treatment might improve the patient's medical prospects militates in favor of a conclusion that it would be negligent not to offer the treatment. Of course, the

[55] See Restatement Third, Torts: Remedies § 5 (Tentative Draft No. 2) (distinguishing the fact of damage, which plaintiff must prove by a preponderance, from the specific dollar amount of damage, which plaintiff need not prove by a preponderance).

[56] Yet another element of damages in some cases is the patient's emotional distress from anxiety and fear over the possibility of suffering the ultimate harm (such as death) in the future. See Minneman, Future disease or condition, supra note []. A court that rejects loss of a chance proportional damages for harm that has already occurred might nevertheless permit this type of emotional distress damage, because the patient can readily demonstrate that, more likely than not, the patient would not have suffered the emotional distress if the doctor had not been negligent.

success rate of the treatment need not be greater than 50% in order for the doctor to have a duty to employ it.

Thus, insofar as the subtraction approach measures the effectiveness of a precaution, judged ex ante, at the time when the precaution must be taken, the probability generated by the subtraction approach is indeed relevant to whether the defendant has breached a duty of care. However, this is not the way that courts that endorse partial damages in loss of chance cases use the subtraction method. Rather, in these cases, the court asks the factfinder to first determine that the medical practitioner was negligent, after considering all the factors (including the effectiveness of a precaution) relevant to breach of duty. If the answer is yes, the further question arises whether the defendant's negligence was, more likely than not, the factual cause of the patient's harm. If the answer to this question is no, the factfinder is told that they may nevertheless award partial damages, computed by the subtraction method. Thus, the problems that we have seen with the subtraction method persist, even though it is also true that the probability that a precaution will prevent a harm in the future is relevant to whether it is negligent not to take that precaution.[57]

h. Analysis if the patient has not suffered the ultimate harm as of the time of trial

The analysis thus far has discussed only cases in which, as of the time of trial, the patient has died or suffered the relevant ultimate harm. Almost all loss of a chance cases fit this fact pattern—but not all do. In the exceptional cases when the patient has not suffered the ultimate harm as of trial, a further question arises: Does a patient have a viable claim for partial damages against a negligent doctor if the doctor has increased the risk of death or other harm, but that harm has yet to occur?

Two situations must be distinguished. First, suppose that at the time of trial, the patient has not suffered the ultimate harm but is certain to do so. For example, in a delayed diagnosis of cancer scenario, the patient's condition is incurable as of the time of trial. This situation presents no special difficulties: for purposes of loss of chance doctrine, the patient is within the category of patients who suffer the ultimate harm, with appropriate adjustment of damages according to when the death or other serious harm is expected to occur. The ratio method is the appropriate measure of partial damages, because the chance that the patient will not suffer the ultimate harm is zero.

[57] An instructive illustration of these two different functions of ex ante probabilities, albeit it outside of the medical context, is the question whether the captain of a ship is liable for not rescuing a person who falls overboard. See discussion in Section [], infra. The probability that a rescue would be successful plays some part in determining whether there is a duty to attempt a rescue and how extensive the rescue effort must be. But a further (factual cause) question is whether, if an adequate attempt to rescue had been made, the person would have been saved.

The second and more challenging scenario is when it is uncertain, as of the time of trial, whether the patient will ever suffer the ultimate harm. For example, suppose the patient has cancer, but it cannot be determined, at the time of trial, whether she will die because of the background risk, will die because of the additional negligent risk created by the defendant's negligent misdiagnosis, or will survive the cancer.

Among the many jurisdictions that endorse partial damages in cases where the patient has already suffered the ultimate harm, few have addressed this second scenario. Most that have addressed it have declined to permit a partial damages award, reasoning that negligence claims for medical malpractice require proof that the patient has already suffered physical harm.[58] But a handful of courts have permitted partial damages for the risk of future harm in this situation.[59]

I will defer until later the challenging question whether partial damages *should* be awarded in this situation. But if the answer is yes, the subtraction approach is indeed the correct measure of partial damages. To be concrete, assume the patient in the earlier Dr. Deficient example is still alive when the lawsuit is concluded. And suppose that it is not possible, at that time, to determine whether the patient is in the background risk group of those who will die prematurely whether or not defendant was negligent (the 30%), the group who will die because of negligence (the 15%), or the group who will not die (or suffer other serious harm) from the medical condition (the 55%). Then a very plausible way to approximate the probability that the defendant's negligence will cause harm to the patient is to adopt the subtraction measure of damages (15% of F) and to award this amount of partial damages to any patient exposed to the defendant's negligence. Subtraction method 2, discussed above, would then be the appropriate way to measure damages.

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[58] See, e.g., Perez, 805 P.2d 589, 592 (Nev. 1991). In Alberts, supra, at 1285, the court reasoned that the legal injury is the loss of a chance, but also firmly rejected the idea that that chance should be understood as a risk of future harm:

> It must be emphasized that the injury—the lost chance—is not in any way speculative. It is manifested by actual physical harm. This claim must not be confused with cases in which, as a result of the tortious conduct of one party, another party suffers exposure to something harmful, which may, in the future lead to an injury. Loss of chance does not involve prognostication about future injury or harm. Rather, the patient must present evidence that the harm for which he or she originally sought treatment—the presenting medical problem—was in fact made worse by the lost chance. (Citation omitted)

This analysis provides indirect support for the ratio calculation method over the subtraction method, insofar as the latter measures only the risk of future injury, not the probability that a past injury was caused by the negligent defendant.

Scholars who believe that the loss of chance partial damage remedy should only be available if the patient has suffered the ultimate harm include King, Reduction of Likelihood, at 496; Rhee, supra; and Aagard, supra.

[59] See, e.g., Dickhoff, supra; Alexander v. Scheid, 726 N.E.2d 272 (Ind. 2000).

However, this conclusion does not support the use of the subtraction method in the much more common scenario in which we *do* know, by the time of trial, that the patient has suffered (or will suffer) the relevant ultimate harm.[60] In this more typical scenario, to be sure, it might have been impossible to know, at the time of the defendant's negligence, whether the patient would eventually suffer a type of harm that might have been caused by that negligence. Thus, the subtraction approach does provide a defensible estimate of the probability, *as of the time of defendant's negligence*, that the negligence would cause that harm in the future. But by the time of trial, if the patient has suffered the ultimate harm such as death, there is no longer good reason to use the initial probability estimates, because those estimates included the possibility that in the future, the patient would be spared from suffering the ultimate harm. Accordingly, as of trial, the ratio method should be used, for it more accurately reflects the probability that the defendant's negligence caused the ultimate harm that the patient actually suffered.[61]

It is also worth noting an irony in employing the terminology "loss of a chance" in this scenario, a scenario in which the factfinder does not know, as of trial, whether the patient will suffer the ultimate harm. The most compelling occasion for using the subtraction method is when it is uncertain, at the time of trial, whether the plaintiff will ever suffer the ultimate harm risked by the defendant's negligence. But that uncertainty means that the factfinder cannot know, as of trial, whether the chance has actually been lost. Thus, the phrase "*loss* of a chance" does not accurately describe the one scenario for which the subtraction method of computing the (so-called) loss of a chance is most suited.[62] Alternative terminology such as "potential loss of a chance" or "loss of a future chance" would be preferable and less misleading.

III. Evaluating the arguments supporting partial (rather than no) damages in loss of chance cases

Why have courts endorsed the subtraction method rather than the ratio method in calculating partial damages? The most important reason, I believe, is quite simple: courts have not focused on the difference between these methods. If they did fully understand the difference, I am confident that most courts would

[60] What if the patient has died as of the time of trial but the cause of death was unrelated to the patient's disease—for example, the patient was killed by a negligent driver? In this scenario, if at the time of death it was impossible to determine whether the patient was in the group that would very soon die from the disease or the group that would have survived the disease but for the accident, the subtraction method does supply the most accurate measure of the probability that the negligence of the doctor would have caused the patient's death.

[61] See Rhee, Probabilistic Causation, at 526-528.

[62] For a similar argument, see Gemma Turton, "Loss of a Chance," Ch. 4 in Evidential Uncertainty in Causation in Negligence (Oxford: Hart Publishing 2016), at 130 ("[Plaintiff's] loss of a chance argument was less readily acceptable than it might otherwise have been because he was claiming for the loss of the chance of avoiding a harm that he had not yet, and may never, suffer.").

endorse the ratio method, at least in cases where the patient has suffered the ultimate harm as of trial and in which the two methods would produce significantly different outcomes.

Why am I confident? For several reasons. First, there is no evidence that courts have squarely addressed the difference between the methods. I have found no cases that explicitly compare the two methods.[63] Second, the history of increasing judicial acceptance of a loss of a chance partial damages remedy reveals that courts have simply assumed that the subtraction approach is the only plausible computation method. The concurring opinion in *Herskovits,* and the King article upon which its reasoning is based, have had an enormous impact on subsequent case law, even though neither that opinion nor King's article discuss the ratio method. In his article, King focused his entire attention on elimination of chance cases rather than reduction of chance cases. And as we have seen, the two computation methods reach the same result in elimination cases. Third, the subtraction method is quite easy to use and seems intuitively correct.[64] The ratio method requires a bit more explanation—especially if the issue is framed in terms of "loss of a chance of survival" rather than its conceptual equivalent, "increased risk of death." Fourth, almost every academic who has explored the two computation methods has endorsed the ratio method.[65]

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[63] The Reporters to the Restatement Third, Torts: Remedies project also have found no such cases. See § 11, Reporters' Note to Comment f (Tent. Draft No. 2, 2023).

I have found one dissenting opinion that correctly applies the ratio approach, but the justice does not explicitly compare this computation method to the subtraction method. See Dickson, supra, at 345 (Dietzen, J., dissenting) (the doctor's negligence decreased the chance of survival from 60% to 40%; the patient (who had not died as of trial) "now has an overall 60% chance of dying from the cancer, of which two-thirds (40/60) is attributable to the cancer itself even without the delay in diagnosis, and one-third (20/60) is attributable to the allegedly negligent delay in diagnosis. This means that [the patient's] death, if it occurs, is very probably (66.7% or 40/60) attributable to the underlying cancer that she was born with, and unlikely (33.3% or 20/60) attributable to anything that [the doctor] did.").

Many cases that support the subtraction approach emphasize that that approach is preferable to a no-liability rule insofar as it results in negligent defendants paying for the harm that they have caused and only for that harm. See, e.g., Matsuyama, supra, 890 N.E.2d at 839 ("The [proportional damages] formula aims to ensure that a defendant is liable in damages only for the monetary value of the portion of the decedent's prospects that the defendant's negligence destroyed"); Mead v. Adrian, 670 N.W.2d 174, 179 (N.M. 2003); Boody v. U.S., 706 F.Supp. 1458, 1465 (D.Kan.1989) (the subtraction method "is preferable [to giving the damage question to the jury without guidance] because it apportions damages in direct relation to the harm caused; it neither overcompensates plaintiffs or unfairly burdens defendant with unattributable fault"). These passages arguably support the ratio approach over the subtraction approach, because liability under the ratio approach is clearly a closer approximation of the harm that negligent actors have caused than liability under the subtraction approach. Nevertheless, it remains true that none of these courts explicitly compared the two approaches.

[64] See, e.g., Dickson, supra []; Matsuyama, supra [], at 840.

[65] See sources cited in note [] above.

But I do not wish to dismiss out of hand potential arguments in favor of the subtraction method. So it is well worth considering the major arguments that courts advance, or might advance, in favor of a partial damages remedy, when they endorse that remedy in loss of a chance scenarios rather than precluding any recovery. The key questions are whether these arguments are persuasive; and whether, even if they are, they favor the subtraction method over the ratio method.

a. The legal injury is not the death but the loss of the chance to avoid the death

A principal reason that many courts offer for endorsing partial damages in loss of chance cases, and for endorsing the subtraction calculation method in particular, is that the relevant legal harm or injury that the patient suffered is not the death itself (or some other serious ultimate injury such as paralysis). Rather, the legal injury is the loss of a chance of avoiding the death or serious injury. On this view of the relevant injury, the defendant *did* cause the injury (the lost chance), and the plaintiff can prove *this* causal connection by a preponderance. And on this view, the lost chance should be valued as of the time of the doctor's negligent act, thus supporting the subtraction method.

This judicial rationale, although frequently invoked, is unpersuasive and problematic in its implications. Furthermore, even if one accepts this rationale, it does not necessarily favor the subtraction method over the ratio method.

In order to give this central argument the attention it deserves, I defer discussion of it for now, addressing it in Section IV, below.

b. The preponderance rule precludes liability in a recurring and significant category of cases

This argument is persuasive and very important. One of the most compelling reasons for departing from the preponderance standard of proof for factual cause in loss of chance cases is the fact that rigidly adhering to the traditional standard would ensure that patients with less than a 50% chance of survival could *never* receive tort compensation, a fact that would often be known to medical practitioners at the time when they are considering what level of care to exercise.[66]

[66] For a dramatic (and frequently cited) statement of this point, see Roberson v. Counselman, 686 P.2d 149, 160 (Kan. 1984):

> The reasoning of [a court that applies the traditional test and rejects liability for loss of chance] ... in essence, declares open season on critically ill or injured persons as care providers would be free of liability for even the grossest malpractice if the patient had only a fifty-fifty chance of surviving the disease or injury even with proper treatment. Under such rationale a segment of society often least able to exercise independent judgment would be at the mercy of those professionals on whom it must rely for life-saving health care.

Thus, we have a recurring situation in which negligent actors will be, and often know that they will be, immune from legal liability; and they will know this at the time when they are considering whether to take the relevant precaution to avoid harm.[67] Principles both of fairness and of efficient deterrence support imposing at least some level of liability, notwithstanding the plaintiff's failure to prove factual cause by a preponderance.[68]

By contrast, in most negligence cases in which it is possible but not probable that the defendant's negligence made the plaintiff worse off, a recurring pocket of immunity does not exist, and the argument for partial damages for loss of a chance is much weaker. If the owner of a boat fails to equip it with adequate lifesaving equipment, his negligence sometimes will make no difference to whether the plaintiff suffers harm (if, for example, a person falls overboard and immediately drowns) but often will indeed make a difference (if the person remains afloat for at least a brief period). In such a case, the traditional proof requirement for factual cause does not create a pocket of immunity, nor does it create undesirable incentives for a boat owner, because at the time the owner is considering what equipment to provide, he knows or should know that either type of rescue situation might arise.[69]

However, this argument is not relevant in all loss of a chance cases. In some cases, the negligent doctor could not reasonably know, at the time of his or her negligent conduct, that the patient would only be able to prove that that negligence *possibly* caused the patient's harm and would not be able to prove that it was a probable cause. For example, in some negligently delayed diagnosis cases, at the time when the proper diagnosis should have been made, the symptoms of certain patients might be such that the doctor's reasonable care probably would have avoided the patient's harm. In this type of case, the policy of avoiding a "recurring pocket of immunity" does not apply.

[67] See Saul Levmore, Probabilistic Recoveries, Restitution, and Recurring Wrongs, 19 J. Legal Stud. 691 (1990); Farnsworth & Grady, supra; Farber, Recurring Misses, []. Ariel Porat provides a vivid illustration of this problem:

> *Patients with low chances of recovery*. In a particular hospital, there is a unit that treats very ill patients whose average chances of recovery are 30%. The doctors are sometimes negligent toward these patients, many of whom do not recover in the end. Since in most of the latter cases, it is more probable than not that the patients would not have recovered even if the doctors had treated them reasonably, those patients (or their families, in the event of death) are very rarely compensated for their harms.

Ariel Porat, Misalignments in Tort Law, 121 Yale L.J. 82, 108 (2011).

[68] However, there are plausible reasons to doubt that deterrence alone is a sufficient justification for tort liability in these cases. Medical practitioners have professional and personal incentives, apart from the risk of tort liability, to use reasonable care. See Steel, supra note [], at 269-275. On the other hand, the cost pressures of hospitals and health insurance companies might sometimes cause practitioners, at the margin, to give less priority to diagnostic tests and other treatments than the reasonable care standard demands.

[69] See Ward Farnsworth, The Legal Analyst 257-261 (Univ. of Chicago 2007).

But the fact that the award of partial damages in loss of a chance cases helps prevent an undesirable pocket of immunity from forming does not favor the subtraction approach over the ratio approach. To the contrary, the ratio approach is more likely to require negligent defendants to pay compensation that approximates the harm that they actually cause, as we have seen.

c. Reliable proof of the relevant probabilities exists

It is very often true that reliable proof of the relevant probabilities exists in the lost chance of a better medical outcome cases. For example, epidemiological studies might quantify the different survival rates of patients who are diagnosed with cancer at Stage 1, Stage 2, Stage 3, or Stage 4. This point, emphasized by many courts, [70] assuages the concern that an unusually flexible approach to proof of causation will spread well beyond medical malpractice to a large portion of tort negligence cases, greatly increasing the cost of litigation. Outside medical malpractice, it is usually extremely difficult to obtain reliable evidence about the probability that if a defendant had not been negligent, the plaintiff would not have suffered harm. In a slip and fall case, for example, the fact-finder might conclude that if a store had not overwaxed the floor, it is possible but not probable that the plaintiff would not have suffered harm. (Suppose that the plaintiff was running at high speed just prior to his fall.) Yet it is quite doubtful that academic studies exist that would permit an expert to assign a credible probability to the increased risk of harm that the store created.

But this argument does not favor the subtraction approach. Rather, it casts doubt on the reliability of evidence to support either computation method. After all, the same evidence that is needed for the subtraction approach will also suffice for the ratio approach.[71]

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[70] See, e.g., Matsuyama, supra at 833-834:

> [S]urvival rates are not random guesses. They are estimates based on data obtained and analyzed scientifically and accepted by the relevant medical community as part of the repertoire of diagnosis and treatment, as applied to the specific facts of the plaintiff's case. … [A]t least for certain conditions, medical science has progressed to the point that physicians can gauge a patient's chances of survival to a reasonable degree of medical certainty, and indeed routinely use such statistics as a tool of medicine.

See also Smith v. Providence Health & Services, 393 P.3d 1106, 1115-1116 (Or. 2017); Dickhoff, supra, at 335 (“[T]he reliability of the evidence that victims of medical malpractice are able to marshal when a physician's negligence reduces a patient's chance of recovery or survival has dramatically improved in recent years—now making it possible to prove causation in a loss of chance case.”)

[71] This statement might not always be true. Perhaps an expert could be confident that the defendant’s negligence decreased the patient’s chances by 20% but could be much less confident that the decrease was from 45% to 25% as opposed to 35% to 15%. Realistically, however, the expert is likely to rely on studies that provide the latter type of information,

d. Awarding partial damages approximates the harm that the negligent doctor caused

Courts frequently invoke this argument,[72] and the argument is compelling. Applying the traditional preponderance test in recurring loss of a chance scenarios would systematically result in negligent doctors paying nothing for their negligence. On the other hand, allowing full recovery in these scenarios would systematically result in negligent doctors paying substantially more damages for their negligence than they actually caused.[73] Recall the discussion of the Dr. Deficient example in Section [], in which a doctor negligently exposed 100 patients to an increased risk of cancer, causing $15 million in total harm. If all patients treated by the doctor who died from cancer obtain a full recovery, the doctor would pay $45 million in damages. And if a full recovery is obtained by all patients who were exposed to the risk (and not just by those who died from cancer), the doctor would pay $100 million. Thus, awarding partial rather than full damages to the doctor's patients better approximates the aggregate loss. But for reasons already explained in Section [], the ratio method is very likely to result in aggregate damage awards that better approximate the total harm caused by negligence than the subtraction method.

One important objection to this argument is the observation that the partial damages remedy creates a huge number of errors. In fact, it gets every single case wrong.[74] Both the subtraction method and the ratio method give each plaintiff only a portion of their full damages. In actual fact, some of the plaintiffs deserve full damages (in this example, the 15 who were negligently killed), while other plaintiffs deserve no damages (namely, the 30 who would have died even if defendant had not been negligent, as well as the 55 who did not die). This observation is factually correct, as is the point that the traditional preponderance test makes fewer errors.[75]

However, proponents of a partial damages remedy have a persuasive response: as a policy matter, minimizing the total number of errors is less important

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and that information is sufficient to calculate damages under both the subtraction and the ratio approach.

[72] See cases cited in note [] supra.

[73] Damages for personal injury are of course an imperfect measure of the extent to which the injured plaintiff has been made worse off by the defendant's tortious conduct. If you believe that the current tort damage rules provide inadequate (or excessive) compensation, that might affect your willingness to endorse partial damage remedies in loss of chance cases. However, the most appropriate solution to unjustifiable damage rules is to change the rules themselves. This paper does not address that broader question.

[74] See Fennell v. Southern Maryland Hosp., 580 A.2d 206, 212–213 (Md. 1990).

[75] As the court in *Fennell* notes, the preponderance test correctly denies recovery to most plaintiffs, because most of them would have survived even if the defendant had not been negligent. Id. at 213. To be sure, the preponderance test also incorrectly denies recovery to some plaintiffs—those who died because of defendant's negligence and who should receive full damages. But the preponderance test causes fewer total errors than a partial damage remedy causes.

than adopting a partial damage remedy as a second-best solution in this scenario, a scenario in which the traditional preponderance standard would permit a recurring pocket of legal immunity to develop and in which factual causation is fundamentally uncertain. If it were feasible to determine accurately whether plaintiff is in the class of those who died only because of defendant's negligence or in the class of those who would have died anyway, then of course that determination should be made, and plaintiff should either recover in full or recover nothing, depending on the evidence. But a distinguishing characteristic of loss of chance cases is the impossibility[76] of making that determination, due to no fault on the part of the plaintiff.[77]

This assumption is critical. If it were feasible for the plaintiff to prove that she was within the group who died only because of defendant's negligence, then she would be entitled to a full recovery, and there would be no reason to apply a loss of a chance partial remedy. (Suppose the plaintiff could prove that because of her particular genetic condition, her cancer would have been fully curable if diagnosed earlier.) Similarly, if it were feasible for the defendant to prove that the plaintiff was within the background risk group that would have died even if the defendant had not been negligent, the plaintiff would not be entitled to obtain any remedy, even in a jurisdiction that endorses a partial remedy in loss of a chance cases.

e. The chance of survival that the patient lost has substantial value to the patient

[76] For detailed discussion of some ambiguities about "impossibility" in this context, see Steel, at [].

[77] In contrast to the reasoning of the court in *Fennell*, supra note [], Rhee provides a very different analysis of comparative errors that supports a partial damages remedy for loss of chance cases. Rhee, Probabilistic Causation, supra note [20]. Rhee's formula for total error cost supports the view that the ratio method is preferable to the alternatives. The formula defines total error costs as the sum of "under-deterrence" (i.e., the extent to which the liability of the negligent actor falls short of the harm the actor caused) and errors in overpaying or underpaying plaintiffs. Id. at 520. Rhee argues that "error" minimization under this formula promotes economic efficiency.

This analysis is illuminating, but it does not explain why, on efficiency grounds, the error cost formula gives the same weight to (a) whether the defendant pays in full for the harm she causes and (b) whether those who receive and who do not receive compensation have received an appropriate amount. I believe that (a) is the most critical factor for purposes of efficiency, while (b) is more a matter of fairness. Moreover, Rhee's exclusive emphasis on efficiency to the exclusion of principles of justice and fairness is not shared by all courts that endorse a partial compensation remedy in loss of chance cases.

This argument[78] is both persuasive and important. Ex ante, at the time when the patient was consulting the doctor, the patient (or the patient's insurance company) would be willing to pay more for the services of a doctor who would be more careful in reducing the risk of serious injury to the patient, even if that risk was less than 50%. However, this point does not provide a basis for preferring one calculation method over the other.

f. Defendant's negligence caused plaintiff's inability to prove causation

This argument, although often invoked by courts and some commentators (including King),[79] is less persuasive. For it is also true, at least in many loss of chance cases, that the plaintiff's preexisting condition has caused plaintiff's inability to prove causation. It may simply be an unfortunate fact about medical science that determining the relative causal contributions that preexisting disease and substandard medical care make to a patient's health or illness is often very difficult.[80]

But even if this argument has some force in justifying partial rather than no damages, it does not favor one calculation method over the other.

g. Medical practitioners undertake to improve the patient's chance of survival

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[78] See, e.g., Dickhoff, supra, at 334. The Missouri Supreme Court articulates this argument well:

> A patient with cancer ... would pay to have a choice between three unmarked doors—behind two of which were death, with life the third option. A physician who deprived a patient of this opportunity, even though only a one-third chance, would have caused her real harm.

Wollen v. DePaul Health Center, 828 S.W.2d 681, 684 (Mo. 1992).

[79] Many courts have cited this passage from one of the earliest loss of chance cases:

> When a defendant's negligent action or inaction has effectively terminated a person's chance of survival, it does not lie in the defendant's mouth to raise conjectures as to the measure of the chances that he has put beyond the possibility of realization. If there was any substantial possibility of survival and the defendant has destroyed it, he is answerable.

Hicks v. United States, 368 F.2d 626, 632 (4th Cir. 1966).

In his second article on loss of a chance, King places special emphasis on this argument. See King, Reduction of Likelihood, at 559.

[80] See Steel, supra, at 275, noting that England, France and Germany usually rely on this rationale to relax the ordinary standard of proof *only* when the defendant's fault was greater than ordinary negligence. The standard might be relaxed, for example, if defendant destroyed or failed to preserve evidence of negligence.

This argument[81] initially seems plausible, but on reflection, it is not fully persuasive. An actor's voluntary undertaking to improve someone's health does not seem to be categorically different, for purposes of justifying a partial damages award, from other cases in which an actor has a legal duty to protect a plaintiff. A landlord might not voluntarily undertake to protect her tenants from violent attacks, but she nevertheless sometimes has such a duty of protection (especially if prior attacks have occurred). If a tenant suffers such an attack, and if it is quite possible but not probable that a reasonable precaution by the landlord would have prevented the harm, it is at least an open question whether partial damages should be awarded. In the end, I believe that question should be answered in the negative, but for different and more compelling reasons: in this scenario, we lack reliable evidence of probabilities, and there also is a much lesser concern than in the medical malpractice delayed diagnosis cases about a recurring pocket of legal immunity.

But once again, even if this argument has some force in justifying partial damages, it does not favor the subtraction method of calculation.

h. The difference between the methods is sometimes small or zero

In many cases, such as the fact pattern in *Herskovits*, there is little difference between the calculation methods (14% x F under subtraction, 19% x F under ratio).[82] And in elimination of chance cases, as we have seen, the methods produce identical outcomes.

When the differences in outcomes are small or zero, there is something to be said for employing the somewhat simpler subtraction approach. On the other hand, the ratio method is not complex. Both methods rely on the same two probabilities as inputs: B (the background risk apart from the defendant's negligence) and C (the cumulative risk after the defendant's negligence).[83] And in many cases, the outcomes of the two methods will differ substantially.

In theory, a court might adopt a bifurcated solution, under which the subtraction approach is used only when it reaches results similar or identical to the

[81] See, e.g., Dan B. Dobbs, Paul T. Hayden and Ellen M. Bublick, The Law of Torts § 197, at notes 8 through 11 (2d ed. May 2023 update) (citing cases); Benjamin C. Zipursky & John C.P. Goldberg, Unrealized Torts, 88 Va. L. Rev. 1625, 1658-1660 (2002).

Mark Geistfeld has recently endorsed a version of this argument: that doctors have a duty to provide patients, including those with preexisting conditions that probably cannot be cured, with professionally competent treatment, and it would be inconsistent with that duty for negligent doctors to rely on the preexisting condition to deny liability for this entire category of cases. Geistfeld, supra note []. This duty-preserving rationale is promising, but it fails to explain the many loss of a chance cases that permit partial recovery for negligent treatment that does not involving a preexisting medical condition.

[82] Robert Rhee has written two very helpful articles analyzing the two calculation methods (see Rhee, supra note [20]), but in many of his examples, the difference in outcomes under the two methods is relatively small. In this paper, I have provided some plausible fact patterns in which the difference is larger.

[83] See Rhee, Probabilistic Causation, at 528-529.

ratio approach. But that solution would be pointless, for it would require performing calculations under *both* methods in order to justify performing the calculation only under the simpler subtraction method! Thus, the most straightforward solution is to adopt the ratio method.

IV. Problems with recasting the legal injury as the loss of the chance to avoid death

As noted above, a principal reason that many courts explicitly offer for endorsing partial damages in loss of chance cases is that the relevant legal harm or injury that the patient suffered is not the death itself, but the loss of a chance of avoiding the death. On this view, which seems to be endorsed by the majority of courts that support the award of proportional damages in loss of chance cases, the defendant *did* cause the injury (the loss of the chance), and the plaintiff *can* prove *this* causal connection by a preponderance.[84] And it perhaps follows from this view that the subtraction method is the best way to measure the lost chance. Thus, in *Herskovits*, although plaintiff *cannot* prove that defendant's negligent delay in diagnosis probably caused the death of the patient (because the patient had a preexisting risk of death greater than 50%), plaintiff *can* prove that defendant's negligence probably caused the patient to lose a less than 50% chance of avoiding death.[85]

This section makes the case that the "recharacterization of injury" argument, although frequently invoked, is unpersuasive, because it relies on an ad hoc, unnecessary, and problematic redefinition of the legal injury suffered in loss of chance cases. However, a narrow version of that argument, that patients *who have not yet suffered harm* should be entitled to partial compensation for exposure to a risk of future of harm, is more appealing. But even that more restrictive version, I will suggest, would be a controversial expansion of traditional tort principles.

The most fundamental objections to the recharacterization argument are its breathtaking scope and its inconsistency with traditional tort principles. If taken to its logical conclusion, this redefinition would have radical consequences—for example, it would permit everyone endangered by a speeding driver to obtain partial damages for that risk exposure, even if we know that the driver did not harm the plaintiff, indeed even if we know that the driver did not harm anyone whom she endangered. The driver did create an unjustifiable risk of harm to her potential victims. So, if the recharacterization argument were accepted here, a court would be entitled to say that those potential victims actually did suffer a legal injury—of being endangered—and those victims might easily be able to prove *that* injury by a

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[84] Courts that adopt this view still do require proof by a preponderance that the doctor's negligence increased the risk of the ultimate harm. Expert testimony to that effect is ordinarily required.

[85] Recall that in *Herskovits*, the preexisting risk of death from cancer was 61%; the additional risk of death due to defendant's negligence was either 14% (under the subtraction method) or 19% (under the ratio method). That additional risk is equivalent to the lost chance of avoiding death.

preponderance. If widely accepted, the strategy of recasting the injury would permit endangered individuals to obtain a compensation remedy whenever they were exposed to risk by anyone's negligence.

Moreover, the recharacterization argument, taken literally, supports a partial damage remedy even if, as of the time of trial, the patient has not suffered the ultimate harm (such as death). Yet only a small proportion of courts that endorse the argument also permit a patient to recover for the risk that they might suffer the ultimate harm in the future. It seems inconsistent to measure damages by the ex ante risk of future harm, determined as of the time of the defendant's negligent conduct, and at the same time to insist that the plaintiff must have actually suffered the ultimate harm as of the time of trial in order to obtain a compensatory remedy.

Why do many courts adopt this fiction that the "real" injury is the *loss of a chance* of avoiding the death or paralysis or other serious injury? After all, the more natural and straightforward analysis is that the injury that tort law's negligence doctrine is intended to prevent (and is intended to compensate if it is not prevented) is the patient's death or serious injury.

The best explanation is that these courts are trying to justify compensating a sympathetic group of plaintiffs—patients who were exposed to the negligence of medical practitioners and who might have been harmed by that negligence—without violating the traditional rule that plaintiffs must prove each element of a negligence claim, including factual cause, by a preponderance. And it is certainly understandable, and indeed commendable, that courts are reluctant to endorse a legal approach that violate that traditional rule. It would be highly undesirable to permit widespread exceptions to the rule. Allowing partial compensation remedies in every case where proof of factual causation is uncertain would be a cure worse than the disease, for it would burden courts and litigants with costly inquiries that would quite often be very difficult to resolve accurately, because of the unreliability of evidence of the relevant probabilities.

However, the solution of redefining the injury is also highly problematic in its implications. Why not say, in every case where defendant's negligence possibly but not probably was a factual cause of plaintiff's harm, that the defendant has deprived the plaintiff of a chance of avoiding injury? If there is only a small chance that a driver's exceeding the speed limit caused the death of an unconscious pedestrian lying in the middle of a street, why not award the estate compensation for the loss of that chance? Or recall the example of a supermarket overwaxing the floors, making them very slightly more slippery. Suppose a teenager runs at full speed around a corner in the store, suffering injury. I very much doubt that courts would extend the loss of a chance doctrine and permit partial damages in ordinary causation cases such as these in which the actor's negligence possibly is, but probably is not, a but-for cause of the harm.

Courts have a much better, more persuasive, and more intellectually honest option for justifying partial damages in loss of a chance cases than adopting the fiction that the relevant legal injury is the loss of a chance of avoiding the ultimate injury. The option is to create a carefully circumscribed exception to the usual

preponderance requirement for factual cause because of the compelling policy reasons supporting such an exception.

Some courts have indeed taken this option in loss of chance cases, rejecting or declining to employ the "reconceived injury" rationale but nevertheless endorsing proportional damages.[86] These courts often describe their approach as a "relaxed causation" approach. This language is potentially confusing, because the same language is also used by other courts that endorse damages for loss of a chance but *do not* require that those damages be limited to a proportional rather than a full recovery.[87] It would be more accurate to characterize the partial damages remedy in loss of chance cases as a justified and narrow exception to traditional proof requirements for factual cause. It is also notable that many scholars who endorse loss of a chance proportional damages do not explicitly base their endorsement on the "reconceptualized injury" approach.[88]

From a broader perspective, outside the context of loss of chance, courts have already widely embraced this type of option in a limited but important set of doctrines in which applying the traditional proof requirements for factual causation would be unjust or would produce troublesome consequences. Thus, when multiple sufficient concurrent tortious causes contribute to a harm, the plaintiff need not prove that each cause was a but-for cause of the harm.[89] When plaintiff cannot prove which of two or more tortious defendants was the sole factual cause, each defendant must prove that they were not the cause, and if they cannot, they are jointly and severally liable.[90] "Some cases ease the plaintiff's burden on factual causation by employing a presumption of causation in negligence per se cases."[91]

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[86] Examples include McKellips v. Saint Francis Hosp. Inc., 741 P.2d 467 (Okla. 1987); Scafidi v. Seiler, 574 A.2d 398 (N.J. 1990); Reynolds v. Gonzalez 798 A.2d 67 (N.J. 2002); and Estate of Frey, supra, at 1210 (describing the reconceptualized injury approach as "incongruous").

[87] See King, Reduction of Likelihood, at 506-508.

[88] See Cohen & Twerski, supra; Epstein, supra; Levmore, supra; Rhee, supra note [20]. However, law student notes do tend to endorse the reconceptualized injury approach.

[89] Suppose A negligently causes a forest fire, and, independently, B negligently does the same; each fire arrives at P's building at the same time; the building is destroyed; and each fire is sufficient to have caused the loss. Neither is a but-for cause, yet courts hold A and B jointly and severally liable. See Restatement Third, Torts: Liability for Physical and Emotional Harm § 27 (2010). Whether understood as an exception or a supplement to but-for cause, this is a special causation rule that departs from the usual but-for cause requirement, a rule that is quite justifiable for reasons of fairness and perhaps efficiency.

[90] See Summers v Tice, 199 P.2d 1 (Cal. 1948).

[91] Restatement Third, Torts: Liability for Physical and Emotional Harm § 26(b), Comment g (2010). A prominent example is Haft v. Lone Palm Hotel, 478 P.2d 465 (Cal. 1970), in which the court shifted the burden of proof on negligence to a defendant who had violated a statute requiring hotels with swimming pools either to have a lifeguard present or to post a sign indicating that no lifeguard was present. Under a strict application of the but-for cause test, the plaintiff would have failed in their negligence per se claim, because under the facts of the case, satisfying the statute by providing a sign warning that no lifeguard was present was quite unlikely to have prevented the drownings. The court instead adopted a more flexible approach to factual cause, in light of the legislative policy to protect swimmers in hotel swimming pools from danger.

And if it is unclear whether a plaintiff would have heeded a legally adequate warning on a product, many courts adopt a heeding presumption, making it easier for the plaintiff to satisfy the factual cause requirement, in order to avoid a pocket of legal immunity.[92] Market-share liability is a more controversial example in which a minority of courts have endorsed an exception to the usual factual cause proof requirements, and have permitted plaintiffs to obtain partial compensation from manufacturers of DES, in order to ensure that the defendants pay compensation in an amount roughly commensurate with the harm that they have caused.[93] As we have seen, that very rationale is prominent in judicial opinions endorsing partial damages in loss of chance cases.

Moreover, in discussing reasonable inferences of factual cause when there are multiple possible causes of plaintiff's injury, the Restatement Third, Torts: Liability for Physical and Emotional Harm § 28, Comment b, first rejects the view that proof that defendant's negligence increased the risk of harm is always sufficient to permit such an inference, but then concludes: "Thus, only when the tortious conduct reasonably could be found, *after the fact*, to have increased the risk of harm to a greater extent than the risk posed by all other potential causes would an inference from tortious conduct alone be permissible" (emphasis added). Notably, this reasoning is more consistent with the ratio approach than the subtraction approach, because it explicitly focuses on the *ex post* question whether defendant's negligence is more likely to have been the cause than other factors such as a patient's preexisting condition.

In these cases, courts could have redefined the nature of the legal injury, thus avoiding a departure from the general rule requiring proof of factual cause by a preponderance. But that would simply be an unhelpful legal fiction. Instead, courts have taken a more sensible course: offering persuasive policy reasons for the particular exceptions to that general rule.

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[92] See Neil Cohen & Aaron Twerski, Resolving the Dilemma of Nonjusticiable Causation in Failure-to-Warn Litigation, 84 S. Cal. L. Rev. 125 (2010).

[93] For a general discussion, see Restatement, Third: Torts, Liability for Physical and Emotional Harm § 28, Comment p and accompanying Reporters' Note. Some courts have permitted plaintiffs to obtain market share damages, even though the plaintiff was unable to identify the particular defendant who sold the medication that caused the plaintiff's harm. But even those courts that have adopted this novel causation theory have always insisted that the plaintiff prove that they suffered physical harm from the medication. By contrast, some courts using the subtraction approach in loss of chance cases do not require proof that the plaintiff suffered harm as of the time of trial.

The controversial nature of market share damages might seem to undercut the judicial practice of awarding partial damages in loss of chance cases. But the market share approach has been marred by serious difficulties in proving market share and also in determining which market to use (such as national v. local) and whether to permit defendants to exculpate themselves if they can prove that they could not have been a cause. Medical malpractice loss of chance cases do not pose the same concerns or do not pose them to the same degree.

Consider *Summers v. Tice*,[94] the famous "alternative liability" case in which two hunters negligently and independently fired in plaintiff's direction, causing an injury. Only one of the hunters was the cause, but it was impossible to determine which one. The California Supreme Court adopted an innovative rule: in these unusual circumstances, the burden of proof (both production and persuasion) shifts to each of the defendants to prove that they were not the factual cause.

The court *could* have reasoned as follows: Each negligent hunter *might* have caused the harm; therefore, the plaintiff can recover, from each hunter, for the loss of a chance of avoiding injury. But that reasoning would obviously be a misleading fiction. Instead, the court simply pointed out the injustice of leaving a potentially innocent plaintiff without a remedy in this unusual situation, in which one of a small number of wrongdoers must have caused the harm but it is impossible to identify which one. Similarly, the Restatement Second and the Restatement Third of Torts, in endorsing the special rule in *Summers* that departs from the traditional requirement of proof of factual cause by a preponderance, does not reconceptualize the harm as the loss of a chance. Rather, they reason that "as between two culpable defendants and an innocent plaintiff, it is preferable to put the risk of error on the culpable defendants."[95]

Or consider the heeding presumption that many courts employ to address uncertainty about causation when a product manufacturer provides an inadequate warning about the risks of the product. It is very difficult to determine whether the product user would have heeded the warning and thus avoided the risk that came to fruition. And in many cases, most users would still have used the product if properly warned. If the preponderance test of factual causation were strictly applied, product users might rarely prevail, even if the warning was clearly deficient. In response to these concerns, many courts adopt a presumption that the user would have read and heeded an adequate warning, if it had been given.[96] This is a reasonable solution to the problem, for it puts a thumb on the scale in favor of product users, making it easier for them to reach the jury on the factual cause question.[97] And this solution helps avoid the significant danger that applying the

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[94] Supra, note [].

[95] Restatement Third, Torts: Liability for Physical and Emotional Harm § 26(b), Comment g (2010); see also Restatement Second, Torts § 433(B)(3) (1965).

[96] A different response to this problem is to award damages even if the user clearly would have made the same decision if a proper warning had been included, because the defendant violated the user's right to make an informed decision. See Aaron Twerski & Neil Cohen, Informed Decision Making and the Law of Informed Consent: The Myth of Justiciable Causation, 1988 U.Ill. L. Rev. 607. This is a more radical approach, however, and courts have not adopted it in negligence cases. Moreover, this approach would likely result in a much smaller award than the plaintiff would receive if the heeding presumption resulted in plaintiff obtaining full damages. In a later article, by contrast, Twerski and Cohen endorse a proportional damages award. But the proportion would depend on both fault and causation, unlike the calculation methods used in loss of a chance cases. Twerski & Cohen, supra, at 153-158.

[97] See Levmore, supra note []. Levmore notes that loss of a chance medical malpractice cases and deficient warning cases both create the problem of "recurring misses," a problem

traditional factual causation proof requirements would result in a recurring pocket of legal immunity (the same danger that exists in loss of a chance medical malpractice cases). But notice what courts have *not* done in response to proof problems in product warning cases: they have not reconceptualized the plaintiff's legal injury as the loss of the chance that an adequate warning would have prompted the plaintiff not to use the product and thus would have prevented the plaintiff from suffering the ultimate injury, the risk of which would have been disclosed by an adequate warning. Such a recharacterization is unnecessary.

In loss of a chance cases, just as in alternative liability and inadequate warning cases, courts should not rely on the fiction of redefining the nature of the legal injury but should instead invoke the types of arguments of policy and principle that amply justify departures from the strict preponderance rule in other exceptional categories of factual cause cases.

A final category involving uncertain causation is highly relevant here. In Gardner v. National Bulk Carriers, Inc.,[98] the captain of a ship chose not to try to rescue a crew member who had fallen overboard and had last been seen more than five hours before he was discovered missing. The court could have followed the traditional preponderance rule and denied all recovery based on lack of proof of factual cause. Or it could have allowed partial recovery based on the probability that a rescue would have been successful. That remedy would probably have been quite modest; I suspect that there was no more than a 5% or 10% chance that the rescue would have succeeded.[99] But instead, the court of appeals held that the defendant was required to pay full damages, reasoning as follows:

> [P]roximate cause here is implicit in the breach of duty [to rescue]. Indeed, the duty would be empty if it did not itself embrace the loss as a consequence of its breach. Once the evidence sustains the reasonable possibility of rescue, ample or narrow, according to the circumstances, total disregard of the duty, refusal to make even a try, as was the case here, imposes liability.[100]

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that is more specific and pressing than the general problem of uncertain proof of factual causation. He then offers a range of possible common law and regulatory solutions, such as awarding proportional remedies and shifting the burden of proof.

[98] 310 F.2d 284 (4th Cir. 1962).

[99] This is most likely an elimination rather than reduction of chance case: the captain's decision not to attempt a rescue decreased the deceased's chance of life to zero or perhaps close to zero.

[100] A later case involving a lost chance of a better medical outcome distinguished *Gardner* on the following grounds:

> We do not see *Gardner* as analogous to the medical malpractice situation .... *Gardner* only concerns a specialized duty peculiar to admiralty law which imposes liability on a highly-culpable ship master through a relaxed causation requirement. Such a specialized duty with a "watered-down" causation requirement should not be extended from the high seas to the hospital bed.

Hurley v. United States, 923 F.2d 1091, 1095 (4th Cir. 1991) (footnote omitted). I agree with the court's view that *Gardner* imposed a relaxed causation standard, but I do not agree that

Gardner is a distinctive judicial response to the loss of a chance problem, most likely limited to admiralty cases in which the captain does not make any effort whatsoever to rescue a crew member. The policies of strongly encouraging efforts to rescue crew members when the rescue has some chance of success and of relaxing causation requirements when the defendant is highly culpable persuaded the court to adopt a strongly pro-plaintiff rule and to treat the failure to rescue as a factual cause as a matter of law. Whether or not one agrees with this doctrinal rule, it clearly is based on policy grounds, not on a reconceptualization of the injury as loss of a chance, because that reconceptualization would have supported only partial damages, not the full damages that the court required defendant to pay.

A final reason not to adopt the "reconceptualized injury" framework in loss of a chance cases is a concern that this framework, by employing a fictional and ad hoc definition of the legal injury that is potentially quite far-reaching in scope, might dissuade courts from adopting a partial damage remedy in loss of chance cases at all, and might instead encourage courts to retain the traditional all-or-nothing approach. This concern is not entirely speculative. Some courts and some judges have objected to the partial remedy approach in loss of chance cases precisely because that approach relies on a fiction or is problematically broad.[101] It is possible that some courts would be more willing to endorse a partial damage remedy if this approach rested on a firmer intellectual foundation.

Thus far, I have pointed to serious problems with the argument that the legal injury in the medical malpractice cases under discussion should be defined as the loss of the chance to avoid death or other serious harm. But even if my analysis is unpersuasive, it is not at all clear that the "reconceived injury" argument supports the subtraction approach over the ratio approach, for the following reason. If we

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a relaxed causation framework is inapplicable to cases involving lost chances of a better medical outcome, especially if courts award proportional rather than full damages in such cases.

[101] See, e.g., Fennell v. S. Md. Hosp. Ctr., Inc., 580 A.2d 206, 213 (Md. 1990) ("[I]t would seem that the true injury is the death"; "While we should not award damages if there is no injury, the logical extension of the loss of chance damages theory arguably should allow loss of chance damages for negligence, even when the patient miraculously recovers"); Kramer v. Lewisville Mem. Hosp., 858 S.W.2d 397, 405 (Tex. 1993) ("[I]t should matter not that the [plaintiffs'] theory of recovery limits damages in some metaphysical sense to the value of the lost chance. The true harm remains [the patient's] ultimate death. Unless courts are going to compensate patients who 'beat the odds' and make full recovery, the lost chance cannot be proven unless and until the ultimate harm occurs."); Dickhoff, supra, at 347 (Justice Dietzen, dissenting) ("[T]he majority seeks to mask its alteration of traditional causation requirements by casting its opinion instead as a redefinition of the concept of recoverable damages… [T]he majority has concocted a legal fiction in order to obscure the very real causation problem in this case."); Mohr v. Grantham, 262 P.3d 490, 499 (Wash. 2011) (C.J. Madsen, dissenting) ("The majority holding rests on the fiction that the 'injury' is actually the loss of a chance of a better outcome. This is semantic pretense. No matter how the cause of action is described, at the end of the day liability is based on no more than the mere *possibility* that the physician's negligence has caused harm…").

know, at the time of trial, that the patient has died from the disease, we need to measure the size of the chance that the patient has "lost." But it makes little sense to consider, in that calculation, the group of patients who did *not* die. Those patients did not actually *lose* a chance. Rather, we should consider only the two groups containing patients who did die (the background risk group B and the negligently-caused risk group N). So, although I find the reconceived injury argument unpersuasive, that argument still seems to demand inquiry into whether a chance was genuinely lost. And in cases where the patient has died from the disease, the ratio method still is a much better measure of whether a chance was lost than the subtraction method.

Although the argument that the relevant injury is the loss of a chance is highly problematic, a different argument is more plausible—namely, the argument that suffering *exposure to a risk* created by defendant's negligence is sometimes a proper basis for obtaining a tort remedy, including the remedy of compensation. As noted earlier, the one situation in which the subtraction method is a plausible computation method is when the patient has not yet suffered the relevant harm. This narrower argument is problematic in a different way, however, as we will see in Section VI.

V. Complications

a. How should probabilistic and individualized evidence be integrated?

Most courts have been persuaded by arguments favoring a proportional damage rule when a doctor's negligence possibly, but not probably, caused a patient to die or suffer serious harm, or to lose the chance for a better medical outcome. In many such cases, I agree, so long as (1) the negligence at issue occurs in recurring situations in which injured plaintiffs will quite often be unable to satisfy the preponderance test and (2) reliable statistical evidence is available that permits the fact-finder to quantify the relevant proportion.

This second qualification is important. In some important categories of cases, (1) is satisfied but (2) is not. Recall the problem of inadequate product warnings. Statistical studies do not exist that reliably quantify the likelihood that users of a particular product would decline to use the product if presented with a specific warning that the manufacturer failed to include. Indeed, the facts of defective warning cases are highly specific to the product, the warning, and the type of users, so it is doubtful that a reliable study could be created that would assist the fact-finder in determining whether the absence of an adequate warning was a factual cause.

But even within the category of medical negligence that possibly but not probably causes a patient's death or injury, the reliability of the statistical evidence may be more problematic than is usually assumed. Consider the use of epidemiological evidence of mortality rates for different stages of cancer. This type of evidence underlay the statistical analysis of the concurring opinion in *Herskovits* and has been introduced and relied on in numerous loss of a chance cases. But

mortality rates are a generalization across the populations of medical studies. They cannot possibly include every potentially relevant feature of each patient or that patient's medical condition.[102]

When courts employ statistics to quantify the probabilities underlying the subtraction or ratio methods for computing partial damages, they inevitably rely on imperfect data, and there is a risk that they will rely too much on the most available data, even if that data is not the most relevant.[103] It is therefore critically important that judges facilitate the admission of expert testimony from both parties about the validity and relevance of statistical information, to ensure that quantification of the probabilities, for purposes of determining proportional damages, is as accurate as possible.

A more complex approach is proposed in a recent article by Elissa Gentry. She is concerned about courts and factfinders giving too much weight to general statistical probabilities and too little weight to ex post circumstantial facts about causation that are particular to the patient's situation.[104] Thus, she would support

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[102] For example, Noah points out that courts sometimes make inappropriate comparisons of survival chances at different stages of a disease, or misunderstand a five year survival rate as representing the best case scenario for the patient's life expectancy, or fail to account for background mortality rates. Noah, at 384-393. Similarly, in Gregg v. Scott, 1 [2005] UKHL 2, the House of Lords declined to permit a loss of chance recovery based on a delayed diagnosis of cancer. Their decision was influenced by the fact that the personalized estimates of the plaintiff's prospects of cure fluctuated over time. For a careful analysis of these probabilities and of the opinions in the case, see Jane Stapleton, Loss of the Chance of Cure for Cancer, (2005) 68 Mod. L. Rev. 996.

[103] See Gentry, at 424-425.

[104] Gentry provides the following arresting illustration of the problem:

> [A] recent study suggests that a 1% increase in speed results in an increased chance of crash of 2%. Applying the doubling rule [requiring a doubling of risk due to negligence in order to satisfy the preponderance test], a 50% increase in speed will lead to a 100% increase in harm rate (i.e., a doubling). Suppose a driver was speeding in a 70-mph zone. If the driver was going 90-mph in a 70-mph zone (roughly a 28.6% increase in speed), a reasonable jury may well find that the driver breached the standard of care; however, a jury would not be allowed to find that speeding caused an accident unless the driver was going 105-mph (1.50 x 70) in a 70-mph zone. Intuitively, this seems over-restrictive, missing many cases in which a reasonable jury could find that the speeding caused the crash.

Gentry, at 423 (footnote omitted).

I concur with Gentry's conclusion that the factfinder should be permitted to find that the defendant's negligence was a cause in this type of case, and that conclusion does support her general point that courts should not permit factfinders to give undue weight to probabilistic evidence. Perhaps the best explanation for the conclusion is that, in cases where a speeding driver's car harms a plaintiff, it is very likely that the driver was also negligent in some other way, such as failing to pay sufficient attention to his surroundings or failing to keep a safe distance from other drivers. Thus, even if the probabilistic evidence about the general effect of different degrees of speeding on crashes is statistically valid, that

proportional liability only if it is clear that the plaintiff's injury is indistinguishable from other injuries; otherwise, she would require proof, from both statistical and individualized evidence, of factual causation by a preponderance. But Gentry would also caution courts against creating thresholds that make it unduly difficult to present the factual causation question to the jury.

The proper mix of statistical and individualized evidence is a challenging problem. However, so long as courts clearly explain the governing computation method and are realistic about the strengths and limitations of statistical information, they should feel comfortable continuing to permit partial damage awards in loss of chance cases.[105]

b. Should partial damages be awarded both for probabilities less than and greater than 50%?

Should plaintiffs in loss of chance scenarios receive only proportional damages, rather than full damages, if the probability that the negligence of the defendant caused plaintiff's harm exceeds 50% but is less than 100%? Suppose, for example, that the background risk that the patient would die from cancer is 30%, and the doctor's negligence increased the risk to 100%. Should the doctor pay only 70% of the full damages?[106] Under the traditional preponderance rule, the doctor's negligence would be treated as a factual cause, because 70% is greater than 50%, and the doctor would be liable for full damages. But reducing damages to 70% would achieve symmetry with the proportional damage remedy that many courts endorse when the probability of causation is *less* than 50%. King and other scholars

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evidence does not take into account the likelihood that, when a crash occurs, it is likely that the driver was negligent in some additional respect.

[105] For judicial recognition of the need to integrate statistical and more individualized evidence, see, McKellips, supra, 741 P.2d at 476:

> Statistical evidence … merely provides a base estimate and is not in itself sufficient to make the damage determination. Facts relevant to the particular patient should also be weighed in determining the net reduced figure used to represent the patient's loss of survival chance attributable to the defendant's negligence.

For further discussion of potential misunderstandings of statistical evidence relevant to medical malpractice loss of a chance cases, see King, Reduction of Likelihood, supra, at 547-556.

[106] The same question arises if the doctor's negligence reduces but does not eliminate the chance of survival. Suppose, for example, that the doctor increases the background risk of death from 30% to 90%. Although this satisfies the preponderance test, perhaps the doctor should pay only 60% of the full damages (if the subtraction approach applies) or only 67% of those damages (if the ratio approach applies).

have advocated for such symmetry.[107] However, no court has officially adopted this position.[108]

This issue is significant, but it is orthogonal to the question whether to employ the subtraction or ratio method. Under either method, if we are trying to ensure that the damage remedy accurately measures the relevant chance (of future harm, or of causation of a past harm), arguably we should treat probabilities greater than and less than 50% symmetrically. Once we identify a category of cases in which it is justifiable to depart from the all-or-nothing preponderance test for proof of factual cause, arguably the symmetrical approach is preferable. Among other things, symmetry results in negligent defendants paying an aggregate amount of

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[107] See King, Causation and Valuation, at 1387; King, Reduction of Likelihood, at 556-557; Levmore, []; Epstein, supra; Guest, et al, at 56; Fischer, supra, at 619. See also Fennell, supra, at 214 (arguing that the traditional preponderance test achieves symmetry, insofar as it awards either full recovery or no recovery; thus, that test supports *rejection* of loss of chance partial recovery). Others have argued against symmetry. See, e.g., Ellis, Loss of Chance as Technique: Toeing the Line at Fifty Percent, 72 Tex. L. Rev. 369 (1993).

[108] The issue is discussed, but not resolved, in Indiana Dept. of Ins. v. Everhart, 960 N.E.2d 129, 133-137 (Ind. 2012). Two cases has been found that appears to require reduction of a recovery even though it was (probably) more likely than not that the defendant's negligence caused the ultimate injury. In LaRose v. Washington Univ., 154 S.W.3d 356 (Mo.Ct.App. 2004), there was evidence that the plaintiff had a 60% preexisting chance of survival which the defendant's negligence reduced to 3%. Under either computation method, it was more likely than not that the plaintiff would have survived but for the defendant's negligence, which would ordinarily support full damages. (Under ratio, the probability that negligence caused the plaintiff's death was 57/97 or 59%; under subtraction, it was 57%). But the trial judge apparently reduced the recovery to 57% of full damages. For discussion, see Dan B. Dobbs, Paul T. Hayden and Ellen M. Bublick, The Law of Torts § 197 (2d ed. May 2023 update).

In DeBurkarte v. Louvar, 393 N.W.2d 131 (Iowa 1986), the court relied upon the loss of a chance theory to permit partial damages for a delayed diagnosis of cancer, based on medical evidence that the patient's chance of surviving ten years would have been at least fifty and as high as eighty percent absent negligence; as of trial, her chance of surviving ten years had dropped to zero. (Put differently, negligence increased her risk of death from an initial range between 20% and 50% absent negligence, to a final risk of 100%.) The court reasoned: "From this testimony, the jury could find that the defendant *probably* caused a reduction in her chance of survival. The district court clearly limited damages to this reduction in its instructions. The jury was thus precluded from awarding *all* damages for the underlying injury: the preexisting cancer." Id. at 138. However, the court does not focus upon the fact that plaintiff, by proving an increased chance of death from 20-50% to 100%, actually satisfied the traditional preponderance test, unless the jury found that the chance of survival was exactly 50%, rather than greater than 50%. And it is unclear whether, in the quoted language, the court meant to endorse a general rule that probabilities greater than 50% but less than 100% should result in proportional rather than full compensation.

The problem posed by probabilities greater than 50% does not arise if courts only permit the loss of chance partial damages remedy when the patient had a background risk of death or serious injury that is greater than 50%. Narrowing the remedy in this way ensures that no cases will arise in which, based on the probabilistic evidence, the defendant is the probable but not certain cause of the harm. However, there are independent reasons

damages that more closely approximates the harm that those defendants actually caused than an asymmetrical approach achieves. Awarding full damages when the probability of harm is more than 50% but less than 100%, while awarding damages in proportion to probability when that probability is 50% or less, will predictably result in negligent defendants paying for more harm than they have actually caused.

However, symmetry might be too great a departure from the preponderance test for courts to accept. It is also in tension with the current practice of permitting plaintiffs to choose whether to pursue (a) full damages under the traditional proof standards for causation or (b) loss of chance proportional damages.[109]

VI. Proportional damages if plaintiff is merely exposed to a risk of future harm?

A more fundamental question about the loss of chance doctrine is whether it logically supports, and should be incorporated within, a systematic evolution of tort law towards providing more ample remedies for individuals who are tortiously exposed to risks of future harm. Perhaps we should rethink negligence law's almost exclusive focus on providing compensation for harm that the negligent actor has already caused. Why not allow tort recovery for the risk of tortiously caused harms that have yet to occur, even if those harms are not related to injuries that plaintiffs have already suffered as a result of the tort?

This is a controversial topic over which much ink has been spilled, and many keystrokes struck.[110] If suffering exposure to a risk of future harm is sufficient for a compensatory award in tort law, many difficult questions arise. Does the duty to compensate extend to risks far in the future? Should courts insist on especially reliable statistical evidence? If some harm has already been suffered as of trial, how does this affect recovery for risk-exposure? Should a plaintiff who has suffered the ultimate harm that the negligent defendant risked also be entitled to recover for having been exposed to future risks? The intuitive response is no, but why not?[111] (Some courts have addressed this issue insofar as they permit a jury *either* to award full damages if plaintiff establishes the ultimate harm by a preponderance, or to

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not to remedy the remedy in this manner. See [] supra.

[109] See, e.g., Mead, supra. See Restatement Third, Torts: Remedies § 11, Comment a, Reporters' Note (Tentative Draft No. 2, 2023).

[110] Arguing in favor of tort liability for the risk of future harm, see Glen Robinson, Probabilistic Causation and Compensation for Tortious Risk, 14 J. L. Stud. 779 (1985); Andrew R. Klein, A Model for Enhanced Risk Recovery in Tort, 56 Wash. & Lee L. Rev. 1173 (1999) (but limiting his enhanced risk recovery proposal to cases in which plaintiff can prove that toxic exposure more than doubled the plaintiff's risk of contracting disease in the future). Arguing against tort liability for the risk of future harm, see Zipursky & Goldberg, supra, 88 Va. L.Rev. at 1652 ("The duty of care owed in most instances of actionable negligence is a duty to take care to avoid causing an ultimate harm, such as physical injury or property damage, not a duty to take care to avoid causing the intermediate harm of heightened risk.").

[111] See Steel, at [], discussing Claire Finkelstein's argument that a claim for risk exposure "merges" and disappears if the claimant is actually injured.

award partial damages under loss of a chance, but do not permit both awards.[112]) Should a plaintiff who might have suffered the ultimate harm but now is entirely free of the risk be entitled to recover? If so, should she obtain damages in proportion to the risk?[113] This view has quite radical implications. In assault cases, for example, the risk of physical harm is often quite high. Suppose defendant fires a gun at plaintiff but his shot misses. The plaintiff, if contemporaneously aware of the risk, is entitled to recover for assault. Should the plaintiff also be able to recover a proportionate share of the damages that he or his survivors would have been entitled to if the defendant had succeeded in causing serious physical harm? That could be a very substantial additional damage award if the ex ante probability of causing that harm was quite high. The same question arises if the defendant drove negligently and just missed accidentally running over a pedestrian.

For purposes of this paper, it suffices to note the widespread judicial reluctance to permit compensation for harms that have not yet, and might never, occur. Most courts are unwilling to develop common law doctrine too aggressively in this direction. Even modest efforts along this path are controversial. Consider, for example, the sharp division of opinion over whether a negligent actor should compensate for medical monitoring costs when the actor exposes people to serious risks of future illness.[114] And when broader proposals are suggested that would provide ex ante tort compensation to those exposed to a wide array of risks of future harm, plausible objections arise about the legitimacy and institutional competence of common law courts. Perhaps civil regulation and criminal prohibitions are usually the more appropriate responses to risky conduct that has not yet caused harm.

This broader judicial reluctance throws cold water on the prospects of using the subtraction method in the one context in which that method is most attractive: when the patient has not yet suffered, but might suffer in the future, a harm that the medical practitioner could have avoided by using reasonable care. Recall that the main objection to the subtraction method is its inclusion, in all cases, of the category of unharmed patients when computing the ex post probability that a chance of a better medical outcome was decreased or that a risk of a worse outcome was increased.[115] That objection is fatal, I have argued, if the patient has

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[112] See, e.g., Renzi v. Paredes, 890 N.E.2d 806 (Mass. 2008).

[113] Steel's observation is relevant here:

> [L]osing a chance of avoiding a physical injury is nothing like suffering a physical injury. It is an immaterial loss. Consequently, losing a 20 per cent chance of avoiding a painful physical injury is nothing like suffering 20 per cent of the pain involved in that injury.

Steel, supra note [], at 351.

[114] See Dan B. Dobbs, Paul T. Hayden and Ellen M. Bublick, The Law of Torts § 197, at notes 22 and 23 (2d ed. May 2023 update); Restatement Third, Torts: Miscellaneous Provisions, Medical Monitoring (Council Draft No. 3 (2022).

[115] Those who characterize the legal injury as the loss of a chance, determined ex ante as of the time of the defendant's negligence, believe that that is a sufficient answer to this objection. But this article provides reasons both to reject that characterization of the legal injury and to reject the subtraction approach even if that characterization is accepted.

died of the disease as of the time of trial, because the subtraction method will very often undercompensate plaintiffs and impose insufficient liability on defendants. But when we do not know, as of trial, whether the patient will suffer harm from the disease, the subtraction method offers a sensible measure of the probability that the patient will both suffer such harm and suffer it because of the defendant's negligence.[116]

So the crucial question lingers. Should courts permit a patient to sue the negligent defendant for partial damages before we know whether the patient will die from the disease? Few courts have addressed this question, and fewer still have answered it affirmatively. To avoid this difficult question, we might adjust statutes of limitations or ignore single recovery requirements, thereby permitting the plaintiff to wait until we know whether the patient will die from the disease. But that might entail very lengthy delays before the case is adjudicated and compensation is awarded. In the end, advocates of the subtraction method must address the very difficult question whether tort law principles and policies require negligent actors to compensate those whom they expose to the mere risk of future harm.

[116] Consider Claudet v. Weyric, 662 So.2d 131 (La.App. 4 Cir. 1995). Because of the negligent doctor's delayed diagnosis of cancer, the patient's risk of death increased from 25% to 58%. The patient was alive as of the time of trial. The court, applying the subtraction approach, upheld a jury award that included a recovery of 33% for the risk of death in the future due to cancer. This is, in my view, a proper use of the subtraction approach, because at the time the damages were awarded, it was quite possible (with a probability of 42%) that the patient would not die of cancer. This fact pattern has an interesting feature: if the patient *had* died as of the time of trial, her survivors would satisfy the preponderance test of factual cause (because the 25% background risk was less than the 33% risk-due-to-negligence) and thus would be entitled to *full* damages. For discussion of the case, see Fischer, supra, at 613, 633.

VII. Conclusion

This paper has attempted to explain the significant difference between the subtraction and ratio methods for computing partial damages in loss of a chance cases, and it has offered several arguments in favor of employing the ratio method rather than the subtraction method. The central point is that determining whether a medical practitioner's negligence probably or possible was a factual cause of a patient's harm is an ex post judgment, a judgment that can only be made after the patient has suffered the harm that the practitioner risked. And even though recognizing a partial damages remedy in loss of a chance cases is a departure from traditional tort law principles, it is best understood as a special causation rule, a rule that overcomes the injustice and social cost of strictly applying the preponderance standard to the usual factual cause test requiring but-for cause. On that understanding, the ratio calculation method is clearly superior to the subtraction method.

To be sure, many courts are understandably concerned about departing from the traditional but-for test of factual cause—so concerned that they go to the length of redefining the legal injury itself as the increased risk of suffering the ultimate harm or as the lost chance of avoiding that harm. But this fiction is not necessary: courts can instead offer justifiable reasons for creating a special causation rule in loss of chance cases, just as they create other kinds of special causation rules. And, what is worse, this fiction creates significant new problems. The reconceived injury approach entails that the plaintiff is entitled to compensatory damages even when we can be confident, at the time of trial, that the plaintiff has not suffered and will not suffer the ultimate harm.[117]

However, subtraction is indeed an appropriate calculation method in the following narrow circumstances: when the patient has not died or suffered the relevant ultimate harm as of the time of trial, *and* when the jurisdiction recognizes a patient's right to recover compensatory damages for their exposure to the risk that they will suffer the ultimate harm in the future. On the other hand, recognizing a right to recover compensation for mere risk exposure raises very serious problems of its own, problems that courts endorsing the subtraction approach have not adequately considered.

The following two tables summarize some of the important points in the paper:

Table 1: Subtraction v. ratio computation method

Has the ultimate harm (e.g. death) occurred as of trial?	Judicial approaches	Recommended approach

[117] Furthermore, even if the reconceived legal injury approach is defensible, it may not justify the subtraction method over the ratio approach, once we focus on the requirement that the chance must actually have been "lost." See text at [] [second para. from the end of Section IV]

Yes	Majority: Subtraction method	Ratio method
No	Majority: No recovery for future risk	Majority approach of no recovery for future risk. But if partial damages for future risk are recoverable, use subtraction method.
	Minority: Recovery for future risk using subtraction method	

Table 2: Characterizing the legal injury in loss of chance cases

	Judicial approaches	Recommended approach
What is the legal injury in loss of a chance cases?	Majority: The loss of a chance of avoiding the ultimate harm	The ultimate harm
	Minority: The ultimate harm	

We are now in a position to answer the questions posed by the title of this paper. Is recovery for a lost chance best understood as a new tort? No, because lost chance is parasitic on an existing tort cause of action. It applies in medical malpractice scenarios only if the defendant was negligent under the relevant legal criteria. If it applies to legal malpractice, to failure to warn, or to failure to rescue scenarios, it applies only if the defendant's conduct is tortious under the criteria relevant to those scenarios.[118]

Is recovery for a lost chance best understood as a new type of compensable injury? That is precisely the justification that most courts offer when they allow the award of partial damages for loss of a chance. But I have argued that this interpretation is unnecessary, insofar as a much better interpretation is available; and problematic, insofar as it is a radical and potentially far-reaching exception to the general rule in negligence cases that risk-exposure alone is insufficient for tort liability.

That leaves us with the most defensible interpretation of the loss of a chance doctrine: it serves as a new causation rule. More precisely, it is a justifiable exception to the preponderance of evidence requirement for proof of factual cause, justifiable because of the need to avoid a pocket of legal immunity from liability in a recurring type of medical malpractice case and because credible statistical

[118] But see Estate of Frey v. Mastroianni, supra, stating that those courts that recognize the lost chance for a better outcome as itself a legal injury "have essentially created a new tort which recognizes the loss of chance as a compensable injury distinct from other medical malpractice claims." The court rejects this approach. 463 P.3d at 1210.

evidence exists that can reliably quantify the size of the increased risk or of the lost chance.

Appendix A:

Suggestions to the Reporters of the Restatement Third, Torts: Medical Malpractice and of the Restatement Third, Torts: Remedies

This Appendix first reviews the brief discussion of the loss of chance issue in an earlier Restatement Third, Torts project that has been approved by the ALI, and then offers suggestions to the Reporters of the two current Restatement Third, Torts projects that are now addressing the issue.

1. Restatement Third, Torts, Liability for Physical and Emotional Harm

An earlier Restatement Third, Torts project briefly addresses some of the issues that are
discussed in this article and that two current projects plan to resolve. In an approved Restatement project, Restatement Third, Torts: Liability for Physical and Emotional Harm § 26, Comment n (2010), the Reporters' Note clearly recognizes the different outcomes under the subtraction and ratio computation methods:

> There is a difference between compensation for a "lost opportunity," which would be available to all who suffer a diminution in the chance for a cure [citing a case holding that a lost-chance plaintiff who had not suffered the harm for which the chance was lost but suffered other unrelated harm could recover for the lost chance], and compensation for the probability that the defendant caused the harm, which would be limited to those who suffered the outcome to be avoided. If the recovery were for the latter, it should be for somewhat more money, as the probability the plaintiff was harmed is greater than the lost opportunity.

The Reporters' Note then analyzes an example similar to the facts of *Herskovits* and the facts of the introductory examples in this paper. The Note endorses (what I have called) the subtraction approach for situations that the Reporters call a "lost opportunity," while it endorses the ratio approach for situations that the Reporters call "compensation for the probability that the defendant caused the harm":

> Thus, if plaintiff's chance of cure is reduced from 50 percent to 25 percent, the value of the lost
> opportunity is 25 percent of the value of the harm. But the probability that such an individual who suffers the harm was harmed by the defendant's negligence is 33 percent. That is because we know that a harmed individual is not among the lucky 25 percent who, despite delayed treatment, are cured. The probability that the delay in treatment caused the plaintiff's harm is found by taking the 25 percent who are harmed due to the delay as the numerator and the 75 percent who are harmed as the denominator.

Unfortunately, in Comment n itself, as opposed to the Reporters' Note,[119] the Restatement discusses only the "lost opportunity" approach and thus might be incorrectly interpreted as endorsing the subtraction approach. Here is the relevant language from that Comment:

> Rather than full damages for the adverse outcome, the plaintiff is only compensated for the lost opportunity. The lost opportunity may be thought of as the adverse outcome discounted by the difference between the *ex ante probability* of the outcome in light of the defendant's negligence and the probability of the outcome absent the defendant's negligence (emphasis added).

As a result of this passage, some courts seem to have interpreted Comment n as endorsing the subtraction approach.[120] The Comment's reference to *ex ante* probability gives some support to the subtraction method. Further discussion in Comment n compares the "lost opportunity" approach to an approach that would award full damages in loss of chance cases, and plausibly argues in favor of the former.[121] But the Comment does not discuss the ratio approach as an alternative way to compute the partial damages remedy. Unfortunately, that discussion occurs only in the Reporters' Note.

2. Restatement Third, Torts: Medical Malpractice and Remedies

Two current and intertwined projects of the American Law Institute are addressing the issue of tort liability for loss of a chance of a better medical outcome. One project addresses the nature of the legal injury, while a second project addresses the method for computing partial damages.

The Restatement Third, Torts: Medical Malpractice is tasked with identifying the nature of the injury in loss of a chance medical malpractice cases. See Council

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[119] The black letter and comments in approved Restatements are the official position of the American Law Institute. The discussion and analysis in the Reporters' Notes, by contrast, are not. Rather, they express only the views of the Reporters.

[120] The Supreme Judicial Court in Matuyama, supra, cites this Restatement Comment and equates the loss of chance doctrine with the "lost opportunity" doctrine described in the Comment. It is therefore possible that the Comment influenced the court to adopt the subtraction approach. See also Mohr v. Grantham, 262 P.3d 490, 497 (Wash. 2011).

[121] Comment n provides:

> Among courts that are inclined to modify the law in this area in response to the difficulties of proof, recognizing lost opportunity as harm is preferable to employing a diluted substantial-factor or other factual-causation test, thereby leaving recovery to the unconstrained inclination of any given jury and providing some fortunate plaintiffs with a full measure of damages for their physical harm while denying any recovery to others.

Draft No. 1, §8 (2023). That Section provides: "If a provider breaches a duty … and the provider's breach significantly increases the chance the patient will suffer a serious injury (or death), the patient has sustained a legally cognizable harm." Comment g clarifies that this provision retains the conventional tort law requirement that the plaintiff must prove that defendant's negligence was a factual cause of plaintiff's legal injury but "recogniz[es] as legally compensable harm the patient's loss of a 'chance interest,' rather than the ultimate medical injury that the patient sustains." The Comment concedes that "this conceptual approach raises the issue of whether a patient may, or indeed *must*, state a lost-chance claim prior to knowing whether the adverse medical outcome occurred" (emphasis original). The Comment continues: "Courts have not yet resolved that vexing question, and so this Restatement takes no position on it."

The Reporters' Note to §8, Comment g, states that about half the states that have adopted the loss of chance theory reconceptualize the injury as the lost chance, while many other states adopt a relaxed-causation approach. The Note further states that in the last few decades, most states recognizing loss of chance have adopted the reconceptualized injury approach that §8 endorses.

The Restatement Third, Torts: Remedies undertakes a different task: stating the measure of damages *if* the jurisdiction recognizes a loss of chance theory of recovery. See Tentative Draft No. 2, § 11 (2023). That Section and Comments a and b currently provide that, if a jurisdiction recognizes liability for loss of a chance, and if plaintiff cannot prove causation under the traditional preponderance rule (restated in Restatement Third, Torts: Liability for Physical and Emotional Harm § 26 and § 27 (2010)), partial damages should be awarded under (what I call) the subtraction computation method.[122] At the same time, Comment b acknowledges that the ratio approach (which the Comment describes as the "probability-of-causation proportional method) is an alternative possible method. Furthermore, Comments c, d, e and f carefully and accurately explain the mathematical and outcome differences between these two computation methods.

This article is relevant to both the Medical Malpractice and the Remedies projects. My assessment of the analysis of loss of chance in the most recent drafts of those projects, and my suggestions for improvement, are as follows.

1. The Reporters of both projects have carefully researched the issues and have drafted very useful black letter sections and comments. They are correct that (a) most courts that endorse a partial damages remedy for loss of chance cases rely on the "reconceived injury" rationale for that remedy and (b) almost all courts endorse the subtraction approach. Because the projects are Restatements, not Model Rules, the Reporters appropriately give significant weight to current judicial practices.

2. However, no court has squarely addressed the choice between the subtraction and ratio approaches. For reasons provided in this article, there is an

[122] The Remedies Restatement does not use the language "subtraction method." Rather, it employs the language "value-of-the-chance proportional method." § 11 and Comment b.

excellent chance that many courts would decline to employ their current computational method (subtraction) and would replace it with the ratio method if they were to carefully consider the substantially different outcomes under the two approaches and the arguments of principle and policy in favor of the ratio approach.

Moreover, courts often emphasize that they support a partial damage award in loss of chance cases because this remedy, as compared to full damages or no damages, provides a compensation award that much more closely approximates the harm that the negligent doctor has caused. Following this logic, courts should support the ratio method over the subtraction method, because the ratio method better approximates that harm. This conclusion is easy to grasp when one compares the aggregate effects of the subtraction method and the ratio method. See Section IIc supra.

3. It would be quite unfortunate if the Restatements endorsed, without any qualification or caution, both:

(a1) the reconceived injury rationale for loss of chance partial damages; and
(b1) the subtraction method for computing those damages.

Rather, the Restatements should present the following approaches as viable alternatives for courts to consider:

(a2) approximation-of-causation and other rationales for loss of chance partial damages that courts, tort scholars, and this paper have discussed; and
(b2) the ratio computation method.

Unqualified endorsement of (a1) and (b1) would be likely to entrench problematic tort doctrines for decades, even thought courts have not carefully considered the viable alternatives (a2) and (b2).

With respect to the choice between (a1) and (a2), the Reporters of the Medical Malpractice project concede serious difficulties with (a1) in § 8, Comment g, especially "the issue of whether a patient may, or indeed *must*, state a lost-chance claim prior to knowing whether the adverse medical outcome occurred." It would be valuable if the Comment noted that (a2) avoids this problem by clearly treating loss of a chance as a special causation rule. This treatment would much more readily explain the majority judicial rule that damages may not be awarded for mere risk-exposure that has not yet caused, and might never cause, the ultimate harm.

With respect to the choice between (b1) and (b2), the Reporters of both projects recognize the ratio method as a potential alternative to the subtraction method, but the arguments in favor of that method and against the subtraction method could be set forth more fully.

4. As a matter of presentation, it would be desirable if the Reporters for the Remedies project made the following changes:

a. Present the ratio method in its clearest form, formulated in terms of the increased risk of death (or of other harm), not the decreased chance of life (or of a better medical outcome). See section [], supra.

b. Label the two computation methods (1) "subtraction" rather than "value of a chance," and (2) "ratio" rather than "probability of causation."

The labels "subtraction" and "ratio" are neutral terms that merely describe the mathematical operations that each method requires. By contrast, using the terminology "value of a chance" is misleading, because it presupposes that the most accurate way to measure the chance that is lost in a reduction case is by subtraction; but that assumption is a matter of serious debate. This article has argued that in a reduction case when the patient has already died, the ratio approach more accurately measures the chance that the patient actually lost.

If the Reporters retain the language "value of a chance," it would be preferable to use more accurate language, such as "value of a future chance," "loss of a future chance," "probability of future harm," or "potential loss of a chance."[123] This language would be an improvement because the most persuasive occasion—indeed the only persuasive occasion—for judicial use of the subtraction formula is when, as of the time of trial, the plaintiff has not yet suffered the ultimate harm and it is unknown whether the plaintiff will suffer that harm in the future.

5. The Comments in both the Medical Malpractice and the Remedies projects should clarify that courts only do apply, and only should apply, the partial remedy for loss of a chance when:

a. It is impossible to determine whether the patient who died is within the background risk group of people who would have died apart from defendant's negligence, or within the group of people who died only because of defendant's negligence; and

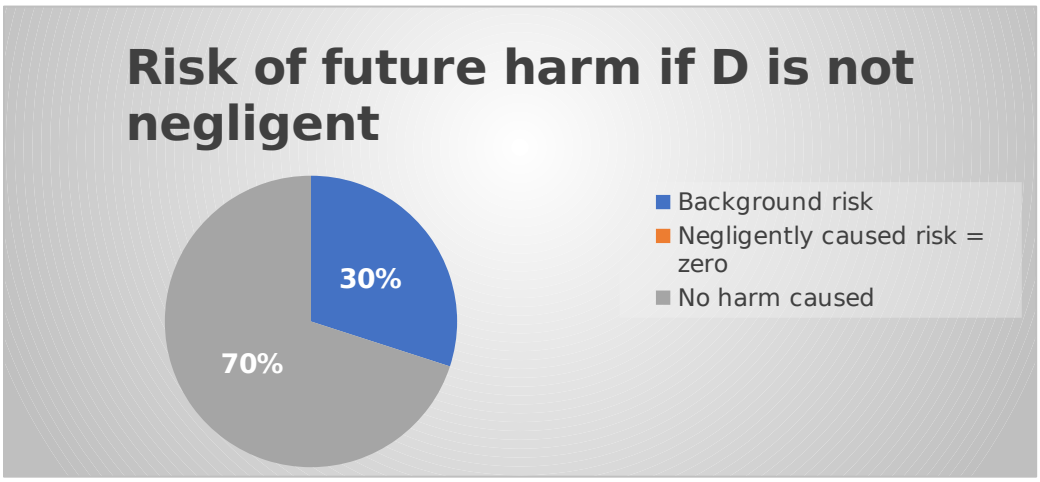
b. Reliable statistical evidence exists that provides a reasonably accurate measure of both the background risk and the negligently-created risk.

[123] Another alternative is "ex ante probability," in contrast to the "ex post probability" determination that undergirds the ratio method. But these Latins terms might be difficult for lay factfinders to grasp.

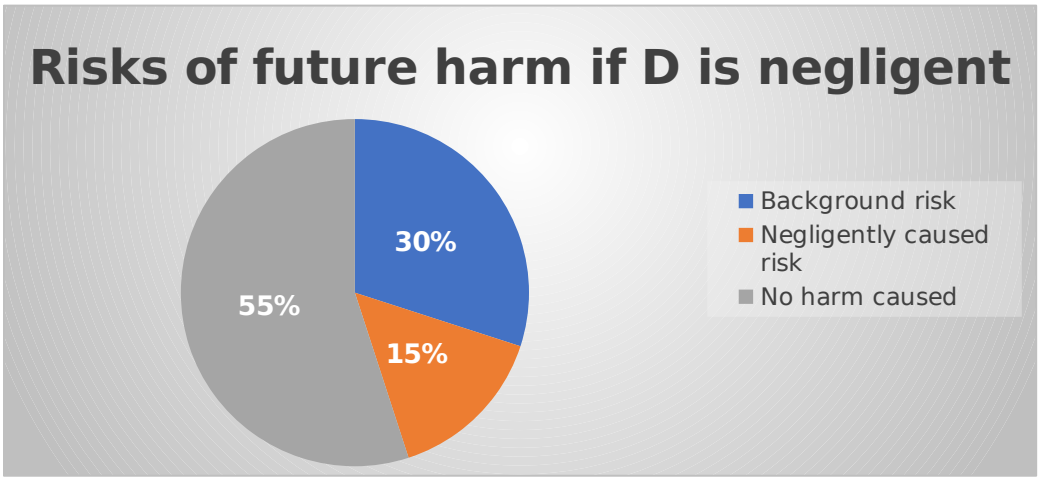
Appendix B: Additional charts

1. How negligence affects the ex ante probability of harm

In the Dr. Deficiency example, if the doctor had not been negligent, the patient would have faced only the background risk of harm, but no additional risk of harm due to negligence. The patient would have had a 70% chance of suffering no harm.



But if the doctor is negligent, that negligence increases the patient's risk of harm by 15 percentage points. Put differently, that negligence reduces the 70% chance that the patient would suffer no harm by 15 percentage points.



2. Results if the ratio N/C is kept constant[124]

Cases	Pure subtraction proportional damages	Pure ratio proportional damages
6. B = 2%, C = 3%	1% x F	33% = 1/3
7. B = 4%, C = 6%	2%	33% = 2/6
8. B = 10%, C = 15%	5%	33% = 5/15
9. B = 20%, C = 30%	10%	33% = 10/30
10. B = 40%, C = 60%	20%	33% = 20/60
11. B = 60%, C = 90%	30%	33% = 30/90

In cases 6 through 11, the negligent defendant increases the background risk of harm by the same percentage, 50%, a percentage that is insufficient to satisfy the preponderance test. For example, in case 9, defendant's negligence increases the background risk from 20% to a cumulative risk of 30%.

As noted in the text, a court that endorses proportional damages in loss of chance cases might nevertheless find that, at very low absolute risk levels such as 6 and 7, the statistical evidence is insufficiently reliable. Accordingly, the court might justifiably preclude the award of any damages in such cases.

[124] Recall that N = C-B.