Danger in Sabbath Law: A Novel Perspective Using Causality and Statistics

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The category of a *ḥoleh she-yesh bo sakanah*, a sick person whose life is in danger, appears in a number of places in Halakhah, including in the laws of Shabbat and Yom Kippur. The condition may allow and even mandate suspension of many of the usual laws and regulations.

One might think that danger could be defined quantitatively for these laws. Some have attempted to do so for other situations (e.g., putting one's life at risk by attempting to save someone else's or by attempting a risky procedure in the hope of curing a possibly fatal condition).[1] However, in this area, there has been little attempt at quantification. Thus, in discussing the topic, *Shulḥan Arukh* first lists a number of conditions which constitute danger (*O.Ḥ.* 328:3–9). It then discusses whether expert opinion is required to determine the presence of danger (*O.Ḥ.* 328:10). Danger itself is not defined. More recently, Rabbi Shlomo Zalman Auerbach suggested that danger can be determined by people's fears; if a majority of people fear a condition sufficiently, it can be classified as dangerous (*Minḥat Shlomo* 2:29 or 2:37 [2nd edition]).

Before considering the topic quantitatively, it is necessary to consider it further conceptually. Here there is a substantial literature. In this essay, we review important parts of this literature conceptually, making use of modern ideas of causal inference. This field has developed in statistics, econometrics, epidemiology, computer science, philosophy, and other areas over the last several decades. Several statements of important halakhic authorities about danger translate naturally into the terminology of causal inference. In particular, there are two major ways of thinking about the suspension of the Sabbath under the causality paradigm.

This essay presents these two major ways of thinking about the dispensation from the usual rules. It then considers the roles of time, which complicates both approaches, then moves on to problems in obtaining

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[1] See Akiva Tatz, *Dangerous Disease and Dangerous Therapy in Jewish Medical Ethics: Principles and Practice* (Southfield, Michigan: Targum Press, 2010), pp. 45–70 and 81–88 for some discussion and earlier sources.

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the information to apply either approach. Over the course of the essay, we show how formulation of these problems in the language of causal inference provides insight into the meaning of several passages of earlier and later authorities dealing with the subject. We also show how these disciplines help clarify issues which have not yet been treated in the literature in a fully satisfactory manner. The essay concludes with a short discussion.

Two Views of the Dispensation

There are two views of the nature of the dispensation from the usual rules for a person who is dangerously ill. According to one view, the dispensation is only for those interventions that are likely to lead to saving a life, or at least to a nontrivial reduction in the probability of death. According to the second view, the rules are suspended more generally, allowing the sick person to be treated as he or she would be on a weekday. We consider the more lenient[2] view first, as it is somewhat surprising and so deserves explanation.

The lenient view

There are two views of the basis for suspending the usual restrictions on the Sabbath (or Yom Kippur): that the Sabbath prohibitions are permitted or released (שבת הותרה), or that they are merely pushed off (שבת דחויה, the first view leading to broader dispensation from the restrictions.[3] Some have argued that the difference between the two possible bases aligns perfectly with the extent of the suspension of the rules: those who say that the rules are released are lenient, whereas those who say the rules are merely pushed aside are strict. However, some who rule that the Sabbath is pushed away are lenient in practice. Why?

A responsum of Rabbi David ben Shlomo ibn Zimra (Resp. Radbaz 4:130) attempts to answer this question:

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[2] Some have noted that an approach that is strict regarding Sabbath and other similar prohibitions is lenient regarding saving human life (e.g., Howard Jachter, "Shabbat and *Pikuaḥ Nefesh,* Part I," Kol Torah, 1996, <https://www.koltorah.org/halachah/shabbat-and-pikuach-nefesh-part-i-by-rabbi-howard-jachter>). We nonetheless adopt the convention of characterizing stringency of a position based on Sabbath law, as this is done by Radbaz and *Biur Halakhah*, whose views are considered below.

[3] See Rabbi Ovadiah Yosef (*Yeḥaveh Da'at* 4:30), who cites many sources on the status of the Sabbath in the presence of a threat to life.

שאלה שאלת אם מותר לעשות לחולה שיש בו סכנה בשבת דברים שאין
בהם צורך כל כך:
תשובה דבר זה מחלוקת בין הפוסקים ואני מן המקילין מדקאמרינן דחויה
היא שבת אצל סכנת נפשות ואם כן יהיה מותר לעשות לו אפי' דברים
שאין בהם צורך. הא ליתא ודאי דאין כאן צד סכנת נפשות אבל בדברים
שיש בהם קצת צורך אפשר שאם לא תעשה לו הדברים שיש בהם קצת
צורך יבוא לדברים שיש בהם צורך הרבה והדבר ידוע דאפילו ספק ספקא
דוחה את השבת. תדע שהרי שוחטין לחולה בשבת אעפ"י שאפשר
להאכילו נבלה דאין דאין בו אלא איסור לאו משום דילמא ידע שהיה נבלה
ויקוץ בה ויסתכן.

Question: You asked, 'Is it permitted to do things for a sick person
whose life is in danger that are not of that much need?'
Answer: This matter is subject to dispute among halakhic authori-
ties, and I am among the lenient, since we say that the Sabbath is
pushed off by danger to life; if so, it would be permitted to do for
him [the sick person] even things that are not of [any real] need.
This certainly is not true, since there is no way to construe this as
[acting to mitigate] danger to life. But for things in which there is a
little need, it is possible that if one does not do for him things that
have a little need, it [the situation] will come to things that have
great need, and it is well known that even a doubt within a doubt
pushes off the Sabbath [and so it is not necessary to wait for a great
need to develop]. You should know this to be so, since we permit
kosher slaughter of an animal on the Sabbath even when it is pos-
sible to feed him [already available] non-kosher meat, which merely
involves transgressing of a negative commandment [less serious
than slaughtering on the Sabbath], because perhaps he will find out
that [the meat] was not slaughtered properly, be revolted by it, and
come to danger.

According to Radbaz, actions with only a small apparent need can
possibly lead to saving a life. Radbaz explains mechanistically that re-
fraining from such actions may lead to a great need to perform some
action (i.e., a worsened clinical condition and a greater risk to life), and
so such actions are permitted, since "even a doubt within a doubt push-
es off the Sabbath." In a footnote,[4] we formulate this approach mathe-

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4   We begin with some notation. Let D denote the outcome, taking the value 1 if
     a person dies, 0 otherwise. Let A denote an intervention or treatment, taking
     the value 1 if a person receives the intervention, 0 otherwise. Let $D(a)$ denote
     the outcome that would be observed if a person received level a of the inter-
     vention. The effect of an intervention on a subject is a comparison of what

matically. This allows additional precision in defining who is a *ḥoleh she-yesh bo sakanah* and the nature of the permission to suspend the Sabbath laws. The notation in the footnote will be used in other footnotes.

There are other understandings of this responsum of Radbaz. Rabbi Nissim Chaim Moshe Mizrachi (Resp. *Admat Kodesh* 1 *O.Ḥ.* 6) writes:

> וס"ל דאפי למ"ד דחויה שרי לעשות כל דבר צורך ואפי' בצורך כל דהו שרי לפי שמוטב שנחלל שבת בדבר שיש בו קצת צורך דאיפשר שיתרפא ברפואה זו הקלה ולא נצטרך לחלל שבת לעשות צורך הרבה וזו סברא ישרה.

> and he [Radbaz] holds that even for one who holds that [the Sabbath] is merely pushed off, it is permitted to do anything of need, even a tiny need, since it is better that the Sabbath be profaned in a matter that has a small need with a light treatment so that we do not need to profane the Sabbath to do something of great need [i.e., a harsher treatment for a more serious condition]. This is a proper explanation.

In this passage, Rabbi Mizrachi understands Radbaz as being concerned about worsening the patient's condition if the minor intervention is withheld, not so much because of increased risk to life, but because of harsher treatments later and no reduction in forbidden Sabbath activity.

Rabbi Ovadiah Yosef (*Yeḥaveh Da'at* 4:30) understands Radbaz yet differently. He quotes or paraphrases part of the above Radbaz:

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would happen to the subject if treated (i.e., $D(1)$) with what would happen to the subject if not treated (i.e., $D(0)$), typically $D(1)$-$D(0)$. Because we cannot observe both potential outcomes $D(1)$ and $D(0)$, the causal effect of the treatment is never observable; this is known as "the fundamental problem of causal inference." (Holland, Paul W., "Statistics and Causal Inference," *Journal of the American Statistical Association*, vol. 81, no. 396, December 1986, pp. 945–960.)

As a result of this fundamental problem, we can rarely know whether an intervention will be beneficial for an individual, and so we concentrate on aggregate risks or probabilities. Let $\Pr\{D(0)=1\}$ denote the probability of dying were one not to receive the intervention, and let $\Pr\{D(1)=1\}$ denote the probability were one to receive it. Radbaz argues that if the probability of death if untreated $\Pr\{D(0)=1\}$ is large, an intervention with only a minor apparent need may reduce that chance. Conversely, if the risk of death is small, there is not room for substantial reduction in risk. Implicitly, Radbaz defines danger as a sufficiently large risk of death were a person to remain untreated (i.e., a large value of $\Pr\{D(0)=1\}$). We argue that both the definition and reason for leniency are Rashi's as well; we take up Rashi's view in full in Appendix 1.

שאפשר שאם לא תעשה לו דברים שיש בהם קצת צורך, יבא [להמנע]
גם מדברים שיש בהם צורך הרבה.

It is possible that if one does not do for him things that have a slight need, he will come to [refrain][5] from things that have great need.

In this view, refraining from actions with only a minor need may lead to an attitude of excessive concern for avoiding Sabbath violation, which will in turn lead to avoiding even necessary actions where the need is great and thus to loss of life.[6] In this view, even if we know that such an action will not save a life, it is permitted, even though the Sabbath is merely pushed aside, whereas according to the other readings of Radbaz, this may not be true. Some earlier authorities who rule that the Sabbath is released permit certain actions which will not save a life (*Maggid Mishneh, Shabbat* 2:14).

Avnei Nezer (*Resp. Avnei Nezer, O.Ḥ.* 453) proposes a similar and complementary explanation to our initial explanation of Radbaz:

הכי נמי בחולה שיש בו סכנה הואיל אף יעשה לו כל צרכיו הוא מסוכן. שוב כל מה שיחסר לו חשיב לו סכנה. כי יצטרף חסרון זה אל הסכנה שיש לו בלאו הכי ויסתכן יותר.

Here too regarding a sick person in danger, since even if all his needs are taken care of, he is in danger, any additional deficiency is considered a threat, because this deficiency joins with the danger he is already in and so his danger will increase further.

In other words, for a patient already at risk, withholding even apparently minor things is likely to weaken him further and so increase the risk of death. Avnei Nezer is more confident of the efficacy of minor interventions than Radbaz.[7] Nonetheless, they both argue for similar leniency for such interventions.

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[5]   The word להמנע, to refrain, does not appear in the original wording of Radbaz.

[6]   This reading of Radbaz seems somewhat problematic, because the following text והדבר ידוע דאפילו ספק ספקא דוחה את השבת, תדע שהרי שוחטין לחולה בשבת אעפ"י שאפשר להאכילו נבלה דאין בו אלא איסור לאו משום דילמא ידע שהיה נבלה ויקוץ ויסתכן בה. seems to refer to doubt about whether the action will save a life and not merely to express the importance of saving lives. Even if the reading is problematic, the idea that excessive stringency will lead to loss of life can still justify leniency regarding suspension of the Sabbath rules. Perhaps Rabbi Yosef had a different version of the text of the responsum.

[7]   Avnei Nezer argues that if the probability of dying if treated ($\Pr\{D(1){=}1\}$) is substantial, the probability of dying if untreated will be even larger. Implicitly, he assumes that if the risk of death if treated is low, the risk of death if un-

In the lenient view, the dispensation is broad. Rambam writes (*Mishneh Torah, Shabbat* 2:2):

כללו של דבר שבת לגבי חולה שיש בו סכנה הרי הוא כחול לכל הדברים
שהוא צריך להן.

The gist of the matter is: the Sabbath is like a weekday regarding everything he needs.

Similarly, *Shulḥan Arukh* (O.Ḥ. 328:4) writes, based on Ramban (*Torat Ha-Adam: Sha'ar Ha-Meḥush*, *Inyan Ha-Sakanah* 5):

מכה של חלל אינה צריכה אומד, שאפילו אין שם בקיאים וחולה אינו
אומר כלום, עושים לו כל שרגילים לעשות לו בחול; אבל כשיודעים
ומכירים באותו חולי שממתין ואין צריך חילול, אסור לחלל עליו אף על
פי שהיא מכה של חלל.

An internal injury does not require an [expert] appraisal, so even if there are no experts there, and the sick person does not say anything, they do for him as they would be accustomed to do for him on a weekday. But when they know and recognize that the particular illness can wait and does not require [Sabbath] desecration, it is forbidden to desecrate over it even though it is an internal injury.

According to *Shulḥan Arukh*, the breadth of the dispensation is that "they do for him as they would be accustomed to do for him on a weekday," not just what will have a direct effect[8] on the disease process.

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treated will not be that much higher. Similar assumptions are often made in modern epidemiology and statistics (e.g., in the commonly used logistic and proportional hazards models when there is no interaction between the intervention of interest and other predictors of the outcome). For many of the minor interventions considered here (e.g., lighting or extinguishing a lamp, heating water, slaughtering an animal), this is reasonable; one would not expect that failing to extinguish a flame and subsequent loss of sleep would threaten the life of a healthy person.

8   In this context, we informally define an indirect effect as an effect mediated through specified things (e.g., a person's mental status or comfort level). The direct effect of an intervention is the part of the effect not mediated by those things. In this context, we expect interventions that have primarily direct effects to have larger overall effect on mortality than ones which target indirect mechanisms. There is a large and growing literature about defining and characterizing these concepts more precisely; see, e.g., Robins, James M. and Sander Greenland, "Identifiability and Exchangeability for Direct and Indirect Effects," *Epidemiology*, vol. 3, no. 2, March 1992, pp. 143–155 and VanderWeele, Tyler J., *Explanation in Causal Inference* (New York: Oxford University Press, 2015).

Even if it is unknown whether a particular intervention substantially reduces risk, we err on the side of caution regarding human life. In particular, according to Ramban, anything which is usually done for a particular illness is to be presumed to be potentially lifesaving until shown otherwise. According to others, the dispensation is even broader, allowing the usual interventions even if they do not reduce mortality.[9]

This approach naturally raises a number of questions. What is sufficient to classify a person as a *ḥoleh she-yesh bo sakanah*? Is this question amenable to quantification? If so, we might want to set a minimum level on the risk[10] that would justify suspension. Even if we follow Rabbi Auerbach and base things on people's subjective fears in the aggregate, there may be settings which are objectively dangerous but may not arouse much fear. Does *sakanah* refer to an individual's risk, or to a specific condition that poses an unacceptable level of risk in general? Further, what is a *safek sakanah* (a possible danger), which also justifies suspension: a lesser degree of danger, or the possibility of a discrete condition (*sakanah*) that rises to a threshold for danger? We raise these issues here not to require detailed risk assessment before undertaking intervention in emergency situations, but to flesh out the issues conceptually and solicit halakhic guidance.

The strict view

According to *Biur Halakhah* (O.Ḥ. 328:4 s.v. *kol she-regilim*), dispensation from the usual rules requires not only that a person be at risk of death but also that the proposed intervention reduce that risk. He adduces a number of early authorities in support of this proposition, who argue that, in many places, the Gemara's use of the term *ḥoleh she-yesh bo sakanah* is shorthand for a substantial risk and an intervention that will decrease that risk. For example,

> דהרי רש"י כתב חולה שאב"ס שאם לא יעשו לו רפואה זו לא ימות עכ"ל
> משמע דיש בו סכנה פירושו דמסוכן הוא אצל התרופה.
> … since Rashi wrote, 'a sick person not in danger, (which means)
> that if this treatment is not provided he will not die.' This implies

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[9]   See the *Maggid Mishneh* to *Rambam, Shabbat* 2:14, who argues that allowing one to heat water for a sick person, a usual activity that is not lifesaving, implies this broader permission. Rashi (see below) and Radbaz, among others, disagree with the characterization of heating water.

[10] $\Pr\{D(0) = 1\}$.

that the phrase 'who is in danger' means that he is in danger with respect to [withholding] the treatment.

Appendix 1 considers a different interpretation of Rashi's approach more in line with our understanding of Radbaz and others taking the lenient view.

Biur Halakhah is explicit about his motivation for stringency. After a review of the literature in which he concludes that the number of early authorities who clearly adopt the lenient view is small, he states,

א"כ בודאי היה מהנכון להחמיר באיסורי תורה ובפרט שהוא שלא במקום סכנה.

If so, it is proper to be stringent on Torah prohibitions, in particular where there is no danger [if treatment is withheld].

In some ways, the stringency may be more theoretical than practical. Thus, *Biur Halakhah* permits certain interventions which indirectly affect the outcome (e.g., lighting a candle to affect a person's mental status, extinguishing it to allow her or him to sleep, washing with hot water to "strengthen his limbs"). These are presented almost as special cases, requiring justification as being known to be efficacious. For example, he writes:

הרי מוכח דיתובי דעתא דחיה אינה כ"א משום דקים להו לחכמים דמסתכנא בה.

It is explicit that [lighting a candle to] calm the mind of a birthing mother [is permitted] only because the Sages knew that she would be endangered by [withholding] it.

In addition to permitting several usual activities because refraining from them may be dangerous, *Biur Halakhah* concludes with this statement:

ודע עוד דאפילו לפי דעת האוסרים הנ"ל היינו דוקא בדבר שברור לנו שלא יכבד חליו ע"י מניעת דבר זה אבל בדבר שיש חשש שע"י מניעת דבר זה יחלש ויכבד חליו מחללין עליו השבת.

Know too that even according to the view of those forbidding [the usual activities], this is only where it is clear to us that the illness will not worsen as a result of withholding this thing, but when there is a concern that by withholding this thing he will become weaker and his sickness will become more severe, we profane the Sabbath for him.

The first part of the statement sounds exactly like Radbaz, in that we presume these activities potentially lifesaving until we know otherwise. The latter part is unclear about how to behave in situations where there

is no specific concern about the danger of withholding but also no certainty about safety.

How can we operationalize the notion of a reduction in risk, or of its absence? For such purposes we shall require measures of the effect of an intervention or treatment. Because of the fundamental problem of causal inference, we cannot know the effect for an individual.[11] Additionally, the probability of intervention saving a life[12] is not by itself an appropriate measure, since the countervailing probability of its killing someone is not considered in this measure (even a treatment which is more often beneficial than not, the treatment may kill some, and the proportions killed and saved cannot generally be inferred from the data). Researchers more typically use contrasts between the risks under an intervention and under its absence[13] as measures of the effect of the intervention. Typical contrasts are the risk difference, the risk ratio, and the odds ratio.[14] There is a literature in epidemiology and statistics evaluating the strengths and weaknesses of each measure.[15]

How much risk reduction is sufficient to mandate suspension of the usual rules for a particular intervention? What measures of effect should be used? While these are interesting questions, we defer discussion for two reasons. First, many would argue that even very small reductions in risk would mandate suspension, based on the principle that (*Sanhedrin* 37a):

וכל המקיים נפש אחת מישראל - מעלה עליו הכתוב כאילו קיים עולם מלא.

and anyone who sustains one soul from the Jewish people, the verse ascribes him credit as if he sustained an entire world.

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11   I.e., a comparison of $D(1)$ with $D(0)$.

12   $\Pr\{D(1) = 0, D(0) = 1\}$

13   $\Pr\{D(1) = 1\}$ and $\Pr\{D(0) = 1\}$

14   The causal risk difference, risk ratio, and odds ratio are $\Pr\{D(1) = 1\} - \Pr\{D(0) = 1\}$,
$\Pr\{D(1) = 1\}/\Pr\{D(0) = 1\}$, and $[\Pr\{D(1) = 1\}/\Pr\{D(1) = 0\}]/[\Pr\{D(0) = 1\}/\Pr\{D(0) = 0\}]$, respectively. Later, we discuss how causal measures can be estimated from observable quantities. The unstated assumption of the various authorities is that the action or intervention of interest is not harmful, at least at the aggregate level; i.e., that $\Pr\{D(1) = 1\} \leq \Pr\{D(0) = 1\}$ (implying that causal risk difference is not positive and the causal risk and odds ratios are no greater than 1).

15   See, for example, Greenland, Sander, et al., "Confounding and Collapsibility in Causal Inference," *Statistical Science*, vol. 14, no. 1, 29–46, 1999.

Perhaps more importantly, what evidence suffices to establish an intervention as reducing the risk of death, of being a plausible candidate for reducing that risk, or, conversely, of not reducing that risk? Before taking up these questions, we first consider the roles of time. Timing of treatment and outcome complicates definition of risks and effects as well as ways to evaluate evidence, and so we take up the roles of time in the next section.

The Roles of Time

So far, we have not considered the role of time. In many settings of interest, the short-term risk is high: potential drownings, gunshots, other injuries, acute appendicitis, etc. In such circumstances, time is of the essence, immediate attention is required, and the usual rules are suspended. In other settings, the period of increased risk due to some danger or illness is days, weeks, months, or even years, while the risk over a single day may be relatively small. What risk over what amount of time is sufficient to classify a condition as dangerous? How much reduction in risk at various times after a delay in initiation of a treatment justifies suspending the usual rules?

We consider how to pose the questions above more formally; this will require the ideas of survival analysis in addition to those of causality. We illustrate some of the ideas graphically, and provide explanatory notation in a footnote.[16] It is common to plot the cumulative risk of death as a function of time. Figure 1 plots risk as a function of time for four groups of people: Americans between ages 45 and 54, Americans 85 or older,[17] people just diagnosed with ovarian cancer (for which the one-year mortality is about 27.6%),[18] and people just diagnosed with pancreatic cancer (for which the one-year mortality is about 80%).[19] The cancer mortality curves average over all ages at diagnosis and stages.

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[16]   Let T denote the time from a set starting point until death, and let t denote an arbitrary time. The risk of dying by time t is $R_T(t) \equiv \Pr(T \leq t)$. The probability of surviving to t is $S_T(t) \equiv \Pr(T > t) = 1 - R_T(t)$. If our time scale is in months, $R_T(1)$ is the probability of dying in the first month, and $R_T(12)$ is the probability of dying in the first 12 months.

[17]   Xu, Jiaquan, et al., "Mortality in the United States, 2018," NCHS Data Brief No. 355, January 2020.
        <https://www.cdc.gov/nchs/products/databriefs/db355.htm>.

[18]   <https://ocrahope.org/patients/about-ovarian-cancer/staging/>

[19]   <http://pancreatic.org/pancreatic-cancer/about-the-pancreas/prognosis/>

We return to some of our earlier questions. What kind of risk profile or curve justifies classifying a person as being in a state of *sakanah*? Is there an absolute standard, or should one's risk curve be compared to a curve overall for that person's age group (e.g., the lower two curves in figure 1), or for healthy people in that group?

In practice, questions of interest often revolve around timing: when, not whether, a treatment should be provided. In some cases, the question at hand is whether to start a repeated treatment, perhaps of fixed duration (e.g., a regimen of intravenous antibiotics), on or after the Sabbath. In other cases, the relevant question is whether a one-time treatment (e.g., surgery or vaccination) should be postponed until after the Sabbath. In yet other cases, the question is whether treatment should be interrupted for the Sabbath or other holiday.

Timing of both treatment and outcome has been considered in both Talmudic and later sources. A key passage in the Talmud considers two examples. The Mishnah (*Yoma* 83a) states:

ועוד אמר רבי מתיא בן חרש: החושש בגרונו מטילין לו סם בתוך פיו בשבת, מפני שהוא ספק נפשות, וכל ספק נפשות דוחה את השבת.

And furthermore, Rabbi Matya ben H arash said: [With regard to] one who suffers pain in his throat, one may place medicine inside his mouth on Shabbat [although administering a remedy is prohibited on Shabbat]. This is because there is uncertainty whether or not it is a life-threatening situation for him. And a case of uncertainty concerning a life-threatening situation overrides Shabbat.

The Gemara (*Yoma* 84b) explains an important passage in the Mishnah as follows:

למה לי תו למימר וכל ספק נפשות דוחה את השבת? אמר רב יהודה אמר רב: לא ספק שבת זו בלבד אמרו, אלא אפילו ספק שבת אחרת. היכי דמי? כגון דאמדוה לתמניא יומי, ויומא קמא שבתא. מהו דתימא: ליעכב עד לאורתא כי היכי דלא ניחול עליה תרי שבתא, קא משמע לן. תניא נמי הכי: מחמין חמין לחולה בשבת בין להשקותו בין להברותו. ולא שבת זו בלבד אמרו אלא לשבת אחרת. ואין אומרים: נמתין לו שמא יבריא, אלא מחמין לו מיד, מפני שספק נפשות דוחה את השבת ולא ספק שבת זו אלא אפילו ספק שבת אחרת.

Why do I need to say furthermore, 'And any case of uncertainty concerning a life-threatening situation overrides Shabbat?' Rav Yehudah said that Rav said: They stated this not only in a case where there is uncertainty with regard to this Shabbat, but even if the uncertainty is with regard to a different future Shabbat. What are the circumstances [in which such uncertainty would arise]? They are a

case where doctors assess that an ill person needs a certain treat-
ment for eight days, and the first day of his illness is Shabbat. Lest
you say: He should wait until evening and begin his treatment after
Shabbat so they will not need to desecrate two *Shabbatot* for his
sake, therefore it teaches us that one must immediately desecrate
Shabbat for his sake. That was also taught in a *baraita*: One heats
water for an ill person on Shabbat, whether to give him to drink or
to wash him. And they did not say only the current Shabbat, but
even a different, future Shabbat. And one must not say: Let us wait
and perform this labor for him after Shabbat, perhaps he will get
well in the meantime. Rather, one heats it for him immediately be-
cause any case of uncertainty concerning a life-threatening situation
overrides Shabbat. And this is so not only with regard to uncertain-
ty whether his life is in danger on the current Shabbat, but even in
a case of uncertainty with regard to danger on a different Shabbat.

Rashi (*Yoma* 84b s.v. *lo safek*) explains a key phrase in this passage as
follows:

לא ספק שבת זו בלבד - לא שיהא ספק הנפשות לשבת זו, אלא אפילו אין
הספק לשבת זו, דפשיטא לן דהיום לא ימות, אלא ספק שאם לא יעשו לו
היום - שמא ימות לשבת הבאה.

'This not only in a case where there is uncertainty with regard to
this Sabbath'— Not that the uncertainty pertains to this Sabbath;
rather, even if the uncertainty does not pertain to this Sabbath,
since it is obvious to us that he will not die today, but instead un-
certainty that if one does not do the action for him today, perhaps
he will die on the following Sabbath.

Rambam and *Shulḥan Arukh* rule in accordance with this passage. In
language echoed by *Shulḥan Arukh* (O.Ḥ. 328:11), Rambam (*M.T. Shab-
bat* 2:2) states:

אמדוהו ביום השבת שהוא צריך לכך וכך שמונה ימים אין אומרים נמתין
עד הערב כדי שלא לחלל עליו שתי שבתות אלא מתחילין מהיום שהוא
שבת ומחללין עליו אפילו מאה שבתות כל זמן שהוא צריך ויש בו סכנה
או ספק סכנה מחללין.

If it has been estimated on the Sabbath that the patient will require
a certain treatment for eight days, we must not say: 'Let us wait un-
til evening, so as not to desecrate two Sabbaths.' We should rather
begin the treatment from that Sabbath day, and desecrate even a
hundred Sabbaths for his sake as long as he needs treatment in the
presence of danger or possible danger.

The Talmudic passage above and Rashi's interpretation of it have important implications, both for delayed outcomes and repeated treatments. First, one may desecrate the Sabbath now to attempt to prevent death later, even well after the Sabbath, even if there is no risk of dying on the Sabbath itself (for a somewhat contrary view, see the commentary of Rabbi Samuel Strason [Rashash] on this passage). Second, from the context, it seems that the initial intervention (prescribed for eight days) mentioned is fairly efficacious, whereas hot water for drinking or washing is likely less so. Nonetheless, even the lesser interventions are permitted, even for delayed responses (again, see Rashash for a different view). We provide a fuller and more technical exposition of this Talmudic passage and Rashi's commentary in Appendix 1. Figure 2 provides a graphical illustration of a scenario consistent with this passage; the text below the figure provides further discussion.

Regarding timing of treatment, *Shulḥan Arukh* (O.Ḥ. 328:4) also rules, based on Ramban (*Torat Ha-Adam: Sha'ar Ha-Meḥush, Inyan Ha-Sakanah* 5):

אבל כשיודעים ומכירים באותו חולי שממתין ואין צריך חילול, אסור
לחלל עליו אף על פי שהיא מכה של חלל.

But when they know and recognize that the particular illness can wait and does not require [Sabbath] desecration, it is forbidden to desecrate over it even though it is an internal injury.

Here again, it would appear that the view of *Shulḥan Arukh* is that we assume that an internal injury requires immediate attention until we know otherwise, and that we err on the side of caution regarding preserving life. In Appendix 1, we argue that this caution is implicit in Rashi's interpretation.

Recent opinions of Rabbi Shlomo Zalman Auerbach discuss postponing a one-time treatment. Writing about vaccination on the Sabbath against a potentially dangerous condition (*Minḥat Shlomo* 2:29 [2:37 in 2nd edition]), he explains that since doctors would typically be in little rush to provide the vaccination, it would be generally forbidden to vaccinate on the Sabbath, even though there would be some minor increase in risk due to the delay. It is remarkable that, in principle, Rabbi Auerbach would be willing to permit actions despite there being no active illness; it is only because delay would not pose a substantial danger that it is forbidden.

In a different setting, he considers a case of emergency hip surgery, about which he was informed that a delay of a day or two would not increase mortality and was routine when operating rooms were required for more urgent procedures. Nonetheless, he rules that the operation

should take place on the Sabbath.[20] Here, the presence of an emergency changes the halakhic calculations. It is not clear whether this is because he agrees with the *Maggid Mishnah* that the Sabbath is to be suspended whenever there is danger to life, even if the treatment will not reduce mortality, or because he was not confident that delay would not be harmful. We shall reconsider some aspects of this case later.

Learning about Probabilities and Treatment Effects

The probabilities discussed in the previous sections are never known precisely. To make judgments about the degree of danger a person is in or how much treatment might reduce that danger, we typically make use of results from a study or series of studies and then try to generalize or extrapolate to the situation at hand. In this section, we discuss some difficulties in these steps and the ramifications of these difficulties for the issues discussed above.

We first mention a few problems with individual studies. We have formulated our definitions of *ḥoleh she-yesh bo sakanah* and of treatment effects in terms of quantities that are not always observable (e.g., whether an individual would die were treatment withheld). This approach highlights the fact that learning about these quantities requires not only data but also a combination of study design and appropriate assumptions to allow us to express averages of these sometimes unobservable quantities in terms of observable ones. Usually, we require that people who are untreated are comparable to treated people except for the effect of treatment.[21] Random assignment of treatment guarantees this in large samples. Otherwise, analysts typically substitute a combination of measuring confounding variables and revisions of the comparability assumptions, and, even then, there is no guarantee that the assumptions will hold, even approximately. Failure of these assumptions can lead to bias. The situation becomes more complicated yet when, as in situations considered here, one is trying to estimate the effects of a series of repeated

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[20]   Mordechai Halperin, "The Laws of Saving Lives: The Teachings of Rabbi S. Z. Auerbach," *ASSIA-Jewish Medical Ethics*, vol. 3, no.1, 44–49, 1997.

[21]   Greenland, Sander and James M. Robins, "Identifiability, Exchangeability, and Epidemiological Confounding,"*International Journal of Epidemiology*, vol. 15, no. 3, 413–419, 1986; Rosenbaum, Paul R. and Donald B. Rubin, "The Central Role of the Propensity Score in Observational Studies for Causal Effects," *Biometrika*, vol. 70, no. 1, 41–55, 1983.

treatments, or estimate the effects of delaying treatment initiation.[22] Additional potential problems include measurement error and missing data. These can all lead to systematic error or bias in estimating probabilities and various measures of effect. Even in the absence of bias, there is always some uncertainty in the estimates of risks and of treatment effects. Such uncertainty decreases with the size of the studies used to derive the estimates, but never disappears (in contrast, bias does not necessarily decrease as studies get larger). Large effects can be harder to explain as being solely due to bias than small effects.

With extended periods of risk and follow-up, there are additional problems. Although survival or risk curves may contain all the information one wants, they are often unavailable and, even when available, can be hard to use. These curves are thus often summarized as a single number: a risk at a particular time (five-year survival is common in oncology), the expected or average remaining time to live, the median remaining time to live, and the instantaneous rate of mortality ("hazard"). In addition, inability to ascertain outcomes of study participants can lead to bias, and limited duration of follow-up of study participants can lead to inability to estimate risk beyond the longest duration of follow-up.

In addition to problems with individual studies, there are difficulties in applying the findings of those studies to individual cases. Formal statistical inference from an individual study applies only to the study population or a hypothetical larger population from which the study subjects are drawn at random. In general, typical biomedical studies are (often for good reason) not random samples of anything, and so estimates of probabilities and measures of effect may not apply precisely or even approximately to the individual at hand. Finally, individuals, including physicians, are notoriously poor in making probability judgments.

There are several implications of all of this for practical application of modern concepts in statistics and related fields to this area of halakhah. First, what sort of evidence is required to conclude that an intervention is or is not beneficial? It is nearly impossible based solely on statistical criteria to conclude that a potential intervention has no effect on saving lives. This is in line with Radbaz's statement that "there is no certainty here that there is no aspect of [saving one from] danger to life." There must then be other criteria to determine what is permitted in such situations. Sometimes there are other scientific criteria for evaluat-

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[22]   Hernán, Miguel A., James M. Robins, *Causal Inference: What If* (Boca Raton: Chapman & Hall/CRC, 2020), pp. 233–287. The draft is only available on-line at <https://www.hsph.harvard.edu/miguel-hernan/causal-inference-book/>.

ing the plausibility of an intervention effect. In addition, the criterion of *Shulḥan Arukh* (based on Ramban) that in certain cases of danger to life, "they do for him as they would be accustomed to do for him on a weekday" is such a halakhic criterion.

As effect sizes get smaller, it becomes increasingly difficult to show conclusively that an intervention has a benefit, because of our inability to exclude both bias and statistical variability as explanations for observed associations.

In light of this, we reconsider the case of hip fracture Rabbi Auerbach discusses. Here, the doctor advising against performing the procedure on the Sabbath because a delay would not be harmful had probably committed a logical error. The studies he had considered might not have demonstrated an effect of delay on mortality or even an association between the two. However, because both of possible biases and statistical variability, a conclusion that early surgery would not be beneficial was unwarranted, even before possibly conflicting studies came to light; the absence of evidence for an effect is not evidence of its absence. These points are widely unknown or misunderstood among physicians and other science-oriented professionals.[23]

In the case of vaccination, it is easy to see that short delays in vaccination would have only minor effects on the long-term cumulative probability of infection, so justifying delay until after the Sabbath. Other cases may not be so clear-cut. In principle, we might propose delaying or withholding the intervention only if is highly unlikely it has much of an effect: i.e., that the probability that a suitable measure of effect is greater than some small threshold is sufficiently small. Obtaining this probability is an extremely difficult task, as it involves combining information from available studies with assessment of their biases and other background information, then applying all this to the unique characteristics of the situation at hand.[24]

Although there are many possible sources of bias in estimating risks, it often is possible to obtain rough approximations of such probabilities. This will especially be true when the intervention of interest is thought to have, at best, small effects on mortality, and so the unobservable

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[23] See, for example, Wasserstein, Ronald L., *et al.*, "Moving to a World Beyond 'p < 0.05'," *The American Statistician*, vol. 73, sup. 1, 1–19, 2019, which reflects the official position of the American Statistical Association.

[24] We have used an objective Bayesian formulation. One could also use a subjective Bayesian approach, or, less formally, use multiple bias modeling (Greenland, Sander, "Multiple-Bias Modelling for Analysis of Observational Data," *Journal of the Royal Statistical Society, Series A*, vol. 168, no. 2, 267–306, 2005).

probability of death if untreated[25] is close to the observable probability of death.[26] Thus, if the definition (based on Rashi and Radbaz) of a *ḥoleh she-yesh bo sakanah* is "a sick person whose life is in danger *if the intervention is withheld*," judgments may be made about the disease as a whole without referring to specific interventions, so long as there are not interventions that nearly eliminate the risk of death.

There are diseases where an intervention can largely eliminate at least the short-term risk associated with the disease. Consider type I diabetes, where insulin is required to control blood sugar and prevent the possibly life-threatening complications of uncontrolled blood sugar. Someone whose blood sugar level is well-controlled on insulin is not at high risk of death in the short term. Such a person would be classified as a *ḥoleh she-yesh bo sakanah* regarding insulin and the checking of blood glucose levels required for its dosing, but would not be considered a *ḥoleh she-yesh bo sakanah* with respect to extinguishing a lamp, since insulin would be sufficient for controlling high sugar. As medical science advances, more diseases which formerly posed short-term risks may no longer do so, and this analysis may apply there.[27] Apart from our analysis of the applicability of the category of *ḥoleh she-yesh bo sakanah*, the criterion of Ramban and *Shulḥan Arukh* that in certain cases of danger, "they do for him as they would be accustomed to do for him on a weekday" implies that, as medical practice changes in response to scientific advances, actions once permissible on the Sabbath may later become forbidden.

Discussion

This essay has outlined two approaches to characterizing the nature of the dispensation from the usual Sabbath restrictions, one based on risk, the other on effect. We have argued that the effect-based approach may be more difficult to implement practically because of scientific considerations and may have less support from the sources than previously thought. Nonetheless, the motivation behind the approach, that permission to suspend the Sabbath rules depends on a connection to saving a life or reducing the risk of death, is powerful. As we have seen, *Shulḥan Arukh*, who adopts the risk-based approach, rules that interventions

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[25] $\Pr\{D(0)=1\}$.

[26] $\Pr(D=1)$.

[27] A fuller discussion of diseases classified by the Talmud as dangerous but not so considered by modern science is beyond the scope of this essay.

which are known not to affect mortality are forbidden even for a *ḥoleh she-yesh bo sakanah.*

The ways used to define danger have been subjective. This can lead to various types of variability and inconsistency. Two doctors or experts may classify the same condition as dangerous or not based solely on their personal inclinations, with no real halakhic guidance. Further, one condition with a particular risk profile may conventionally be classified as dangerous, whereas a different condition with a similar profile may not be classified that way. In principle, our approaches provide a way to reduce such inconsistency and ground judgment on more objective standards. However, much work remains in defining such standards, which would require guidance from halakhic experts. We believe that this is a worthwhile pursuit.

Appendix 1. Discussion of Rashi on *Shabbat* 129a and *Yoma* 84b

We discuss here two short Talmudic passages and Rashi's commentary on them. They shed some light on the concept of *ḥoleh she-yesh bo sa-kanah*, especially in the context of extended periods of risk and treatment. We also show that Rashi's commentary may not support the strict approach. We take up the passage in *Shabbat* first, as it does not deal with the various dimensions of time.

The Gemara (*Shabbat* 129a) states:

> כדרב עולא בריה דרב עילאי, דאמר: כל צרכי חולה נעשין על ידי ארמאי בשבת. וכדרב המנונא, דאמר רב המנונא: דבר שאין בו סכנה - אומר לנכרי ועושה.

> This ruling is in accordance with the statement of Rav Ulla, son of Rav Ilai, who said: All needs of a sick person [whose life is not in danger] are performed by means of a gentile on Shabbat. And this ruling is in accordance with the opinion of Rav Hamnuna, as Rav Hamnuna says: With regard to a matter in which there is no danger, one says to the gentile to perform the act, and the gentile performs the act.

Rashi explains:

> דבר שאין בו סכנה - חולה שאם לא יעשו לו רפואה זו אין מסוכן למות, ומכל מקום צריך הוא לה. אומר לארמאי ועושה - אבל דבר שיש בו סכנה - ישראל עצמו עושה לו.

> 'A matter in which there is no danger' — A sick person that if this healing action is not performed for him, he is not in danger of dying, but nonetheless he needs it [the action] — 'One says to the

gentile to perform the act, and the gentile performs the act' — but a matter in which there is danger, an Israelite himself performs the act for him.

Beit Yosef (*O.Ḥ.* 328) understands Rashi as follows:

ומדברי רש"י משמע דלא שרי לחלל שבת בשביל חולה שיש בו סכנה אלא דוקא בדבר שאם לא יעשוהו לו הוא מסוכן למות בשבילו אבל דבר שאף אם לא יעשוהו לו אינו מסוכן למות בשבילו אין עושין אותו על ידי ישראל שבסוף פרק מפנין (קכט.) אהא דאמרינן חולה שאין בו סכנה אומר לגוי [ועושה] פירש רש"י צרכי חולה שאם לא יעשו לו רפואה זו אין מסוכן למות ומכל מקום צריך הוא לה.

The words of Rashi imply that it is not permitted to profane the Sabbath for a sick person whose life is in danger except for a matter [i.e., treatment] that, if not done, he is in danger of dying as a result, but for a matter that, even if not done, he is not at risk of dying as a result, an Israelite may not perform the action, since at the end of chapter [18 of *Shabbat*], Rashi explains [the Gemara's statement] 'a sick person whose life is not in danger' as 'the needs of a sick person that if this healing action is not performed for him, he is not in danger of dying, but nonetheless he needs it [the action].'

The first part of the *Beit Yosef* understands Rashi to limit the dispensation for violating the Sabbath for a *ḥoleh she-yesh bo sakanah* to cases where withholding treatment leads to a higher risk of death.[28] The continuation states the apparent converse, that when withholding treatment does not lead to a higher risk of death, the usual prohibitions apply. What to do when it is unclear whether withholding treatment raises the risk is not clear.

Biur Halakhah takes this interpretation several steps further. Recall his understanding of Rashi (O.C. 328:4 s.v. *kol she-regilim*):

דהרי רש"י כתב חולה שאב"ס שאם לא יעשו לו רפואה זו לא ימות עכ"ל משמע דיש בו סכנה דפירושו דמסוכן הוא אצל התרופה וכבר הביאו ב"י.

… since Rashi wrote, 'a sick person not in danger, (which means) that if this treatment is not provided he will not die.' This implies that the phrase 'who is in danger' means that he is in danger with respect to [withholding] the treatment, and the Beit Yosef has already brought him [i.e., interpreted Rashi similarly].

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28   I.e., $\Pr\{D(0) = 1\} - \Pr\{D(1) = 1\} > 0$.

The simplest interpretation of this is that one is considered in danger if (and perhaps only if) withholding the treatment leads to increased risk. Unlike the Beit Yosef, he redefines the phrase *yesh bo sakanah* to refer to danger due to withholding the treatment. In addition, he seems to limit the dispensation according to Rashi's view to cases where treatment reduces the risk of death; the Beit Yosef is more equivocal in cases where the efficacy of treatment is unclear. Finally, the legal ruling of Rabbi Yosef Karo in *Shulḥan Arukh* does not reflect his understanding of the Rashi as expressed in the *Beit Yosef*, whereas *Biur Halakhah* calls that ruling into question.

A simpler reading of Rashi's definition of חולה שאין בו סכנה (a sick person not in danger), "a sick person that if this healing action is not performed for him, he is not in danger of dying," is to take it literally, or, more broadly, that the probability of dying if not treated is close to zero.[29] The definition of a person in danger is then the opposite or complement of a person not in danger; i.e., the probability of dying if not treated is (substantially) greater than zero.[30] Unlike the reading of *Biur Halakhah*, this reading of Rashi defines the term *ḥoleh she-yesh bo sakanah* in a way similar to its simple meaning. Under this reading of Rashi, the passage implies that for a sick person whose life is in danger, a Jew may perform otherwise forbidden healing interventions; there is no statement about the efficacy of such interventions in reducing mortality. This is essentially Radbaz's view. This definition is not far from the view of Rambam (*Shabbat* 2:1–3,11), presumably based on the above Talmudic passage (*Maggid Mishneh*), and also codified by *Shulḥan Arukh* (*O.Ḥ.* 328:2,17).

We consider next the passage in *Yoma* 84b quoted in full above. The Gemara presents two examples where there is a possible danger for the following Sabbath. In the first example, the expert prescribes eight days of a treatment, starting now (on the Sabbath). The Gemara also considers an alternative plan, to start treatment after the Sabbath, possibly for eight days. Define a treatment regime G as a plan that assigns a treatment at each time to a subject. With up to nine days considered, there are 512 possible plans. We shall consider two:

  $G1$:   Treat for the first eight days.
  $G2$:   Treat for eight days, starting on day two.
Recall Rashi on this passage:

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[29]   I.e., $\Pr\{D(0) = 1\} = 0$, or $\Pr\{D(0) = 1\} < \varepsilon$ for some ε close to 0.
[30]   I.e., $\Pr\{D(0) = 1\} > 0$, or $\Pr\{D(0) = 1\} \geq \varepsilon$ for some ε close to 0.

לא ספק שבת זו בלבד - לא שיהא ספק הנפשות לשבת זו, אלא אפילו אין
הספק לשבת זו, דפשיטא לן דהיום לא ימות, אלא ספק שאם לא יעשו לו
היום - שמא ימות לשבת הבאה.

'This not only in a case where there is uncertainty with regard to
this Sabbath'— Not that the uncertainty pertains to this Sabbath;
rather, even if the uncertainty does not pertain to this Sabbath,
since it is obvious to us that he will not die today, but instead un-
certainty that if one does not do the action for him today, perhaps
he will die on the following Sabbath.

According to Rashi on this passage, no matter what is done regard-
ing the treatment, the patient will not die on the Sabbath.[31] Rashi's
statement, "but instead uncertainty that if one does not do the action for
him today, perhaps he will die on the following Sabbath" should be un-
derstood in context of the expert's advice to provide eight days of
treatment, to refer to what would happen even if we merely waited until
after the Sabbath to start treatment. In any case, this Rashi here says
nothing about what would happen if treatment were provided; in partic-
ular, he does not state that the intervention will prevent or reduce the
risk of dying on the following Sabbath.[32]

The second case in the Gemara involves heating water for drinking
or washing. Rashi comments:

להברותו - רחיצה, שמא יבריא מאיליו.

'To wash him'—washing, perhaps he will heal on his own.

Washing in hot water would rarely be a curative treatment. This may
explain Rashi's characterization of the effect as uncertain and "on his
own." Further, the justification for heating water, a violation of a Bibli-
cal prohibition, is that it might lead to healing and saving a life. Under
this view, the Talmudic passages themselves express Radbaz's view that
the dispensation is for a dangerously ill person as we have defined, ap-
plies broadly, beyond treatments dealing directly with the underlying
condition, and is based on the possibility of averting death.
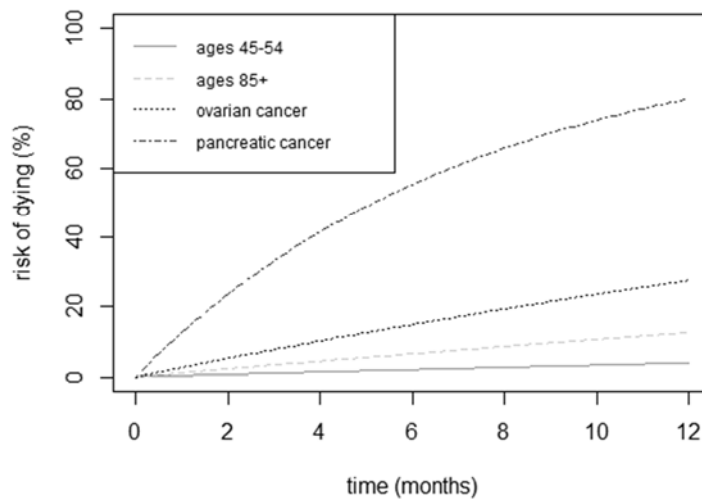
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[31] Denote by $R_{T(G)}(t)$ the risk of dying by t under regime G. Here, the risk of
dying on the Sabbath (day 1) is 0 no matter what treatment is provided, so
$R_{T(G1)}(1) = R_{T(G2)}(1) = 0$.

[32] Rashi's condition translates roughly to $\Pr\{7 < T(G2) \leq 8\} > 0$ or, more
generally, $\Pr\{7 < T(G) \leq 8\} > 0$ for any regime G under which treatment is
not given on Shabbat (day 1). Rashi says nothing here about $\Pr\{7 < T(G1) \leq 8\}$.

Acknowledgments

Figure 1. Plot of risk of dying (expressed in %) for Americans in four groups: ages 45–54, 85 and older, women just diagnosed with ovarian cancer, and people just diagnosed with pancreatic cancer. The curves for cancer mortality make a working (but likely incorrect) assumption that the hazard or rate of mortality is constant over the course of the year following diagnosis.
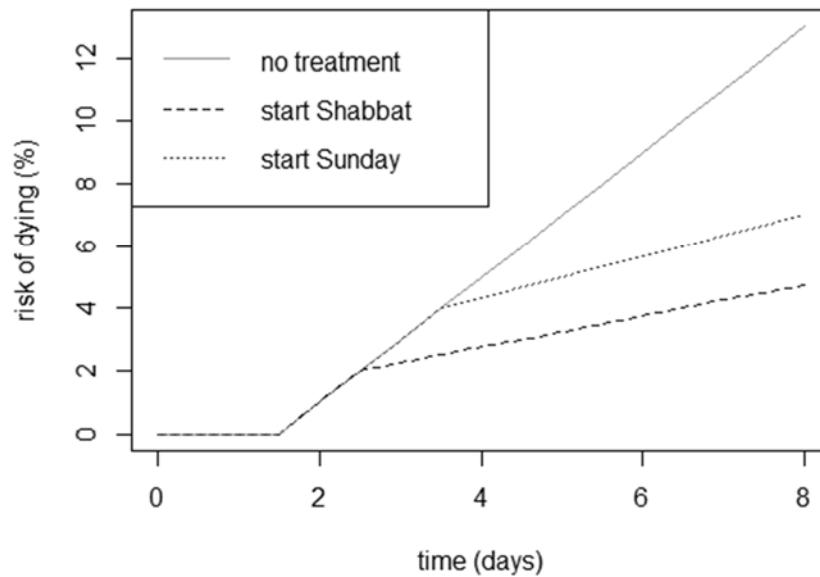
Figure 2. Plot illustrating situation in *Yoma* 84b as understood by Rashi. Time 0 refers to the beginning of Shabbat. The Y-axis is the risk of dying (expressed as a percent) by the time on the X-axis. The three curves represent the risk curves under three scenarios: no treatment provided (solid green curve), treatment starting on Shabbat and continuing each day (long blue dashes), and treatment beginning on Sunday (short red dashes). No matter what is done, the patient will not die on the first Shabbat. Even if treatment is begun on Sunday, there is a substantial chance he will die on or by the following Shabbat (short-dashed red line). This, according to our understanding of Rashi and Radbaz, justifies suspending the usual Sabbath regulations to give the treatment unless, according to Ramban and *Shulḥan Arukh*, it is clear that starting treatment early will not reduce mortality below what is expected if treatment is delayed until after Shabbat. So long as it is possible or plausible that prompt intervention decreases mortality (as illustrated by the long-dashed blue line), intervention is permitted. According to *Biur Hala-khah*'s understanding of Rashi, we require the risk curve under immediate treatment to be below that for delayed treatment for at least one point in time to justify suspension of the usual prohibitions. ❧