Betting on CPR: a modern version of Pascal's Wager

David Y Harari,[1] Robert C Macauley[2]

[1]Dept. of Psychiatry, University of Vermont Medical Center, Burlington, Vermont, USA
[2]Dept. of Pediatrics, Oregon Health & Science University School of Medicine, Portland, Oregon, USA

Correspondence to
Dr David Y Harari;
DavidHarari.MD@gmail.com

Received 14 May 2019
Revised 28 August 2019
Accepted 1 September 2019

To cite: Harari DY, Macauley RC. *J Med Ethics* Epub ahead of print: [please include Day Month Year]. doi:10.1136/medethics-2019-105558

ABSTRACT

Many patients believe that cardiopulmonary resuscitation (CPR) is more likely to be successful than it really is in clinical practice. Even when working with accurate information, some nevertheless remain resolute in demanding maximal treatment. They maintain that even if survival after cardiac arrest with CPR is extremely low, the fact remains that it is still greater than the probability of survival after cardiac arrest *without* CPR (ie, zero). Without realising it, this line of reasoning is strikingly similar to Pascal's Wager, a Renaissance-era argument for accepting the proposition for God's existence. But while the original argument is quite logical—if not universally compelling—the modern variant makes several erroneous assumptions. The authors here present a case of a patient who unwittingly appeals to Pascal's Wager to explain his request for maximal treatment, in order to highlight the crucial divergences from the original Wager. In understanding the faulty assumptions inherent in the application of Pascal's Wager to code status decisions—and identifying the underlying motivations which the Wager serves to confirm—providers can better ensure that the true values and preferences of patients are upheld.

CASE

Mr Smith is an 81-year-old man with moderate cirrhosis who is admitted to the hospital with spontaneous bacterial peritonitis. He is not a transplant candidate because of ongoing alcohol use. His condition continues to deteriorate despite antibiotic treatment, prompting transfer to the intensive care unit for vasopressor support. When the medical team attempts to engage him in a goals-of-care conversation, he is clear that is eager to go home and never return to the hospital, which he despises. While everyone is hopeful that his condition could improve and he would be able to return home without the need for 'heroic interventions', if he were to experience cardiac arrest the odds of him surviving—let alone going home and not being re-admitted soon thereafter—are extremely low. A DNAR (Do Not Attempt Resuscitation) order is therefore recommended.

Mr Smith, however, is explicit that he wants 'everything done'. When asked to explain his reasoning, he says: "The way I see it, if CPR doesn't work, I'm dead already. If it does work, then even if I have some discomfort, it's still better than being dead".

INTRODUCTION

Many patients believe that cardiopulmonary resuscitation (CPR) is more likely to be successful than it really is, often due to an overly optimistic depiction of the procedure in popular culture such as television and movies.[1] Such misperceptions are often unaddressed in code status discussions on hospital admission, which tend to be brief—in one study, lasting a median of 10 min with the physician speaking most of the time—and lacking critical details.[2] In the previously cited study, for instance, only 55% of physicians mentioned chest compressions, 2% anticipated subsequent need for intensive care and 13% specified the likelihood of survival after CPR (with no physician offering a numerical estimate).

In reality, in-hospital CPR succeeds in restoring spontaneous circulation roughly 25% of the time.[3] The odds are even worse for elderly patients with chronic illness. Given Mr Smith's age and moderate cirrhosis, if he experienced an in-hospital cardiac arrest and received CPR, he would have a roughly 14% chance of surviving to discharge, with a median survival of less than 6 months. Less than 3% of patients like him manage to stay out of the hospital during the subsequent 6 months.[4]

Studies have shown that if the true odds of success are fully explained, elderly patients like Mr Smith are less likely to request 'full code' status.[5 6] Some patients, however, remain resolute in demanding maximal treatment. To physicians who have presented what they feel to be persuasive data and argumentation only to have the patient respond in precisely the opposite way than they had anticipated, this may seem at best counter-intuitive and at worst reflective of a lack of decision-making capacity.

When viewed in comparative terms, however, Mr Smith's request for maximal treatment appears quite rational. For even if the probability of survival after cardiac arrest with CPR is extremely low, the fact remains that it is still greater than the probability of survival after cardiac arrest *without* CPR (ie, zero).

Without realising it, Mr Smith is applying Pascal's Wager, a Renaissance-era argument for accepting the proposition for God's existence, to a code status decision. But while the original argument is quite logical—if not universally compelling—the modern variant makes several erroneous assumptions. Recognising these crucial divergences from the original Wager helps identify the logical flaws in Mr Smith's argument, as well as the underlying motivations which the Wager serves to confirm. By doing so providers can better ensure that the true values and preferences of patients are upheld.

PASCAL'S WAGER

Over the course of history, many arguments have been proffered for believing in God, which usually hinge on an attempted proof of God's existence either as a necessary explanation for observed phenomena (as in Aquinas' 'cosmological argument'[7]) or as a logical requirement based on the very definition of God (as in Anselm's 'ontological argument').[8] By contrast, the noted French mathematician and theologian Blaise Pascal (1623–1662) did not argue that God's existence was obvious, necessary, or even likely. Pascal readily admitted that 'God is, or He is not. But to which side shall we incline? Reason can decide nothing here'.[9]

Rather than attempting an a priori proof of God's existence, Pascal offered a *pragmatic* reason for belief in God, based on a calculation of consequences and probabilities. His concern was not so much what is true or false, but rather what offers the greatest likelihood of a positive outcome to an individual person. Simply put, if a person 'bets' on God's existence, he is more likely to win than to lose. Pascal wrote, "If you gain, you gain all; if you lose, you lose nothing. Wager, then, without hesitation that He is".[9]

Pascal's Wager is thus designed to appeal to people of all religious backgrounds, or none at all. Rather than asserting that the probability of God's existence (p) is high, Pascal readily admitted that some deem God's existence to be unlikely (perhaps extremely unlikely). The Wager, therefore, begins with the much more modest claim that p not be infinitesimally small. Ardent atheists notwithstanding, presumably everyone would be willing to grant this claim.

Whether God exists or not is obviously outside of an individual's control. Pascal claims, however, that whether to *believe* that God exists is within a person's control. This claim has prompted one of the best-known criticisms of the Wager, namely, whether one can simply choose to believe in God,[10] at least in a way that isn't obviously self-serving (so-called 'doxastic voluntarism').

If God does indeed exist—however, remote that possibility—then according to the Christian worldview under which Pascal was working, the consequence (C) to that person of believing in God is eternal bliss (C_{Heaven}), which is infinite (∞) in value. The consequence of not believing in God is misery (C_{Hades}), which is obviously negative (and potentially also infinite). Clearly, this binary construct is predicated on the assumption that there is one 'god' whose existence can either be accepted or rejected. In a modern pluralistic society, this assumption is vulnerable to the argument from inconsistent revelations (otherwise known as the 'avoiding the wrong hell problem',[11] which recognises that one might opt to believe in the 'wrong god' and thus not get the reward (or the punishment) that is anticipated.

But what if there is no God? Divine blessing or punishment would consequently no longer be considerations. Correctly denying the reality of something that does not, in fact, exist ($C_{Correct\text{-}atheism}$) would offer greater latitude of choice in one's life (without a divine being to obey or answer to). Pascal claims that, conversely, there would really be no real 'penalty' for believing in a non-existent God, which at worst would condemn a person to a moral life (C_{Piety}). To be sure, those who have been asked to make substantial sacrifices to lead what the their religion deems a 'moral' life would beg to differ.[12]

Having already posited that the probability of God's existence is not infinitesimally small, Pascal invokes the basics of decision theory to advocate for—or 'wager on'—belief in God. According to decision theory, the expected consequence of a certain action can be calculated in this way:

C = (Outcome that an action produces in a specific situation) × (Likelihood of that situation)

To take a mundane example, it would make sense to spend \$2 on a lottery ticket that has a 10% chance of winning the \$50 grand prize, since the expected consequence is winning \$5 (ie, \$50×0.1), which is greater than the price of the ticket. By contrast, it would not make sense to buy a ticket to a much richer lottery—with a grand prize of, say, \$1000—if the odds of winning were only 0.1%, since the expected consequence would be winning only \$1.

Applying decision theory to theological belief yields the following equation:

$$C_{Belief} = (C_{Heaven} \times p) + (C_{Piety} \times [1 - p])$$

Since C_{Heaven} is infinite, as long as p is not infinitesimally small, then the product of these two is also infinite. It therefore does not matter what C_{Piety} is—and to some it could be a negative number, depending on the sacrifices they have to make to lead a so-called 'godly' life—so long as it is finite. The sum C_{Belief} would still be infinitely positive.

The consequence of *not* believing in God can be expressed this way:

$$C_{Unbelief} = (C_{Hades} \times p) + (C_{correct\text{-}atheism} \times [1 - p])$$

None of the variables here are infinitely positive; quite the contrary, one could make an argument based on the theology of Pascal's day that C_{Hades} is infinitely *negative*. But even if it is not, the sum $C_{Unbelief}$ is a number of some finite value. And since infinity is greater than any finite number, of necessity $C_{Belief} > C_{Unbelief}$. As Pascal put it, "Wherever the infinite is and there is not an infinity of chances of loss against that of gain, there is no time to hesitate, you must give all".[9]

In the centuries since its formulation, Pascal's argument has remained influential. Modern-day theologians such as Rick Warren continue to appeal to its logic:

> [The atheist and I are] both betting. He's betting his life that he's right. I'm betting my life that Jesus was not a liar. When we die, if he's right, I've lost nothing. If I'm right, he's lost everything. I'm not willing to make that gamble.[13]

As does Mr Smith, who essentially (although unwittingly) applies the same argument to CPR. In this context, the aforementioned criticisms of the original Wager no longer pertain. There is no concern for 'inconsistent revelations', for example, because there is only one route to survival following cardiac arrest: CPR. Doxastic voluntarism is similarly not a concern because even if one cannot choose to believe that God exists, one can certainly choose whether to accept CPR or not.

At the same time, there exist crucial distinctions between the theological and pro-resuscitation versions of the Wager, which fundamentally affect the reliability of the argument's conclusion. If these discrepancies were brought to his attention, Mr Smith might be able to see that the consequence of attempted resuscitation (C_{CPR}) is not only *not* infinitely positive, but it may ultimately be less than the consequence of not attempting it (C_{DNAR}).

(Mis)Application of Pascal's Wager to code status decisions

If p once again represents probability—in this case, the probability of successful CPR rather than of God's existence—then the consequence of CPR for Mr Smith could mathematically be represented this way:

$$C_{CPR} = (C_{Survival-without-immediate-readmission} \times 0.03) + (C_{Survival-with-complications} \times 0.11) + (C_{Death-after-CPR} \times 0.86)$$

Common misperceptions about high rates of success for CPR (ie, a falsely elevated p) would artificially inflate the sum C_{CPR}. But given that Mr Smith is working with accurate information—which suggests a 14% chance of survival-to-discharge for an elderly patient with moderate cirrhosis—his individual consequence from CPR would then be:

Harari DY, Macauley RC. *J Med Ethics* 2019;**0**:1–4. doi:10.1136/medethics-2019-105558

$$C_{CPR} = (C_{Survival} \times 0.14) + (C_{Death\text{-}after\text{-}CPR} \times 0.86)$$

Judging from his comment that 'if CPR doesn't work, I'm dead already', Mr Smith seems to believe there is nothing to lose if CPR is unsuccessful. But there also appears nothing to gain from undergoing unsuccessful CPR—at least physiologically—which would mean that $C_{Death\text{-}after\text{-}CPR}=0$. The overall consequence of CPR is therefore simply ($C_{Survival}\times 0.14$). So long as this is more positive than the consequence of being DNAR, then it makes perfect sense to opt for maximal treatment.

While C_{CPR} is partially determined by the value of p, C_{DNAR} is not dependent on the probability that CPR *would have* worked, since it would not be given a chance to. Thus:

$$C_{DNAR} = C_{Death\text{-}after\text{-}CPR}$$

If Mr Smith's exclusive goal is survival, there would be no positive consequence to death, and thus $C_{Death\text{-}without\text{-}CPR}=0$. Then by the transitive property of equality, C_{DNAR} would also equal zero in the event of a cardiac arrest.

By this reasoning, if there is *any* positive consequence whatsoever to successful CPR (ie, $C_{CPR}>0$), then Mr Smith's refusal of a DNAR order would be eminently reasonable. There would be no reason to question the decision-making capacity of such a patient requesting maximal treatment; quite the contrary, one might well wonder about the capacity of any patient who *refuses* CPR, as this seems to reduce the likelihood of a positive outcome without any drawbacks.

Faulty assumptions in the code status version of the wager

While the above argument is valid (ie, the conclusion logically follows from the premises), it is not sound because the premises involve three erroneous assumptions, thereby rendering the conclusion equally unreliable.

Assumption #1: The primary goal has infinite value

The reason that the original Wager is so elegant and mathematically compelling is because the ultimate goal (ie, eternal life in heaven) is of infinite value. As a result, it really does not matter how small p is, as long it is not infinitesimally small. The value attributed to other variables are also inconsequential because they cannot compare to the infinite product of C_{Heaven} and any non-infinitesimal number.

With regard to code status decisions, life is indeed precious and for some patients prolonging it (even after having to endure CPR) is the ultimate goal. Nevertheless, even with successful resuscitation—which, as demonstrated, is unlikely in the context of chronic illness—the benefit is temporal. Rather than being 'the end of the story', the most-sought variable is only a part of that story. The simple fact that $C_{Survival}$ is finite means that it could conceivably be exceeded by other variables, thereby demanding that they also be taken into consideration.

Assumption #2: 'Survival' is monolithic

Not only is $C_{Survival}$ not infinite, it is also not monolithic. Whereas on television CPR survivors appear none the worse for wear—and often seem rather rejuvenated and refreshed—'survival' in real life can take many forms. These include neurological devastation, greater dependence and increased fragility. Mr Smith is not merely seeking to survive long enough to leave the hospital; he is seeking some degree of independence or, at the very least, sufficient health to avoid re-hospitalisation in the following months.

Since only 3% of patients like him avoid re-hospitalisation over the next 6 months, a more appropriate calculation based on his individual goals would be:

$$C_{CPR} = (C_{Survival-without-immediate-readmission} \times 0.03) + (C_{Survival-with-complications} \times 0.11) + (C_{Death-after-CPR} \times 0.86)$$

Assuming that $C_{Death\text{-}after\text{-}CPR}=0$—which, as noted below, is a questionable assumption—the overall consequence of CPR can be further simplified as:

$$C_{CPR} = (C_{Survival-without-immediate-readmission} \times 0.03) + (C_{Survival-with-complications} \times 0.11)$$

This clarification has significant ramifications. The first is that the actual probability of achieving Mr Smith's primary goal is markedly reduced, from 14% to 3%. The second is that since his goal is not to return to the hospital, logically $C_{Survival\text{-}with\text{-}complications}<C_{Survival\text{-}without\text{-}immediate\text{-}readmission}$. One might go so far as to argue that $C_{Survival\text{-}with\text{-}complications}$ could even be a negative number if Mr Smith's quality of life significantly worsened, such as through neurological devastation or complete dependency on others. Put more colloquially, certain forms of post-CPR survival—depending on a patient's goals and values—could conceivably be 'worse than death'.

This is not an uncontentious claim. Some would argue that any life is better than no life, for reasons ranging from humans having been created in the image of God[14] to a person's inherent worth and dignity not being compromised by—indeed, possibly being accentuated by—vulnerability and dependence.[15] In response, it should be noted that $C_{Survival\text{-}with\text{-}complications}$ is not an external assessment that is susceptible to ableist and other biases,[16] but rather Mr Smith's evaluation of his own quality of life. If he preferred death over extreme dependence—and there was no positive value associated with death—then mathematically $C_{Survival\text{-}with\text{-}complications}$ must be a negative number.

And since Mr Smith is much more likely to survive *with* complications than to avoid readmission, $C_{Survival\text{-}with\text{-}complications}$ disproportionately affects the value of C_{CPR}. If the former were even a modest negative number, it could potentially render C_{CPR} also negative. In which case, even if $C_{DNAR}=0$, it would still be greater than C_{CPR}, making refusal of CPR the more logical choice.

Assumption #3: All deaths are the same

Implicit in the modern version of CPR is the belief that all deaths are the same (ie, $C_{Death\text{-}after\text{-}CPR}=C_{DNAR}=0$). While it may not be possible to definitively disprove this assertion—precisely because one cannot interview patients for whom CPR was unsuccessful—postmortem findings suggest significant burden associated with unsuccessful CPR. One study found that among such non-survivors, 29% experienced rib fractures, 14% incurred sternal fracture and 11% evidenced chest wall bruising.[17] Provision of CPR also routinely involves invasive interventions such as endotracheal intubation, line placement and cardioversion or defibrillation.[18]

So, while some patients might wish to 'go down fighting', one might reasonably postulate that, if given a choice of dying after unsuccessful CPR or peacefully and comfortably without CPR, most patients would choose the latter. Phrased mathematically, this means that $C_{DNAR}>C_{Death\text{-}after\text{-}CPR}$. Thus, if C_{DNAR} still equals zero, then logically $C_{Death\text{-}after\text{-}CPR}$ must be a negative number. This is particularly significant because $C_{Death\text{-}after\text{-}CPR}$ affects the overall value of C_{CPR} even more than $C_{Survival\text{-}with\text{-}complications}$ does, by virtue of its overwhelming likelihood of 0.86.

CONCLUSION

Mr Smith has probably never heard of Pascal's Wager, and even if he had, it is highly unlikely that he is consciously applying it to his decision about CPR. It would therefore be unhelpful—and a little bizarre—to elucidate for him the distinctions between a Renaissance-era theological argument and his rationale for requesting maximal treatment.

The fact remains, however, that Mr Smith is implicitly applying a very similar line of reasoning: something of infinite value, no matter how unlikely it is to occur, makes it worth risking something—*everything*—of merely finite value. While that argument may have worked for Pascal, it falls short when applied to code status discussions because of numerous inaccurate assumptions. What is of preeminent value (in this case, prolonged life) is not of *infinite* value. As a result, it needs to be weighed against the relative benefit and likelihood of alternative outcomes which are potentially determinative because of their greater probability of occurring (especially for an elderly patient with chronic illness).

Yet even if one were to point out to Mr Smith the logical fallacies in his unknowing misapplication of Pascal's Wager to his code status, it is unlikely to impact his decision. The reason is that 'decision theory' is almost surely not the primary reason he has opted for full code status. Such decisions are typically far more personal—and frequently more emotional—than mathematical calculations.[19] For instance, Mr Smith might be so scared of dying that he is willing to accept any intervention no matter the probability of success. Or he could hold out hope that he might beat the odds and have a good quality of life after surviving CPR. Or maybe being a 'fighter' is so intrinsic to his values that he can't bear making a decision that would seem an admission of defeat.[20] Represented mathematically this would mean that, for Mr Smith, $C_{\text{Death-after-CPR}} > C_{\text{DNAR}}$.

Whatever his individual reasons for opting for full code status, decision theory likely plays an adjunct role: either to render full code status a reasonable option to consider, or to confirm that a choice he has already made to receive CPR is, indeed, a rational one.

In this respect, decision theory functions in the same way it did for Pascal. Pascal did not envision that inquisitive people would adopt theism based on the calculations of the Wager—even assuming that this is possible, given the criticism of doxastic voluntarism noted above—but rather that it would assure them that, should they be drawn for more personal reasons to believe in God, this would not be an illogical or irational belief to hold. It is also useful from a confirmatory perspective, essentially deeming one's conclusion—reached by other routes—the only rational one.

Herein lies the more modest benefit in identifying the parallels between Mr Smith's argument and Pascal's. By exploring the nuances of the potential outcome(s) of Mr Smith's decision—thereby highlighting the false assumptions inherent in applying Pascal's framework to the question of code status—it will become clear that opting for maximal treatment is not the *only* rational choice. It may, in fact, be the 'right' choice for Mr Smith, based on his goals and values. But it is only when those goals and values are identified and explored—as well as the emotional component of such a momentous decision—that a plan can be formulated which provides Mr Smith the best chance of achieving what he most wants, and is least likely to bring him to a place that he is desperate to avoid.

Contributors Both authors (DYH and RCM) contributed to development of this manuscript, including but not limited to the drafting, writing, organising, editing, revising and editing process.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

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