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Pascal's Wager, Infective Endocarditis and the "No-lose" Philosophy in Medicine

D. Shaw (Lecturer in Ethics) and D.I. Conway (Clinical Senior Lecturer)

Dental School, Faculty of Medicine, University of Glasgow,
378 Sauchiehall Street, Glasgow, G2 3JZ. Email: d.shaw@dental.gla.ac.uk

Standfirst: *the fact that some doctors still believe that antibiotic prophylaxis against infective endocarditis is the best clinical option indicates that the no-lose philosophy is still present in the era of evidence-based medicine. Just as Pascal's Wager is flawed, so is the no-lose/safety first philosophy, and patients may be at risk because of this.*

Abstract

Doctors and dentists have traditionally used antibiotic prophylaxis in certain patient groups in order to prevent infective endocarditis (IE). New guidelines, however, suggest that the risk to patients from using antibiotics is higher than the risk from IE. This paper analyses the relative risks of prescribing and not prescribing antibiotic prophylaxis against the background of Pascal's Wager, the infamous assertion that it is better to believe in God regardless of evidence, because of the prospective benefits should He exist. Many doctors seem to believe the parallel proposition that it is better to prescribe antibiotics, regardless of evidence, because of the prospective benefit conferred upon the patient. This has been called the "no lose philosophy" in medicine: better safe than sorry, even if the evidence inconveniently suggests that following this mantra is potentially more likely to result in sorry than safe. It transpires that, just as Pascal's Wager fails to convince because of a lack of evidence to support it and the costs incurred by trying to believe, so the "belts and braces" approach of prescribing antibiotic prophylaxis is unjustifiable given the actual evidence of potential risk and benefit to the patient. Ultimately, there is no no-lose if your clinical decisions, like Pascal's Wager, are based on faith rather than evidence.

Introduction

Blaise Pascal embarrassed many contemporary theologians when he made his famous Wager, which appeals to prudential gambling rather than faith:

Let us weigh up the gain and the loss involved in calling heads that God exists. Let us assess the two cases: if you win you win everything. If you lose you lose nothing. Do not hesitate then; wager that he does exist. [1]

In other words, it is better to assume that God exists and live your life accordingly in order to achieve the infinite payoff of eternal bliss in heaven; if He turns out not to exist, you have at worst a small loss. This decision matrix can be represented by a table:

	God exists	God doesn't exist
You believe in God	Infinite benefit	No loss
You don't believe	Infinite loss	No loss

Table 1: Pascal's wager

Pascal's Wager is widely seen as being a first in terms of theology and decision theory, but its relevance to modern medicine has been neglected. Thirty years ago, former Scottish Minister and neurosurgeon Sam Galbraith compared the Wager to the "no lose" philosophy in medicine, defining the latter as taking a clinical decision "to do one thing or another without being quite sure of the outcome of either action".[2] Galbraith worked through the example of investigating patients to gather as much information as possible before coming to a diagnosis and highlighted this precautionary approach ignores the potential morbidity and mortality from unnecessary diagnostic procedures. Like Pascal's Wager, the no-lose philosophy in medicine advocates "playing it safe"; the difference, of course, is that no harm is done if you accept Pascal's Wager and God doesn't exist: if you make the wrong clinical decision, however, it can have devastating consequences for patients.

One might hope that in the 21st-century era of evidence-based medicine the idea of doing unjustified tests and treating patients unnecessarily might be ridiculous; however, it appears that Pascal-like thinking is still evident in many areas of medicine. This paper looks at the example of the prescription of antibiotics to avoid IE in patients undergoing dental procedures.

Antibiotic Prophylaxis for Infective Endocarditis

Registered dentists are legally entitled to prescribe from the entirety of the 'British National Formulary' (BNF) and 'BNF for Children' (BNFC).[3,4] However, dental prescribing within the National Health Service (NHS) is restricted to those drugs contained within the 'List of Dental Preparations' in the 'Dental Practitioners Formulary' (DPF).[5] Until recently, the DPF was a distinct publication, providing information on prescribing for general dental practitioners. However, it has now been withdrawn and advice on dental prescribing has been incorporated into the body of the BNF and BNFC, making this advice available to both medical and dental practitioners.

To facilitate easy access to information that is most relevant to primary care dental practice, the Scottish Dental Clinical Effectiveness Programme (SDCEP) recently published guidance entitled 'Drug Prescribing for Dentistry', which brings together advice on dental prescribing from the BNF and BNFC and presents it in a problem-orientated style.[6] This advice is based on information provided in the

most recent BNF and BNFC, and guidance published by the Resuscitation Council (UK). This guidance has led to considerable debate around the issue of prescribing antibiotic prophylaxis against IE for people undergoing dental procedures.

In the past someone with a prosthetic heart valve, septal defect or other specified condition would have been prescribed antibiotics to take one hour prior to certain dental procedures. However, the National Institute for Health and Clinical Excellence (NICE) has recently produced guidance recommending that antibiotic prophylaxis is not used in patients undergoing dental procedures: “Antibiotic prophylaxis against infective endocarditis is not recommended for people undergoing dental procedures.”[7] This updated advice is now reflected in the latest volume of the BNF and SCDEP guidance [3,6].

On one hand the dental profession is firmly behind the recommendation that antibiotic prophylaxis against IE is not recommended for people undergoing dental procedures. In contrast, some cardiologists disagree with the revised guidance, with the following quote summing up the attitudes of many: “Overall, the benefits of prophylaxis [for dental procedures] are likely to be considerable in high risk patients (prosthetic valves, previous IE, congenital cyanotic heart disease) and relatively small in low risk groups such as patients with mitral valve prolapse.” [8] This is despite NICE’s conclusion that “There is insufficient evidence to determine whether or not antibiotic prophylaxis in those at risk of developing infective endocarditis reduces the incidence of IE when given before a defined interventional procedure (both dental and non-dental)”.[7]

So who is right? It appears that the cardiologists are holding to the “no-lose” philosophy: even if prophylaxis isn’t routinely necessary, it’s worth doing it given the negative consequences if infection were to occur. It’s better for the patient to take antibiotics just as it is better to (try to) believe in God according to Pascal; even if the probability of endocarditis is small (and even if the probability of God existing is small) it’s better to take antibiotics (or believe) given the potential downside if it should occur in the absence of antibiotics (or if He exists but you didn’t believe). This cardiologist’s wager can be represented in a similar form to Pascal’s:

	No IE	IE develops
Provide prophylaxis	Benefit	No loss
Don’t provide prophylaxis	No loss	Harm

Table 2: the Cardiologist’s Wager. IE = infective endocarditis

Note that NICE's claim is not that prophylaxis does not work, but simply that there is insufficient evidence either way (as supporters of Pascal's Wager might also argue). Those who adhere to the no-lose philosophy argue that this means we should go for a "better safe than sorry" approach and provide the added protection of antibiotic cover. The problem with this approach is that we don't have enough evidence to support the claim that prophylaxis *is* safer rather than sorrier: the converse might well be true, just as it might be true that God doesn't exist.

To take one example of the cardiologist's wager in action, here is a quote from an editorial by T Cheng in the *International Journal of Cardiology*:

Until the dust settles, it seems to be prudent to continue endocarditis prophylaxis for patients with MVP...As the Yellow Emperor of China said, it is far better and easier to prevent than to treat a disease. The benefits of chemoprophylaxis far outweigh the disadvantages. The benefits are: (1) it is efficacious; (2) it is cost-effective; and (3) it is simple to do. The only possible disadvantage of chemoprophylaxis is risk of adverse reactions such as fatal anaphylaxis. [9]

Just as Pascal said it is prudent to believe in God, so Cheng believes it is prudent to prescribe prophylaxis, but one can easily rebut all his points. It is obviously better to prevent than to treat a disease, but we don't have any evidence that prophylaxis prevents IE, so this aphorism is worthless. We don't know that it prophylaxis is efficacious, and thus can't say whether it is cost-effective: all Cheng is left with is that it is simple to do. He is also quite wrong to state the "only possible disadvantage" is adverse reactions: another major risk is the development of antibiotic resistance (see below). Cheng is ignoring the wider population picture in favour of what (he thinks is) best for the individual, which is perhaps understandable for clinicians who are used to seeing single patients rather than thinking in global terms. Evidence is derived from populations, not individual patients, and there are no anecdotes about populations. Ethical public health policy requires a shift from the individual to the population approach. Furthermore, case reports are a much weaker class of evidence than systematic reviews;[10] just as some cardiologists may neglect the bigger picture by focussing on the individual patient, so their expert evidence neglects the population approach by focussing on anecdotal cases.

Furthermore, it is somewhat ironic that Cheng states that the benefits of prophylaxis "far outweigh" the risks given that he approvingly quotes in the same article that there is an "absence of data documenting that antibiotic prophylaxis prevents endocarditis as a result of procedure-induced bacteremia; however, it could not exclude that a small number of IE cases could be prevented by antibiotic prophylaxis." [9] These are extremely tenuous grounds for administering prophylaxis, and there is another parallel with Pascal here. The argument is that, although we have no evidence supporting prophylaxis, we can't rule out the possibility, so we should use it. Equally, we have no evidence for the existence of God, but that obviously doesn't rule out his existence, so we

should obviously believe in Him. If theologians were embarrassed by Pascal's logic, shouldn't doctors be embarrassed by this example of the no-lose philosophy?

From the patient's point of view, the choice is between taking some drugs and potentially decreasing the risk of endocarditis, and not taking them and running the risk. Given that the worst outcome for the patient is death (Pascal's equivalent would be going to Hell instead of Heaven – or at best, oblivion) it is understandable that the patient might want to take the antibiotics despite the evidence. But given NICE's verdict that there isn't enough evidence to say whether prophylaxis reduces incidence of IE, we could frame the Wager differently here: if we have no evidence for the efficacy of prophylaxis (God's existence), should we not simply avoid administering prophylaxis (believing in Him) given the possible downsides in terms of anaphylaxis, which causes the deaths of 20 people for every million treated with antibiotics. [11]

There is also an additional dimension at play here that complicates matters further: if prophylaxis is overused, it increases the risk of antibiotic resistance developing, with the potential future effect that prophylaxis becomes impossible even for those who really do need it. (The Pascal equivalent would be that so many people believed in God that he ceased to exist!) This might seem like an over-pessimistic concern, but this is not so:

The impact of the loss of antibiotics as effective agents in the treatment of human infection cannot be over-emphasised and this truly represents a potential medical disaster....There is now clear evidence linking the dental prescribing of these antimicrobial agents to the emergence of penicillin resistance in the community...at least one patient a month dies in the United Kingdom due to unsuccessful management of acute dental infection. [12]

NICE's guidelines are clear, but should dentists and doctors perhaps give patients the choice, stating clearly the relative risks of IE and antibiotics? Of course, a problem with this is that patients don't tend to care about resistance. But even if it would be inappropriate (on grounds of fighting resistance) to present each individual patient with the choice of whether to receive prophylaxis, asking what the typical patient would say when faced with the basic available evidence has two advantages: it cuts through the different prejudices of widely varied specialities, and it is more likely to produce a solution that respects patients' autonomy. If patients are told that the risk of (potentially survivable) IE is normally less than 10 in 100,000,[13] but they have a 2 in 100,000 risk of death if they receive antibiotic prophylaxis,[11] it seems likely that many will opt not to receive cover – even if they were not informed of the lack of evidence of efficacy and the potential development of resistance. Furthermore, there is some evidence that daily toothbrushing poses a greater risk of IE than dental surgery:

Routine daily oral activities (e.g. tooth brushing and chewing) cause transient streptococcal bacteraemia, the cumulative result of which is an annual bacteraemic exposure thousands to millions of times greater than that caused by a single tooth extraction. Moreover, a direct link between routine dental procedures and IE has never been proven. [14]

Those who support prophylaxis for dental treatment would do well to ask themselves whether they would also recommend prophylaxis before daily and nightly toothbrushing. If we put all of this data into a patient information sheet, the actual decision matrix for the patient would look something like this:

	Lucky	Unlucky
Receive prophylaxis	No harm	Anaphylaxis or IE (or both)
Don't receive prophylaxis	No harm	IE

Table 3: the Patient's Wager. IE=infective endocarditis ('lucky' and 'unlucky' represent the patient's assessment of probabilities)

Although it is extremely unlikely, the possibility exists that an extremely unlucky patient could be given prophylaxis, have an anaphylactic reaction, and then go on to develop endocarditis if they are lucky enough to survive the reaction. Given this table, it seems likely that most patients would opt not to receive prophylaxis (and even those who have received antibiotic cover in the past and are not at risk of anaphylaxis might opt out.) Of course, patients often have problems interpreting risk, but the principle of respect for autonomy requires that we give them the relevant information rather than simply ask them to trust our supposedly "safety-first" approach. To put things in the more patient-friendly incidence format, Agha and colleagues found that for every 10 million people with cardiac conditions treated with prophylaxis, 119 cases of endocarditis would be prevented; but 200 people would die of anaphylaxis.[11] Another problem with the no-lose philosophy is that it is inherently paternalistic. Imagine a patient's reaction if he was presented with Table 3 after having received prophylaxis on the assurance of his cardiologist that it was for the best; he could well argue that informed consent had not been obtained from him.

One last problem with prophylaxis is its extreme lack of cost-effectiveness. Caviness and colleagues calculated that the cost of preventing one case of endocarditis could cost as much as \$95 million, or \$13 million per quality-adjusted life year, given the number that would have to receive prophylaxis to achieve this one prevention.[15] In addition, of course, that is a great deal of antibiotics to prescribe in order to help one patient, and it runs the risk of many cases of anaphylaxis.

The Pascal parallel here would be forcing one million people to believe in God in order to get seven of them into heaven.[15]

Ultimately, the use of prophylaxis against IE seems to be unjustifiable given the available evidence and consideration of the possible risks and benefits to individual patients. In fact, given the unproven efficacy of prophylaxis and the added risk factor of anaphylaxis, it could well be the case that providing prophylaxis increases rather than decreases risk: if the NICE guideline is correct, then prescribing prophylaxis adds the risk of anaphylaxis while doing nothing to reduce the risk of IE. When we add the complication of increased antibiotic resistance, it becomes apparent that the “no-lose” philosophy is neither an ethical approach nor a real philosophy.

Conclusion

Pascal’s Wager and the “no-lose” philosophy in medicine have a lot in common. Both recommend ignoring the evidence and acting on faith: faith that God exists despite the lack of any evidence for this proposition and faith that a treatment will be better for the patient despite the lack of evidence for this assertion – and often despite evidence to the contrary. (Another parallel is that both religion and the no-lose philosophy rely to some extent on expert opinion.) In the case of IE, NICE’s guideline indicates that prophylaxis is unnecessary for most and probably all patients, and also that prescription of prophylaxis increases the risk of antibiotic resistance. Nonetheless, many doctors still believe that providing prophylaxis is the best option and do so, placing their patients and others at risk. The no-lose philosophy is still present in medicine, and we wager that it will take some time to lose it.

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