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Review

Parental decision-making in childhood vaccination

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Abstract

Recent concerns about childhood vaccines such as the measles, mumps and rubella (MMR) vaccine have led to reduced vaccine uptake and increased probability of disease outbreaks. Psychological aspects of parental decision-making about vaccines are reviewed. Inconsistencies and gaps in the literature are highlighted and implications of what is known for public health are outlined. A decision theory model of the decision to vaccinate fits the facts well and generates practical strategies for uptake of MMR and similar childhood vaccines.

Keywords: Vaccination; Decision theory; Heuristics; Measles mumps and rubella vaccine; MMR

Contents

1. Introduction

There is currently a drop in vaccination coverage against measles, mumps and rubella (MMR) in the UK which may lead to reduced herd immunity and large-scale outbreaks [1,2] of serious diseases. Measles outbreaks, for instance, are likely to result in some children's deaths and lifelong disability in others. Parental concern about vaccines appears to be the main cause of the drop. In a UK study, around 70% of parents had concerns about MMR [3] and many chose to avoid vaccinating or choose single agent vaccines [4]. In parts of London, less than half of 5-year-old have had a full MMR course [5], well below the level at which outbreaks of vaccine preventable disease (VPD) are likely to occur [6].

The current MMR controversy gained strength after suggestions of a possible link between MMR and inflammatory bowel disease and perhaps autism received wide media coverage [7]. Parental concerns continue despite subsequent studies showing no link between MMR and autism [8–10] or inflammatory bowel disease [11]. This is not the first time parents have become concerned about vaccines; for example, similar concerns surrounded pertussis in the UK during the 1970s and 1980s [12]. Nor are concerns about vaccine safety in respect of children limited to the UK. A recent US study suggested that 15% of adults believe vaccines are

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unnecessary to prevent disease and that 61% believe that childhood vaccines are at least somewhat unsafe [13]. Recent concerns about the safety of polio vaccine in Nigeria led to a regional outbreak and severely set back a polio elimination programme [14].

Parental concerns are not the only factors affecting vaccine uptake. As with other types of healthcare, the poor are less likely to vaccinate. The direct and indirect costs of accessing healthcare and poor access to healthcare are important factors [15]. In the case of MMR, however, it is well-off parents who have more concerns and lower uptake [16]. The role of healthcare professionals in relation to vaccine uptake has also received attention. It is claimed that in 78–97% of cases where children attend a clinic and do not receive appropriate vaccinations, this is due to failures by professionals [17,18] either through lack of information, ambivalence towards the vaccine or fear of litigation following any adverse event [19,20]. However, these figures are based on routine vaccinations and may not apply where a vaccine has attracted controversy.

Just as parental concern is not the only factor in vaccine uptake so there is not a perfect match between parental concern and vaccination uptake. Ramsay et al. [3] found that even though 70% of UK parents had concerns about MMR, the majority still intended to vaccinate. Nonetheless, if parental concerns are raised, they can lead to a major reduction in vaccination rates. It is, therefore important to understand how parents consider possible risks associated with vaccination and the process by which they decide whether to have their children vaccinated. In this paper we review what is known about the genesis and maintenance of such concerns over risk and how available evidence fits into what is known about people's thinking about risk and probability.

2. Taking risky decisions

People take decisions frequently about all sorts of things, often fairly automatically, without much conscious thought. For most decisions, whether it be what dish one will choose in a restaurant, or whether a house will prove affordable or, with a rise in interest rates, bankrupt the buyer, available information is incomplete and of variable quality. Such problems cannot be solved through conventional mathematics and the mathematics of risk is, in any case, beyond most people's abilities. The same applies to whether to vaccinate one's child. The average parent is unlikely to be clear what the risk of adverse events is, as conflicting information is available. Also, available information about risks is about *average* risk. What the parent wants to know is not what is the risk to children in general, but what is the risk to *their particular child*.

A consistent body of evidence shows that when people are faced with making decisions where they have no direct way of estimating probability, they utilise *heuristics*, ways of estimating risk indirectly [21]. One common way of estimating probability is to use *availability*—the number of examples recalled or the ease of recall of examples of the events for which they are trying to assess probability. Examples may come from personal experience, acquired via others or via the media. Probability estimates may then be adjusted up or down according to how closely the individual thinks a particular event (or person or object) fits the exemplar, usually called *anchor and adjust* [21] (p. 164). For instance a man might be aware that heart attacks are common because it is easy to think of examples but, quite reasonably, adjust his own risk of such an event downwards because he is a 20-year-old athlete. How he adjusts depends on his beliefs (which may be more or less well-founded) about who is susceptible to the disease.

These indirect ways of estimating probability are quick, efficient and often surprisingly accurate [22]. However, the use of heuristics can "sometimes yield reasonable judgments and sometimes lead to severe and systematic errors" [21] (p. 48).

In particular, availability depends on salience. The availability heuristic is often accurate because it is easier to recall examples of more frequent events. However, this breaks down if, for some reason, infrequent events become particularly salient, for instance where there is extensive media coverage. Rare events then become very memorable and their frequency may be overestimated. The abduction of children by strangers is very rare in the UK but cases receive extensive press coverage leading to high parental concern.

Media coverage of MMR has been both extensive and emotive, with parents who believe their child has been damaged by the vaccine appearing in the media. Journalists need to make articles and TV programmes more interesting through 'human interest' and to find novel and dramatic stories, particularly where there is controversy. Straight negatives – 'my child was not harmed by the vaccine' – usually make poor news. Presenting both sides of a story not only provides 'balance' but also tends to make for a better story, even if the evidence for both sides of the story are not of equal strength. Lewis and Speers [16] reviewed UK media coverage of MMR between January and September 2002. Parents whose views were covered were five times as likely to be against MMR (often because they had a 'vaccine damaged child') than in favour. Articles about the risk of not vaccinating appeared only rarely (e.g. [23]). The MMR issue was presented by the media as about vaccine risks, not the risks of VPDs.

Balance in the media is often provided from 'Government' sources, in the UK frequently associated with the Department of Health. It is well established that before accepting information, individuals consider how trustworthy the source may be [24,25]. If parents mistrust the government in general, they are less likely to trust information about vaccines provided through government sources. In the UK, inaccurate or misleading statements by government about the risks associated with BSE have probably not helped source credibility. Evidence suggests that such mistrust is not limited to the UK [26]. The motive for providing information also influences message uptake and governments may be seen as

having some self-interested investment in conspiring against the public, whereas the motivation of the parent of a child with autism is less obviously open to question.

Parents also access other sources of information, including websites. A Google search using the term 'MMR' generates over half-a-million hits. Inspection of a small number of these sites shows both strongly positive and strongly negative views, with often differing interpretations based on apparently the same information.

Studies from a wide range of countries suggest that people mistrust the media and the Internet. It might therefore be asked why simultaneously these seem to be common sources of vaccine and other health scares. There are several issues here. Firstly the media alerts people to a possible problem, and hence makes some parents consider the possibility of risk where they might not otherwise do so. Secondly, a message may be rejected outright if it is felt to be biased. If not rejected outright it will initially be remembered with its source and allowances made for source reliability [27]. After a few months, however, people may remember the message but not the source and therefore information about relative reliability is lost. Thirdly, while the media in general may be mistrusted, it carries the accounts of parents who are likely not to be subject to the same mistrust. Finally there is likely to be an element of volume of information, to which the media is a major contributor.

It seems likely that sheer volume of attention something receives may influence subjective estimates of risk. At the very least a high level of attention being paid to an issue is likely to alert people to a possible risk they had not considered. This is the belief that there is 'no smoke without fire'. People adjust their risk estimates to account for their belief in the trustworthiness of the source [28]. However, there is another possible influence of conflicting evidence. People can go beyond a simple point estimate and put some sort of informal confidence interval around their estimates of probability of an event [29]. One influence on the width of their 'confidence intervals' may be the perceived amount of conflict in the information available; the greater the conflict, the less certain one can be about the probability of a particular outcome. If people base their behaviour on 'worst case' scenarios, they may decide against vaccination even though their estimate of absolute risks is low, providing their uncertainty about the accuracy of their risk assessment is high.

3. The nature of the evidence

There are problems not simply with the way in which evidence about vaccines is presented by the media but also with the nature of the evidence itself. Higher vaccine coverage leads to fewer VPDs and more VAEs. Few people in the UK are likely to be able to recall seeing or hearing of cases of serious sequelae from many vaccine preventable diseases [30,31]. Diseases such as polio have been eradicated in the UK as a result of vaccination. If VAEs are proportional to the number of vaccinations given, rates of such events will increase as vaccine coverage rises, increasing people's estimates of VAE risk. This effect is likely to be exacerbated by better adverse event reporting and recording [32].

Evidence suggests that some parents consider both the perceived risk of VPDs and the perceived risk of VAEs when making a decision about whether to vaccinate [33]. However, there is no reason to suppose that they give them equal weight. Perceived seriousness is an important factor in health seeking behaviour [34]. VPDs are likely to play little part in the decision whether to vaccinate if they are considered non-serious; in contrast, if VAEs are considered extremely serious this is likely to lead to parents withholding vaccination even if they believe the risk of such events is low. There is evidence that non-vaccinators are aware that their children are at increased risk of VPDs, but that they consider these trivial [31]. Woo et al. [35] compared non-vaccinator parents with data from a general population survey of parents and showed that non-vaccinators believed VPDs to be less serious than the general population. Some parents consider the risks from vaccine to be more serious than those from the disease. Smailbegovic et al.'s study showed that 1/3 of non-vaccinator parents considered vaccines more harmful than the disease they prevent [36]. This view was also held by many non-vaccinators in Simpson et al. survey [33].

Another factor is controllability, the extent to which people believe that risks can be reduced by their own actions. Evidence from US and UK studies [36,37] suggest that parents see their child's response to a vaccine as something which they are unable to control. This contrasts with their understanding of VPDs, which they see as something they can control both exposure and response to [31,33,36]. They may believe their child does not require MMR because they can protect her from exposure to measles or make sure that if she does get it, she does not become severely ill. One parent in Simpson's paper said "We do not believe that healthy children living in healthy conditions need protecting by immunisation" [33] (p. 226).

Finally it is worth considering that, even if two alternative outcomes are considered equally serious, this does not mean that are accorded equal weight in a decision-making process. People tend to attend to one particular aspect of a problem and often fail to think widely around an issue or to recall or process all relevant information. One might predict that, because the issue being considered is whether to vaccinate a child, rather than whether a child will get measles, then vaccine safety will be more heavily weighted than disease risk.

4. Other biases

It is well known that when people consider the risks from diseases, they consider not only the incidence of the disease but their personal susceptibility [34], based on representations of the sort of person who might be more or less

susceptible to a particular disease. This fits in well with the use of an anchor and adjust approach to risk estimation. Children, especially younger children, are often perceived to be particularly susceptible to particular diseases. The view that children are weak, vulnerable and need protection is likely to underpin the commonly reported view that multiple vaccines such as MMR are '. . . too much for their immune system to cope with [31,36]. These beliefs are widespread and cross cultures, despite evidence that a new-born's immune system is well able to cope with the administration of several vaccines concurrently [38].

Parental perception of the susceptibility of an individual child is likely also to vary with the perceived characteristics of the child. Some parents see their child as particularly vulnerable, for example because they are often unwell or there is a family history of problems such as autism [30]. Other parents may believe that a healthy child should not need 'artificial' intervention [31]. The belief that natural is good and artificial bad when it comes to health is, of course, a common societal – perhaps human – value. Stein [39] reported a case in which parents refuse to have their 2-month-old child immunised. "Monica is so healthy . . ." the parents stated, "why give her shots that may make her sick" (p. S87).

5. Taking a decision

Having formed an impression of the risks associated with vaccination and/or non-vaccination a parent still has to make a decision about whether to vaccinate. This might seem to be a simple accounting matter, costs versus benefits. However, the costs and the benefits are not easily compared because they lack a common 'currency' (for instance, comparing a small possible risk of autism versus a larger but still small risk of death). People also show systematic biases in their preferences for costs and benefits which might be expected to affect what decision they take. For instance people value losses over equivalent gains [40].

However, it appears that the way people decide on issues around vaccination may lead to a bias against vaccination. When Ritov and Baron [41] presented respondents with the hypothetical decision of whether to use a vaccine with a markedly higher death rate from VPD than from VAE (12/1000 versus 6/1000), most chose not to vaccinate. This is understandable in terms of a tendency to favour acts of omission over acts of commission where risks are involved [42,43]. In the case of vaccines there are two likely reasons why parents might favour omission. Firstly, a decision not to vaccinate is reversible, whereas a decision to vaccinate is not [3]. Where uncertainty is perceived, parents may prefer to wait for more information to become available and therefore postpone vaccination. In fact there is evidence that parents not only postpone vaccination, but that they adopt other strategies which suggest strong conflicts over how they should act. For instance, parents may give the first dose of MMR but not the second and indeed they often state that it is their intention to follow that pattern with future children [43]. Presumably this is seen as a compromise between vaccinating and not vaccinating and a way to reduce the risks presented by both. Secondly, people see events caused by their actions as their responsibility—and hence foresee feeling guilty if they go wrong. They do not always see events following from inaction in the same light [42,44]. Anticipated regret has been shown to account for much of the variance in decision making in other risky situations [45]. If parents see potential VAEs as their fault but VPDs as acts of God they will be biased towards non-vaccination.

Vaccination decisions in the real world differ from experimental studies of decision making and risk. In the latter, the exact risks of different decisions are known, e.g. [46,47] whilst in real life, parents are unable to quantify the exact risks involved. Studies suggest that in situations of ambiguity, people tend to show *ambiguity aversion*, in that they stick to the status quo [48,49]. Such studies suggest that parents may withhold vaccinations where they perceive information about safety to be inconsistent or ambiguous.

Finally it is worth considering whether 'free-riding' might be a factor in non-vaccination. If parents feel that others vaccinating reduces the risk of their child being infected, then they may feel that they need not vaccinate their own child as long as local vaccine coverage is good. This is discussed in relation to adult vaccination by Berger and Hershey [50]. However, data is conflicting regarding whether parents use this strategy. Meszaros and colleagues showed that significantly more non-vaccinators than vaccinators indicated that they would be less likely to vaccinate if they knew that most other children were vaccinated (28% versus 18%). However, parents surveyed by Evans et al. did not rely on other parents immunising their children to protect their own children [31].

6. Implications

In this paper we have explored what is known about childhood vaccination in the light of decision theory. If our analysis is correct, it has important implications for the problem of encouraging parents to vaccinate their children, assuming that there is strong scientific evidence that such a strategy is likely to prove optimal in protecting the children's health [12]. It is repeatedly suggested in the literature that simply providing better information to parents will cause them to vaccinate their children. This seems to be informed by the belief that if people are provided with 'all the facts, about complex health issues, they will take the optimal decision by default. There is no evidence for this and no reason whatsoever to assume that it is true, at least when applied to well-publicised vaccines such as MMR (and its successors). Certainly parents often ask for more or better information, presumably in the hope that some crucial missing piece of information will convince them and so make the decision easy, but it is not clear that any such evidence exists. Parents are repeatedly exposed to the orthodox scientific view and a proportion of them not only

do not believe it but do not trust the sources providing it. The idea that more of the same might be expected to produce better results is a triumph of hope over experience.

No government seeks to put all sides of the argument to the public about smoking and let them make up their own minds. Information about diet is not always totally clear but this does not stop governments trying to influence people's eating habits. If health agencies and governments truly believe that the scientific evidence supports the use of particular vaccines in children to reduce deaths and disability, then they need to set out to convince the public, and indeed some health professionals, of that. That does not imply that they should not tell the public of all the risks they are aware of, but they should at least have the courage of their convictions and seek the optimal strategy to persuade.

Decision theory and existing literature suggests several key elements to a pro-vaccination campaign. Firstly, most parents and many health professionals do not appreciate the risks associated with measles and other childhood diseases. It is important to concentrate on these since they are critical to a decision by parents and the evidence suggests they are not properly considered. Linked to that is stressing that not vaccinating, and not vaccinating at the optimal moment are active decisions and that a parent choosing to withhold a vaccination puts their child at risk of VPDs just as surely as someone who vaccinates puts their child at risk of VAEs. Parents cannot realistically act to avoid their children being at risk of contracting measles in an epidemic short of locking them in their bedroom and estimating susceptibility is difficult. Perfectly healthy children die of measles or get brain damage from mumps. Unsavoury though it may seem, media coverage of children damaged by measles is worth a thousand press statements. Children's lives are, after all, at risk.

It is important to provide clear information on any risks that there are in connection with vaccines. There are small risks of serious VAEs from MMR, such as severe allergic reactions and these need to be admitted and even given prominence. Bland statements that vaccines are 'safe' are unlikely to carry weight. Nothing is risk-free and it helps to say so. People are, reasonably enough, more likely to believe the reassuring part of a message if they feel they are being given all the negative information. At the same time the formula that there is 'no evidence' for something needs to be dropped. While this may be appropriate in a scientific paper, it is harmful nonsense when translated to public health. If the truth, beyond what the courts call 'all reasonable doubt' is that MMR does not cause autism then that needs to be clearly stated.

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