Building Confidence in Vaccines

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Abstract

Despite significant efforts by governments, organizations and individuals to maintain public trust in vaccines, concerns persist and threaten to undermine the effectiveness of immunization programs. Vaccine advocates have traditionally focused on education based on evidence to address vaccine concerns and hesitancy. However, being informed of the facts about immunization does not always translate into support for immunization. While many are persuaded by scientific evidence, others are more influenced by cognitive shortcuts, beliefs, societal pressure and the media, with the latter group more likely to hesitate over immunization.

Understanding evidence from the behaviour sciences opens new doors to better support individual decision-making about immunization. Drawing on heuristics, this overview explores how individuals find, process and utilize vaccine information and the role health care professionals and society can play in vaccine decision-making.

Traditional, evidence-based approaches aimed at staunching the erosion of public confidence in vaccines are proving inadequate and expensive. Enhancing public confidence in vaccines will be complex, necessitating a much wider range of strategies than currently used. Success will require a shift in how the public, health care professionals and media are informed and educated about vaccine benefits, risks and safety; considerable introspection and change in current academic and vaccine decision-making practices; development of proactive strategies to broadly address current and potential future concerns, as well as targeted interventions such as programs to address pain with immunization. This overview outlines ten such opportunities for change to improve vaccine confidence.

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Table 6.1 Influenza vaccination coverage among sample of 1931 health-care personnel in US in 2010–2011 by selected characteristics. (Adapted from [6])

Work setting	Vaccinated (%)	Occupation	Vaccinated (%)	Age	Vaccinated (%)
Hospital	71	Physician or dentist	84	18–29	56
Long-term care	64	Nurse	70	30–44	58
Home health	54	Allied health professional	64	45–59	69
Other	47	Assistant/aide	56	≥60	74

6.1 Introduction

Immunization is heralded as one of the most important public health achievements of the last century and without question, vaccines have saved millions of lives and increased life expectancy. However, despite robust scientific evidence showing vaccines to be effective and safe, public doubts persist as they have since the first vaccine efforts by Jenner over two centuries ago. Other factors beyond the availability of evidence are clearly at play [1], undermining immunization programs and the potential for control of vaccine-preventable diseases. This chapter expands on a previous article that outlined several factors undermining confidence in vaccines and that suggested several strategies for how vaccination advocates might increase support and uptake of vaccines [2].

Key topics explored include perception of vaccine risk, the influence of heuristics and beliefs, the impact of the disease control cycle on vaccine uptake, and a discussion of several other factors that influence vaccine confidence. Current strategies to address vaccine concerns are examined followed by an exploration of several different and new opportunities for staunching the erosion of public confidence in vaccines.

6.2 The Vaccine Confidence Deficit

Many factors are involved in the decision to immunize. If the public was fully supportive of vaccines, immunization rates would be well over 95 %. Such is not the case. Lack of confidence or doubt in the safety and effectiveness of vaccines often results in the decision not to immunize. Unfortunately, there are no half measures with immunization, a person is either immunized or not. Not immunizing, even if this occurs in only a small segment of the population, can undermine the control of vaccine preventable diseases. Public trust in vaccines and immunization programs has to be built; it does not occur by chance and it is not a simple task.

Vaccine confidence is not just a problem for the general public. Even some health care providers remain unconvinced that vaccines are safe, effective, and necessary for health. Although trained to rely on scientific evidence for their decision-making, some also succumb to other influences and question the value of immunization [3, 4]. The persistent annual problem of only moderate uptake of yearly influenza vaccine among health care providers well illustrates this conundrum [5, 6]. Even the threat of an influenza pandemic in 2009 did not drive voluntary compliance rates for the H1N1 vaccine high enough among American health care providers to provide adequate workplace protection [5]. Only health care workplaces that mandated influenza vaccine tended to reach the recommended 90 % target for coverage among their healthcare providers [5]. As shown in Table 6.1, modified from the United States' Centers for Disease Control and Prevention report on influenza vaccination coverage among healthcare personnel for the 2010 influenza season [6], the overall influenza vaccine uptake among the 1931 health care providers sampled was 63.5 % but the rates varied widely by workplace setting, health care worker type, and age.

Vaccine uptake by the public remains suboptimal in many industrialized countries in spite of a wealth of educational materials and a plethora of campaigns and government-funded immunization programs that removed financial barriers to vaccines. With all of this support, one would have

anticipated high uptake of vaccines supplied by governments. Not so. For example, despite easy access to professionally developed evidence-based educational materials on the risks of cervical cancer and the benefits and safety of the human papilloma virus (HPV) vaccine, a publicly-funded school-based HPV vaccine program for girls in British Columbia, Canada, reported only a 65 % uptake in 2008–2009 [7].

Unfortunately, to be truly effective in reducing the burden of circulating vaccine-preventable infections, high immunization rates are required across entire populations. For example, in the case of measles, >95 % of the population must be immune [8]. Outbreaks can occur if the virus is introduced by a visitor into populations <95 % immune, as has recently occurred in parts of Canada [9]. Garnering a behavior compliance rate of this magnitude across entire populations for different vaccine-preventable infections is a daunting task. Few, if any, public health measures require such a high rate of compliance for success. Nurturing confidence in vaccines is thus critical to achieve this goal [10]. Outbreaks in areas where vaccines are easily available but uptake is suboptimal have repeatedly shown just how crucial these high immunization rates are and not just for measles. The pertussis outbreaks in California in 2010–2011, again, illustrate the problem created by emerging pockets of low vaccine uptake [11].

Evidence and fact-based strategies in support of immunization have been used for decades with some success as most parents choose to have their children immunized and many health care providers receive the annual influenza vaccine. But some remain unconvinced and hesitate to immunize despite the evidence, professional recommendations, and easy access to vaccines. To achieve the high vaccine uptake rates required to control diseases such as measles, the unconvinced and vaccine-hesitant minority must also become convinced. The current vaccine promotion strategies are not sufficient to achieve the required vaccine uptake rates.

Among commonly cited reasons for hesitation to immunize are concerns about vaccine safety and the perception that immunization risks outweigh the danger of vaccine-targeted diseases [12, 13]. A better understanding of how vaccine-related risks are perceived is crucial for the development of future programs for success. The expansion of vaccinology from health sciences thinking to include that of the behaviour sciences enhances our understanding of why and how vaccine concerns arise despite the obvious benefits of immunization.

6.2.1 Vaccine Perception of Risk: the Role of Heuristics

Many people take pride in making major decisions believing these are based upon conscious and methodical deliberations of available information and evidence. Behaviour scientists, however, have long known that humans are hardwired to deal with threatening situations with reflexive reactions called heuristics (i.e., the use of simple cognitive shortcuts to rapidly solve complex problems) [14, 15]. These automatic mental associations, already biased by previously accessed information and experience, subconsciously influence choices including decisions about health [16]. Whether a parent decides to immunize his or her child or a health care provider opts for annual influenza immunization, automatic associations unconsciously influence the decision-making process. While at a conscious level we may think we are deliberating options and feel undecided, on an unconscious level the decision has already been made. Table 6.2 provides some examples of heuristics and the role heuristics play in vaccine decision-making [2, 14, 16].

One way to think of heuristics is to liken the amalgamation of these reflexive mental associations to a selective brain filter (Fig. 6.1). Beliefs and emotions are on the inside and facts on the outside. While evidence that bolsters preconceived convictions easily passes through the filter, facts contrary to previously held beliefs are met with resistance. Building on the analogy, evidence that can be reshaped in accordance with already held beliefs eventually enters. However, facts that remain contrary to convictions are rejected and may, in fact, serve to strengthen

Table 6.2 Heuristics and Vaccines. (Adapted from [2, 14, 16])

Heuristic	Simplified definition	Resulting behaviour or belief
Anchoring	Start from a known value or belief i.e. anchor	Healthcare worker sees a serious adverse event following immunization (AEFI) e.g. anaphylaxis following HPV vaccine and now believes AEFI following HPV vaccine to be more common than it is
	Judge probability of a future event by what occurred in past	
Availability	Easily imagined or recalled and therefore judged as frequent or likely to occur	Serious vaccine preventable diseases not seen or recalled, but multiple sclerosis following HBV vaccine misinformation recently heard or seen in the media is believed as correct and common—hence fear of HBV vaccine (France)
Co-incidence dragon	After this therefore because of this	All adverse events that follow immunization must be due to the vaccine. The possibility of coincidence is ignored e.g. autism following MMR vaccine
Compression	Over estimate rare occurrence, underestimate frequent. Misunderstanding of sample size	Incidence of Guillain-Barré syndrome following influenza immunization perceived by health care provider as more common and serious than influenza complications
Free Loading	Herd immunity will provide protection, no need to immunize myself or my child	Parent believe it is safe to not immunize their child because (1) all other children are immunized (2) the disease is gone. No need for their child to take on "risk" of vaccine
Compression	Over estimate rare occurrence, underestimate frequent. Misunderstanding of sample size	Incidence of Guillain-Barré syndrome following influenza immunization perceived by health care provider as more common and serious than influenza complications
Omission Bias	Taking action is seen as more harmful than inaction, therefore do nothing	Not immunizing is seen as safer than immunizing. More health care providers took seasonal vaccine than the H1N1 vaccine in 2009–2010 i.e. not to take "new" H1N1 vaccine safer than taking it
Over confidence	Faith in own judgments. Believe they know their own health risks. Think nothing bad could happen to them	Have never had serious influenza and therefore don't need to be immunized. "I am healthy, wash my hands, no need for vaccine"

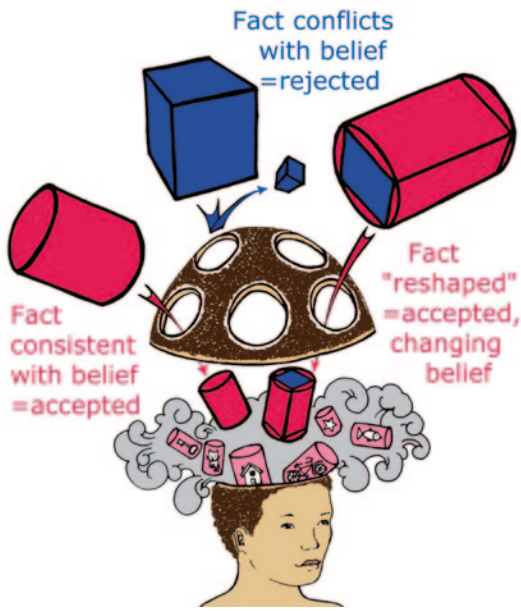

Fig. 6.1 An illustration of heuristics at work filtering fact information. Original art work Kyla Francis with permission

preconceived contrary beliefs, thereby increasing the selectivity of the heuristic-driven filter. While the opinions derived from this process may feel rational, it is really beliefs that are driving the process and consequently biasing conclusions.

Take for example the impact of the *free loading* heuristic on decisions about vaccines (Table 6.2). *Free loading* refers to the belief that other people will assume the risk, so one does not have to put oneself at risk. A parent may choose not to have his/her child immunized because of the belief that sufficient numbers of other children in the community are immunized, thereby providing indirect protection for his/her child through herd immunity. Unfortunately, as has been shown in the pertussis outbreak in California [11], like-minded parents who do not immunize their children often cluster together so the immunization rate in their local under-immunized community is not sufficient for protection through herd

immunity. *Free loading* does not offer adequate protection here. Non-immunized children can develop the vaccine-preventable disease when the disease is introduced into the community and even some of those who are immunized will succumb if they did not respond well to the vaccine [9]. They too were not able to benefit from herd immunity because the overall rate of immunization was not high enough in the locale.

Omission bias, another heuristic, notes that actions are more harmful than inactions. In this case, the risks of getting immunized—an active process—is perceived as carrying more risk than the vaccine-preventable disease—something obtained passively. This perception is incorrect. The H1N1 influenza vaccine saga illustrates this. In 2009, in the face of the H1N1 influenza pandemic, more health care providers were willing to get seasonal influenza vaccine than H1N1 vaccine [5] because the latter was new, untested and hence perceived to present a higher risk. Being immunized for H1N1 was viewed as more harmful than the consequences of not being immunized.

The *over confidence* heuristic refers to placing great faith in one's own judgments. For example, believing that being healthy, eating well, exercising often and carrying out good hand washing will protect oneself from vaccine-preventable diseases like influenza, thereby negating the need for annual immunization. Like the other heuristics in Table 6.2, this and the other automatic thought processes contribute to vaccine hesitancy and suboptimal immunization rates, leaving both the individual and populations at large susceptible to vaccine-preventable diseases.

Politics provides a strong exemplar of the great power of heuristics [17]. In an experiment, an ideology group was given mock news articles that contained either a misleading claim from a politician alone, or a misleading claim followed by a correction. The experiment revealed that subsequent corrections usually did not change the original misperceptions. The subjects remained convinced that the misinformation was correct because the misinformation that supported their beliefs went through their brain filter but the corrections did not. There are many instances where working to correct misinformation have instead further reinforced erroneous beliefs. For example, some people continue to believe that US President Obama was not born in the US, in spite of a verified certificate showing his Hawaiian birthplace. They prefer to believe the misinformation and see the certificate as a cover up and government conspiracy (i.e., their belief has been reinforced by their misinterpretation of the evidence). Heuristics are powerful. The brain filter rejects facts that do not fit the belief. Beliefs begin early, are shaped through maturation, and are sustained through life. In order to avoid selective impermeability to positive vaccine practices, pro-immunization beliefs must be actively shaped and the process started early to maximize better outcomes.

6.2.1.1 The Internet, Heuristics and Perception of Vaccine Risks

Internet search technology also reinforces heuristics. Previous Internet inquiries shape future searches, since Internet search engines are preset to recognize patterns. Google™, currently the most utilized Internet search engine, personalizes search results based on previous browsing habits [18]. Combine this with the uneven quality of the health advice that parents can find through Google™ [19] and the problem for vaccines becomes clear. For example, one search for vaccine information that leads to an anti-vaccine site triggers the search engine to return to these websites in the next search for vaccine information. This confirms automatic associations in the user's mind between immunization and immunization concerns as highlighted on these anti-vaccine websites. Given that 70–80 % of households in industrialized countries have access to electronically organized and personalized information on the Internet, the Internet has become a major factor influencing human behaviour and decision-making.

The powerful impact of viewing of anti-vaccine websites and heuristics is shown in a German study where even 5–10 min spent viewing an anti-vaccine website had a significant negative impact on vaccine perceptions and decisions to immunize [20]. Another key observation from

this study was that alarming anecdotal cases and testimonials viewed on anti-vaccine websites affected decisions. They easily passed through the brain filter to reinforce negative vaccine beliefs, while fact-based information on the pro-vaccine sites had minimal impact and was repelled by the brain filter.

The arguments against immunization posted on anti-vaccine web sites are also influenced by heuristics, exemplifying serious lapses in reasoning and logic [21]. For example, the natural human desire to find order and predictability in random events can result in the false assumption that events related only by time (temporally) must also be related causally. An example of this *co-incident dragon* heuristic (Table 6.2) is the assumed association between vaccines and autism. Given that autistic features emerge around the time of the immunization at 18 months to two years, causality between these two events has been erroneously assumed. Unfortunately, correcting for false assumptions is not easy. Despite the retraction of the controversial paper by Wakefield that purported a link between the measles, mumps and rubella (MMR) vaccine and autism, that was shown to be both fraudulent and in parts unethical [22, 23], and that Wakefield's medical license to practice medicine in the United Kingdom has been revoked, there are parents who remain convinced of the link between autism and the MMR vaccine [24]. They believe the attempts to discredit Wakefield are a conspiracy (see anti-vaccine website: http://www.naturalnews.com/028101_The_Lancet_Dr_Wake-field.html).

Reshaping of ambiguous and/or poor quality data to fit preconceived hypotheses is another source of erroneous reasoning on anti-vaccine websites [21]. The hypothesis that vaccine-preventable diseases are no longer a threat because of better hygiene and nutrition rather than immunization illustrates this point [21] as does the false assumption that all spontaneous reports of adverse events following immunization must be secondary to vaccines [21]. While many adverse events following immunization are reported to programs such as Vaccine Adverse Event Reporting System (VAERS) in the United States [25], many such events are subsequently proven to be unrelated to immunization [26]. However, the association has already been made in minds of many (i.e. the *co-incidence dragon* heuristic). Furthermore, the lack of formal feedback to the health care provider or parent who reported the adverse event, following formal causality assessment to determine if there is a relationship, does nothing to correct any misperceptions. Nor are these individual causality assessment outcomes readily accessible or made easily understandable for the public who have concerns about a specific event. There are no national or international programs that systematically provide a rapid summary of the formal causality assessments to help rectify public misperceptions about specific serious adverse events following immunization. Also, the causality assessment reports provided to vaccine program authorities are often written in very technical language. Even if the public had access to these documents they might not be easily understood.

The public does, however, have Internet access to academic publications and reports by august bodies on vaccine adverse events. Unfortunately, these documents also may not be well understood and conclusions may be lifted out of context and misinterpreted, further feeding negative vaccine beliefs. Public reaction to the August 2011 Institute of Medicine report "Adverse Effects of Vaccines" [26] illustrates this point. This report was written with an academic lens and thus assumes an understanding of medical and scientific terms plus a background in vaccinology. This report provides a rigorous review of the evidence for and against causality from a long list of serious vaccine adverse events following immunization that will be useful for health care providers and vaccine researchers. The lay public, however, may easily misinterpret the findings, as has been seen on Internet blogs following the release of the report. Some have taken parts of the well publicized report to support pre-existing anti-vaccine beliefs, overlooking reference to the very rare serious adverse events and the severity of vaccine-preventable diseases.

Thus even robust immunization data may be intentionally and sometimes even unintentionally misconstrued by anti-vaccine advocates, further undermining trust in vaccines. Some anti-vaccine websites fuel conspiracy theories (see above), suggesting that governments, pharmaceutical companies and even health care experts purposefully suppress evidence that immunizations are dangerous [21]. Heuristics mean that once these beliefs are set, shifting them with facts alone becomes very difficult and almost impossible. Anti-vaccine tales of horror (*availability* heuristic, see Table 6.2) are recalled instead of the evidence that vaccines are safe, effective and important for health.

6.2.2 Other Factors Contributing to the Vaccine Confidence Deficit

Other factors known to influence immunization acceptance include vaccination experience, the disease cycle stage, population-related factors, and the role of experts.

Given heuristics, it not surprising that older vaccines tend to be more trusted than newer ones; that is, the acceptability and safety of older vaccines has already been established, reinforced and is easily recalled (*anchoring* and *availability* heuristics—Table 6.2). In the case of new immunizations, trust must be earned and may not necessarily be transferred from previous vaccines. The earlier example of parents being hesitant about the human papilloma virus vaccine in British Columbia [7], noted above, with only a 65 % uptake rate, contrasts sharply with the high uptake rates for the older well established immunizations for children such as vaccines for measles, mumps, rubella and hepatitis B in the same population. While the *omission bias* heuristic may markedly sway their choices, other factors such as how others in the community are responding may also influence decisions. If parents know that many are refusing then more will.

Vaccine acceptance is also influenced by the disease cycle. A vaccine that prevents a prevalent disease with serious consequences that cannot otherwise be mitigated is highly valued [25]. However, when the disease disappears due to high immunization rates, the vaccine may no longer be seen as important and concerns about vaccine safety may overtake fear of the disease. The automatic assumption to immunize, in order to decrease the threat of disease, is eroded by increasing uncertainty about the value and safety of immunization. Less disease risk leads to more concern about vaccine safety (*anchoring* heuristic, see Table 6.2).

Automatic associations that influence vaccine benefit-to-risk assessments also vary among and within populations, by country and culture, and according to the background experience, environment and knowledge of the decision-maker (e.g., the variation within health-care providers for influenza vaccine as shown in Table 6.1). Context is key.

The role of experts is another factor that can influence immunization decisions. Trust in health care workers is critical to translating advice into action [10], confirming the importance of providers' knowledge of and commitment to immunization. Nurses in particular, because they administer the majority of immunizations, play a significant role as vaccine advisors. The understanding and beliefs held by nurses about the necessity, safety and effectiveness of vaccines not only affects their own immunization behaviour, but also the vaccine practices of others [3, 27]. When health care providers doubt the merit of immunization so do the patients they advise, leading to a negative impact on immunization programs.

In summary, vaccine confidence is indeed complicated and complex with many factors playing into the assessment by the public and health care providers of vaccine benefit, vaccine risks and disease risks. Thus it is not surprising that a 'one size fits all' evidence centered approach to vaccine education and promotion is insufficient to foster and maintain trust. Rather, an immunization program that is more comprehensive, adaptable and responsive is much needed.

6.3 Current Evidence-based Strategies to Deal with Vaccine Concerns

The public health community is well aware that more effort is needed to better address current vaccine safety concerns overall and to meet the needs of different subgroups [11]. While many information materials have been developed for parents these have often been very detailed and complex, many reading more like vaccine package inserts. Hence, a variety of more targeted vaccine information and training materials have been developed by governments and professional groups to better meet the needs of the general public for clear information on risks and benefits. One good example is the quick reference immunization communication tool designed by the Centre for Disease Control in British Columbia, Canada. Written in plain language, this guide provides immunizers with evidence to easily answer common parental vaccine questions and to help explain complex topics [28].

While using evidence and clear language to better answer vaccine-related queries is an important step forward, it does not address the complex behavioral factors noted above. Evidence may or may not get through the heuristic brain filter (Fig. 6.1). Easily understandable well packaged evidence is more likely to pass through and influence decisions but many other factors may prevent even this from happening, as noted above.

New vaccine concerns and questions have arisen for decades and will continue to arise, which means that ever more research will be needed to find evidence that proves or disproves each new allegation. This leaves many vaccine advocates frustrated and puts immunization experts continually on the defensive as they try to respond to these ever shifting concerns while still trying to retain public confidence. Public concerns deserve to be addressed. However, to tackle these unsubstantiated worries one by one through rigorous scientific research requires a substantial commitment of time, money and resources that might be better utilized addressing other serious health-related issues. Even if evidence-based answers could be provided for all such questions in a very timely fashion (which is almost impossible as it often takes several years to study the question and find the evidence that refutes or proves a new allegation), public mistrust in vaccines would likely persist. Evidence does not necessarily translate into trust. As noted above, negative vaccine anecdotes are much more likely to be recalled than evidence. Hence, a proactive rather than reactive strategy and one that embraces the behavioral understanding of vaccine confidence is required to nurture and foster public support of immunization programs.

Table 6.3 Ten novel approaches to consider for enhancing vaccine confidence

1.	Exploiting heuristics to benefit vaccines in communication and social media
2.	Development of broad awareness of rigorous vaccine safety system
3.	Ensure clarity of language in all vaccine communications: public and academic
4.	Vaccine science: appropriateness, clarity and quality
5.	More open transparent decision making for vaccine approval, programs and policy
6.	Employ Strategies to Reduce Vaccine-Related Pain
7.	Enhance vaccinology education for health care providers, especially physicians and nurses
8.	Proactively educate children on vaccine necessity, benefits and safety
9.	Media vaccinology education
10.	Facilitate changes in vaccine decision making behaviour with a multi pronged approach

6.4 Novel Approaches to Enhance Vaccine Confidence

Given that current strategies have not garnered the confidence in vaccines that is needed and based upon a better understanding of factors that influence vaccine decisions, a number of novel approaches are proposed for consideration in Table 6.3. None of these are mutually exclusive or ‘golden arrows’ that will nail the target. Some

may garner early wins such as pain control, while others like child education will take much time before they bear fruit. All are likely to interact synergistically.

6.4.1 Exploiting Heuristics for Communications and Social Media

Given that everyone uses heuristics to make decisions, albeit not at a conscious level, vaccine advocates need to understand and exploit heuristics to garner public support for immunization. Two potential heuristics to exploit are *anchoring* and *availability* (Table 6.2). *Anchoring* involves judging the probability of a future event based on what has already occurred, while *availability* involves judging an event as frequent or likely to occur when the event can easily be imagined or recalled. Informing the public of outbreaks of vaccine-preventable diseases in graphic detail can evoke "anchoring" and "availability" heuristics. The clustering of polio cases in Tajikistan in 2010 serves as a useful example. The large outbreak proved that polio can re-emerge, even in regions previously certified as polio-free, if vaccination rates fall below 90 % and asymptomatic cases are imported [29]. In the absence of a disease cure, polio paralysis can be devastating, resulting in death and disability. The image of a child on crutches is heart wrenching to see and readily recalled (*availability*). Hence, describing these unfortunate cases and showing the extent of the outbreak, explaining how the outbreak occurred in a designated polio-free region due to declining immunization rates and emphasizing the potential for similar outbreaks in other certified polio-free regions if immunization rates fall, can make polio real for parents (i.e., easy to recall as it was for parents in the 1950's and 60's because they probably knew someone who had polio). This helps cultivate the belief that vaccines are necessary and important for health. Similarly, the painful complications from the mumps outbreaks in young adults in Canada and the United States, where mumps had previously been controlled [30], provide another excellent example. A description of the mumps orchitis pain as like having two basketballs on fire provides vivid unforgettable imagery (www.gov.ns.ca/hpp/images/testicular.jpg).

Raising public awareness, especially among parents, of these outbreaks of vaccine preventable diseases and reminding them of the consequences, reinforces *anchoring* and *availability* heuristics. This further nurtures the belief that vaccines are important for health. Parents are then more likely to recall these examples of vaccine-preventable morbidity and mortality when their child is due to be immunized. To craft these messages well takes skills not often present among public health professionals but more commonly found in advertising and marketing experts. Vaccinologists need to develop collaborations with a much broader range of experts than those in health care.

Vaccine advocates themselves should also be educated about historical rates of vaccine-preventable diseases, both locally and globally, and how these rates have waxed and waned with the success and failure of immunization programs [31–33]. Figure 6.2 demonstrates the impact of vaccine on *Haemophilus influenzae b* disease in Canada [31, 32]. Regularly sharing this type of information with the public supports the importance of immunization—again reinforcing *anchoring* and *availability* heuristics for a positive belief in vaccines. It is also worth highlighting where disease resurgences have occurred because vaccination rates dropped as this helps to further refute misinformation that these diseases disappeared due to factors other than immunization [33]. Outbreaks contradict this—vaccines are needed and are powerful. Not being immunized can be tragic. That is the belief that needs to get *anchored*.

In addition, vaccine advocates need to be well aware of the background rates of serious illnesses with unknown and little understood etiologies, such as Guillain Barré Syndrome and multiple sclerosis [34]. As new vaccines are introduced, causality may be inappropriately attributed. Information on background rates can help immunizers and their patients address the flawed reasoning of the *co-incidence dragon* heuristic (i.e., "after it therefore because of it"), as well as the *com-*

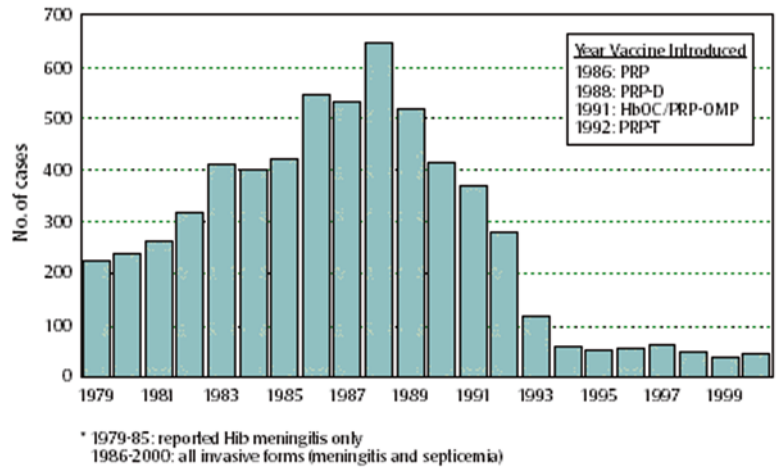

Fig. 6.2 *Haemophilus influenzae* type b (Hib) Disease reported cases 1979–2003 in Canada. (Adapted from [33])

pression heuristic (i.e., believing that rare little-understood events are more common than serious disease-related adverse events) (Table 6.2). Many adverse events following immunization, when examined in a formal causality process, are not due to the vaccine but are just co-incidence [35]. As noted above, without transparency about the causality assessment process and a solid feedback loop to those who reported the adverse event following immunization on the findings of the causality assessment, mistrust in vaccine safety will persist among health care workers and the public alike as the *co-incidence dragon* reinforces the belief and is left unchallenged. Communication about the outcomes of causality assessments needs to be well done and well targeted to reach those most involved. The *co-incidence dragon* can be slain if there is only a temporal but not a causal association.

Anti-vaccine advocates well recognize the power of social media, very effectively utilizing the Internet-enabled technologies to garner support for their beliefs. While pro-vaccine websites tend to stick to facts, anti-vaccine Internet sites adopt alternative techniques, including the use of frightening anecdotal stories that easily slide through the brain filter to enhance anti-vaccine beliefs. As described above, based on heuristics, people are more likely to be persuaded by stories and associations rather than stark facts when facing complex decisions. Governments and public health organizations must take this into consideration when designing pro-vaccine websites. They need to better utilize strategies that appeal to heuristics, such as storytelling and anecdotes, in addition to providing evidence. Stories about the terrible outcomes resulting from failure to immunize (e.g., death in children not immunized with *Haemophilus influenzae b* vaccines) [33] helps reinforce and *anchor* the importance of immunization. Fortunately, despite anti-vaccine advocates' efforts to generate an impression of widespread social support for the anti-vaccine stance, most parents continue to support childhood immunization. Vaccination advocates must ensure that parents know this so they will become less susceptible to the anti-vaccine pitch that immunization refusal is the norm in their community or region.

While vaccine advocates have long used printed materials and more recently websites, forays into new social media are now increasing, especially among young parents. Social media has become a normative communication tool for millions. Quality research is needed to ascertain how best to exploit new media; that is, what works well for enhancing confidence in vaccines and what does not. Facebook™, Twitter™, MySpace™, Friendster™, Linkedin™ and YouTube™ can be utilized for communication about vaccines but this takes appropriate skills to do well. Clever use of humour, well crafted messages and respect for the audience requires finesse, but the pay off in audience reach can be astounding.

Dedicated resources are needed to better develop the communication tools used by many parents today as well as future tools that will be utilized by upcoming generations. Pamphlets and television advertisements are not enough.

6.5 Develop Broad Awareness of Vaccine Safety System

Recognizing the importance of heuristics in decision-making, parents and health care providers must be continually reminded of the rigorous safety evaluation of all vaccines [36]. Doing so can help bolster trust in immunizations as well as help filter out vaccine safety misinformation. Unfortunately, most industrialized countries have invested little in educating health care providers and the public about the strength and reliability of their vaccine safety systems that are indeed more fulsome and rigorous than the drug safety systems. The first supplement of the National Vaccine Program Office of the US Department of Health and Human Services, outlining vaccine safety throughout the product cycle, was only published in 2011 [37]. Of note, an article in this supplement outlines how the Vaccine Safety Datalink system can be used to quickly check on purported adverse events linked to a vaccine, to determine if there is sufficient evidence to stimulate a more in-depth assessment [38] but there is no information on whether this is then reported back to the health care workers or parents who initiated the reports.

The Cuban government long ago recognized the importance of garnering community support for vaccines. Despite the fact that polio was eradicated from Cuba over 30 years ago, a national annual polio immunization program continues to flourish. Involving thousands of mothers and children, under the auspices of the Cuban Federation of Women, the neighborhood Committees for the Revolution and Public Health, this annual public show of support for immunization reinforces the community's trust in vaccines [36]. The Cuban national vaccine education program, starting with school-aged children and continuing into adulthood, further bolsters national confidence in vaccines. Interestingly, Cuba has not suffered from the vaccine safety angst seen elsewhere. Indeed, other countries can learn much from Cuba, where vaccine education is an integral part of citizenship and trust in immunization is the norm.

6.6 Clarity of Language

Academic and overly-scientific language can unintentionally subvert efforts to educate the public about vaccines. While scientific journals and technical academic reports used to be the purview only of those trained to read and interpret them, the widespread availability of these materials via the Internet, as noted above, has created the potential for misuse and misunderstanding, especially by lay readers including the media.

Academic jargon can easily obscure the intended scientific meaning, confusing untrained journalists and parents, and fostering misinterpretation by anti-vaccine advocates [39]. This can lead to anti-vaccine websites using misinformation in support of their beliefs. The Internet provides ready access to a multitude of scientific reports, including those from august bodies such as the Institute of Medicine in the United States and the National Institute for Health and Clinical Excellence in the United Kingdom and to a wide array of open access academic journals. Thus, greater care is now needed to ensure that the conclusions, implications, and executive summaries in academic articles and reports are easy to understand and are not obfuscated by jargon [39].

Unfortunately, the recent trend has been away from clear plain language in many academic articles. Technical reports are also becoming longer and more complex often with hundreds of references, making clarity of language in the executive summary and the final conclusions even more crucial as these will be the most read sections. Few people will read an exhaustive report in its entirety. The vaccine recommendations from the national immunization technical advisory groups (NITAGs) like the United States Advisory Committee on Immunization Practices (ACIP) exemplify this point. Even experienced

users may struggle to find and interpret the major recommendations made by these advisory committees [40]. Ambiguous, complicated language and academic jargon are confusing for many, including many health care providers. Clarity in communications must become the norm whether they be academic articles, technical reports or advisory committee recommendations. As Einstein noted, "*Make everything as simple as possible, but not simpler*".

6.7 Vaccine Science: Appropriateness, Clarity and Quality

Polland and colleagues have also emphasized that great care must be used when research tools such as meta-analyses and evidence-based medicine techniques are applied to vaccines [41, 42]. Evidence-based analyses value outcomes such as infection rates much more than proxy outcomes such as immunogenicity. For rare diseases such as meningococcal infections or rabies, this would mean vaccine studies would require huge populations followed over several years for randomized controlled trials, an expensive and untenable position. Emphasizing such well-used research tools could lead to an undervaluing of vaccines studies compared to other drugs where more classic end points are used. This can lead to the erroneous implication that vaccine science is somehow less rigorous, thus less valuable and less credible. Similarly, assessing the findings from tools like meta-analyses needs to be used with care for vaccines, given their potential for undermining immunization program communications.

Journal editors also need to be reminded of the critical role vaccines play in population health. Not only must they critically assess the language of submitted articles for clarity and ease of understanding but also take great care in assessing the scientific quality of submissions. Poor quality science, when published in esteemed journals, has the potential to undermine public and professional confidence. Because high rates of vaccination are needed to control disease, even a small shift in confidence because of a well publicized academic article, such as occurred with the Wakefield article noted above, can lead to deaths. Much damage had already been done by the time that article was withdrawn years later.

While not suggesting that editors should decline to publish articles that cast doubt on vaccine benefits or highlight risks, they must bear in mind and be cautious of ecological and epidemiological studies that purport to show vaccine associations with diseases of unknown etiologies, such as multiple sclerosis, as the observed association may well be due to chance alone and not be causally related.

6.8 More Open Transparent Decision Making

Many anti-vaccine websites abound with allegations that governments conspire to suppress and even distort negative information about vaccines. These allegations are hard to refute when discussions and decisions about public funding of vaccines and programs, vaccine licensure, and vaccine safety assessments are not done openly. Although there has been some movement towards more open and transparent processes by some NITAGs and drug licensing bodies (i.e., ACIP in the US) [40], other organizations have lagged behind. As well, oft times, conflicts of interest in decision-making remains shielded from public scrutiny. Anti-vaccine websites harp on this flaw. This is not trivial. Previous failures to bring medication safety information to the public's attention in a timely fashion as occurred with Vioxx™, has led to an erosion in the public's confidence in drugs and the pharmaceutical industry in general [43]. This experience has only added fuel to the belief of many that vaccine problems are also being covered up. This is heuristics at work, augmenting public doubt in vaccines. Transparency is crucial.

Moving to a model of more robust disclosure will not be easy. NITAGs and drug licensing bodies will require a better understanding of the public's concerns about vaccine decision-making and then an open mind when considering how best to address these transparency concerns. Overly defensive responses to calls for more public scrutiny need to be avoided. Instead, organi-

zations must learn to address public inquiries in a sensitive manner. Commitment to an open and transparent vaccine system can help enhance the public's confidence in vaccines and undermine anti-vaccine conspiracy allegations.

6.9 Strategies to Reduce Vaccine-related Pain

Pain from immunization has been long neglected as a cause for vaccine hesitancy, overshadowed by other vaccine-related concerns. However, pain with immunization is a significant source of distress for children, parents and health care providers—a concern expressed by 44 % of parents in one survey [44]. Fear of needles and anxiety about procedures can negatively impact vaccination and health-seeking behaviors [45]. In 2010, an evidence-based Canadian clinical practice guideline intended to reduce pain related to childhood immunization was published [45]. Designed by an interdisciplinary group of experts in pain and in vaccinology and approved by several professional societies, the guideline has been met with considerable interest by both immunizers and parents in Canada. Reducing pain with immunization is a step in the right direction to decrease vaccine hesitancy and increase vaccine uptake. Ignoring this for so long has been folly. However, the effectiveness of these approaches across populations and settings still requires thoughtful evaluation. Getting pain control right is important.

6.10 Vaccine Education for Physicians and Nurses

Formal education in medical and nursing schools has not typically provided sufficient information and training to prepare physicians and nurses to answer the vaccine-related questions from patients that often arise in their practices [46]. Low immunization uptake rates for annual influenza vaccine among health care providers, as noted above, demonstrates that physicians and nurses have not all been convinced during their training and while out in practice that immunization is necessary to reduce the burden of diseases such as influenza. Education must be improved. In addition to enhancement of vaccine education in medical and nursing school, standardized competencies for those who immunize, such as the Immunization Competencies published by the Public Health Agency of Canada [47], could further reinforce the importance for health care providers of immunizing themselves and their patients. Given the important role health care providers play in patient vaccine decision making [12, 27], the training of these professionals needs urgent attention by curriculum planners and much pressure from vaccine programs and governments. Having a health care work force undereducated about vaccines critically undermines vaccine program success.

6.11 Vaccine Education for Children

Building confidence in vaccines should start early. A basic explanation of vaccines, including how they work and how vaccine safety is monitored, could be part of the health curriculum for elementary students and then reinforced in secondary school. Immunization is such an important public health measure that its significance could be incorporated into history and science classes as well. This would begin the process of building trust and shaping positive vaccine beliefs at an early age, a powerful technique for shaping adult decision making. There are a variety of teaching approaches that have been shown to make vaccine information meaningful to young students including drawings, word puzzles and stories of real people who have experienced vaccine-preventable diseases [48]. Figure 6.3 shows an example of a student's poster drawn after participating in such a program.

6.12 Vaccine Education for the Media

While health care providers play a major role in parental decisions to immunize their children [12, 27], what appears in the media, both tradi-

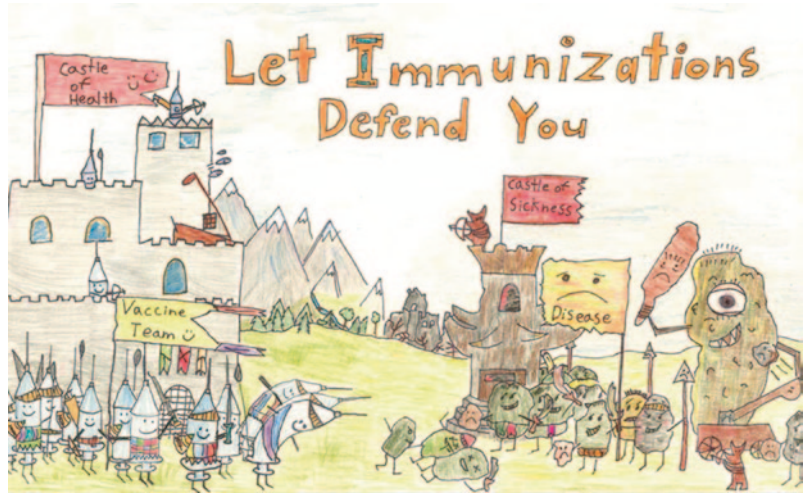

Fig. 6.3 Immunization: protecting you, your family and your community. Ryan McGee winner 2008 National Immunization Poster Context. Canada. Public Health Agency of Canada. With permission

tional print and broadcast media as well as social media, is also influential as noted above [20]. Heuristics are at work here. Media stories that reinforce beliefs are well heard but those that disagree are filtered out. If there are no preconceived beliefs about vaccines, media stories may shape these beliefs, pro or con, depending on the story.

Unfortunately, vaccines are variably portrayed in the formal media. A 2011 report of a 10 year survey of vaccine-related articles in U.S. daily newspapers, with circulations equal to or over 50,000, found that 37 % of the articles suggested that vaccines were unsafe [49]. Over 60 % of all the vaccine articles were written by newspaper or wire service staff, many of whom likely only had a rudimentary background in science and probably no background in vaccine science. Recognizing the importance of journalists in shaping public opinion, many organizations that advocate for vaccines distribute news releases and backgrounders for the media, hoping journalists will simply use their vaccine facts in their articles. However, journalists are trained to question traditional sources and to present 'the other side' of the story which sometimes means the anti-vaccine side. As traditional media outlets experience more and more staff cuts, there are now fewer journalists who focus solely on science or health issues. Even fewer have substantive enough health or science expertise to fully brief themselves on the issues presented. Hence, it is increasingly important to simplify the knowledge translation of vaccine science and to make the major findings in academic articles crystal clear, not only in the covering news release but also in the document's conclusions as noted above.

Ideally, journalists could attend educational workshops and seminars on vaccines, such as the European Media Workshop organized by the Fondation Mérieux in Annecy, France, April 2009, aptly titled "Unjustified scare or reasonable skepticism" [50]. Similar educational workshops for journalists have been offered at the biannual Canadian Immunization Conferences. While the importance of these education opportunities for media has not been formally assessed, this may be a promising avenue that leads to enhanced confidence in vaccines in the media and, by extension, the public. It is interesting to note that one of the most prominent health reporters in Canada who writes for the largest national daily is well educated about vaccines and is a staunch supporter of vaccines [51].

Given that annual national immunization weeks as well as regional and national immunization conferences are becoming more common throughout the world, journalists could be encouraged to not only report on the vaccine events but also to participate in short courses on vaccine science (online or in person) designed specifically for them. Other tools such as online briefings and backgrounders could also be made

readily available to journalists including explanations of basic vaccinology terms and concepts relevant to the study—all provided in lay language. Expert spokespeople should also use plain language, and be clear about the implications of reports and articles. As outlined above, obfuscation is an open door to misunderstandings.

Working with social media, especially bloggers, presents an enormous challenge as there are so many of them. Blogs should be monitored and those with large followings responded to wherever possible if vaccine misinformation is being promulgated. While this takes time and effort, as politicians have well learned, you ignore bloggers at your peril.

6.13 Facilitate Changes in Behaviour

Most beliefs and behaviours are deep rooted, difficult to change, and well established by adulthood. Modifying beliefs and behaviors is thus, a complex process. There is no one way to build confidence in vaccines among adults that leads to high vaccine uptake. As noted above, sowing provaccine belief seeds in childhood may be key but this will take at least a generation before accruing the benefits. What can be done in the interim? For adults, multiple approaches will be required, including many outlined above. Positive public vaccine beliefs will need to be actively shaped and reinforced.

6.13.1 How can this be Accomplished?

One model to consider is the World Health Organization Communication-for-Behavioural (WHO COMBI) program, a comprehensive, people-centered approach used to facilitate behavioural change at individual, family and societal levels [52]. Although typically applied to diseases in developing countries, the WHO COMBI strategy may be amenable to immunization programs nationally and globally. Drawing on the Cuban example noted above, comprehensive national immunization strategies that effectively influence behaviour can be highly successful. The potential of a COMBI like program for immunization deserves serious exploration.

As well, national vaccine programs need to involve a broader range of disciplines, expanding beyond traditional players with health backgrounds, to include contributions from the behaviour sciences, marketing, and communication. These disciplines would bring a wealth of new expertise and knowledge to the development of immunization programs and the field of vaccinology. Strategies for building vaccine confidence locally can be much stronger if they draw on local capacity to build robust immunization programs. Engaging community members in finding solutions to the vaccine confidence deficit problem will be fundamental work here as the literature has well shown that top down solutions often fail [53].

6.14 Conclusion

Fact-based communications and effective programs have achieved the high rates of immunization needed to control many vaccine-preventable diseases. These strategies need to continue. However, while many people have been convinced by scientific evidence, the vaccine-hesitant minority have not. Given that very high immunization rates are required for disease control across populations, ignoring the vaccine hesitant is not an option. The vaccine hesitant more often rely on beliefs and automatic assumptions and are not influenced by evidence. As stated by Goethe, a German polymath, over 150 years ago, "*Belief is not the beginning but the end of all knowledge*". He continued, "*We are so constituted that we believe the most incredible things; and, once they are engraved upon the memory, woe to him who would endeavour to erase them*".

A proactive, multidisciplinary, multifaceted approach capable of reshaping immunization beliefs is needed to address the vaccine confidence deficit. Devising such a strategy will not be easy. Vaccine advocates need to collaborate with experts in the behaviour and social sciences, in marketing and advertising, as well as members of the community to bring more depth and breadth

to immunization programs. Milestone evaluations will be needed to ensure that the devised programs achieve the stepwise desired goals. Fortunately, there are some successful models to examine and build upon including the Cuban national immunization program and the WHO COMBI strategy for dengue fever control.

Vaccines are a critical public health strategy for population health and well being. The trust, support and confidence of health care providers and the general public in vaccine programs is essential for success. Given the high costs of failure, including health care costs and needless morbidity and mortality from vaccine-preventable diseases, immunization advocates need to aggressively address the vaccine confidence deficit at its roots by actively working to shape vaccine beliefs.

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