## Abstract

Few topics in medicine have been studied more thoroughly than vaccines. The science is clear on the public and global health benefits of vaccinations; however, the topic still results in vigorous discussion about their efficacy, safety and possible adverse effects. Anti-vaccination groups and conspiracy theorists have found a place in the online world and on social media sites to spread misinformation. Parents want the best for their children, but when they are influenced by the anti-vaccination movement the health of their children when not vaccinated, can be compromised. They also present a risk to health of others in the community. Health professionals, including nurses, have a responsibility to educate themselves and others about the science of vaccination, and take active steps to dispel misinformation.

## Introduction

It has been claimed that vaccinations (also known as immunizations) have made the greatest contribution to global health than any other measure (Greenwood, 2014). The COVID-19 pandemic, or more specifically, the coronavirus SARS-CoV-2 virus outbreak, has led to a mass, global vaccination program that has started in many countries around the world. Despite the success of many previous vaccination programs however, there is a concerted effort by anti-vaccination groups to thwart the success of the vaccine rollout. Politicians and celebrities have created confusion by fueling inaccurate non-science-based information, even though the science is clear and the link between vaccination and autism has been debunked (Gould, 2017).

Few medical and nursing professionals and generations of the general public can remember the panic associated with the poliomyelitis (polio) epidemic and the rows of negative pressure ventilators needed to treat those who contracted polio. These are photographic reminders, however in contemporary society those photographs do not convey the visceral fear that was experienced at the time (Kurlander, 2020). US President Roosevelt, who had himself been paralysed by polio, founded the National Institute of Infant Paralysis, which later became known as the March of Dimes. President Roosevelt encouraged Americans to send their dimes to the White House to fund the treatment of polio victims and research a cure (Kurlander, 2020).

The purpose of this discussion paper is to outline the rise of the anti-vaccination movement, vaccine hesitancy and consider the implications for the health of children, and the risk that the unvaccinated child presents to other vulnerable populations such as the elderly and those with co-morbidities. With the COVID-19 vaccine being distributed throughout the world, this paper will be a timely reminder and a snapshot of the issues related to the importance of vaccination.

## The Science of Vaccination

The immunity is the ability of the body to tolerate the presence of material that belongs to itself and to eliminate foreign material (Simon et al., 2015). At birth, the infant is exposed to an enormous number of environmental antigens. This predisposes them to a wide range of bacteria, therefore risking infection. The innate immune system is immature at birth, so the newborn is more prone to bacterial and viral infections (Simon et al., 2015). As the young child develops, the immune system begins to mature but remains at risk from infection in the early years. As the child grows, the immunity is shaped by varied exposure to infections and of course, vaccinations when administered.

Immunity can be identified as active or passive. Passive immunity is the transfer of an antibody produced by the mother to the fetus. This provides temporary protection of 2 months to one year; therefore, the baby requires vaccination thereafter. Active immunity is achieved by the person's own immune system, by recovering from an infection and is often life-long (Simon et al., 2015). An antibody-antigen reaction is a specific chemical interaction between antibodies and antigens during an immune reaction. An antibody is a Y-shaped protein that binds together in a 'Lock and Key' fashion (Ghose, 2020) to foreign invaders such as bacteria, or viruses. The antibody can be referred to as an immunoglobulin (Ig) which is produced by the immune system, in response to an antigen (foreign substance). Each antigen has a specific response due to its distinctive surface, or epitopes (MacDonald, 2017).

Vaccines contain antigens to stimulate the B lymphocytes of the immune system to respond by producing plasma cells secreting specific antibodies (primary response). Some of these can become memory cells to assist in future recognition of the illness (secondary response) (MacDonald, 2017). The aim of a vaccine is to produce a protective response to a specific

target pathogen without the risk of acquiring the disease (Vetter et al., 2018). Vaccines are classified into 2 basic types: (Oxford Vaccination Group, 2021)

- Attenuated
- Inactivated

Attenuated vaccines are those that are alive. These vaccines contain a version of the virus or bacteria that has been weakened so that the person receiving the vaccination does not develop serious disease (Vetter et al., 2017); that is, they do receive immunity but do not develop illness. Examples of live attenuated vaccines are measles, mumps and rubella (MMR) and varicella (chicken pox) (Oxford Vaccination Group, 2021). Inactivated vaccines are made by inactivating or killing the germ in the process of making them. They can be made up of whole viruses or bacteria in small amounts. An example of this is polio vaccine. These vaccines respond differently to the live vaccines, therefore requiring multiple vaccinations (Vetter et al., 2018).

Vaccinations have been proven to be safe; however, reactions can occur. Most reactions from vaccinations are minor and often short-lived. These can be local reactions, such as redness and pain at the site, occurring shortly after injection. A local reaction means the vaccine is interacting with the immune system (Australian Academy of Science, 2020). Other reactions such as fatigue, slight fever and general aches and pains may also occur. Some side effects may take up to 7-12 days to identify if an attenuated vaccine has been administered, because extra time is required to induce an immune response. (Australian Academy of Science 2020). Some adverse reactions have been incorrectly linked to the administration of the vaccine, such as the MMR and the link to autism. Many common reactions to vaccinations are often not caused by the vaccine but occur by chance at the time of administration (Australian Academy of Science, 2020). Serious side effects are rare.

**The Covid-19 Vaccine**

Different types of vaccines.

The COVID-19 Messenger-RNA (mRNA) vaccine represents a new approach to vaccines. While other vaccines rely on inactivated pathogens to trigger an immune response the COVID-19 mRNA vaccine gives cells the instructions to make a small piece of the ‘spike’ protein that is found on the surface of the virus. As the protein has been made, the body’s cells break down the instructions and removes them from the body (Center for Disease

Control (CDC), 2020). The body's cells display the protein fragment on its surface, thereby prompting the immune system that recognise the protein as foreign and thereby building an immune response and making antibodies (CDC, 2020). It is noteworthy that conspiracy theorists and anti-vaccination groups claim that vaccines alter the body's DNA. In fact, the COVID-19 mRNA never enters the nucleus of the cell; therefore, it does not encounter the cellular DNA (CDC, 2020).

It has been established that children's rates of hospitalization and death due to COVID-19 are significantly lower than adults (World Health Organization (WHO), 2020a). However, a rare disease named multisystem inflammatory syndrome that causes critical illness in children has been linked to COVID-19 (WHO, 2020a). While the priority is to target high-risk groups in the adult population, vaccination against COVID-19 for children may be required. It has been recommended that older children and adolescents who are more at risk of severe and fatal disease than younger children be vaccinated first, and then extend the vaccination to younger children (Wong et al. 2021). Currently there are 3 major vaccines available. The Pfizer-BioNTech vaccine has been authorized for young people aged 16 and above, and trials for those 12-15 have been announced by Pfizer (Jenco & Korioth, 2021). Moderna's vaccine has been authorized for those aged 18, and Moderna has started trials on children from 6 months to 12 years (Jenco 2021). Johnson and Johnson / Janssen plan to test its vaccine on newborns, pregnant women and those with a compromised immune system

## The Rise of the 'Anti-Vaxxer'

The anti-vaxxer movement is almost as old as the history of vaccination itself. Edward Jenner, the originator of the smallpox vaccine, faced opposition from both physicians and clergy and called these people 'anti-vaxx' in the early 19th century (Howard, 2003). The medical men were a powerful opposing force, using the developing power of the 'press' to spread their arguments against the procedure, arguing that the safety of vaccination could not be proven (Howard, 2003).

As smallpox case numbers dropped significantly, the efficacy of the vaccine became clear, and this first wave of opposition waned. People eagerly took up vaccination against this disease. However, the poorer classes were unable to afford treatment and unhygienic procedures often led to secondary infections leading to a drop-in vaccination rates amongst the working class. To counteract this, the UK Government passed at Act in 1853 making

smallpox vaccination mandatory for infants, with parents facing a fine or imprisonment for disobeying the law. Similar laws were also passed in the USA to mandate vaccination (Howard, 2003 resulting in an organised and formal anti-vaccination movement on both sides of the Atlantic. Both middle and working-class people fought against what they saw as increasing coercion by the elite forces of government and medicine, threatening their rights and liberties (Durbach, 2005).

In the UK, the Leicester Anti-Vaccination League started in 1869, and mass protests of up to 100,000 people protested in the streets of Britain (Wolfe & Sharp, 2002). This League and its American counterpart, the Anti-Vaccination League of America, claimed that improved hygiene was the cause of decrease in disease, rather than the vaccinations themselves. To address these fears, the British Vaccination Act 1898 introduced the concept of 'conscientious objection' to mandatory vaccination, which was picked up rapidly by the antivaccination activists (Howard, 2003).

In the early years of the 20th century, a series of devastating epidemics; namely, smallpox, diphtheria, cholera, measles, and polio, prompted a greater uptake of vaccines despite the antivaccination lobby. Vaccination programs for an increasing number of diseases led to what became known as 'herd immunity'. However, several tragic events involving contaminated and faulty vaccines eroded public trust and confidence (Wolfe & Sharp, 2002; Flaherty, 2011). These disasters added to the argument against vaccination. Public fear was also compounded by apathy, as vaccines became 'victims of their own success' (Camargo Jr, 2020, p.2). As herd immunity grew, once-common diseases became less visible in the community. The importance of vaccination began to wane, leading to rejection or, at least, hesitancy (Smith, 2017). This situation deteriorated further with what has been described as 'the most damaging medical hoax of the last 100 years' – Andrew Wakefield's infamous 1998 study linking the measles-mumps-rubella (MMR) vaccine to autism (Flaherty, 2011), later proven to be completely unsubstantiated. Moreover, autism is a condition with no known etiology and no cure, and affects children in the age range during which most vaccines are administered.

Nonetheless, for parents grief-stricken to discover their child had developed autism, and searching for something to blame, this study provided them with a reason that they could understand (Flaherty, 2011). Parents began to refuse the MMR vaccine and it seemed that the

proven benefits of vaccination against these common childhood diseases were outweighed by the tiny possibility that they might cause another condition that would be life changing. Vaccination rates consequently plummeted (Smith, 2017).

Today's antivaccination movement may seem to fly in the face of science, but it may simply be due to hysteria; a response that depends not only on what is happening now, but also on what happened in the past. Many of the issues prompting antivaccination sentiment today can be seen in the history of the antivax movement – mistrust of a new and unproven treatment, fear of curtailment of liberties, class struggle, public apathy, and the spread of misinformation through a new and rapid form of communication (Wolfe & Sharp, 2002).

## Vaccine Hesitancy

An important consideration in the immunization debate is vaccine hesitancy, defined as "the reluctance or refusal to vaccinate despite the availability of vaccines" (WHO, 2019). Vaccine hesitancy has been described as the main contributor to the reduction to herd immunity globally (Haroune & King, 2020) and contributed to outbreaks of preventable diseases in some countries (Gordon, 2020). It is, therefore, an important issue that needs to be addressed early before it becomes vaccine refusal which is an increasing problem (McGee & Suh, 2019). Vaccine hesitant people have not yet decided about whether they will vaccinate or not; they instead are merely questioning whether they should vaccinate and therefore can be persuaded to immunize. In comparison, those who are 'anti-vaxx', have already made up their minds to not vaccinate; hence why it is important to address hesitancy before this situation arises.

Vaccine hesitancy is complex and not just about parents agreeing or disagreeing to vaccinate their child or themselves (McGee & Suh, 2019). The factors that contribute to vaccine hesitancy have been explored in a study which identified three main themes; vaccine safety, effectiveness and healthcare issues (Haroune and King, 2020). Vaccine safety referred to a concern about the ingredients in the vaccine as well as toxicity and the potential side effects from the vaccine with autism, of course, being the main concern (Haroune & King, 2020). This theme also included pain/discomfort from the vaccination and that vaccinating weakens the immune system. The effectiveness of the vaccine included the belief that some diseases had been eradicated, questioning the need for the vaccine. There was also a desire to fight off disease with natural immunity rather than by vaccinating, including breastfeeding, in the

belief that this was more effective. The third contributing factor arose because of previous negative experience with healthcare, including delayed immunizations due to the child being unwell or difficulty getting appointments due to either the carer or General Practitioner being too busy (Haroune & King, 2020). These parents may be motivated to vaccinate but have logistical difficulties including not being able to take time off work or lack of public transport to access services. Conflicting or confusing vaccine information may also inhibit the decision to vaccinate.

Vaccine hesitant parents are also more likely to access social media for information to help them make the decision to vaccinate or not (McGee & Suh, 2019). A substantial amount of information is available through these platforms and it is easy to find. While it may lead to parents making the right decision for their child, it can also be detrimental as much information is inaccurate and, in some cases, deceptive (Grant et al., 2015). Generally, these platforms focus on creating communities of vaccine affected families including resources about vaccinations allegedly presenting an unbiased opinion. However, these sites are found to be strongly biased against vaccinations (Grant et al., 2015). Social media vaccine skeptical information is therefore considered to be troublesome, discouraging parents from vaccinating through several strategies. These include portraying themselves as authorities on vaccination, listing adverse effects, presenting themselves as unbiased and appealing to user's emotions through personal testimonies of adverse effects (Grant et al., 2015). The problem is compounded by the fact that vaccine critics are more successful at using social media then vaccine promoters. Furthermore, the information disseminated is more difficult to dismiss by trying to educate the public to the contrary (Grant et al., 2015). Other issues that social media may present in the context of the vaccination debate will be further discussed later.

## Conspiracy Theories

Conspiracy theories explain the origins of world events or situations as plots, led by powerful groups of people, usually malevolent, who hide the truth and disseminate misinformation (Douglas et al., 2019; Sutton & Douglas, 2020; Wood, 2017). They are also associated with medical conditions such as COVID-19 (Andrade, 2020; Chen et al., 2020; Duplaga, 2020; Romer & Jamieson, 2020) and HIV/AIDS (Brotherton et al., 2013; Friedman, 2020), vaccination use (Brotherton et al., 2013; Douglas et al., 2019; Romer & Jamieson, 2020), and can be detrimental to health promotion and illness prevention. Underpinning conspiracy theories is a distrust of people in power (Sutton & Douglas, 2020; Romer & Jamieson, 2020),

an alleged conspiracy (Douglas et al., 2019), and belief in the conspiracy despite evidence of more probable causes (Brotherton et al., 2013; Freeman & Bentall, 2017; Wood, 2017). Confirmation bias, the acceptance of evidence that confirms a person's existing beliefs and rejection or failure to consider contradictory evidence (American Psychological Association (APA), 2020), and the backfire effect, whereby a person's beliefs are strengthened in the face of contradictory evidence (Noor, 2020), can perpetuate conspiracy beliefs.

A range of psychosocial and demographic factors are associated with holding conspiratory beliefs. A tendency to accept weak beliefs (Sutton & Douglas, 2020) and attempts to make sense of life during uncertainty and when faced with complex and threatening phenomena can contribute to a belief in conspiracy theories (Douglas et al., 2019; Freeman & Bentall, 2017). Younger people, males, those with lower levels of education, income, and health literacy, those from an ethnic minority, the socially disconnected, and the politically disenfranchised, are more likely to believe in conspiracy theories (Duplaga, 2020; Freeman & Bentall, 2017; Romer & Jamieson, 2020). Support of conspiracy theories is also associated with traits of individual and collective narcissism, and exaggerated feelings of self-importance (Cichocka et al. 2016; Golec de Zavala & Federico, 2018).

Subscribing to conspiracy theories can have adverse impacts on an individual's health and wellbeing, including their mental wellbeing. Freeman and Bentall (2017) demonstrated in a general population, that those who held a conspiratory world view had lower levels of physical and mental wellbeing, were more likely to have had adverse childhood experiences, had fewer current social connections, and experienced more negative emotions. Chen et al. (2020) found that health care workers who believed COVID-19 conspiracy theories were more likely to report psychological distress, anxiety, and lower satisfaction with their work and life as compared to those who did not.

Conspiracy beliefs may also be associated with some mental health conditions. People who experience paranoia, a mistrust and fear of harm from others, and who meet the diagnostic criteria for a paranoid personality disorder, are likely to accept the beliefs of malevolence espoused in conspiracy theories (Andrade, 2020). Even after controlling for paranoia, those who adopt conspiratory beliefs were more likely to meet the diagnostic criteria for a mental health disorder and to consider attempting suicide, as compared to those who did not hold such beliefs (Freeman and Bentall, 2017). To counteract vulnerability to the misinformation

of conspiracy theories, health professionals have a role in the promotion of critical thinking skills and development of coping strategies in health care consumers (Andrade, 2020; Friedman, 2020).

There are a significant number of people worldwide who espouse conspiracy theories, which are explanations for important events that involve secret plots by powerful and malevolent groups (Douglas et al., 2017; 2019), when other explanations are more plausible (Brotherton et al., 2017). For example, in 2020, significant numbers of people around the world believe COVID-19 was created deliberately, is a hoax, has killed far fewer people than reported, and the vaccine will have untenable side effects (Henley & McIntyre, 2020). Conspiracy theories are dangerous and even more so in a pandemic when they encourage people to ignore the official advice (Henley & McIntyre, 2020).

## The Power of Social Media

In 2013, the World Economic Forum lamented that massive digital misinformation was a great threat to society (Schmidt et al., 2018). Social media provides a platform for people to engage with, share views and opinions and learn from others. It has the advantage over mainstream media because it can facilitate public participation in science and health communication, and the sheer number of social media users makes it the main channel of communication during a health crisis (Orr et al., 2016). In October 2020, Facebook was the largest online social network, ranked as the most popular social networking site (SNS) in the world with 2.7 billion monthly active users (Zephoria, 2020).

Websites and Facebook groups opposing vaccination are prevalent, and they are places where anti-vaccine activists can effectively spread their messages questioning the legitimacy of science (Kata, 2012). Anti-vaxx websites and groups are problematic because individuals turn to the internet and Facebook for vaccination advice, and these sites have been shown to influence whether people vaccinate themselves and/or their children (Kata, 2012). In fact, Betsch et al, (2010) found that visiting online anti-vaccination sites for 5–10 minutes was shown to increase perceptions of vaccination risks, and therefore decrease an individual's intentions to vaccinate. Several studies have found that the power of the online anti-vaxx sites is about appealing to the emotions of their website visitors, using narrative and personal stories with photos which are designed to increase perception of risk and decrease vaccination (Betsch et al., 2011).

Buchanan and Beckett (2014) analysed the vaccination pages on Facebook and found that it may play a large role in the propagation of vaccination misinformation, with the anti-vaxx groups promulgating anger, fear and skepticism. What is concerning is that although information dispelling vaccinations myths can be readily found on Facebook, there was less interest in this information compared to the misinformation on the ant-vaxx websites (Buchanan & Beckett, 2014). Smith and Graham (2017) analysed the anti-vaxx Facebook sites, and found that participating in a community of like-minded others reinforced anti-vaxx beliefs. Participants were active across several anti-vaxx Facebook groups and pages, and by liking and actively commenting on a number of the anti-vaxx Facebook pages, they created a 'bubble effect' that made the network appear larger than it actually was, thus reinforcing anti-vaxx sentiment (Smith & Graham, 2017). Facebook pages designed to dispel the fear-mongering of the anti-vaxx sites and educate the public include 'Refutations to anti-vaccination memes', 'Stop the anti-science movement', 'One-vaxxed Nurse', 'Pro-Vaxxer' and 'Nurse Doodle', to name but a few.

In 2020, a major conspiracy theory erupted on Facebook linking COVID-19, the virus originating from China, the vaccine that was being researched and manufactured and 5G technology, with concerns that 5G could make COVID-19 more virulent (Bruns, Harrington & Hurcombe, 2020). The dissemination of a rumour on Facebook started from conspiracy groups, can be amplified when it is picked up by celebrities, sports stars and media outlets (Bruns et al., 2020). This situation may be further complicated by echo chambers. These are online environments in which 'like-minded' users are exposed to confirming opinions and alternative voices are excluded or discredited leading to polarisation and even radicalisation (Risius et al., 2019). Facebook encourages echo chambers, and it is noteworthy that confirmatory information gets accepted even if containing deliberately false claims while dissenting information is mainly ignored or might even increase group polarization (Del Vicario et al., 2016).

As this is written, the COVID-19 vaccine has started to be rolled out in Europe and the USA. It is now believed that social media and Facebook are the main vehicle by which anti-vaxx groups spread lies and misinformation by strengthening and popularising anti-vaccination rhetoric (Smith & Graham, 2019). Facebook's capacity for user generated content means that the messages are accessed by an extensive and diverse audience (Bradshaw et al., 2020). In

fact, Facebook has been accused of creating a direct path for users to produce and consume content with the intention of spreading misinformation (Schmidt et al., 2018) and spreading anti-vaccination ideas on a global scale (Smith & Graham, 2019). It is interesting that Facebook posts about anti-vaxx stories, articles, and photos were shared between multiple Facebook groups (Hoffman et al., 2019). This contributes to the bubble effect discussed earlier.

Facebook is now identifying content and fact-checking posts for misinformation stating that it "rates the accuracy of stories through original reporting, including interviewing primary sources, consulting public data and conducting analyses of media, including photos and video". Moreover, with the number of anti-vaxx groups increasing and the potential public health consequences, Facebook has been under increasing pressure to deal with the anti-vaxxers who spread false information about vaccines yet promote alternate treatments such as high dose Vitamin C for vaccine injury (Pilkington & Glenza, 2018). Facebook has claimed that it is addressing anti-vaccination misinformation by making those posts harder to find, remove anti-vaxx pages and any group that spreads misinformation and elevate authoritative information about vaccines in the news feed (Barbaschow. 2020).

## A Global Perspective

From a global perspective, there is no question that vaccination saves many children's lives; currently estimated as between 2-3 million lives saved each year (WHO, 2020b) and is an integral component in achieving the sustainable development goals. The measles vaccine single-handedly has avoided 23 million deaths in a decade (Patel et al. 2019). Furthermore, global elimination of disease is possible with vaccines, with smallpox being eradicated in 1979 and maternal and neonatal tetanus close to elimination (McIntyre & Walls, 2020). Despite this, many of the world's youngest children do not receive any vaccinations, with an estimated nearly 20 million children less than one year of age not given the recommended vaccinations (WHO, 2020b) The global challenges are to ensure that vaccinations are available to all children especially in those more likely to miss out and where the greatest impact can be made, in developing countries and in fragile and humanitarian settings (Greenwood, 2014).

Fortunately, there are many stakeholders committed to ensuring vaccination programs reach all corners of the globe, with one of the key organisations, which has made substantial

contribution to improving vaccination and child mortality, the Global Alliance for Vaccine and Immunization (GAVI), a public-private partnership) (Bustre et al., 2015). In 2018, GAVI supported vaccination in 73 countries and have a five-year strategy to 'leave no-one behind' (Global Alliance for Vaccine and Immunization [GAVI], 2021). They are also co-leading 'COVAX' with the Coalition for Epidemic Preparedness Innovations and WHO, a collaboration to not only accelerate the development and manufacture of COVID-19 vaccines but to guarantee fair and equitable access globally (GAVI Covax Facility, 2020). UNICEF, being one of the largest vaccine purchasers, is also collaborating with the group to obtain and supply the vaccines using their experience with vaccination programs to support travel logistics, cold chain and storage (United Nations Children's Fund, 2021).

In addition, to address the impact of the pandemic on vaccinations, in late 2020 the World Health Organization released a document "Immunization as an essential health service: guiding principles for immunization activities during the COVID-19 pandemic and other times of severe disruption" (WHO, 2020c). This report provides strategies for countries to implement to ensure that vaccinations continue during major disruptions to health care services such as during pandemics, emergencies and humanitarian crises. Key principles and strategies focus on nine key areas; "health systems and policy; service delivery; catch-up vaccination strategies; mass vaccination campaigns; surveillance and coverage monitoring; Supply chain, communication strategies and recovery and rebuilding" (WHO, 2020c). The report is congruent with the Immunization Agenda 2030, where the four central principles to this agenda is ensuring that it is supported by the countries in which it is occurring, the strategies are concentrated on supporting the people it is aimed to help and it is based on the best evidence from the available data (Immunization Agenda, 2020). While most of the world's population (92%) believe that vaccines are important for children, there is great variation in this belief across the world; with some countries, such as France, where the support was 76% while others such as India and Mexico rating 98%. The reasons are unclear (Our World in Data, 2021).

As previously discussed, one of the greatest threats to global health, is that of vaccine hesitancy highlighted following the recent outbreaks of vaccine preventable diseases such as measles, in countries across the world (Haroune & King, 2020; Gordon, 2020; WHO, 2020). Vaccine hesitancy is not a new phenomenon and has been reported from countries across the world, not just in high income countries (Cooper et al. 2018; Wagner et al. 2020). Lane et al.

reported hesitancy in >90% of countries surveyed and in all regions of the world (Lane et al. 2018). What is more recent is the speed and ease at which anti-vaccination information is spread around the world (Larson & Schulz, 2019).

## PARENTS' DECISION-MAKING

The decision for some parents about vaccinating their child can go beyond agreeing or disagreeing with vaccination (Haroune & King, 2020). Health literacy is important, and complex decision-making process may be occurring that can result in conflicted views based on the parent's inability to interpret scientific evidence (Meppelink et al., 2019). This decision-making process can be further mediated by parents' cultural and religious beliefs (Jolley & Douglas, 2014; Dyda et al., 2020; Meppelink et al., 2019; Song, 2014), misinformation and conspiracy theories (Jolley & Douglas, 2014), and previous adverse immunization reactions (Chow et al., 2017).

In some circumstances, parents may be ambivalent or unaware about the importance of vaccination or be unable to easily access vaccinations. Trust has been identified as an important facilitator for vaccination or if lacking an inhibitor to vaccination (Benin et al. 2006). Significantly, trust in health professionals was a central theme within the literature as to whether parents vaccinate their children or where they sought sources of information to support their decision-making (Austvoll-Dahlgren & Helseth, 2010; Benin et al., 2006; Chow et al., 2017). Austvoll-Daglgran and Helseth (2010) expand on the importance of trust to include common-sense and experience to inform decision-making. A word of caution is provided that when decisions are based on trust in someone else, such as a health professional, rather than his/her own knowledge as a parent, parental uncertainty may occur (Austvoll-Dahlgren & Helseth, 2010).

The decision to vaccinate has been found to involve a general decision-making process of "… awareness, assessing and choosing, followed by either stasis or ongoing assessment" (Brunson, 2013 p. 5466). Decision-making may be difficult when parents express low levels of confidence in the decisions they have made in the past, and they can also be uncertain about their parental rights and responsibilities around decision-making for their children (Austvoll-Dahlgren & Helseth, 2010).

Another way to categorize parents on their decision making was identified, and it depended on the decisions they made. For example, research by Benin et al. (2006) identified two main groups with subgroups. The first group were vaccinators with subgroups of acceptors who agreed with or did not question the use of the vaccination; and vaccine-hesitant who had significant concerns but accepted the vaccination (Benin et al., 2006). The second group were non-vaccinators with sub-groups of late vaccinators who were selective in the vaccines they chose or purposely delayed their child's vaccination; or rejectors who completely rejected vaccine use (Benin et al., 2006). An alternative approach by Brunson (2013) identified three groups; acceptors, reliers and searchers (Brunson, 2013). Acceptors rely on general social norms to make decisions about vaccination. The second group of reliers depend on information and advice from other people. Finally, searchers find information on their own, usually from published sources (Brunson, 2013).

Wiley et al. (2020) grouped 21 parents into three groups: never have vaccinated; changed position once; and changed position twice. This study found that in some cases, decision-making progressed intuitively, starting with a generalised doubt, while for others, it started with an adverse event or specific issue, often compounded by feelings of being failed by the mainstream health care system (Wiley et al., 2020). In some situations, the parents' vaccination trajectories were intertwined with alternative or mainstream lifestyle choices (Wiley et al., 2020).

## The Role of the Nurse in Promoting Vaccinations

One of the main responsibilities of nurses is to promote the health and wellbeing of the patients and people who they encounter. This is firmly embedded in key nursing documents, for example:

> *"Registered nurses make an important contribution to the promotion of health, health protection and the prevention of ill health."* (Nursing and Midwifery Council, 2018: 3).

Global medical and nursing organisations have an important role and need to acknowledge and promote the importance of vaccinations in preventing deaths. With the global COVID-19

vaccination program, the International Council of Nurses (ICN) have stated that nurses are integral to the success of this program (ICN, 2021; International Pediatric Association, 2021).

Miller et al. (2015) commented on the fundamental role that nurses have in terms of promoting vaccine uptake; there are a number of strategies that have been implemented to potentially facilitate this, for example, in the UK, the Make Every Contact Count program aims to change health related behaviour by utilising "the millions of day to day interactions that organisations and individuals have with other people to support them in making positive changes to their physical and mental health and wellbeing" (Health Education England, 2020). These opportunities can be used to discuss vaccinations with a parent when, for instance, their infant visits an Emergency Department – using the contact to highlight the benefits of vaccinations, perhaps providing a supporting leaflet or referring the family to another service.

Promoting vaccination, however, is not without its challenges. McGee and Suh (2019) highlight the importance of acknowledging vaccine hesitancy and of taking steps to try to ensure that it does not lead to vaccine refusal. The authors suggest that communication is of paramount importance and they recommend that a 'presumptive' approach, that assumes the parent will be providing their consent, is initially undertaken. If concerns are raised, these can then be appropriately addressed in an honest, respectful manner. Several models have been developed to facilitate a discussion about vaccines; these enable nurses to use a framework to address any parental worries (such as the risks of vaccination), offer evidenced based information and recommend the vaccine. Such models are discussed by Brewer et al. (2017a) and include CASE [Corroborate, About Me, Science, Explain/Advise]; EASE [Elicit, Acknowledge, Share, Explain]; Ask-Acknowledge-Advise. However, whilst these tools have been widely advocated, they should perhaps be used with caution as there is minimal evidence at the moment that substantiates their value. CASE itself has not been the focus of research (Brewer et al., 2017a); an evaluation of EASE was not able to highlight whether the model itself was effective in promoting vaccine uptake (Brewer et al., 2017b) and Ask-Acknowledge-Advise was not shown to be effective in terms of altering parental confidence in vaccines (Henrikson et al., 2015).

If parents develop false beliefs about vaccination, these can be challenging to remedy, therefore, communication should focus on correct information as early as possible (Jolley &

Douglas, 2017) rather than waiting to discuss vaccinations shortly before they are due and ongoing brief discussions during health encounters could be of value. School nurses are, for example, in an ideal position to introduce the benefits of vaccinations to young people when they are in their teenage years. Social media has become an increasingly important communication mechanism, so nurses may feel that their strategies are not just restricted to the clinical setting, but also embrace websites and applications as they can provide a good arena to promote positive vaccine messages (The Health Policy Partnership, 2020). A range of resources are available for professionals (including nurses); accessing these to support discussions with families are crucial so that up-to-date evidence-based information is provided Examples include the US CDC (2016), the American Academy of Pediatrics (AAP) (2021), the Australian Government (2021) and Gov.UK (2021). In addition, sites such as the Children's Hospital of Philadelphia (2021) Vaccine Education Center offer suggested resources for families. The importance of directing parents to websites that provide accurate scientific information should not be under-estimated. This is because as Grant et al. (2015) discuss 'vaccine-skeptical' ones that centre on people affected by vaccines, may not give a wholly balanced perspective.

It is crucial to remember that nurses may be recommending vaccinations for diseases that a parent has never seen or encountered; therefore, there may not be a full understanding of its dangers. Moreover, it has also been suggested that parent vaccine hesitancy is more likely to be related to safety factors rather than the procedure itself (Miton & Mercier, 2015); therefore, the building of a trusting relationship is of fundamental importance and may require several encounters with the family.

**Recommendations**

In summary, there are number of strategies that nurses can use to promote vaccination uptake with parents:

- Maximise contact opportunities with families and discuss vaccination even if that is not the prime intent of the appointment.
- Revisit the topic of vaccination in future health encounters (or ask a colleague to have a 'follow-up' conversation).
- Draw on a 'presumptive' approach that assumes that the parent is intending to vaccinate their child.

- Spend time with a family to provide an individualised, compassionate, trusting and understanding approach that facilitates an environment where parents feel 'safe' to ask questions.
- Think about and plan how parental questions will be answered so that you are able to do so in a confident, professional and authoritative manner. Consider using a model such as CASE, EASE or Ask-Acknowledge-Advise.
- Provide up-to-date evidence-based information.

There is, however, no simple solution to this avalanche of information in social media. It is not possible to stop online misinformation or stop people from searching this information. Instead, it is about providing a different way of communicating according to McGee and Suh (2019). These authors have suggested a range of strategies including communication with a caring, trusted and concerned provider. There is also about how this communication is done. For example, persistent discussion on vaccines in same visit, introduce need for vaccine using presumptive style language rather the participatory, discussion of the science that addresses only parents' specific questions rather than other common concerns which could unintentionally give parents new areas of concern, include brief personal anecdotes which bring the discussion to a more emotional level. This discussion then includes both logical and emotional arguments in support of vaccination and has been described as being more effective (McGee & Suh, 2019).

In addition, there is a need to rethink how pro vaccine information is presented through social media. Generally, information that is too technical and less certain in the conclusions do not help parent decide (McGee & Suh, 2019). Instead, the information needs to be focused more on a collaborative decision-making approach and be directed towards what the vaccine hesitant parent requires, for example, story-telling or direct answers to questions.

## Conclusion

The science is clear; vaccines are safe, efficacious and play a significant and valuable contribution to global health. The challenge for the roll-out of the COVID-19 vaccine is to maintain the confidence in vaccination when 'anti-vaxxers', conspiracy theorists and those with vaccine hesitancy represent a growing threat to the success vaccination efforts. Governments and international health agencies have a critical leadership role to play in

developing evidence-based recommendations and to disseminate them globally, and consistency is important. Efforts by social media platforms such as Facebook, to manage misinformation is encouraging; however, it is not possible to curtail the avalanche of information that bombard people on the internet and social media. Therefore, all health professionals need to take any opportunity to present scientific explanations that expose bad science and debunk misinformation, thereby helping the public to judge information based on scientific merit.

**REFERENCES**


Andrade, G. (2020). The role of psychiatrists in addressing COVID-19 conspiracy theories. *Asian Journal of Psychiatry,* 53, 102404. https://doi.org/10.1016/j.ajp.2020.102404

American Academy of Pediatrics. (2021). American Academy of Pediatrics Guidance: The Covid-19 vaccine is safe, effective and should be given to all who are eligible. https://services.aap.org/en/news-room/news-releases/aap/2021/american-academy-of-pediatrics-guidance-the-covid-19-vaccine-is-safe-effective-and-should-be-given-to-all-who-are-eligible/

American Psychological Association. (2020, December 20). *Dictionary of Psychology,* https://dictionary.apa.org/confirmation-bias

Australian Academy of Science (2020, December 18) The science of immunisation. https://www.science.org.au/education/immunisation-climate-change-genetic-modification/science-immunisation

Australian Government Department of Health. (2021). Covid-19 vaccines. https://www.health.gov.au/initiatives-and-programs/covid-19-vaccines

Austvoll-Dahlgren, A., & Helseth, S. (2010). What informs parents' decision-making about childhood vaccinations? *Journal of Advanced Nursing,* 66(11), 2421-2430. https://doi:10.1111/j.1365-2648.2010.05403.x

Barbaschow, A. (2020, December 22). Facebook tries to make it harder to find an anti-vax group. https://www.zdnet.com/article/facebook-tries-to-make-it-harder-to-find-an-anti-vax-group/

Benin, A., Wisler-Scher, D., Colson, E., Shapiro, E., & Holmboe, E. (2006). Qualitative analysis of mothers' decision-making about vaccines for infants: The importance of trust. *Pediatrics,* 117(5), 1532-1541. https://doi:10.1542/peds.2005-1728

Betsch, C., Renkewitz, F., Betsch, T. & Ulshöfer, C. (2010). The influence of vaccine-critical websites on perceiving vaccination risks. *Journal of Health Psychology*, *15*(3), 446-455.

Betsch, C., Brewer, N. T., Brocard, P., Davies, P., Gaissmaier, W., Haase, N., Leask, J., Renkewitz, F., Renner, B., Reyna, V.F. & Rossmann, C. (2012). Opportunities and challenges of Web 2.0 for vaccination decisions. *Vaccine*, 30(25), 3727-3733.

Bradshaw, A.S., Shelton, S.S., Wollney, E., Treise, D. & Auguste, K. (2020). Pro-vaxxers get out: anti-vaccination advocates influence undecided first-time, pregnant, and new mothers on Facebook. *Health Communication*, 1-10.

Brewer, N.T., Chapman, G.B., Rothman, A.J., Leask, J. & Kempe, A. (2017a). Increasing Vaccination: Putting Psychological Science Into Action. *Psychological Science in the Public Interest,* 18(3), 149-207.

Brewer, N.T., Hall, M.E., Malo, T.L., Gilkey, M.B., Quinn, B., Lathren, C. (2017b). Announcements versus conversations to improve HPV vaccination coverage: A randomized trial. *Pediatrics,* 139(1), e20161764. https://doi:10.1542/peds.2016-1764.

Brotherton, R., French, C. C., & Pickering, A. D. (2013). Measuring belief in conspiracy theories: the generic conspiracist beliefs scale. *Frontiers in Psycholo*gy, 4, 279. https://doi.org/10.3389/fpsyg.2013.00279

Bruns, A., Harrington, S., & Hurcombe, E. (2020). '? covid19?> 'Corona? 5G? or both?': the dynamics of COVID-19/5G conspiracy theories on Facebook', *Media International Australia*, 177(1), 12-29.

Brunson, E. (2013). How parents make decisions about their children's vaccinations. *Vaccine,* 31, 2466-2470. https://doi.org/10.1016/j.vaccine.2013.08.104

Buchanan, R., & Beckett, R. D. (2014). Assessment of vaccination-related information for consumers available on Facebook®. *Health Information & Libraries Journal*, 31(3), 227-234.

Bustreo, F., OkwoBele, J.M., & Kamara, L. (2015). World Health Organizations perspective on contribution of the Global Alliance for Vaccine immunization on reducing child mortality. *Archives of Diseases in Childhood*, 100(Suppl 1), S34-S37.

Carmago Jr, K.R. (2020). Here we go again: the re-emergence of anti-vaccine activism on the Internet. *Cadernos de Saude Publica, 36:* Suppl2:300037620, https://doi: 10.1590/0102-311x00037620

Center for Disease Control and Prevention. (2020, December 20). Understanding mRNA COVID-19 Vaccines
https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/mRNA.html

Chen, X., Zhang, S. X., Jahanshahi, A. A., Alvarez-Risco, A., Dai, H., Li, J., & Ibarra, V. G. (2020). Belief in a COVID-19 conspiracy theory as a predictor of mental health and well-being of health care workers in Ecuador: Cross-sectional survey study. *JMIR Public Health and Surveillance*, *6*(3), e20737. https://doi.org/10.2196/20737

Children's Hospital of Philadelphia (2021, January 25). *Vaccine Education Centre.* Available from: https://www.chop.edu/centers-programs/vaccine-education-center.

Chow, M., Danchin, M., Willaby, H., Pemberton, S., & Leask, J. (2017). Parental attitudes, beliefs, behaviours and concerns towards childhood vaccinations in Australia: A national online survey. *Australian Family Physician,* 46(3), 145-151.

Cichocka, A., Marchlewska, M. & Golec de Zavala, A. (2016). Self-love or self-hate predict conspiracy beliefs? Narcissism, self-esteem, and the endorsement of conspiracy theories. *Social Psychological & Personality Science*, 7(2), 157–166.
https://doi.org/10.1177/1948550615616170

Cooper, S., Betsch, C., Sambala, E.Z., Mchiza, N., & Wiysonge, C.S. (2018). Vaccine hesitancy–a potential threat to the achievements of vaccination programmes in Africa. *Human Vaccines & Immunotherapeutics*. 3, 14(10), 2355-7.

Del Vicario, M., Vivaldo, G., Bessi, A., Zollo, F., Scala, A., Caldarelli, G., & Quattrociocchi, W. (2016). Echo chambers: Emotional contagion and group polarization on Facebook, *Scientific Reports*, *6*, 37825.

Douglas, K.M., Uscinski, J.E., Sutton, R.M., Cichocka, A., Nefes, T., Ang, C.S. & Deravi, F. (2019). Understanding conspiracy theories', *Political Psychology*, *40*, 3-35. https://doi.org/10.1111/pops.12568

Douglas, K.M., Sutton, R.M., & Cichocka, A. (2017). The psychology of conspiracy theories, *Current Directions in Psychological Science*, *26*(6), 538-542

Duplaga, M. (2020). The determinants of conspiracy beliefs related to the COVID-19 pandemic in a nationally representative sample of internet users, *International Journal of Environmental Research and Public Healt*h, 17(21) https://doi.org/10.3390/ijerph17217818

Durbach, N. (2005). *The Anti-Vaccination Movement in England, 1853-1907,* Duke University Press,

Dyda, A., King, C., Dey, A., Leask, J., & Dunn, A. (2020). A systematic review of studies that measure parental vaccine attitudes and beliefs in childhood vaccinations. *BMC Public Health,* 20, 1253. http://doi.org/10.1186/s12889-020-09327-8

Flaherty, D.K. (2011). The vaccine-autism connection: a public health crisis caused by unethical medical practices and fraudulent science. *Annals of Pharmacotherapy, 45*(10): 1302-04

Freeman, D., & Bentall, R. P. (2017). The concomitants of conspiracy concerns. *Social Psychiatry and Psychiatric Epidemiology,* 52(5), 595–604. https://doi.org/10.1007/s00127-017-1354-4

Friedman, R.A. (2020). Why humans are vulnerable to conspiracy theories, *Psychiatry Online*, https://doi.org/10.1176/appi.ps.202000348

Ghose T. (2020, December 20). What are antibodies? Live Science https://www.livescience.com/antibodies.html#:~:text=Antibodies%20are%20Y%2Dshaped%20proteins,%2C%20bacteria%2C%20fungi%20or%20parasites.

Global Alliance for Vaccine and Immunization. (2021, January 18) COVAX AMC. https://www.gavi.org/

Global Alliance for Vaccine and Immunization Covax Facility (2020, December 18) https://www.gavi.org/covax-facility.

Golec de Zavala, A. & Federico, C. M. (2018). Collective narcissism and the growth of conspiracy thinking over the course of the 2016 United States presidential election: A longitudinal analysis. *European Journal of Social Psychology*, 48(7), 1011–1018 https://doi-org.ezproxy.lib.uts.edu.au/10.1002/ejsp.2496

Gordon, S. (2020, November 9) Study about 1 in 5 parents are 'vaccine hesitant'. Children Vaccines News. https://www.webmd.com/children/vaccines/news/20201014/its-tough-to-change-the-minds-of-vaccine-hesitant-parents-study-finds#1. (accessed 17 January 2021).

Gould, K. (2017). Vaccine safety: evidence-based research must prevail. *Dimensions of Critical Care Nursing. 36*(3), 145-147

Gov.UK (2021, January 25). *Immunisation. Information for immunisation practitioners and other health professionals.* Available from: https://www.gov.uk/government/collections/immunisation

Grant, L., Hausman, B.L., Cashion, M., Lucchesi, N., Patel, K. & Roberts, J. (2015). Vaccination Persuasion Online: A Qualitative Study of Two Provaccine and Two Vaccine-Sceptical Websites. *Journal of Medical Internet Research,* 17(5), e133. https://doi: 10.2196/jmir.4153.

Greenwood, B. (2014). The contribution of vaccination to global health: past, present and future. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 369, (1645). 20130433.

Haroune, V. & King, L. (2020). Factors contributing to parental 'vaccine hesitancy' for childhood immunisations. *Nursing Children and Young People,* 32(4), 20-25. https://doi:10.7748/ncyp.2020.e1269

Health Education England (2020, January 25). *Making Every Contact Count.* Available from: https://www.makingeverycontactcount.co.uk/

Henley, J. & McIntyre, N. (2020, November 28). Survey uncovers widespread belief in 'dangerous' Covid conspiracy theories. https://www.theguardian.com/world/2020/oct/26/survey-uncovers-widespread-belief-dangerous-covid-conspiracy-theories

Henrikson, N.B., Opel, D.J, Grothaus, L., Nelson, J., Scrol, A., Dunn, J., Faubion, T., Roberts, M., Marcuse, E.K, Grossman, D.C. (2015). Physician Communication Training and Parental Vaccine Hesitancy: A Randomized Trial. *Pediatrics*, 136(1),70-9.

Hoffman, B.L., Felter, E.M., Chu, K.H., Shensa, A., Hermann, C., Wolynn, T., Williams, D. & Primack, B.A. (2019). It's not all about autism: The emerging landscape of anti-vaccination sentiment on Facebook, *Vaccine*, *37(*16), 2216-2223.

Howard, C.R. (2003). The impact on public health of the 19th century anti-vaccination movement. *Microbiology Today, 30*, 22-24.

Immunization Agenda (2020, December 18) IA2030, file:///C:/Users/23272340/Downloads/ia2030-document-en%20(1).

International Council of Nurses (2021, January 18) ICN Newsletter. https://www.icn.ch/news/success-mass-covid-19-vaccination-programmes-will-depend-frontline-nurses-and-nurse-leaders

International Pediatric Association (2021, January 18) https://ipa-world.org/sag-immunizations.php

Jenco, M. & Korioth, T. (2021, January 21). Experts provide update on 'essential' COVID-19 vaccine trials in children, teens. AAP Publications. https://www.aappublications.org/news/2021/01/27/acip-covid-vaccine-pediatric-trials-012721

Jenco, M. (2021. March 16). Moderna testing COVID-19 vaccine in children under 12. AAP News. https://www.aappublications.org/news/2021/03/16/moderna-covid-trials-children-031621

Jolley, D., & Douglas, K. (2014). The effects of anti-vaccine conspiracy theories on vaccination intentions. *PLoS ONE,* 9(2), e89177. https://doi:10.1371/journal.pone.0089177

Jolley, D. & Douglas, K.M. (2017). Prevention is better than cure: Addressing anti-vaccine conspiracy theories. *Journal of Applied Social Psychology,* 47(8), 459–469.

Kata, A. (2012). Anti-vaccine activists, web 2.0, and the postmodern paradigm – an overview of tactics and tropes used online by the anti-vaccination movement.' *Vaccine*. 30(25), 3778-3789.

Kurlander, C. (2020, March 25). The deadly polio epidemic and why it matters for coronavirus. https://theconversation.com/the-deadly-polio-epidemic-and-why-it-matters-for-coronavirus-133976

Lane, S., MacDonald, N. E., Marti, M., & Dumolard, L. (2018). Vaccine hesitancy around the globe: Analysis of three years of WHO/UNICEF Joint Reporting Form data-2015–2017. *Vaccine*, 36(26), 3861-3867.

Larson, H. J., & Schulz, W. S. (2019). Reverse global vaccine dissent. *Science,* 364, 6436.
McIntye, P., Walls, T. (2020) Global Public Health Impact of Vaccines in Children. *Oxford Research Encyclopaedia of Global Public Health*, https://doi.org/10.1093/acrefore/9780190632366.013.64.

MacDonald, A. (2017, October). Antigen vs Antibody – What Are the Differences? Immunology and Microbiology from technology networks.

https://www.technologynetworks.com/immunology/articles/antigen-vs-antibody-what-are-the-differences-293550

McGee, L.U. & Suh, J. (2019). Communication Strategies to Address Vaccine Hesitancy in Healthcare Settings and on Social Media. *Journal of Applied Research on Children: Informing Policy for Children at Risk,* 10(2), Article 7. Available from: https://digitalcommons.library.tmc.edu/cgi/viewcontent.cgi?article=1397&context=childrenatrisk

McIntyre, P. & Walls, T. (2020 29 May) Global public health impacts of vaccines in children. Global Public Health. Oxford Research Encyclopedias. https://doi.org/10.1093/acrefore/9780190632366.013.64. 2020 (accessed 22 January 2021)

Meppelink, C., Smit, E., Fransen, M., & Diviani, N. (2019). "I was right about vaccination": Confirmation bias and health literacy in online health information. *Journal of Health Communication,* 24 (2), 129-140. https://doi:10.10810730.2019.1583701

Miller, E.R., Shimabukuro, T.T., Hibbs, B.F., Moro, P.L., Broder, K.R., & Vellozzi, C. (2015). Vaccine Safety Resources for Nurses. *The American Journal of Nursing*, 115(8), 55–58.

Miton, H., & Mercier, H. (2015). Cognitive obstacles to pro-vaccination beliefs. *Trends in Cognitive Sciences,*19(11), 633–636.

Noor, I. (2020, December 28). Confirmation bias. *Simply Psychology.* https://www.simplypsychology.org/confirmation-bias.html

Nursing and Midwifery Council (2018). *Future nurse: Standards of proficiency for registered nurse.* NMC: London. Available from: https://www.nmc.org.uk/globalassets/sitedocuments/education-standards/future-nurse-proficiencies.pdf Accessed on 25th January 2021.

Orr, D., Baram-Tsabari, A., & Landsman, K. (2016). Social media as a platform for health-related public debates and discussions: the Polio vaccine on Facebook. *Israel Journal of Health Policy Research*, *5*(1), 34.

Our World in Data, (2021, January 18) How many people support vaccinations. https://ourworldindata.org/vaccination#how-many-people-support-vaccination-across-the-world

Oxford Vaccination Group. (2021, January 20). Types of Vaccine. https://vk.ovg.ox.ac.uk/vk/types-of-vaccine

Patel, M.K., Goodson, J.L., Alexander Jr, J.P., Kretsinger, K., Sodha, S.V., Steulet, C., Gacic-Dobo, M., Rota, P.A., McFarland, J., Menning, L. and Mulders, M.N., (2020). Progress Toward Regional Measles Elimination—Worldwide, 2000–2019. *Morbidity and Mortality Weekly Report*, *69*(45), 1700.

Pilkington, E. & Glenza, J. (2019, February 12). Facebook under pressure to halt rise of anti-vaccination groups. https://www.theguardian.com/technology/2019/feb/12/facebook-anti-vaxxer-vaccination-groups-pressure-misinformation

Risius, M., Aydinguel, O. & Haug, M. (2019, September). Towards an understanding of conspiracy echo chambers on Facebook. https://madoc.bib.uni-mannheim.de/51061

Romer, D. & Jamieson K.H. (2020). Conspiracy theories as barriers to controlling the spread of COVID-19 in the U.S, *Social Science & Medicine* 263 https://doi.org/10.1016/j.socscimed.2020.113356

Schmidt, A.L., Zollo, F., Scala, A., Betsch, C. & Quattrociocchi, W. (2018). Polarization of the vaccination debate on Facebook, *Vaccine*, *36*(25), 3606-3612.

Simon, K., Hollander, G., McMichael, A (2015). Evolution of the immune system in humans from infancy to old age. *Proceeding of The Royal Society B.* https://doi.org/10.1098/rspb.2014.3085

Smith, N., & Graham, T. (2019). Mapping the anti-vaccination movement on Facebook, *Information, Communication & Society*, *22*(9), 1310-1327.
Smith, T. (2017). Vaccine rejection and hesitancy: A review and call to action. *Open Forum Infectious Diseases, 4*(3): ofx146

Song, G. (2014). Understanding public perception of benefits and risks of childhood vaccinations in the United States. *Risk Analysis,* 34(3), 541-555. DOI: 10.1111/risa.12114

Sutton, R.M. & Douglas, K.M. (2020). Conspiracy theories and the conspiracy mindset: implications for political ideology, *Current Opinion in Behavioral Sciences*, 34, 118- 122. https://doi.org/10.1016/j.cobeha.2020.02.015

The Health Policy Partnership (2020, December 28). *Can social media have a role in tackling vaccine hesitancy?* Available from: Can social media have a role in tackling vaccine hesitancy? – The Health Policy Partnership

United Nations Children's Fund, (2021, January 18) Coronavirus COVAX https://www.unicef.org/coronavirus/covax

US Centers for Disease Control and Prevention (2016). *Resources for Professionals. Provider Resources for Vaccine Conversations with Parents.* Available from: https://www.cdc.gov/vaccines/partners/childhood/professionals.html Accessed on 25th January 2021.

Vetter, V., Denizer, G., Friendland, L., Krishnan, J., Sharpiro, M (2018). Understanding the modern-day vaccines: what you need to know. *Annals of Medicine. 50*(2), 110-120

Wagner, A. L., Huang, Z., Ren, J., Laffoon, M., Ji, M., Pinckney, L. C., Sun, X., Prosser, L.A, Boulton, M.L, & Zikmund-Fisher, B. J. (2020). Vaccine hesitancy and concerns about

vaccine safety and effectiveness in Shanghai, China. *American Journal of Preventive Medicine*, 60(1) S77-S86.

Wiley, K., Leask, J., Attwell, K., Helps, C., Degeling, C., Ward, P., & Carter, S. (2020). Parenting and the vaccine refusal process: A new explanation of the relationship between lifestyle and vaccination trajectories. *Social Science & Medicine,* 263:113259. https://doi:10.1016/j.socscimed.2020.113259

Wolfe, R.M. & Sharp, L.K. (2002). Anti-vaccinationists past and present. *British Medical Journal, 325,* 430-432.

Wong, B. L. H., Ramsay, M. E., & Ladhani, S. N. (2021). Should children be vaccinated against COVID-19 now?. *Archives of Disease in Childhood*. https://adc.bmj.com/content/early/2021/01/04/archdischild-2020-321225

Wood, M.J. (2017). Conspiracy suspicions as a proxy for beliefs in conspiracy theories: implications for theory and measurement, *British Journal of Psychology*, 108, 507–527 https://doi.org/10.1111/bjop.12231

World Health Organisation. (2019). Ten threats to Global Health in 2019. www.who.int/emergencies/ten-threats-to-global-health-in-2019. Accessed 17 January 2021.

World Health Organisation. (2020a, September 18). Coronavirus disease (COVID-19): Schools https://www.who.int/news-room/q-a-detail/coronavirus-disease-covid-19-schools#:~:text=So%20far%2C%20data%20suggests,in%20this%20age%20group

World Health Organisation (2020b). Immunization Coverage. https://www.who.int/news-room/fact-55sheets/detail/immunization-coverage accessed January 18th, 2021.

World Health Organization (2020c). Immunization as an essential health service: guiding principles for immunization activities during the COVID-19 pandemic and other times of severe disruption. Geneva: World Health Organization; Licence: CC BY-NC-SA 3.0 IGO.

Zephoria. (2020). The Top 20 Valuable Facebook Statistics – Updated October 2020 https://zephoria.com/top-15-valuable-facebook-statistics/#:~:text=Q4%202019%20(as%20stated%20above,Q2%202019%3A%202.76%20billion