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What are vaccines and how do they work?

Vaccines contain either weakened or inactive parts of an antigen that, when injected or ingested into our body, stimulate our immune system to produce antibodies against the antigen. These ‘antigen parts’ do not cause disease in themselves. Rather, they mimic infection and, in doing so, provide our immune system with enough information to create the antibodies needed to prevent disease if we are ever exposed to the antigen in the future.^{1,2}

As vaccines are about protecting the health of individuals and communities, they ideally need to be able to do several things:

- i. prevent us from becoming infected with a disease;
- ii. prevent serious illness if we do become infected with a disease;
- iii. reduce the mortality rate caused by a disease;
- iv. in a pandemic, ease the strain on healthcare workers and healthcare systems by reducing the number of people becoming severely ill from a disease;
- v. in a pandemic, reduce the ‘knock on’ mortality rate from other illnesses due to the overloading of the healthcare system because of a disease;
- vi. prevent symptomatic and asymptomatic transmission of a disease from those who have it to those who do not have it;
- vii. provide ongoing immunity for the future.

Protecting Our Children Against Measles

Staff of the Nathaniel Centre

There is growing concern amongst health professionals about low rates of childhood immunisations against diseases such as measles, mumps and rubella. As reported in the New Zealand Herald in February 2023: “As of December [2022], 82 per cent of 2-year-olds were [up to date with their immunisations](https://www.nzherald.co.nz/nz/we-need-to-shut-it-down-new-measles-case-raises-concerns-about-falling-vaccination-rates-in-new-zealand/CD37HNFZAJCKRDSH3LJBUKKMEY/), down from 91 per cent before the pandemic. For Māori children, the rate is just 66 per cent. Coverage of 90 to 95 per cent is needed for herd immunity.” (<https://www.nzherald.co.nz/nz/we-need-to-shut-it-down-new-measles-case-raises-concerns-about-falling-vaccination-rates-in-new-zealand/CD37HNFZAJCKRDSH3LJBUKKMEY/>) The potential for a new measles outbreak was highlighted recently by a male traveller to Aotearoa New Zealand testing positive for measles. This was the first case of the highly infectious case being detected since 2019 when an outbreak grew to 2200 cases and also spread to Samoa where it killed 83 people, 87% of them children under 5 years of age. This article provides an update on the disease and backgrounds the vaccinations that are available to protect against it.

What is measles?

Measles is a viral disease of animal origin that is believed to have originally evolved from rinderpest, which infects cattle, sometime between AD 1100 and AD 1200. Current research suggests that human beings are the only natural hosts of the virusⁱ.

It is a highly infectious disease and it spreads quickly: when one person has measles, 90 per cent of the people with whom they come into close contact with will also become infected if they are not already immuneⁱⁱ.

Measles can lead to serious complications, including ear infections (1 in 12 people), pneumonia (1 in 16 people), diarrhoea (or 1 in 12 people), and encephalitis – inflammation of the brain – (1 in 1000 people) which, in turn, can lead to brain damage^{iii iv}. Other complications include immune thrombocytopenic purpura (ITP), which is a problem in blood clotting, and inflammation of the small airways in the lungs, the heart, kidneys or liver^v. Infection with measles during pregnancy increases the risk of miscarriage and premature birth^{vi}.

In rare cases (1 in 100,000 people), measles can lead to a disease of the nervous system called subacute sclerosing panencephalitis (SSPE). This is a persistent viral infection that can occur several years after infection with measles, even though the person seems to have fully recovered from the initial acute infection^{vii}. SSPE leads to the progressive destruction of the central nervous system, causing dementia, loss of motor control, epilepsy and eventually death – the condition is always fatal^{viii ix}.

As well as directly causing serious disease, the measles virus attacks the white blood cells that protect us against other diseases. During any infection by bacteria or viruses, our immune system makes antibodies to fight the infection. For many diseases, an immune memory is then created in special white blood cells called T lymphocytes. Then, if we come into contact with that disease again, these cells will remember it and react quickly to fight it, so that we do not become ill. However, measles infection destroys these special white blood cells, wiping out our immunity to diseases we have already had. This effect can last for as long as three years after the initial infection with measles, making it much more likely that people who have had measles will catch other infections, including ones they have previously had. This explains why, before a measles vaccine was available, it is estimated that measles was the direct or indirect cause of over half of all childhood deaths from infectious disease^x.

In New Zealand, more than 15 out of 100 people with measles are hospitalised^{xi}. The risk of very serious disease is greater for those with a weakened or compromised immune system as they are often unable to be immunised, relying instead on protection from those around them being immunised (herd immunity)^{xii}. It has been established that herd immunity against measles requires about 95% of a population to be immune, which is why we should be extremely concerned about the numbers of fully immunised two-year-old children in New Zealand dropping from 91% before 2020 to 84.4% in 2022^{xiii}.

Death occurs in approximately 1 in 1,000 reported cases of measles in countries with access to good healthcare infrastructure and nutrition^{xiv xv}. However, rates for death and disability are much higher in countries with poor nutrition and reduced access to healthcare services^{xvi xvii} – as many as 1 in 100 will die in the poorest regions of the world^{xviii}.

What are the symptoms of measles?

It usually takes between ten and twelve days from exposure to the virus for the first symptoms to appear^{xix}. Measles usually starts with cold-like symptoms, red eyes (conjunctivitis – inflammation in the eyes) and sensitivity to light, fever, a high temperature, and greyish-white spots in the mouth and throat^{xx}. These symptoms usually last between

two and four days^{xxi}, after which a rash usually appears, spreading from behind the ears to the rest of the body^{xxii}. The rash lasts up to one week^{xxiii}.

How is it spread?

Measles is spread through water droplets, coughed or sneezed into the air, or by direct contact with secretions from the nose or throat of infected people – for example by touching contaminated items or surfaces^{xxiv xxv}. The virus can survive for up to two hours in the air^{xxvi}. People who have measles are infectious from when the first symptoms appear until four days after the rash appears^{xxvii xxviii}.

As already noted, measles is one of the most infectious diseases known. If someone who is not immunised comes into contact with someone who has measles, it is very likely that they will catch the disease, risk developing the complications described above^{xxix}, and pass it on to others, thereby allowing the outbreak to grow.

How common is measles?

Measles is very common. Worldwide, it is still a major cause of death, especially among children in resource-poor countries^{xxx}. Very high vaccination rates are needed to prevent the spread of measles (upwards of 90 per cent of the population)^{xxxi}.

Before a measles vaccine was introduced in 1969 in Aotearoa New Zealand, most people caught measles in childhood^{xxxii}. In 2017, Aotearoa New Zealand was verified by the World Health Organization as having eliminated endemic measles^{xxxiii}. (A disease is considered endemic when it is consistently present but limited to a particular region^{xxxiv}.)

However, measles is often imported into Aotearoa New Zealand following international travel^{xxxv} and, in the wake of historically low immunisation rates, we have continued to experience devastating outbreaks of measles in recent decades^{xxxvi}, such as in 2019 when measles spread throughout the Pacific region^{xxxvii}.

Doctors have expressed serious concern about the low current rates of immunisation against measles and, in light of the recent cases that have occurred here, the Royal New Zealand College of General Practitioners is urging parents and caregivers to take the threat of this disease seriously:

Current childhood immunisation rates, especially for measles, are below the recommended level of 90 percent, and the figures are significantly lower for Māori and Pasifika tamariki, which increases the risk of poor outcomes from a potential measles outbreak.

Dr Bryan Betty, College Medical Director says, “I am deeply concerned. Measles can have devastating effects on our young ones due to the speed at which it can spread within a whānau or community, and the potential for serious complications.

“We saw this, sadly, in 2019 when 80 children tragically died from a measles outbreak in Samoa. Now the borders have reopened, there is the risk of measles being brought into the country from overseas. This, combined with falling childhood immunisation rates, makes us more vulnerable to this disease.”^{xxxviii}

How is measles treated?

There is no specific antiviral treatment for measles. Supportive care, including good nutrition, vitamin A supplements and adequate fluid intake, and hospital care when needed, can only help to manage severe complications^{xxxix}.

What is the vaccine against measles?

The vaccines that are available in Aotearoa New Zealand to protect against measles are combined with two other vaccines which protect against mumps and rubella. There are two commercial formulations offered called Priorix and M-M-R II. They are commonly referred to as the “MMR vaccines” or the “measles, mumps and rubella vaccines”. The MMR vaccines contain live measles, mumps and rubella viruses that have been weakened (attenuated). These weakened viruses stimulate the immune system to produce an immune response and immune memory to each of the viruses, but they do not cause disease in healthy people^{xi}.

The three vaccines are combined in one shot in order to increase immunisation coverage in communities^{xli}. Like measles, rubella and mumps pose their own very serious complications: For rubella, encephalitis and potential brain damage, as well as the risk of serious injury to unborn babies; for mumps, encephalitis and potential brain damage, viral meningitis, and an increased chance of miscarriage in the first trimester of pregnancy^{xlii}.

The MMR vaccine is free for children and adults born on or after 1 January 1969 and consists of a two-course dose. It is not possible to get separate vaccinations for each of the diseases in Aotearoa New Zealand, and, globally, there are no longer any manufacturers producing a single (monovalent) formulation of the rubella vaccination^{xliii xliiv}.

How effective is the vaccine against measles?

The vaccine is regarded as highly effective. Over the last twenty years, vaccination has dramatically reduced the number of deaths from measles around the world. Since 1990, it is estimated that over one in five of all child deaths averted have been due to measles vaccination. For example, since a measles vaccine was introduced in the UK in 1968, Public Health England estimates that 20 million measles cases and 4,500 deaths have been averted in the UK^{xlv}.

Before the introduction of a measles vaccine in the 1960s, major epidemics occurred approximately every two to three years and measles is estimated to have caused 2.6 million deaths each year^{xlvi}. The Measles Initiative (a global combined effort) was formed in 2001 to coordinate efforts to prevent child deaths and morbidity caused by measles.^{xlvii} Whilst there is still a long way to go before we can say that we have established global vaccination protection against measles, there has been a 73% drop in global measles cases between 2000 and 2018.

This real-life epidemiological data is supported by other scientific research: a thorough review of 124 studies assessing the effectiveness of the MMR vaccines found that for children aged 12 months and over, and as well as for adults, two doses of the vaccine were 96% effective in preventing measles (and 86% effective in preventing mumps and upwards of 89% effective in preventing rubella)^{xlviii xlix l i}.

However, research indicates that children under the age of 12 months may not develop immunity to measles after vaccination, because they are still under the influence of maternal antibodies^{lii}.

“Vaccine failure” and waning immunity following vaccination occurs in about five percent of people who have been vaccinated, and only rarely for rubella. However, research suggests that about twenty-six percent of people who are vaccinated will become susceptible to mumps ten to twenty years after vaccination^{liii}.

How safe is the vaccine and what are the potential side effects of it?

As with all medicines and medical treatments, vaccines are not 100% completely risk-free^{liv}. Nevertheless, evidence from decades of research and monitoring indicates that, on the whole, vaccinating against a given disease is much safer than not vaccinating, and that the vast majority of people can safely be given vaccines^{lv}.

The MMR vaccine has a strong safety record^{lvi}. However, it should not be given to people who are immunosuppressed because the weakened viruses in the vaccination can cause a serious infection^{lvii lviii}.

In addition to this, the MMR vaccine should not be given to people who are pregnant. Equally, people who are intending to become pregnant are advised to delay pregnancy for a time^{lix}. However, foetal damage has not been documented in cases when measles, mumps or rubella vaccines have been given to people who were unknowingly pregnant^{lx}.

Transmission of the weakened measles and mumps viruses from people who have been vaccinated to others has also never been documented^{lxi}. Excretion of the rubella virus is known to occur about seven to twenty-eight days after vaccination, but there is no evidence of transmission of this excreted vaccine virus to others^{lxii}.

Because the MMR vaccine contains three separate vaccinations, the side effects of each take place over different time periods^{lxiii}:

Very common side effects, affecting more than 1 in 10 people at each dose – redness, pain and/or swelling at the injection site.

Common side effects, affecting up to 1 in 10 people at each dose – six to ten days after vaccination some people may get a raised temperature, loss of appetite, and a measles-like rash. This can happen when the measles part of the vaccine starts to work and is normal. Symptoms last 2-3 days.

About three weeks after vaccination, around 1 in 50 people may get mumps-like symptoms (slightly raised temperature and swollen glands in the neck, cheek or under the jaw). This can happen when the mumps part of the vaccine starts to work.

The rubella vaccine can cause inflammation in joints (arthritis or arthralgia). This is rare in children but can be quite common in adult women who have the MMR vaccine. When it occurs, it usually lasts about 3 days.

Rare side effects, affecting up to 1 in 1000 people at each dose – fits (also called febrile convulsions or febrile seizures). These may occur in every 1 in 1000 doses of the vaccine. However, fits are more common as a result of measles infection than they are as a result of the MMR vaccine.

Very rare side effects, affecting fewer than 1 in 10,000 people at each dose - in about 1 in every 24,000 doses of vaccine, a skin rash of small, bruise-like spots develops up to six weeks after vaccination. This is called idiopathic thrombocytopenic purpura, or ITP, and it is a disorder that can lead to easy or excessive bruising and bleeding^{lxiv}. ITP can also occur after measles or rubella infection and is more common as a result of the diseases than as a result of the vaccine^{lxv}.

As with any vaccine, there is a very small chance of a severe allergic reaction known as anaphylaxis. Anaphylaxis is causes life-threatening breathing and/or circulation problems and must be treated with adrenaline. Healthcare workers who give vaccines know how to do this^{lxvi}.

In the 1990s, a study was published in the medical journal *The Lancet* that claimed to have found a link between the MMR vaccines and the development of autism. This sparked extensive further research. However, **no link** was ever

found despite further extensive research. More importantly, since its publication, the study in question by Wakefield and colleagues has been discredited and retracted^{lxvii}. The authors of the study were found to be guilty of ethical violations, scientific misrepresentation, and deliberate fraud^{lxviii}.

What link is there between abortion and the MMR vaccine?

The measles and mumps formulations that are part of the MMR vaccine are grown on a culture which contains chicken embryo cells and there is no link to any morally compromised human cell lines^{lxix}. There is, however, a distant, historical link between abortion and the rubella component of the MMR vaccine because the rubella formulation is grown in the laboratory using human cell lines started, many generations ago, from a foetus legally aborted for reasons unrelated to medical research.^{lxx} The cell lines involved do not contain the original cells taken from the foetus. They are made up of “descendant cells”, referred to in biomedical research as ‘immortal cell lines’ because they are artificially created and maintained in a state of continual replication under laboratory conditions. It should be noted that the vaccine itself, while grown on the cell lines, does not contain any cells or tissue from the cell lines in question.

In weighing up the moral dilemma posed by the connection between the life-saving vaccines and the historical link to abortion, a couple of points need to be made.

The first consideration is whether an ethically acceptable and proven effective vaccine alternative exists. In the case of the rubella component of the MMR vaccine, the answer to this is that there is no other proven effective alternative, in which case, the Pontifical Academy for Life decreed in 2005 that it is only right to abstain from using the vaccines in question if it can be done without causing significant risks to children and, indirectly, to the population as a whole^{lxxi}.

In the current context, it is not possible to abstain from the rubella vaccine without also abstaining from the measles and mumps vaccines. There is no doubt that such an action would pose significant risks for children and, ultimately, for the health conditions of the population.

Furthermore, it is unlikely that an ethically acceptable alternative to the rubella vaccine will ever be produced because, to do so, would ultimately require clinical trials in which the new alternative vaccine would need to be clinically tested on children without knowing what its side-effects were or the extent of its effectiveness, thus exposing the trial participants to a significant risk of serious adverse side effects, including, potentially, death.

The second consideration that needs to be noted in assessing the acceptability of the current MMR vaccine, or more specifically the rubella component, is that, critically, no new foetal tissue is needed to maintain the cell line used for its production. That is, the cell lines being used do not require further abortions for their continued existence^{lxxii}. This fulfils an important moral criterion for establishing moral justification in situations where a well-intentioned action has unavoidable negative consequences; the chosen action (being vaccinated) will not lead to further immoral outcomes (additional abortions)^{lxxiii}.

In a note on vaccines published in 2017, the *Pontifical Academy for Life* has stated that “the wrong in the moral sense lies in the actions [of those involved in the original abortion] not in the vaccines or the material itself”^{lxxiv}. This means that the use of such vaccines does not, in itself, signify moral endorsement of the vaccine production process or complicity with abortion^{lxxv}. Or, to borrow from the 2005 Statement from the Pontifical Academy for Life: “the lawfulness of the use of these vaccines should not be misinterpreted as a declaration of the lawfulness of their production, marketing and use, but is ... morally justified as an *extrema ratio* due to the necessity to provide for the good of one's children and of the people who come in contact with the children (pregnant women).” For this reason, parents can be reassured that the MMR vaccine can be used in good conscience.

Expanding further on the “proportional reason” for using the rubella vaccine, the Pontifical Academy for Life goes so far as to state in footnote 15 of the 2005 document that “parents who did not accept the vaccination of their own children become responsible for the malformations in question, and for the subsequent abortion of foetuses, when they have been discovered to be malformed.” In which case, as noted by Rev Kevin McGovern and Kerri Anne Brussen, “all things considered, then, even allowing for the current need to use ethically compromised vaccines, vaccination against rubella and other serious diseases truly is the more pro-life decision”^{xxvi}.

Conclusion

The measles virus is extremely contagious and has the potential to spread rapidly and easily. Its effects, which include pneumonia and encephalitis, can be serious and even fatal for small children, as the relatively recent outbreak in Samoa in 2019 demonstrated. In addition, there is a loss of ‘immune memory’ meaning that the protection built up by the body to other diseases is negatively compromised, increasing mortality rates in children for up to three years after a measles infection. The effectiveness and safety of the measles vaccine has been well established and has prevented millions of deaths worldwide. However, recent drops in vaccination rates around the world have seen a sharp rise in the number of cases in certain countries. It is of grave concern that, in Aotearoa New Zealand, we are currently experiencing a significant drop in the overall childhood vaccination rates. For those concerned about the links of the MMR vaccine to abortion, the Vatican has established that it can be used in good conscience by parents.

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