



WHAT IS A VACCINE?

Adjuvants

- ◆ Not all vaccines elicit a strong immune response. Typically these are vaccines made from dead or weakened bacteria.
- ◆ To boost the response, sometimes an inert chemical called an adjuvant, is added to the vaccine. The adjuvant works to make the vaccine more visible to the immune response¹.
- ◆ In the US, there are two adjuvants, aluminum and Lipid A in use².
- ◆ Both are present in very small amounts and have been shown to be safe, even in very small babies.
- ◆ As adjuvants boost the vaccine, smaller amounts of the microbe can be used.

Vaccines and Cancer

- ⇒ Some cancers are now known to be caused by viruses.
- ⇒ Therefore the use of a vaccine against a cancer-causing virus will protect against those cancers.
- ⇒ Hepatitis B virus attacks the liver and can lead to liver cancer⁴.
- ⇒ Some strains of Human Papilloma Virus cause cervical cancer^{5,6}.
- ⇒ Public Health England has reported an 86% decrease in HPV strains that cause cervical cancer since introduction of the vaccine.
- ⇒ It is reported that universal vaccination has wiped out hepatitis B infection and liver cancer among Alaska's young people⁷.

- A vaccine is a substance that is very similar to a disease-causing microbe, but does not cause that disease. But it is similar enough for the immune system to start an immune response and to produce antibodies and store the information in its immunological memory, providing us with protection should we be infected with that microbe in the future.
- Vaccines can be made of the whole microbe that has been either killed or modified so that it cannot cause disease³.
- There are four basic types of vaccine.
- A **live vaccine** is sometimes called an attenuated vaccine.
- Examples of live, attenuated vaccines are the chickenpox vaccine and the measles vaccine.
- The advantage of a live vaccine is that the immune system responds better to a live vaccine than to a killed one. Also a live vaccine is also able to reproduce itself in the body giving added stimulation to the immune system.
- **Killed vaccines** do not stimulate the immune system as strongly as live vaccines and so they usually have to be given in a number of doses in order to induce protection.
- Examples of killed vaccines include polio vaccine and the rabies vaccine. Because the microbe is killed it cannot cause the disease.
- Another type of vaccine is not made from the microbe, but from a toxin that the microbe produces and it is this that causes the disease. Examples of toxin derived vaccines are the diphtheria vaccine and the tetanus vaccine.
- The toxin, which is a protein, is inactivated by either heating it or treating it with a chemical. Once it has been inactivated it is known as a **toxoid vaccine** and can no longer cause disease
- Toxoids can be recognized by the immune system but they do not produce a strong response, so they are combined with an adjuvant (see sidebar Adjuvants).
- **Sub-unit, conjugate or recombinant vaccines** use a part of the microbe that produces a strong immune response.
- Examples of these vaccines are hepatitis B vaccine, whooping cough (pertussis) vaccine, HiB vaccine which prevents meningitis in infants, the Human Papilloma Virus (HPV) vaccine which can prevent some types of cancer and the pneumococcal vaccine which prevents pneumonia in the elderly.

Preservatives

- ◇ Some vaccines, especially those that are given to many people over a short period of time, such as flu vaccine during an epidemic, are sold in vials that contain many doses.
- ◇ This is good for the speed at which the vaccine can be administered, but it does increase the risk that bacterial contamination of the vial may occur.
- ◇ To prevent this, small amounts of anti-bacterial chemicals, called preservatives are added to each vial.
- ◇ An example of a preservative that has been used for many years is thimerosal, which breaks down in the body to ethyl mercury.
- ◇ Mercury is ubiquitous in our environment and so is one of its derivatives, methyl mercury. Methyl mercury can be damaging to the nervous system.
- ◇ Ethyl mercury from thimerosal behaves very differently than methyl mercury and its only known side effect is redness and swelling at the injection site.

References

1. CDC Vaccine Adjuvants. <https://www.cdc.gov/vaccinesafety/concerns/adjuvants.html> . Last updated September 12, 2016. Accessed on August 14, 2018.
2. National Institute of Allergy and Infectious Diseases. Vaccine Adjuvants. <https://www.niaid.nih.gov/research/vaccine-adjuvants>. Last reviewed April 4, 2016. Accessed August 14, 2018.
3. US Department of Health and Human Services. Vaccine Types. <https://www.vaccines.gov/basics/types/index.html>. Last reviewed December 2017. Accessed August 14, 2018.
4. American Cancer Society. Chronic viral hepatitis (Hep-B or Hep-C). <https://www.cancer.org/cancer/liver-cancer/causes-risks-prevention/risk-factors.html>. Last revised April 28, 2018. Accessed August 14, 2018.
5. Mayo Clinic Cervical Cancer. <https://www.mayoclinic.org/diseases-conditions/cervical-cancer/symptoms-causes/syc-20352501>
6. American Cancer Society. Human Papillomavirus (HPV) infection. <https://www.cancer.org/cancer/cervical-cancer/causes-risks-prevention/risk-factors.html>. Last revised November 1, 2017.
7. McMahon, Bulkow, Singleton, Williams, Snowball, Homan and Parkinson, 2011 Elimination of hepatocellular carcinoma and acute hepatitis B in children 25 years after a hepatitis B newborn and catch-up immunization program. Hepatology 54(3) 801-7.

Further reading

US Department of Health and Human Services. Vaccine Basics. <https://www.vaccines.gov/basics/index.html>.

National Institute of Allergy and Infectious Diseases. What is a Vaccine. <https://www.niaid.nih.gov/research/what-vaccine>