

Vaccines & immunisation

Vaccines are substances that are introduced into the body to protect people and animals from infectious diseases by stimulating the immune system. Each vaccine targets the specific microbes that cause a disease. Vaccinated individuals are protected from the disease on subsequent exposure to infection because the immune system responds very quickly to the microbes.

Immunity

If working properly, the human body can protect itself against infectious diseases. Immunisation protects a person from infection through passive or active immunity.

Passive immunity: protection is provided by antibodies from immune individuals, e.g. across the placenta from mother to baby or blood transfusion. Protection is temporary and lasts only a few weeks or months.

Active immunity: protection is provided by a person's own immune system and acquired through disease or vaccination. Protection is usually long-lasting.

Preventing disease by vaccination

Vaccines are made from dead (inactivated) or modified (attenuated live) whole microbes, or from inactivated or recombinant parts of microbes that are responsible for disease (such as toxins or surface proteins). These antigens stimulate the immune system to produce antibodies to remove the invading foreign objects. The antibodies created will be similar to those produced if the person was exposed to the disease naturally. If the vaccinated person then comes into contact with the disease-causing microbe, the immune system remembers the antibodies it produced to the vaccine and quickly makes them. Antigens from different microbes can be combined into one vaccine, such as the measles, mumps and rubella (MMR) vaccine, to reduce the number of immunisations.

Vaccines are usually given by injection, but can also be given orally or by absorption through the skin.

Adjuvants

Some antigens don't stimulate the immune system enough on their own. For these vaccines, an extra ingredient, called an

adjuvant, is added to enhance the antibody response. The most common adjuvants are aluminium-based. For example, aluminium hydroxide increases the length of time an antigen spends in the body, creating a longer, stronger immune response.

Herd immunity

Vaccines protect individuals, but they also provide 'herd immunity'. Herd or population immunity is the resistance of a group of people to infection. People who have been vaccinated are less likely to be a source of infection. This protects the small number of people who are unable to be vaccinated (because they are too young, have health problems or are pregnant), since there are not enough susceptible people to allow the disease to spread. The herd immunity thresholds (the percentage of population that needs to be immune) are quite high. Polio is 80 - 86 %, diphtheria is 85 %, and for the more infectious diseases like measles it is around 95 %. Herd immunity will only work for diseases that are transmitted between people and not for diseases that can be caught from animals or other reservoirs.

New vaccines and old problems

New diseases, adaptations of old diseases and global travel mean that novel vaccines are increasingly required. Currently, there are no vaccines to protect against the two major worldwide killers, malaria and HIV. However, recent scientific advances have increased the likelihood of developing new and better vaccines against infectious diseases. These advances include:

- ▷ increased knowledge of microbes and how they spread disease
- ▷ use of molecular biology and biochemistry for vaccine design
- ▷ better understanding of the immune system.

microbiology
awareness
campaign

MAC

The Society for General Microbiology (SGM) Microbiology Awareness Campaign (MAC) aims to highlight the important issues relating to microbiology. Through its many members, the SGM can offer impartial and expert information on all microbiological topics. Enquiries are welcome. Contact SGM, Marlborough House, Basingstoke Road, Spencers Wood, Reading RG7 1AG (t 0118 988 1830; f 0118 988 5656; e pa@sgm.ac.uk).

Design: Faye Stokes.
Editor: Janet Hurst.
Thanks are due to Darrel Burdass, SGM, Professor Richard Randall, University of St Andrews, and Dr Olivier Sparagano, University of Newcastle-upon-Tyne, for their helpful comments on the text.
© 2008 Society for General Microbiology



The history of vaccination

Vaccination is a valuable public health intervention. As early as the 6th century, there were reports from China of smallpox inoculations (called variolation), where powdered scabs from infected people were transferred to healthy individuals. Variolation was introduced to Britain from Turkey in 1721 by Lady Mary Wortley Montagu. Later, Doctor Edward Jenner (1749 - 1823) pioneered vaccine development, when he infected people with cowpox to protect them against the more serious disease of smallpox. Vaccination against smallpox became compulsory in England & Wales in 1853. In 1980, the World Health Organization announced that smallpox had been eradicated worldwide due to an immunisation programme. Eradication of polio is now well on the way.

Why vaccinate?

- ▶ vaccines protect against potentially deadly infectious diseases
- ▶ protection is usually long-lasting
- ▶ vaccination benefits individuals and the wider community (herd immunity)
- ▶ immunisation can eradicate deadly diseases (smallpox)

Vaccine preventable diseases

| Disease | Agent |
|---------------------------------------|--|
| diphtheria | <i>Corynebacterium diphtheriae</i> or <i>C. ulcerans</i> |
| <i>Haemophilus influenzae</i> B (Hib) | <i>Haemophilus influenzae</i> type B |
| meningococcal (meningitis) | <i>Neisseria meningitidis</i> |
| pneumococcal disease | <i>Streptococcus pneumoniae</i> |
| tetanus | tetanus toxin from <i>Clostridium tetani</i> |
| tuberculosis | <i>Mycobacterium tuberculosis</i> , <i>M. bovis</i> or <i>M. africanum</i> |
| whooping cough (pertussis) | <i>Bordetella pertussis</i> |
| chickenpox | varicella-zoster virus |
| 'flu | influenza virus (types A, B & C) |
| measles | measles virus |
| mumps | mumps virus |
| polio | poliomyelitis virus (types 1, 2 & 3) |
| rubella (German measles) | rubella virus |

From the UK Health Protection Agency

bacteria
 viruses

Further reading

- www.dh.gov.uk/en/PublicHealth/Healthprotection/Immunisation/Greenbook/index.htm
- www.parliament.uk/post/pn066.pdf
- www.parliament.uk/post/pn131.pdf
- www.parliament.uk/documents/upload/POSTpn219.pdf

