

BRIEFING NOTES ON VACCINES

What are vaccines?

- Vaccines cause the immune system to provide targeted and lasting protection against infection.
- Most vaccines stimulate the immune system by containing all or part of disease-causing germs (bacteria and viruses), or materials that germs produce.
- Vaccines usually contain either live or killed germs, or components of germs.
 - Live vaccines tend to cause more side effects but produce better, longer lasting protection.
 - Non-live vaccines often need additional components (adjuvants, see overleaf) to be effective.
- Vaccines are preventive - they usually need to be given before exposure to a disease- though some can be effective post-exposure (e.g. measles and hepatitis A).

Where, when and how are vaccines used?

- Most vaccines are used because the risk of disease for an individual greatly outweighs the possible adverse effect of the vaccine, and the cost of the vaccine is far less than the cost of not giving it
 - *E.g. Flu vaccines are given to those most at risk, including the elderly.*
- Vaccines may not be given to some groups because they don't work in that group, even if they are at risk
 - *E.g. Babies under 2 months old may not respond adequately to some vaccines.*
- If enough people get vaccinated, the chance of an infection circulating in the community is reduced. This is sometimes called 'population', 'community' or 'herd' immunity.
- 13 vaccines are currently routinely given throughout the UK - 15 if you count influenza and human papilloma virus (HPV) vaccine given only to girls - and of these only the MMR, rotavirus and childhood flu vaccines are live.

How are vaccines made and tested?

- Live vaccines use disease-causing germs that have been weakened (attenuated) using methods such as being passed through tissue cultures in the lab.
- In non-live vaccines, the substances that stimulate the immune system can be produced by replicating the germs, then extracting materials that the immune system recognises and will respond to.
- New vaccines for children are tested in the following order: animals, healthy adults, children, and then high risk groups (like premature babies and people whose immune systems don't work properly).
- The number of test subjects has to be very high to identify the risk of uncommon adverse effects. Some effects are so rare, perhaps 1 in 100,000, that they can only be picked up after the vaccine is introduced.
- All vaccines in the UK are consistently monitored post-release.

Where does the scientific community stand on vaccines?

- Almost everyone agrees that vaccines are one of the best measures we have to fight infections.
- There is healthy debate among scientists on specific issues with particular vaccines.
- There is a small number of doctors and medical professionals in the clinical community who are anti-vaccine for various reasons, ranging from personal experiences to belief in different healthcare approaches.

See overleaf for concerns expressed about vaccines

Side effects and safety

Choice to vaccinate

Adjuvants and mercury

Vaccine overload

Side effects and safety

Undesirable side effects of vaccines can be split between common/mild and uncommon/serious. Mild side effects such as higher temperatures affect many people, whereas serious side effects are rare. Although in 1992 two specific brands of mumps vaccine were withdrawn because they caused a form of meningitis, no entire vaccination programme has been halted in the UK owing to adverse effects.

Examples where serious side effects were identified

Clinical trials of a vaccine for **respiratory syncytial virus**, which causes bad common-cold like symptoms in children, failed in the 1960s by making children more susceptible to severe infections. The vaccine was not released.

A US vaccine for **rotaviruses**, the leading cause of diarrhoea in young children, was found to increase the likelihood of a rare bowel condition by post-release monitoring in the 1990s. The vaccine was pulled from the American market and newer vaccines have now been developed.

Allergies: Severe allergic reactions to vaccines are extremely rare, in the order of one in a million, and there is no evidence to suggest allergies to vaccines run in families. It has been suggested that vaccines can cause asthma and auto-immune responses, though there is no evidence to support such a link despite significant efforts to find any.

MMR: The debunked scare over links between the MMR vaccine and autism was sparked by a *Lancet* paper by Andrew Wakefield *et al.* This paper has since been retracted since Wakefield was found to have multiple conflicts of interest and has been struck off the Medical Register, and the research has been declared fraudulent.

Guillain-Barré syndrome (GBS): GBS is a rare condition of the nervous system that can result in temporary paralysis, possibly linked to the immune system. During a minority of vaccination programmes, cases of GBS appear to increase, though whether there is a causal relationship is not established as cases can appear to increase from post-release monitoring. However there is stronger evidence for a link with the swine flu vaccine used in USA in 1970s.

Choice to vaccinate

Some parents worry about vaccinating their children and rely instead on population immunity. The fewer the number of children vaccinated, the higher the risk of an outbreak. This has been borne out by measles outbreaks among unimmunised groups in the UK, Europe and US.

Uncommon diseases: As vaccination campaigns succeed, the diseases they target become uncommon. However, unless a disease has been globally eradicated, like smallpox, reducing vaccination rates runs the risk of letting the disease break out again. Polio has been eliminated from UK but still occurs in other countries and so until it is eliminated worldwide, immunisation against polio in the UK is still important.

Adjuvants and preservatives (e.g. mercury)

Various additives can be included in vaccines. Adjuvants are compounds included in killed vaccines to make them more effective; they are not needed in live vaccines. They encourage the body to recognise germs and may increase effectiveness up to a thousand fold. A substantial controversy erupted over claimed links between a mercury-based preservative and brain disorders which has not been supported by sound scientific evidence. Nonetheless, most vaccines in the western world have been mercury-free since 2006.

Vaccine overload

The combination of multiple vaccines into one injection has created anxiety about 'overloading' the immune system. New vaccines are always tested for safety and efficacy in combination with the normal vaccination programme.

Links to further information

Marketing authorisations (licences) for vaccines are issued by the [Medicines & Healthcare products Regulatory Agency \(MHRA\)](#).

The [National Institute for Biological Standards and Control \(NIBSC\)](#) is part of the MHRA and independently tests vaccines for release onto the EU market to ensure their continued safety and effectiveness from one batch to the next.

The [Joint Committee on Vaccination and Immunisation \(JCVI\)](#) is an independent expert advisory committee and advises Ministers on matters relating to the provision of immunisation services.



Science Media Centre

These Briefing Notes have been written by the Science Media Centre in consultation with a number of scientists, science press officers and broadcast journalists. They are not intended as a comprehensive summary on a subject, but rather a snapshot of the basics, of points of controversy and a pointer towards sources of more detailed information. They are subject to change and will be updated as and when the science moves on.

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