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Understanding vaccines: key scientific terms and platforms

Definition of common scientific terms related to vaccines

Adjuvant: a component of some vaccines such as aluminium that increases the immune response to the vaccine.

Antibody: a protein produced by the body's immune system (natural defences). Antibodies help protect the body by finding and attaching to specific unwanted substances, such as germs, in order to remove them from the body.

Antigen: a specific substance that the body can recognise as 'foreign' and against which it can produce an antibody.

Correlate of protection: a measurable sign in the body, such as a certain level of antibodies, that indicates a person is likely to be protected against a disease after vaccination.

Booster dose: an additional dose that aims to maintain protection over time.

Combination vaccine: a vaccine that combines two or more different vaccines in a single administration to protect against several diseases at once.

Efficacy vs effectiveness: efficacy describes how well a vaccine works in an ideal and controlled setting, such as a clinical trial, where the vaccine is compared with a placebo (dummy treatment) or an already approved vaccine. On the other hand, effectiveness describes how well the vaccine works in a real-world setting.

Excipients: these are inactive ingredients, like water, or sodium chloride (salt), as well as preservatives or stabilisers that help the vaccine remain stable and sterile during storage.

Immunity and herd immunity: immunity is the body's ability to protect itself against infections and diseases. We refer to herd immunity when enough people in a population have achieved immunity (protection) against an infectious disease so that the disease can no longer spread easily from person to person.

Immunobridging: an immunobridging study is a type of study that compares the immune response produced by a vaccine in one group of people with the immune response seen in another group where

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the vaccine's efficacy is already established. If the immune response (e.g. the level of antibodies) is similar in the two groups, we can infer that the vaccine will provide a similar level of protection.

Immunogenicity: the ability to make the immune system respond to a virus or bacteria. In the context of clinical studies, it refers to the ability of a vaccine to trigger the production of antibodies (or cellular response) against the virus or bacteria.

Innate immune response: the body's first line of defence. The innate immune response is not specific to a particular pathogen and does not provide long-term immune memory. Instead, it mounts a rapid, but general, response to many different threats.

Maternal immunisation (or maternal vaccination): the vaccination of a pregnant woman to protect both the mother and her newborn in the first months of life.

Multivalent (or polyvalent) vaccine: a vaccine that protects against multiple strains, variants or serotypes of the same pathogen. Depending on the number included, it may be described as bivalent, trivalent or quadrivalent.

Pathogens: viruses, bacteria, fungi, parasites and other microbes that can enter our bodies and cause infection and illness.

Plasmid: small circular fragments of DNA that occur naturally in bacteria. In vaccine development, they are commonly used as templates to produce the key ingredients of a vaccine. Plasmids are also well-established tools to produce therapeutic proteins such as insulin.

Reactogenicity: a set of common and expected side effects that follow vaccination due to the inflammatory response elicited by the vaccine. They include pain, redness, swelling or hardening at the injection site, as well as systemic (whole-body) symptoms, such as fever, muscle pain or headache.

Serotype: a distinct form of a pathogen within the same species, characterised by differences in its surface antigens.

Strain: a genetically distinct form of a pathogen, with identifiable characteristics.

Titre: a measure of the amount or concentration of antibodies present in a blood sample.

Variant: a genetically distinct form of a pathogen resulting from one or more genetic changes.

Virulence: a pathogen's ability to cause damage to a host.

Different types of vaccines

Vaccines prepare the body to defend itself against a disease. They contain an element of the virus or bacteria causing the disease. Once in the body, this activates immune cells to produce antibodies and create a memory of the virus or bacteria. Later, if the person comes into contact with the actual virus or bacteria, their immune system will remember it, and then produce antibodies and activate immune cells quickly to kill the virus or bacteria. This protects the person from the disease.

The element from the virus or bacteria used varies depending on the type of vaccine:

mRNA-based vaccine (including self-amplifying mRNA-based vaccines)

A vaccine that contains a molecule called messenger RNA (mRNA) which has instructions for making a protein from the virus or bacteria.

Example*: the COVID-19 vaccines Comirnaty and Spikevax and the RSV vaccine mResvia*

A self-amplifying mRNA vaccine also contains an mRNA molecule which has instructions for making a protein from the virus or bacteria. In addition, it has instructions to make an enzyme called replicase. This generates additional copies of the antigen mRNA. This means that more copies of the antigen will be produced. Vaccines using self-amplifying mRNA can contain a lower dose of mRNA than traditional mRNA vaccines because more copies of the mRNA are made in the cell.

Example*: the COVID-19 vaccine Kostaive*

Viral vector-based vaccine

A vaccine that contains a harmless virus, such as an adenovirus, that has instructions for making a protein from the virus or bacteria causing the disease.

Example: the previously authorised COVID-19 vaccine Vaxzevria

Inactivated vaccine

A vaccine that contains a form of the bacteria or virus that has been inactivated (killed) in a lab using for example heat, radiation or chemicals. Inactivated viruses and bacteria cannot reproduce themselves or cause illness but can still produce an immune response in the body.

Examples*: hepatitis A, some forms of flu, polio and rabies vaccines*

Live attenuated vaccine

A vaccine that contains a form of the virus or bacteria that has been weakened by changing their DNA or by growing them repeatedly in the lab. The virus or bacteria can still multiply a bit in the body, mimicking a real infection without making the person sick. Live attenuated vaccines produce a strong immune response that can last a long time. This means that fewer doses may be needed than for other types of vaccine.

Examples*: measles, mumps and rubella (MMR), smallpox, chickenpox vaccines and rotavirus vaccine*

Subunit (recombinant, polysaccharide or conjugate) vaccine

A vaccine that contains part of the pathogen (such as a protein or sugar found on its surface) that is harmless by itself but is recognised by the immune system triggering an immune response inside the body helping protect against the disease.

In some vaccines the surface sugar is linked to a carrier protein to increase the immune response to the sugar; this is known as a conjugate vaccine.

In a recombinant subunit vaccine, the part of the pathogen used to trigger the immune response is made in a lab.

Examples*: pertussis (whooping cough), hepatitis B, shingles, meningitis and human papillomavirus (HPV) vaccines*

Toxoid vaccine

A vaccine that contains toxins that have been inactivated and are therefore no longer toxic. Toxins are substances produced by bacteria that can cause some diseases, such as tetanus and diphtheria. Toxoids are made in the lab by deactivating disease-causing toxins, using for example chemicals or heat.

Examples*: tetanus and diphtheria vaccines*