Vaccines

A vaccine is a biological preparation that provides active acquired immunity against a particular infectious disease. A vaccine typically contains an agent that resembles a disease-causing microorganism and is often made from weakened or killed forms of the microbe, its toxins, or one of its surface proteins. The agent stimulates the body's immune system to recognize the agent as a threat, destroy it, and to further recognize and destroy any of the microorganisms associated with that agent that it may encounter in the future.

Vaccines can be prophylactic (to prevent or ameliorate the effects of a future infection by a natural or "wild" pathogen), or therapeutic (to fight a disease that has already occurred, such as cancer).

The immune system recognizes vaccine agents as foreign, destroys them, and "remembers" them. When the virulent version of an agent is encountered, the body recognizes the protein coat on the virus, and thus is prepared to respond, by first neutralizing the target agent before it can enter cells, and secondly by recognizing and destroying infected cells before that agent can multiply to vast numbers.

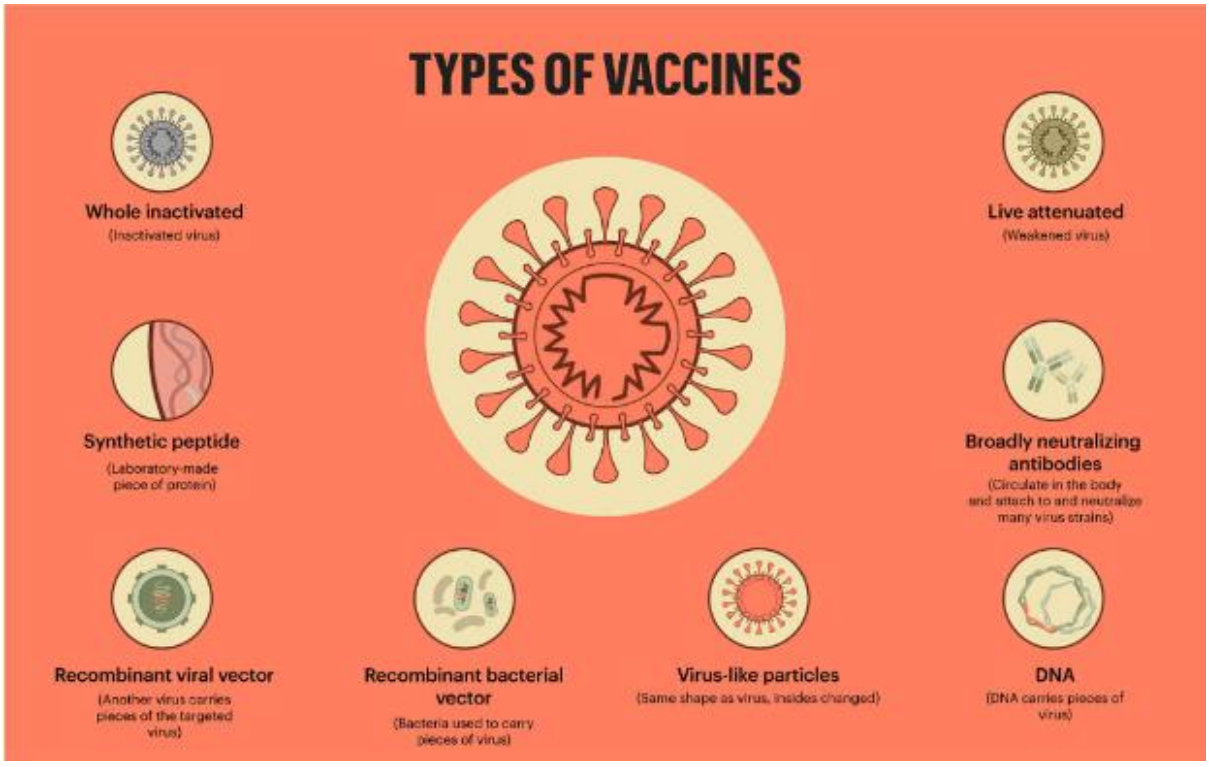
The efficacy or performance of the vaccine is dependent on several factors:

- the disease itself (for some diseases vaccination performs better than for others)
- the strain of vaccine (some vaccines are specific to, or at least most effective against, particular strains of the disease)
- Whether the vaccination schedule has been properly observed.
- Idiosyncratic response to vaccination; some individuals are "non-responders" to certain vaccines, meaning that they do not generate antibodies even after being vaccinated correctly.
- Assorted factors such as ethnicity, age, or genetic predisposition.

Limitations of Vaccines

Strategy	Example(s)	Potential limitations
Live-attenuated virus	Yellow fever 17D; Candid#1 Junin virus	Adverse events; issues with use in immunocompromised populations; reversion to virulence
Inactivated virus	Inactivated 17D vaccine;[41] inactivated Japanese encephalitis virus vaccine	Potential requirement for multiple booster vaccinations; shorter duration of protection; risk of incomplete inactivation
Recombinant virus	VSV-based Ebola vaccine;[20] Junin: TC83 virus	Immune response limited to glycoprotein, may miss protective T-cell epitopes in other viral proteins
Virus-like particle	Lassa and Ebola vaccine candidates[79,89]	Similar to inactivated virus, although without incomplete inactivation risk; lack of nucleic acid may impact activation of cellular pathogen recognition receptors
Reassortant virus	Lassa/Mopeia reassortant[25]	Limited to multi-segment viruses; requires apathogenic virus; risk of adverse events
Engineered T-cell epitope peptide	Pan-arenavirus candidate vaccine[90]	Limited to production of cytotoxic T-cell responses

Types of vaccines



Single Shot vaccines

To provide effective patient protection, many traditional vaccines require multiple injections, which results in a costly and inconvenient regimen. These

disadvantages have spurred the development of single-shot vaccines that can provide protection against infection with only one injection

The Single-Shot Vaccine Concept

The single-shot vaccine is a combination product of a prime component—antigen with an appropriate adjuvant—and a microsphere component that encapsulates antigen and provides the booster immunizations by delayed release of the antigen.

Many aspects need to be taken into consideration when developing such controlled release technology-based vaccines

1. Biodegradable technology
2. Encapsulation efficiency
3. Particle size distribution
4. Scalable process
5. Preservation of bioactivity
6. Effect of various adjuncts

Characters of single shot vaccines

➢The addition product of prime component antigen with an suitable adjuvant and a microsphere component is called as Single Shot Vaccines.
➢For increasing the therapeutic efficiency of such formulations adjuvant are used.
➢Microsphere components helps to encapsulate antigen and provide the booster immunization by delayed release antigen.

FORMULATION AND MANUFACTURING OF SINGLE SHOT VACCINE

• VACCINE ADJUVANTS

➢ Adjuvants are the substances added to vaccines to help them work better.

➢ Adding an adjuvant triggers the immune system to become more sensitive to the vaccine.

• NEED FOR ADJUVANTS

➢ To increase the therapeutic efficiency.

➢ They form depot of antigen at the site of inoculation with slow release of antigens.

➢ It can improves the performance of vaccines by targeting the antigen to APC .

Types of Adjuvants :-

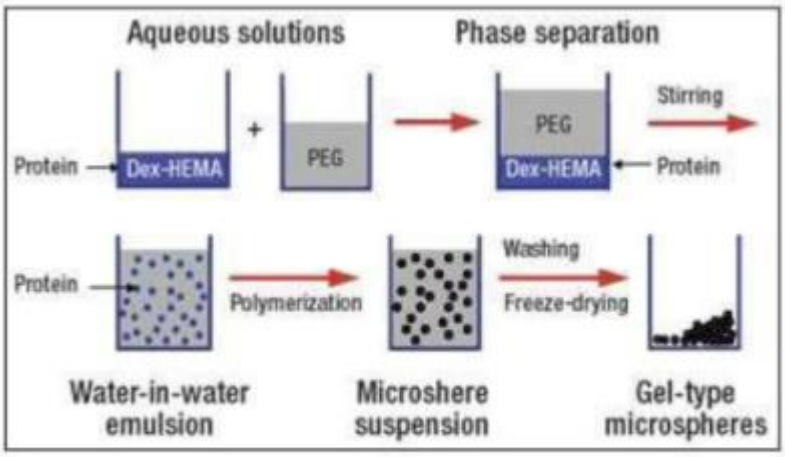
• Gel types eg. :- aluminum hydroxide, calcium phosphate.

• Oil emulsion and emulsifier Particulate based type eg :- liposomes , biodegradable microspheres.

BIODEGRADABLE POLYMERS

• Biodegradable polymers are defined as polymers comprised of monomers linked to one another through functional groups and have unstable links in the backbone.

• Broken down into biologically acceptable molecules that are metabolized and removed from the body via normal metabolic pathways .



Factor affecting antigen release

1. Polymer nature
2. Crystallinity
3. Method of preparation
4. Molecular weight of drug
5. Carrier size and morphology

Adverse effects

- Fever
- Pain around injection site
- Muscle aches

ADVANTAGES

• Economic.
• With one Injection 4 to 6 Infections can be prevented.
• Patient compliance is Improved because, they would replace the need for a prime boost regimen, consequently eliminating the repeated visits to the doctor for mother and their children.

DISADVANTAGES & RISKS

•It consists of live metabolites so itself can cause illness.
•It may stimulate the immuno response.
• Some are not as effective as Multi-dose vaccines, because infection can occur due to micro organisms.