Types of vaccine

Live attenuated (LAV)

- Tuberculosis (BCG)
- Oral polio vaccine (OPV)
- Measles
- *Rotavirus*
- Yellow fever

Inactivated (killed antigen)

- Whole-cell pertussis (wP)
- Inactivated polio virus (IPV)

Subunit (purified antigen)

- Acellular pertussis (aP),
- *Haemophilus influenzae* type b (Hib),
- Pneumococcal (PCV-7, PCV-10, PCV-13)
- Hepatitis B (HepB)

Toxoid (inactivated toxins)

- Tetanus toxoid (TT),
- Diphteria toxoid

Live attenuated vaccines (LAV)

Live attenuated (LAV)

BACTERIA
Tuberculosis (BCG)

VIRUS
Oral polio vaccine (OPV)
Measles
Rotavirus
Yellow fever

Derived from disease-causing pathogens (virus or bacteria) weakened under laboratory conditions.

The disease pathogens that are injected to the vaccine are "live" but are weakened. They cause no or only a very mild disease response.

Immunity vs. stability

enuated
V)

(BCG)

ccine (OPV)

IMMUNE RESPONSE

- Live microorganisms provide continual antigenic stimulation, giving sufficient time for memory cell production.
- Attenuated pathogens are capable of replicating within host cells.

Excellent immune response

SAFETY AND STABILITY

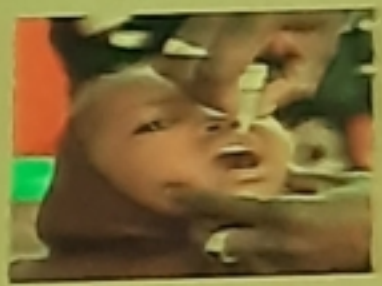
- Attenuated pathogens can revert to original form and cause disease.
- *Potential harm to individuals with compromised immune systems (eg. HIV).*
- Sustained infection (BCG – local lymphadenitis).
- Contamination of tissue culture.
- Immunization errors (*Reconstitution, cold chain*).
- Usually not given in pregnancy.

Less safe compared to inactivated vaccines

Tuberculosis vaccine (BCG)

ive attenuated (LAV)

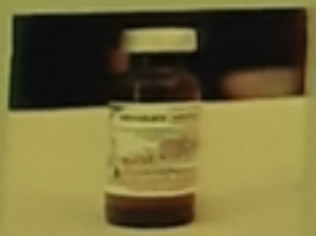
VIRUS
Oral polio vaccine (OPV)

Vaccine	Rare, more severe adverse reactions	Frequency	Comment
Oral polio vaccine (OPV) 	Vaccine-associated paralytic poliomyelitis (VAPP) *in vaccinees and their contacts*	very rare at *0.0002 – 0.0004%*	*An essential component of the global polio campaign despite adverse reactions.*

Measles vaccine

Live attenuated (LAV)

VIRUS
Measles

Vaccine	Rare, more severe adverse reactions	Frequency	Comment
Measles 	Febrile seizures	very rare at 0.0002 – 0.0004%	Adverse reactions, with the exception of allergic anaphylactic reactions, are less likely to occur after receipt of the second dose of measles vaccine.
	Thrombocytopenic purpura	uncommon at 0.3%	
	Anaphylaxis	very rare at 0.001%	Allergic reactions to vaccine components including neomycin and the stabilizers gelatine or sorbitol, may follow vaccination.

Rotavirus vaccine

Live attenuated (LAV)

VIRUS
Rotavirus

Vaccine	Rare, more severe adverse reactions	Frequency	Comment
Rotavirus 	*None reported to WHO*	–	To date, post-licensure surveillance does not indicate any increased risk of intussusception or other serious adverse reaction associated with the use of current rotavirus vaccines.

Yellow fever vaccine (YF)

Live attenuated (LAV)

VIRUS
Yellow fever

Vaccine	Rare, more severe adverse reactions	Frequency	Comment
Yellow fever (YF) 	Hypersensitivity reactions	very rare	Sensitivity to egg, which is commonly used to stabilize the vaccine, may explain at *least* some of these cases.
	Vaccine-associated neurotropic disease (encephalitis)	very rare	Infants seem more susceptible to vaccine-associated neurotropic disease than the YF-vaccinated population at large.
	Vaccine-associated viscerotropic disease	very rare in children at 0.00001%	The elderly seem more susceptible to reaction (very rare at 0.04 – 0.05) than the YF-vaccinated population at large.

Inactivated vaccines

Inactivated
(killed antigen)

BACTERIA
Whole-cell pertussis (wP)

VIRUS
Inactivated polio virus (IPV)

Derived from disease-causing pathogens (virus or bacteria) that have been killed through physical or chemical process.

Killed antigens cannot cause disease.

Considered safe and stable, with *no risk of* inducing the disease.

Immunity vs. stability

Live attenuated (LAV)

Inactivated
(killed antigen)

Subunit (purified antigen)

Toxoid (inactivated toxins)

BACTERIA
Whole-cell pertussis (wP)

VIRUS
Inactivated polio virus (IPV)

IMMUNE RESPONSE

- May not always induce an immune response at first dose.
- Response may not be long-lived, requiring several doses of vaccine.

Less strong immune response compared to live vaccines

SAFETY AND STABILITY

- Have no live components, no risk of inducing the disease.
- Safer and more stable than LAVs.

Excellent stability profile

Panasonic

? QUESTION

What is the main difference between live and inactivated vaccines from

a) Immunologic perspective

b) Safety perspective?

What could be misconceptions to these two vaccine types?

Protein-based subunit vaccines

Live attenuated (LAV)

Inactivated (killed antigen)

Subunit (purified antigen)

Toxoid (inactivated toxin)

Protein-based	BACTERIA: **Acellular pertussis (aP)**
	VIRUS: **Hepatitis B**

Present an antigen to the immune system without viral particles.

Use specific, isolated protein from the pathogen.

The isolated proteins, if denatured, may bind to different antibodies than the intended protein of the pathogen.

Panasonic

Hepatitis B (hepB)

Subunit
(purified antigen)

Protein-based

VIRUS
Hepatitis B

- Composed of a protein produced by the hepatitis B virus (HBsAg).
- *HBsAg no longer produced using infected human plasma, increasing safety and excluding risk from potential contamination.*

Vaccine	Rare, more severe adverse reactions	Comment
Hepatitis B	Very rare	Reports of severe anaphylactic reactions are very rare.

Acellular pertussis (aP)

Subunit (purified antigen)

Protein-based

BACTERIA
Acellular pertussis (aP)

- Contain inactivated pertussis toxin (protein) and may contain one or more other bacterial components.
- Pertussis toxin is detoxified, either by by chemical treatment or molecular genetic techniques.

Vaccine	Rare, more severe adverse reactions	Comment
Acellular pertussis (aP)	Same as tetanus and diphtheria toxoid vaccines.	Acellular pertussis-containing vaccines are less reactogenic in terms of mild-to-moderate reactions than wP-containing vaccines.

Conjugate vaccines

Live attenuated

Inactivated

Subunit
(purified antigen)

Toxoid

BACTERIA
Haemophilus influenzae type b (Hib), Pneumococcal (PCV-7, PCV-10, PCV-13)

Conjugate

EXAMPLES

- *Haemophilus influenzae* type b (Hib)
- Pneumococcal vaccine
- Meningococcal A vaccine

Binds polysaccharide capsule to carrier protein to induce long-term protective response.

Conjugate vaccines, however, can prevent common bacterial infections for which plain polysaccharide vaccines are either ineffective in those most at risk (infants) or provide only short-term protection (everyone else).