Post Graduate course

VMC 607: Vaccinology

History of vaccine

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VACCINE

Definition:

"A vaccine is a biological preparation that improves immunity to a particular disease. It contains certain agents that not only resembles a disease-causing microorganism but it also stimulates body's immune system recognize the foreign agents."

Characteristics of Ideal Vaccine.

- Desirable features to control a disease
  - safety and efficacy
  - cost, easy administration (e.g. orally)
  - thermal stability
  - multivalency
  - long-lived immunity

History of vaccines……

- *VACCINE- from the Latin vacca (cow)*
- *"The diary workers would never have the often fatal disease smallpox because they already have the cowpox"*

History of vaccination I.

- Variolation: against smallpox 10th or 11th century in Central Asia (India)
- 1796: Jenner used cowpox inoculation to prevent smallpox (immunization)

Edward Jenner
(May 17, 1749 – January 26, 1823)

History of vaccination II.

- Worked with anthrax and chicken cholera, developing artificially weakened microorganisms
- He gave the name vaccination (Vacca - cow in Latin) to honour Jenner's work.
- July 6, 1885: First rabies vaccination on a nine-year old boy (with Emile Roux).

Louis Pasteur
(December 27, 1822 – September 28, 1895)

History of vaccination III.

- Tetanus – first vaccine in 1890 BCG (Bacillus Calmette- Guérin) – vaccine against tuberculosis.
- First used in humans in 1921, but wide spreaded only after World War II.
- Diphtheria – first successful vaccine in 1923
- Pertussis – first successful vaccine in 1925 by Thorvald Madsen

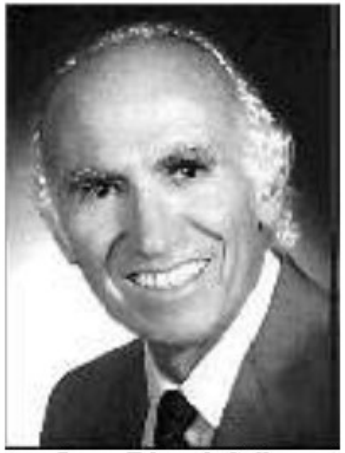
Léon Charles Albert Calmette
(July 12, 1863 – October 29, 1933)

Jean-Marie Camille Guérin
(December 22, 1872 - June 9, 1961)

History of vaccination IV.

- DTP vaccine by Kendrick –1942
- Polio vaccine by Salk – 1952
- Polio vaccine by Sabin –1961
- Measles – 1963
- Mumps – 1967
- Rubella – 1970
- Hepatitis B – 1981
- Haemophilus influenzae B –1985

1979: The world is officially smallpox-free



Jonas Edward Salk
(October 28, 1914 – June 23, 1995)

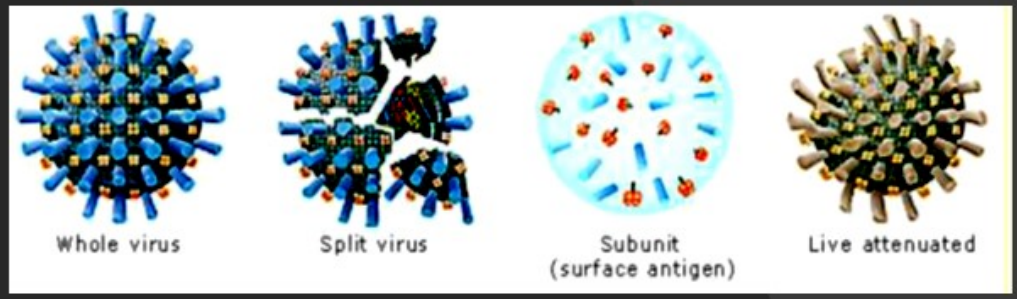
Albert Bruce Sabin
(August 26, 1906 - March 3, 1993)

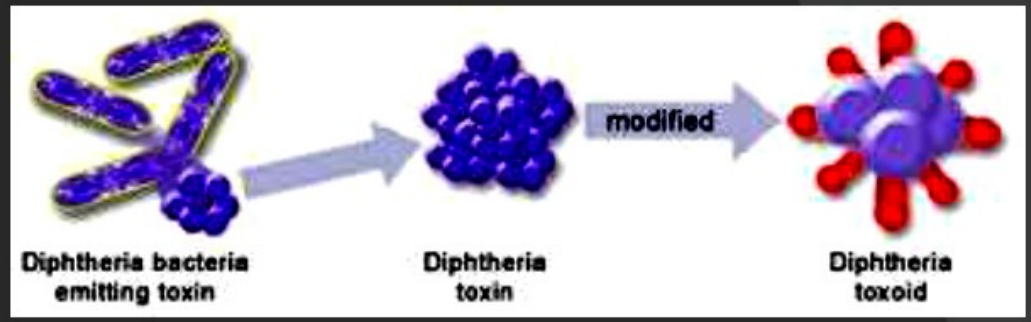
Types of vaccines I.

- **Inactivated vaccine**
- **Live, attenuated**
- **Toxoids**
- **Conjugated (Subunit) Vaccine**
- **Nucleic Acid (DNA) Vaccine**

Types of vaccines I.

1. **Whole virus vaccines** consisting of **inactivated viruses**.
2. **Split virus vaccines** consisting of **inactivated virus particles** disrupted by detergent treatment.
3. **Subunit or surface antigen vaccines** consisting essentially of **purified hemagglutinin and neuraminidase** from which other virus components have been removed.
4. **Live attenuated** (cold-adapted) virus vaccines consisting of weakened (non-pathogenic) whole virus.





Types of vaccines II.

- **Conjugate –**
  - Bacteria have polysaccharide as outer coats that are poorly immunogenic.
  - By linking these outer coats to proteins (e.g. toxins), the immune system can be led to recognize the polysaccharide as if it were a protein antigen.
  - Example: *Haemophilus influenzae* type B.

- **Recombinant vector –**
  - combining the physiology of one micro-organism & the DNA of the other
  - immunity can be created against diseases that have complex infection processes.
  - Example: HPV

Types of vaccines II.

- **DNA vaccination –**
- Works by insertion (and expression, triggering immune system recognition) into human or animal cells, of viral or bacterial DNA.
- Some cells of the immune system that recognize the proteins expressed will mount an attack against these proteins and cells expressing them.

Advantages of Attenuated Vaccines

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- Raises immune response to all protective antigens.
- More durable immunity
- Low cost
- Quick immunity in majority of vaccinees
- In case of polio and adeno vaccines, easy administration
- Easy transport in field

- Disadvantages of Attenuated Vaccines

Mutation; reversion to virulence (often frequent)

Advantages of inactivated vaccines

Gives sufficient humoral immunity if boosters given

- No mutation or reversio

Disadvantages of inactivated vaccines

- Many vaccinees do not raise immunity
- Boosters needed
- No local immunity (important)
- Higher cost
- Shortage of monkeys (polio)
- Failure in inactivation and immunization with virulent virus

Attenuated Vs Inactivated Vaccines

Attenuated	Inactivated
Method of production: Virulent strain grown under by adverse culture conditions by prolonged growth in unnatural radiation host or passage through different unnatural hosts	Virulence is inactivated chemical treatment or
Requirement of booster dose: Generally single booster dose is required	Multiple booster doses are required
Stability: Less stable resistant	More stable and to natural temperature
Type of host Immune responses: Produce both cell mediated and humoral immune response	Mainly produces humoral response
Tendency to revert: May revert to original virulent virulent strain by recombination with wild type strain or reverse mutation	Does not revert to virulent form