

# Vaccination-Strategies

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- Active immunity produced by vaccine
- Immunity and immunologic memory similar to natural infection but without risk of disease.

## **General Rule:**

The more similar a vaccine is to the disease-causing form of the organism, the better the immune response to the vaccine.

# Classification of Vaccines

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- Live attenuated
  - viral
  - bacterial
- Inactivated

## Inactivated Vaccines

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### **Whole**

- viruses
- bacteria

### **Fractional**

- protein-based
  - toxoid
  - subunit
- polysaccharide-based
  - pure
  - conjugate

## Live Attenuated Vaccines

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- Attenuated (weakened) form of the "wild" virus or bacterium
- Must replicate to be effective
- Immune response similar to natural infection
- Usually effective with one dose\*

**\*except those administered orally**

## Live Attenuated Vaccines

- Severe reactions possible
- Interference from circulating antibody
- Fragile – must be stored and handled carefully

## Live Attenuated Vaccines

- Viral                    measles, mumps,  
                                  rubella, vaccinia,  
                                  varicella/zoster,  
                                  yellow fever, rotavirus,  
                                  intranasal influenza,  
                                  oral polio\*
- Bacterial            BCG, oral typhoid

**\*not available in the United States**

## **Inactivated Vaccines**

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- Cannot replicate
- Generally not as effective as live vaccines
- Less interference from circulating antibody than live vaccines
- Generally require 3-5 doses
- Immune response mostly humoral
- Antibody titer may diminish with time

## **Inactivated Vaccines**

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### **Whole-cell vaccines**

- Viral                                      polio, hepatitis A,  
rabies, influenza\*
- Bacterial                                    pertussis\*, typhoid\*  
cholera\*, plague\*

**\*not available in the United States**

## **Inactivated Vaccines**

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### **Fractional vaccines**

- Subunit            hepatitis B, influenza,  
                          acellular pertussis,  
                          human papillomavirus,  
                          anthrax, Lyme\*
- Toxoid             diphtheria, tetanus

\*not available in the United States

## **Pure Polysaccharide Vaccines**

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- Not consistently immunogenic in children younger than 2 years of age
- No booster response
- Antibody with less functional activity
- Immunogenicity improved by conjugation

## Polysaccharide Vaccines

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### Pure polysaccharide

- pneumococcal
- meningococcal
- *Salmonella* Typhi (Vi)

### Conjugate polysaccharide

- *Haemophilus influenzae* type b
- pneumococcal
- meningococcal

### Type of Vaccines by route of administration

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<i>Type of Administration</i>	<i>Bacterial</i>	<i>Viral</i>
<b>Intramuscular</b>	Diphtheria Tetanus Pertussis (whole cell) Acellular Pertussis Plague Pneumococcal Typhoid Vi	Hepatitis A Hepatitis B <i>Haemophilus influenzae</i> b Most Flu Rabies
<b>Subcutaneous</b>	Anthrax Meningococcal Pneumococcal	Japanese Encephalitis Virus Measles Mumps Rubella Polio (IPV) Varicella Yellow Fever
<b>Intradermal</b>	BCG	Vaccinia (Smallpox) Rabies (HDCV for pre-exposure vaccine)
<b>Inhaled</b>		FluMist
<b>Oral</b>	Rotavirus Ty21a	Polio (OPV)

# **Principles of Vaccination**

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## **General Rule**

**Inactivated vaccines are generally not affected by circulating antibody to the antigen.**

**Live attenuated vaccines may be affected by circulating antibody to the antigen.**

## **Intervals and Ages**

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- **Vaccine doses should not be administered at intervals less than the minimum intervals or earlier than the minimum age**

Vaccination doesn't count

- **It is not necessary to restart the series or add doses because of an extended interval between doses**

Vaccination counts

## Vaccine Adverse Reactions

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- **Local**

pain, swelling, redness at site of injection  
common with inactivated vaccines  
usually mild and self-limited

**Systemic**

fever, malaise, headache  
nonspecific  
may be unrelated to vaccine

## Contraindications and Precautions

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**Contraindication:**

- A condition in a recipient that greatly increases the chance of a serious adverse reaction.

**Precaution:**

- A condition in a recipient that might increase the chance or severity of an adverse reaction, or
- Might compromise the ability of the vaccine to produce immunity



## **Contraindications and Precautions**

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### **Permanent contraindications to vaccination:**

- severe allergic reaction to a vaccine component or following a prior dose
- encephalopathy not due to another identifiable cause occurring within 7 days of pertussis vaccination

## **Vaccination of Pregnant Women**

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- Live vaccines should not be administered to women known to be pregnant
- In general inactivated vaccines may be administered to pregnant women for whom they are indicated

## **Vaccination of Immunosuppressed Persons**

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- Live vaccines should not be administered to severely immunosuppressed persons
- Inactivated vaccines are safe to use in immunosuppressed persons but the response to the vaccine may be decreased

## **Invalid Contraindications to Vaccination**

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- Mild illness
- Antimicrobial therapy
- Disease exposure or convalescence
- Pregnant or immunosuppressed person in the household
- Breastfeeding
- Preterm birth
- Allergy to products not present in vaccine or allergy that is not anaphylactic
- Family history of adverse events
- Tuberculin skin testing
- Multiple vaccines

## **Vaccination During Acute Illness**

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- No evidence that acute illness reduces vaccine efficacy or increases vaccine adverse reactions
- Vaccines should be delayed until the illness has improved
- Mild illness, such as otitis media or an upper respiratory infection, is NOT a contraindication to vaccination

## **What is in a vaccine?**

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### **Vaccines have :**

- Antigenic material (live attenuated, killed etc.
- Stabilizers (mono sodium glutamate, 2-phenoxy ethanol)
- Adjuvants (increase immune response)
- Preservatives (prevent fungal and bacterial growth)

(e.g antibiotics, formaldehyde and **thimerosal**)

# Thimerosal

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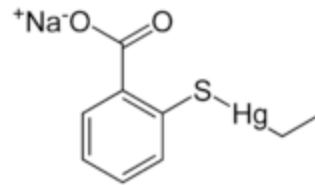
Organic mercury has antifungal and antibacterial properties.

Used in multidose vials to prevent contamination

Not needed in more expensive single dose vaccines.

No convincing evidence that thiomersal is a factor in the onset of autism?

Currently not used for recommended childhood vaccines



# Adjuvant

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- Substances that enhance the immune response
- Two categories:
  - vehicles
  - immunomodulators

## **Adjuvants functioning as vehicles I**

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- Human use:
  - Alum compounds
    - Aluminum hydroxide and phosphate
    - the only licensed adjuvants in U.S.
  - MF59
    - Oil and water emulsion
    - Marketed in Europe

## **Adjuvants functioning as vehicles cont.**

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- Animal use:
  - Freund's Complete Adjuvant (CFA)
    - desiccated *Mycobacterium butyricum*, mineral oil and an emulsifying agent, mannide monooleate
    - causes potentially severe local inflammatory lesions, chronic granulomas, abscesses, and tissue sloughs. Injected into the murine footpad, it can cause chronic lameness and arthritis; injected intraperitoneally, it can cause peritonitis
  - Freund's Incomplete Adjuvant
    - Mineral oil and Mannide monooleate
    - Fewer side effects, adequate for boosting

# Immunomodulatory Adjuvants

- Purified Protein Derivative (PPD)
- Lipopolysaccharide (LPS; bacterial endotoxin)
- Lipid A - lipid portion of LPS
- Cholera toxin B subunit
- CpG

# Immunization schedule for children

**Recommended Immunization Schedule for Persons Aged 0–6 Years—UNITED STATES • 2008**  
*For those who fall behind or start late, see the catch-up schedule*

Vaccine ▼	Age ►	Birth	1 month	2 months	4 months	6 months	12 months	15 months	18 months	19–23 months	2–3 years	4–6 years
Hepatitis B <sup>1</sup>		HepB	HepB	HepB	<i>see footnote 1</i>		HepB					
Rotavirus <sup>2</sup>				Rota	Rota	Rota						
Diphtheria, Tetanus, Pertussis <sup>3</sup>				DTaP	DTaP	DTaP	<i>see footnote 3</i>	DTaP				DTaP
<i>Haemophilus influenzae</i> type b <sup>4</sup>				Hib	Hib	Hib <sup>4</sup>	Hib					
Pneumococcal <sup>5</sup>				PCV	PCV	PCV	PCV					PPV
Inactivated Poliovirus				IPV	IPV		IPV					IPV
Influenza <sup>6</sup>							Influenza (Yearly)					
Measles, Mumps, Rubella <sup>7</sup>							MMR					MMR
Varicella <sup>8</sup>							Varicella					Varicella
Hepatitis A <sup>9</sup>								HepA (2 doses)				HepA Series
Meningococcal <sup>10</sup>												MCV4

Range of recommended ages

Certain high-risk groups