# Vaccine Hesitancy

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# Presentation Outline

An understanding of the following principles:

- Overview of immunity
- Different types of vaccines and vaccine contents
- Vaccine failures
- Time intervals between vaccine doses
- Vaccine overload
- Adverse reactions
- Herd immunity

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# Immunity

**Immunity**

- The ability of the human body to protect itself from infectious disease

**The immune system**

- Cells with a protective function in the
  - bone marrow
  - thymus
  - lymphatic system of ducts and nodes
  - spleen
  - blood

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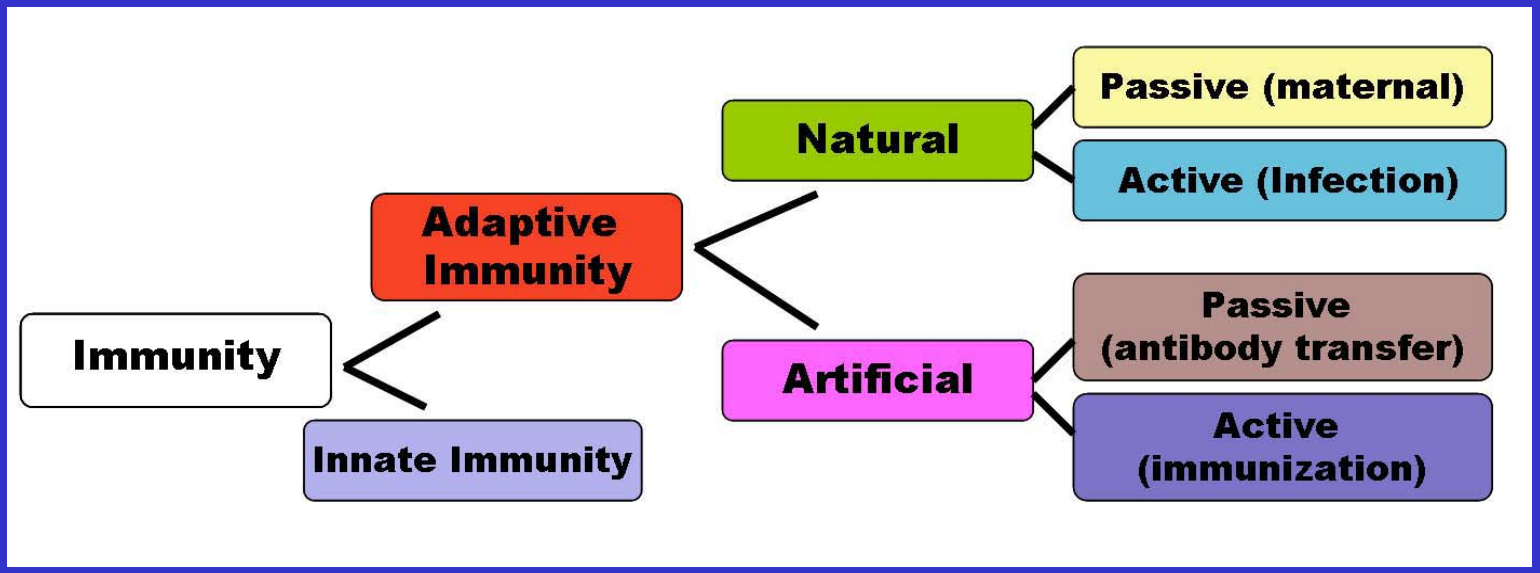
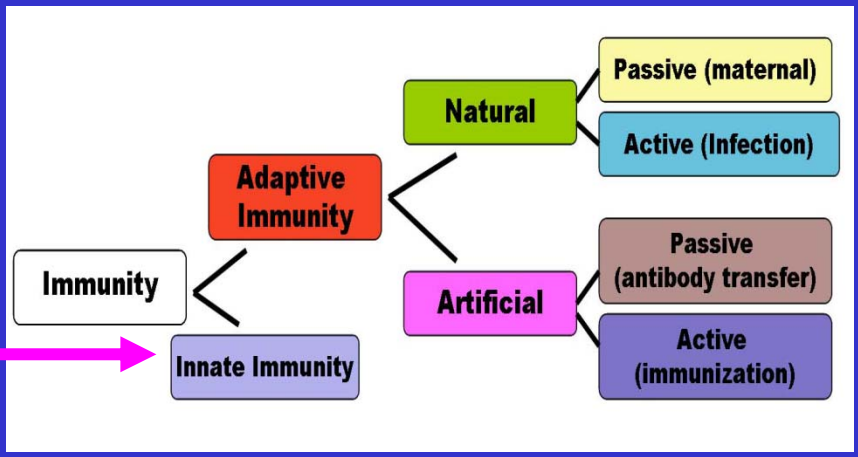
# Types of immunity




Source: http://en.wikipedia.org/wiki/Immunological_memory

# Natural (innate) immunity

Non-specific mechanisms
- Physical barriers
  - skin and mucous membranes
- Chemical barriers
  - gastric and digestive enzymes
- Cellular and protein secretions
  - phagocytes, macrophages, complement system




** No “memory” of protection exists afterwards **

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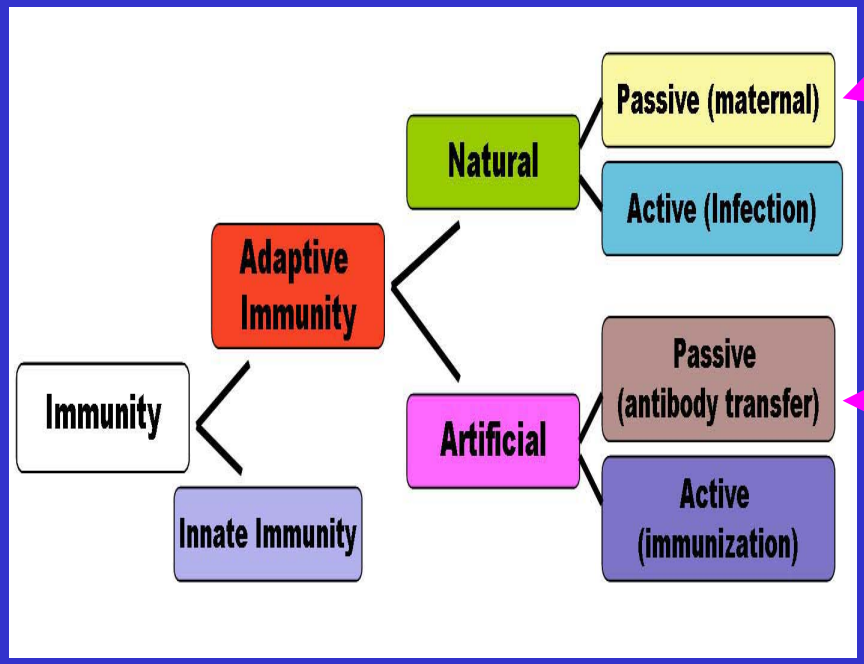
# Passive immunity – adaptive mechanisms




Natural

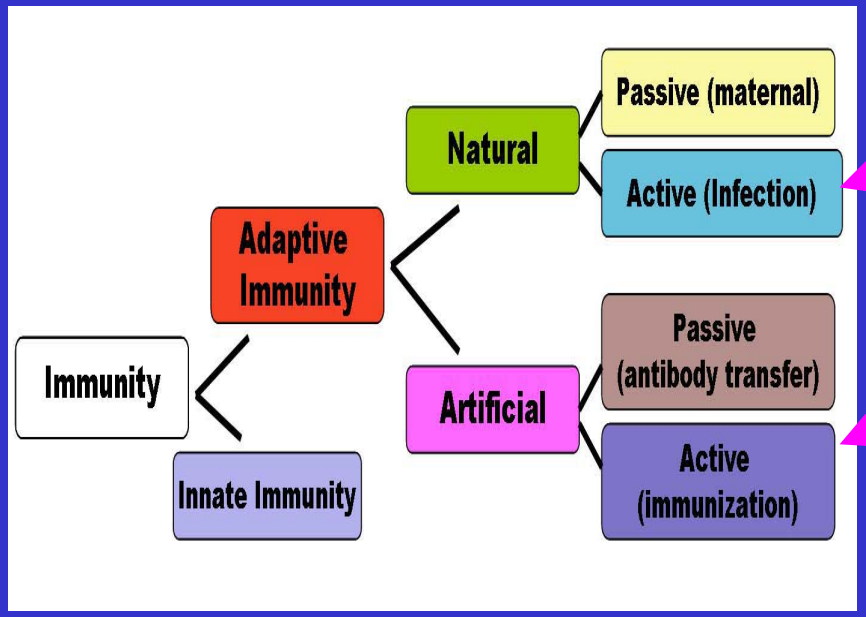
- maternal transfer of antibodies to infant via placenta

Artificial

- administration of pre-formed substance to provide immediate but short-term protection (antitoxin, antibodies)

Protection is temporary and wanes with time (usually few months)

# Active immunity – adaptive mechanisms




Natural
- following contact with organism

Artificial
- administration of agent to stimulate immune response (immunisation)

Acquired through contact with an micro-organism
Protection produced by individual's own immune system
Protection often life-long but may need boosting

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# How vaccines work

- Induce active immunity
  - Immunity and immunologic memory similar to natural infection but without risk of disease

- Immunological memory allows
  - Rapid recognition and response to pathogen
  - Prevent or modify effect of disease

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# Live attenuated vaccines

Weakened viruses /bacteria

- Achieved by growing numerous generations in laboratory
- Produces long lasting immune response after one or two doses
- Stimulates immune system to react as it does to natural infection
- Can cause mild form of the disease (e.g. mini measles which is non transmissible)
- CANNOT be given to immunocompromised persons

e.g. BCG/ MMR/ Varicella/ Yellow fever

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# Non live vaccines

- Cannot cause disease they are designed to protect against
- Doses
  - Two of more doses plus booster doses usually required
- Classified as
  - Inactivated
  - Conjugate
  - Recombinant
  - Sub unit

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## Inactivated vaccine and toxoids

- contains killed bacteria or viruses, or a portion thereof e.g. inactivated polio vaccine
- toxoids

  e.g. tetanus, diphtheria

## Conjugate vaccine

- where a protein or polysaccharide antigen is linked to a carrier protein

  e.g. meningococcal C conjugate vaccine

## Recombinant vaccine

- produced through recombinant DNA technology

  e.g. hepatitis B and HPV vaccine

## Sub unit vaccine

- contains only specific antigenic proteins of an infectious agent

  e.g. acellular pertussis and some influenza vaccines

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# Vaccine Components

- Conjugating agents
  - Carrier proteins which combine with antigens to improve immunogenicity
  - Men C, PCV, Hib
- Suspension fluid
  - Fluid (water, saline, tissue-culture mixture)
- Preservatives, stabilisers, antimicrobial agents
  - Trace amounts used to stabilise vaccine
  - May cause allergic reaction

# Vaccine Components

- Adjuvants
  - Aluminium salt used to increase immunogenicity of vaccines containing inactivated micro-organisms or their products

  e.g.
    - Hepatitis B vaccine
    - Tetanus toxoid
    - Diphtheria toxoid

# Vaccine Failure

- Primary
  - Inadequate immune response to vaccine (e.g.MMR1)
  - Infection possible any time post vaccination

- Secondary
  - Adequate antibody response immediately after vaccination
  - Level of antibodies decrease with time
  - Booster doses usually required
  - Feature of many inactivated vaccines

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# Time intervals between vaccine doses

| Antigen combination | Recommended interval between doses |
|---|---|
| MMR and Yellow Fever* | MMR and Yellow Fever should not be administered on the same day. They should be given at least 4 weeks apart |
| MMR and Varicella and zoster vaccine | Can be given on the same day, if not they should be given at least 4 weeks apart |
| BCG, rotavirus, live attenuated influenza vaccine (LAIV), MMR, oral typhoid vaccine, varicella, yellow fever, and zoster | Apart from the combinations listed above, can be given on the same day or at any time before or after each other |
| ≥2 non-live antigens | May be administered simultaneously or at any interval between doses |
| Non-live and live antigens | May be administered simultaneously or at any interval between doses |

***MMR and yellow fever. If these vaccines are given at the same time there may be reduced immune responses to the mumps, rubella and yellow fever antigens so a four week interval should ideally be left between them. If protection is required rapidly the vaccines may be given at any interval and an additional dose of MMR given at least 4 weeks later**

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# Can vaccines overload the immune system?

- The human body is composed of 10 trillion cells and contains 100 trillion bacteria
- On average there are
  - 1000 bacteria on each $cm^2$ of skin
  - 1,000,000 bacteria on each $cm^2$ of the scalp
  - 100,000,000 bacteria per gram of saliva
- The maximum number of antigens in a vaccine was ~3000 (DTwP, most from wP)
- With the new vaccines this number is much lower still
- No evidence that vaccines can overload the immune system

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# Adverse Events

Live vaccines:

- Frequency of adverse events falls with number of doses
- If antibody is made -> neutralises small amount of vaccine virus in any subsequent vaccine dose

  e.g. MMR

Non live vaccines

- Frequency of adverse events increases with number of doses
- Good antibody levels ->good secondary immune response
- May be inflammatory (i.e. produce a sore arm)

  e.g. tetanus, pertussis

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# Herd Immunity

- Only applies to diseases which are passed from person to person
- For each disease
  - a certain level of immunity in the population which protects the whole population because the disease stops spreading in the community
- Provides indirect protection of unvaccinated as well as vaccinated individuals.
- May be the most important aspect of how vaccines work
  - MMR given to infants protects pregnant women from rubella.
  - Can eradicate disease even if some people remain susceptible

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# Vaccination: It works

REDPEN/
BLACK PEN

Hey guys - I don't even feel any rain. Why are we doing this again? Just put down the stupid umbrellas - they're bad for your arms anyway.

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