Immune prophylaxis and immune therapy

Immunization – terms and definitions

- **Immunization**:
  - a procedure designed to increase concentrations of antibodies and/or effector T-cells which are reactive against infection

- **Immunoprophylaxis**:
  - Immunization performed before exposure to an infectious agent
  - It is intended to prevent the infection
  - Usually the immunizing agent is a vaccine

- I**mmunotherapy:**
  performed during an active infection
  it is intended to treat the infection
  Usually the immunizing agent is serum

Types of Immunization

- **Passive immunization**:
  - Protective Abs are introduced in the recipient to neutralize the infectious agent
  - No immunological memory; w/o T_h cells.

- **Active immunization**:
  - Induction of active adaptive immune response, with protection and memory.
  - Usually vaccines are introduced - stimulate host's immune system to produce specific antibodies or cellular immune responses or both which would protect against a disease.

How to induce passive and active immunization

Passive Immunization –

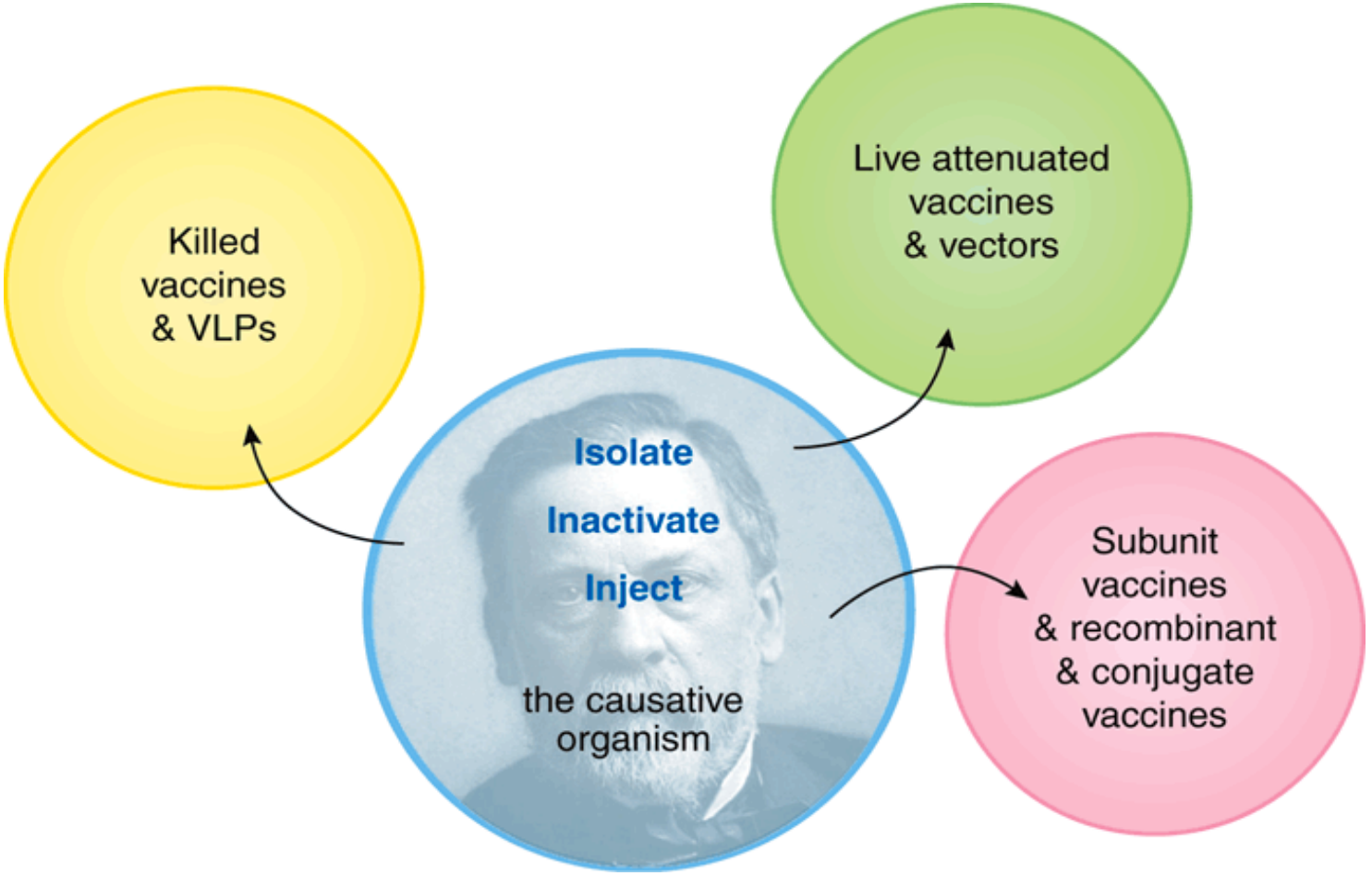
Natural - via placenta (IgG) or maternal milk
Artificial– via immune serum (human intervention)

Active Immunization –

Natural infection - after cholera, grippe…
Artificial - through vaccines (microbial substances in non-infectious form; may contain bacteria or viruses)

- Performed either by i.m. or s.c. injection of killed or attenuated antigens (often with adjuvant) or by ingestion of attenuated live organisms.
- Antibodies and/or immune competent cells are generated

Types of Vaccines



Types of Vaccines

A. Inactivated (Killed by phenol) – cholera

B. Attenuated (Live, Non-infectious)

- example: BCG
- inactivated by heat, chemicals or genetic manipulation
- it stimulates both cell mediated and antibody mediated immune responses
- Risk - it could revert back to infectious agent

LIVE Vaccines are MORE EFFECTIVE THAN KILLED

C. Toxoids

- inactivated toxins which are purified proteins
- stimulates the antibody mediated response only
- e.g. DT (diphtheria, tetanus toxoids)
- stimulate antibody mediated response only

Types of Vaccines

D. Component (subunit):

Contains purified components from bacteria and viruses instead of whole organism
Advantage: no pathogenic particles
Disadvantage: Is protein same as *in situ*? Cost!

E. Recombinant:

Hepatitis B vaccine – purified viral coat protein
Streptococcus pneumoniae– capsular polysaccharide
Hemophilus influenzae (HiB) – capsular polysaccharide,
Nesseria meningiditis – capsular polysaccharide
stimulates the antibody mediated response only

Other vaccinations terms

- **Booster Shots:** same vaccine given at a later date e.g. DT given every 10 years

  BCG
  - to refresh the memory cell population

- **Adjuvant:** chemicals in the vaccine solution that enhance the immune response
  - Alum – Ag
  - gives more time for memory cells to form

Common Vaccinations in Infants and Children

AGE	VACCINE
Birth- 2 months.	BCG and Hepatitis B (recombinant surface Ag)
2 months.	Diphtheria, tetanus, acellular pertussis (DTaP)
	Inactivated Polio virus (IPV)
	Haemophilus influenzae b (Hib-conjugate)
4 mos.	DTaP, IPV, Hib, PCV
6-18 mos.	Hep B, DTaP,Polio (IPV), Hib
12-15 mos.	DTaP, Hib
	Measles, mumps, rubella (MMR)
4-6 yrs	DTaP, IPV, MMR
11-12 yrs	DT

Combination vaccines

Examples

influenza
trivalent OPV, inactivated IPV
DPT, DPT/Hib, etc.
MMR, MMRV
PnC/MnC

Advantages:

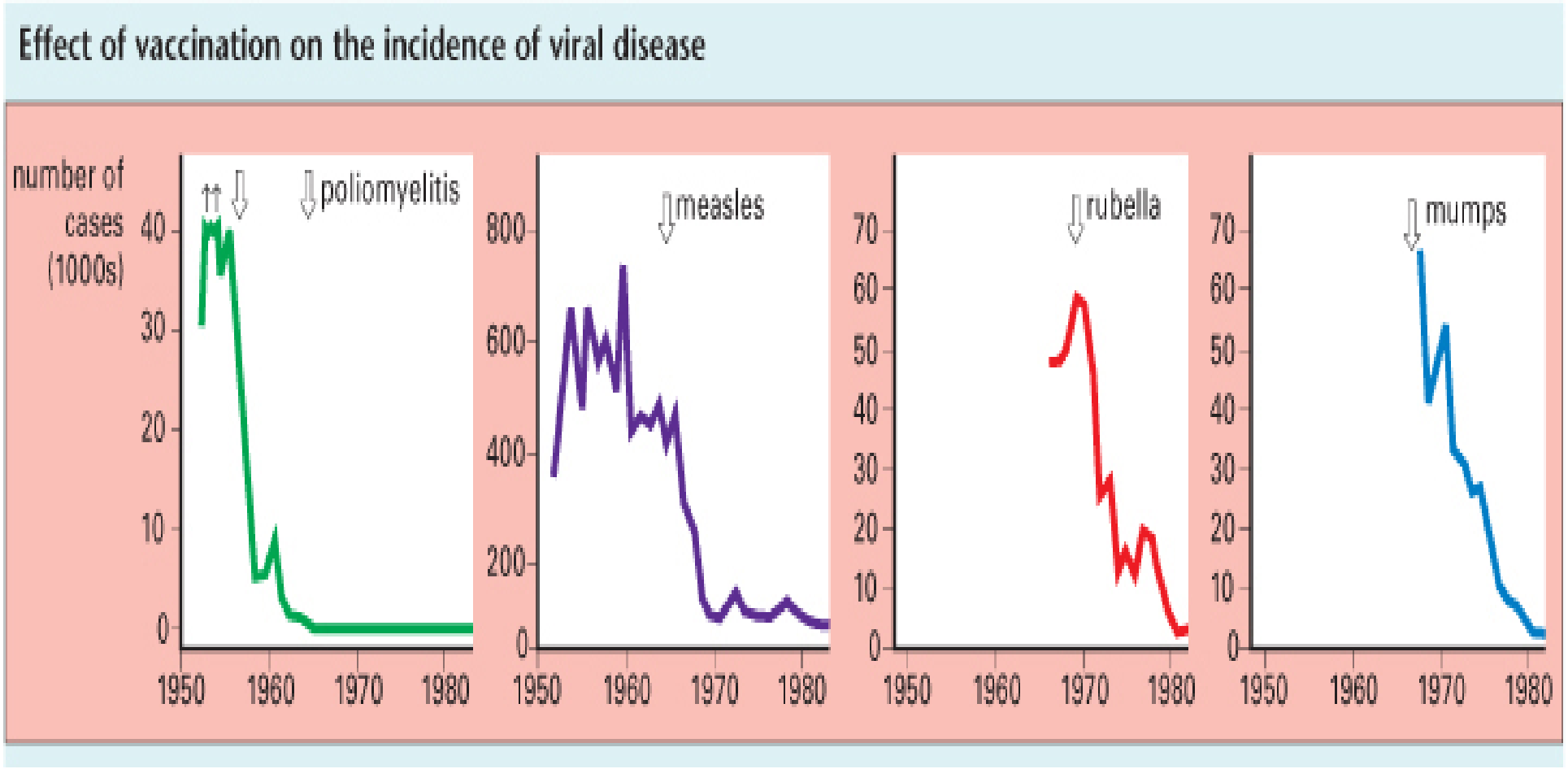
only one needle at a visit
may reduce number of visits
reduces costs of administration
geographic tailoring

Disadvantages:

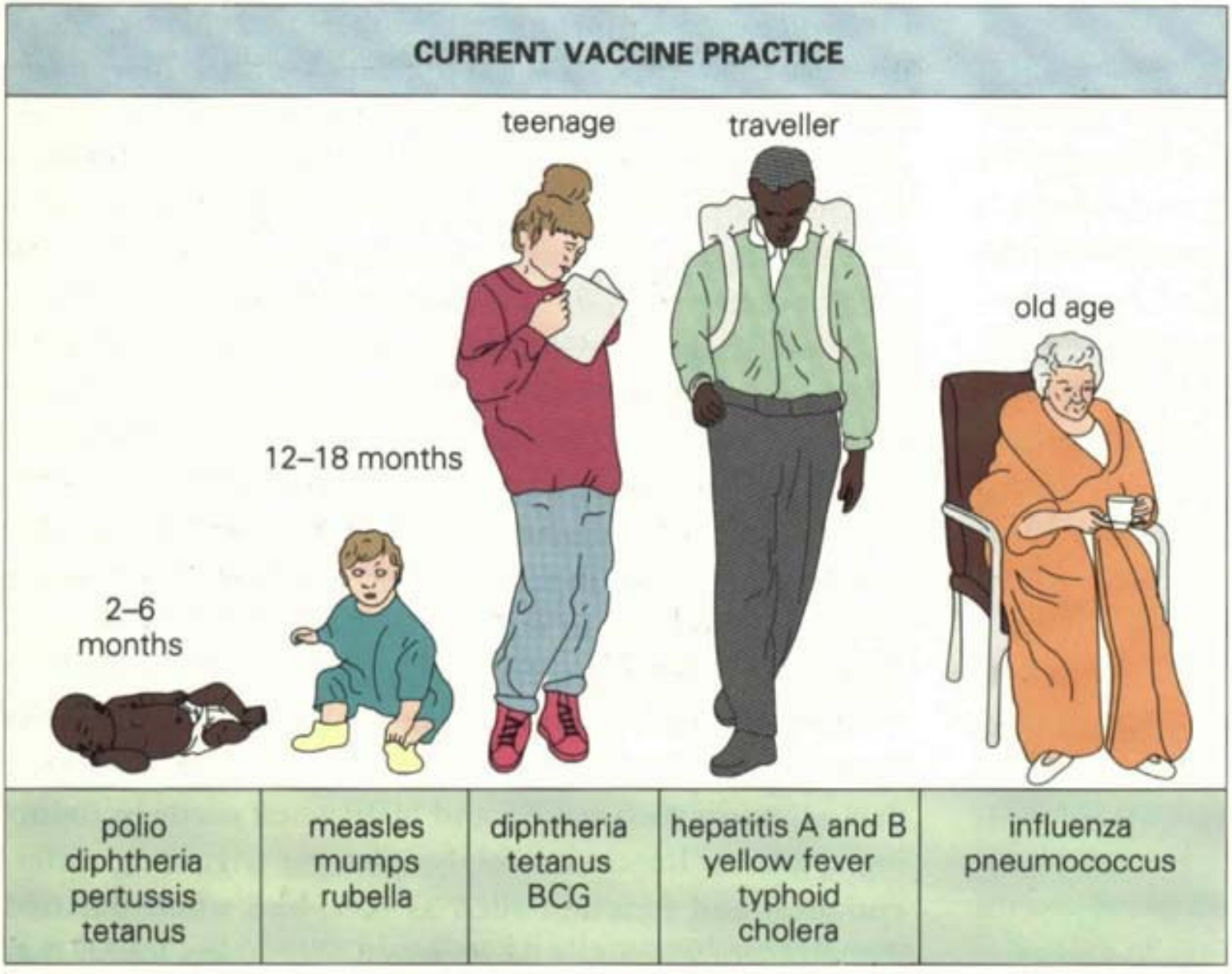
technically more difficult to produce
higher production costs
higher evaluation costs

Correlates ?

- **Humoral component**
  - Tetanus
  - Diphtheria
  - *H. influenzae*
  - *S. pneumoniae*
- **Cellular components**
  - BCG
  - Herpes type 1&2
  - Shingles (herpes zoster)
  - Influenza in elderly
  - Varicella (herpes zoster)
  - Measles



Vaccines provide an antigenic stimulus that does not cause disease but can produce long lasting, protective immunity


CURRENT VACCINE PRACTICE
2–6 months
12–18 months
teenage
traveller
old age
polio
diphtheria
pertussis
tetanus
measles
mumps
rubella
diphtheria
tetanus
BCG
hepatitis A and B
yellow fever
typhoid
cholera
influenza
pneumococcus

Immunotherapy – preformed Ab

Immune serum globulin – (gamma- globulin) contains immunoglobulin extracted from the pooled blood of at least 1,000 human donors

- Treatment of choice for preventing measles, hepatitis A and replacing Ab in the immune deficient
- Lasts 2-3 months

Immunotherapy – preformed Ab

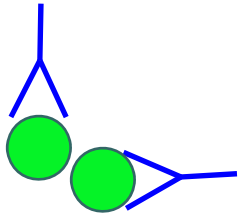
Specific immune globulin- prepared from convalescent patients in a hyperimmune state

- Contains high titer of specific Ab
- pertussis, tetanus, chickenpox, hepatitis B
- sera produced in horses are available for diphtheria, botulism, spider and snake bites
- act immediately and can protect patients for whom no other useful medication exists

Effectors functions of antibodies

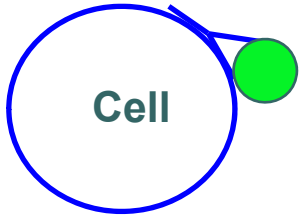
- Neutralization

reduce the pathogen load



Inhibit bacterial toxins

prevent contacts with host cell



- **Complement mediated lyses**

inhibits the pathogen penetration of the host cell

↳Complement binding ➔pathogen destruction

Antianthracis gamma-globulin

- Preparation contains antitoxins.
- It is gamma-globulin fraction of serum of the hyper-immunized animals.

What type of immunity (originally) is created in an organism after introduction?

Passive

Humoral

Antibacterial

Specific

Antidiphtherial antitoxic serum

- preparation is by hyperimmunization of a diphtherial toxoid.
- Effective mean of specific therapy of diphtheria.
- The introduction of heterogenic serum, may induce anaphylactic shock and serum illness.

What type of immunity (originally) is created in an organism after introduction?

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Sources of Passive Immunity

- Blood or blood products
- Homologous pooled human antibody (immune globulin)
- Homologous human hyperimmune globulin
- Heterologous hyperimmune serum (antitoxin)

Classification of the serum preparations

- **homogeneous serum**: serum obtained from blood donor volunteers, that have been immunized.
- **heterogeneous serum**: serum obtained from blood of animals hyperimmunized.

Hypersensitivity reactions by injection of the heterogeneous serum

- **Anaphylactic shock**

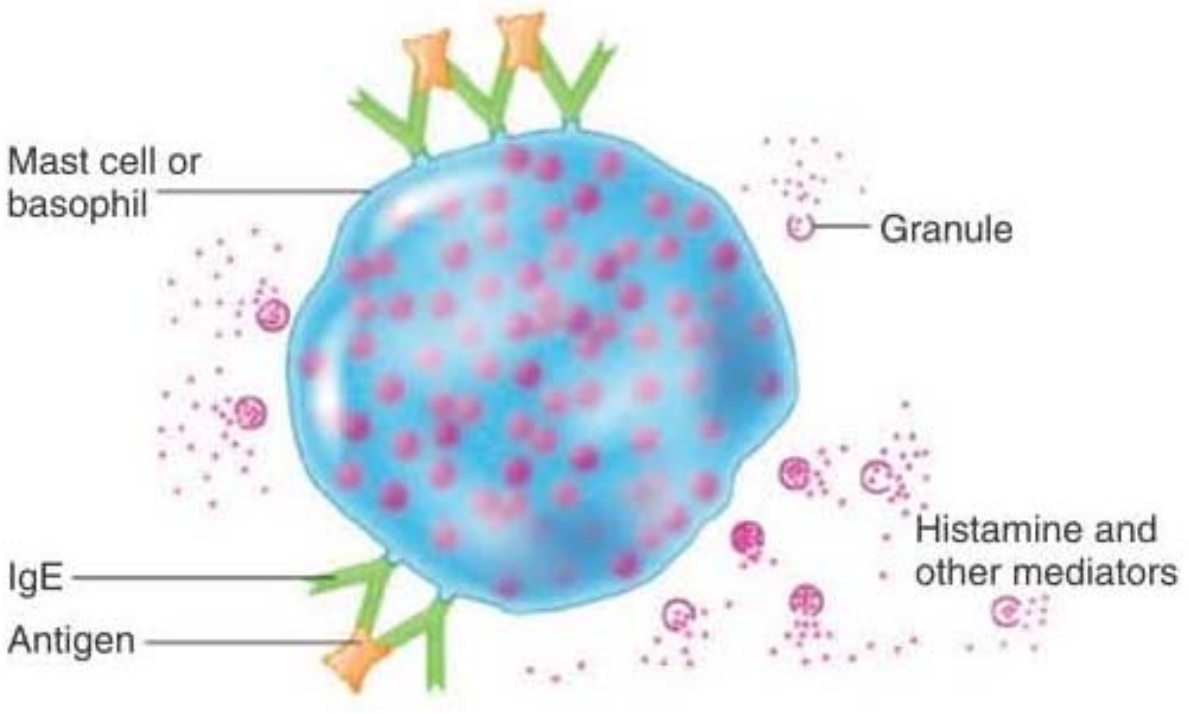
within 2 to 30 minutes after a person sensitized to an antigen.

Anaphylactic responses can be systemic reactions, which produce shock and breathing difficulties and are sometimes fatal, or localized reactions, which include common allergic conditions such as hay fever, asthma, and hives (slightly raised, often itchy and reddened areas of the skin).

- **Serum Sickness**

This is a systemic form of hypersensitivity of immediate reaction. It appears 7 to 12 days following single injection of high concentration of foreign serum

The mechanism of anaphylaxis



IgE antibodies, produced in response to an antigen (heterogenic antibody), coat mast cells and basophils. When an antigen bridges the gap between two adjacent antibody molecules of the same specificity, the cell under goes degranulation and releases histamine and other mediators.