

# Epidemiological determinants of infectious diseases

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Ústav ochrany a podpory zdraví LF MU

Spring 2018



Face lesions on boy with smallpox.  
Source: CDC/Cheryl Tyron



Chicken Pox



Polio\_lores134

Fysiological  
colonisation of  
humans  
by micro-  
organisms.

Many parts of the body are colonized by normal flora, which can be the source of endogenous infection. Large numbers of micro-organisms are found in moist areas of the skin (e.g. the groin, between the toes), the upper respiratory tract, the digestive tract (e.g. the mouth, the nasopharynx), the ileum and large intestine, the anterior parts of the urethra and the vagina.

Other routes are interhuman transmission of infections and exposure to exogenous contamination.

Fysiological  
colonisation of  
humans  
by micro-  
organisms.

Healthy newborn = germ-free organism

Gradual colonization:

- \* Skin - when passing through the mother's birth paths
- \* breathing paths - at first breath
- \* GIT - at first swallowing

... ended until the 8th day

Fysiological  
colonisation of  
humans  
by micro-  
organisms.

Permanent colonization, eumicrobia,

Types of bacteria event. fungi (never virus!)  
are for a given system:

- \* characteristic,
- \* non-pathogenic,
- \* constant composition

Fysiological colonisation of humans by micro-organisms.

Constantly restored balance between the host and the micro-organism.

Balance distorts:

- a) external changes (chemical, physical)
- b) host properties (hormonal, immune status, drugs - ATB, corticosteroids, cytostatics)

Fysiological colonisation of humans by micro-organisms.

The importance of physiological microflora

- + affects digestion, absorption, peristalsis
- + produces vitamins
- + protection of skin and mucous membranes from microbes with higher pathogenicity

Negative influence:

- the risk of endogenous infections in immunosuppressed persons
- complications of interpretation of serological examinations)

## Pathogenesis of infectious diseases

**Parasitism** - survival and multiplication of host microbes with host abuse

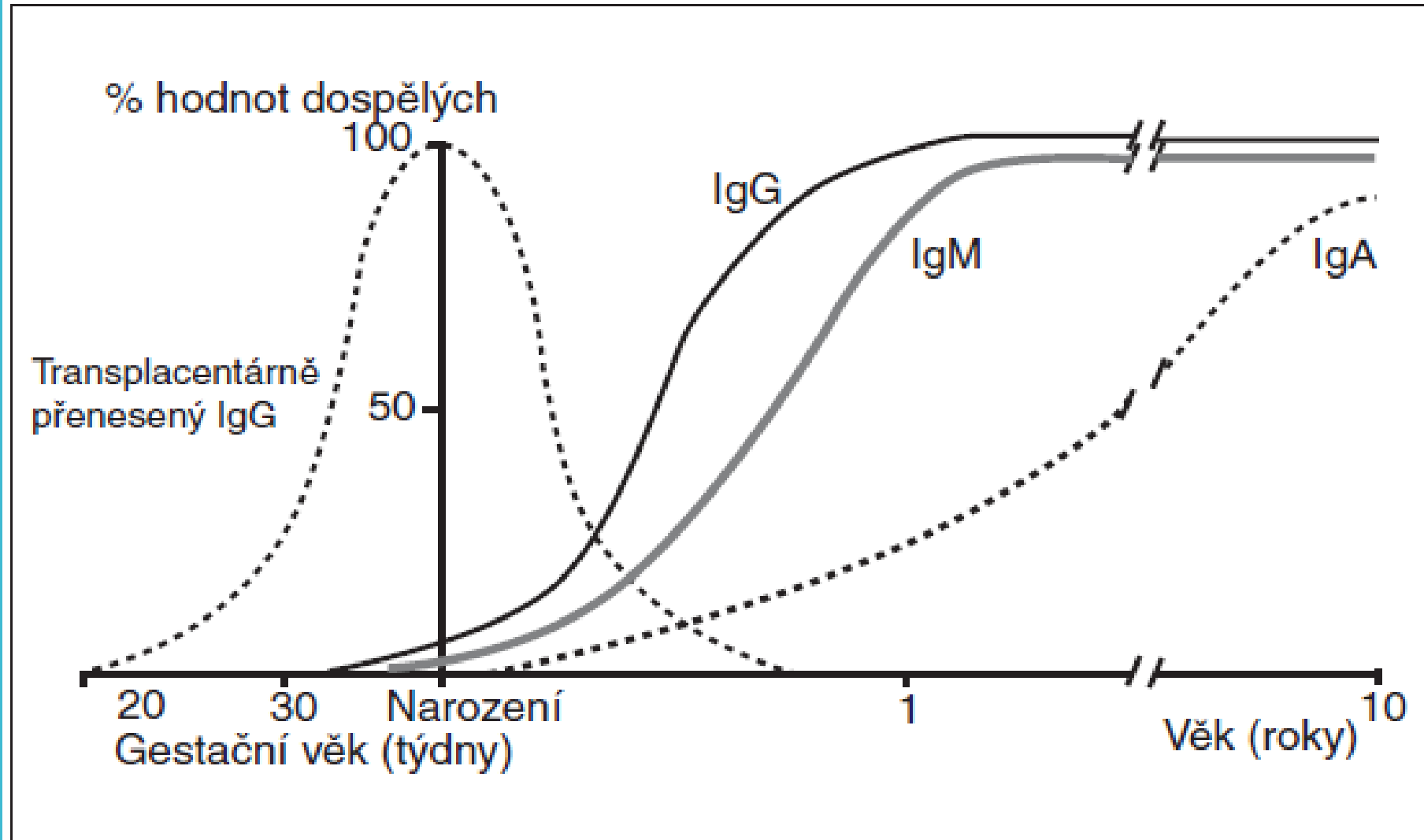
**Comensalism** - the microbe uses the host but does not damage it

**Symbiosis** - hosts and microorganisms benefit from coexistence

**Carriage** - the state of immunobiological balance

**Maturation  
of the immune  
system;  
defense.**

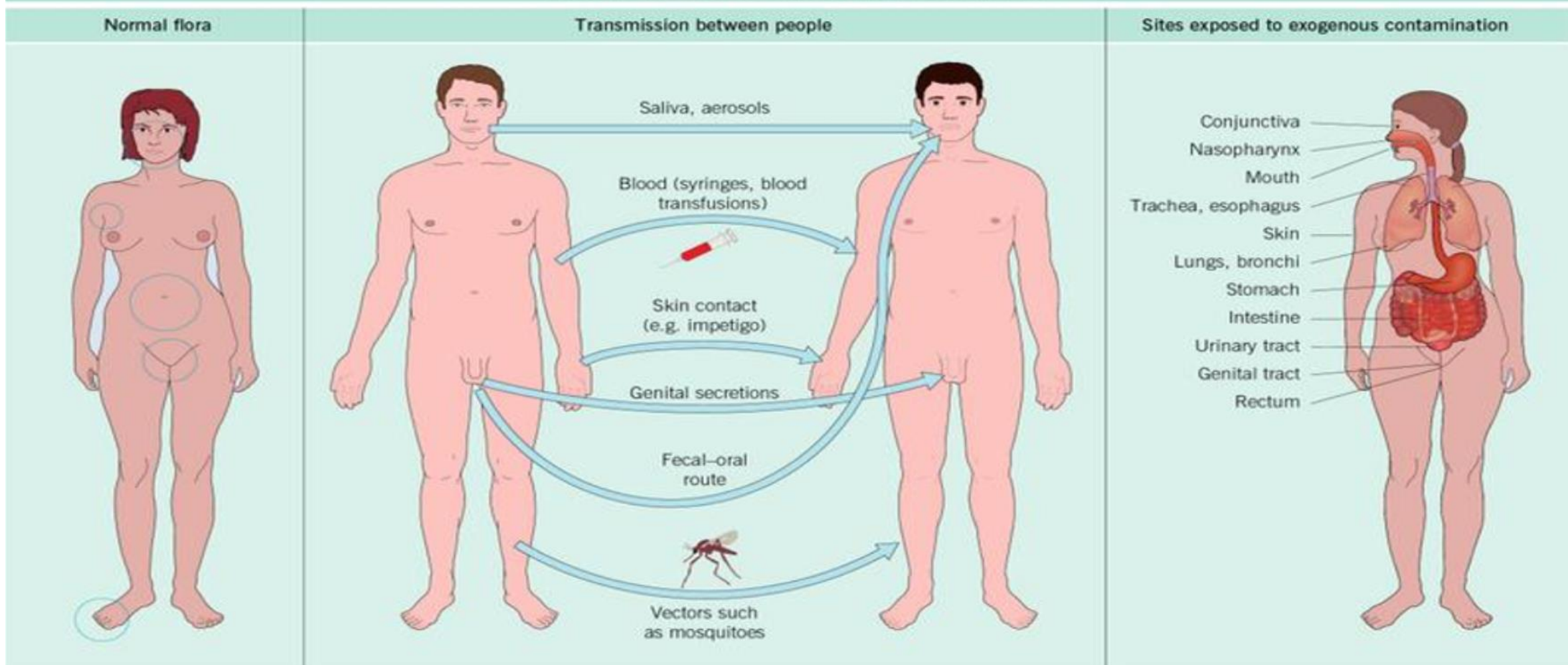
## Development of immunoglobulin levels



Šedivá A. Čes.-slov. Pediat., 2005, roč.60, č.11, s. 617-624



## CONTAMINATION OF HUMANS BY MICRO-ORGANISMS



# Etiological structure of infections

## Bacteria

- Gram positive
- Gram negative
- Acid-resistant rod .--. Mycobacteria

## Viruses

- ❖ Enveloped - HIV, HBV, measles, mumps, influenza, rabies
- ❖ Unenveloped - adenoviruses, HPV, Polio

## Prions

**Parasites** (Eukaryotic Pathogen)

**Fungi** - Candida, Aspergillus

**Protozoa** - Plasmodium, Schistosoma

**Worms** - Ascaris, Taenia

## Etiological structure of infections

The agent of infection – important characteristic:

**infectivity** – capacity to multiply in host

**pathogenicity** – capacity to cause disease in host

**virulence** - pathogenicity in a specific host

**immunogenicity** – capacity to induce specific and lasting immunity in host

**antigenic stability** – can induce long-life immunity

resistance - in environment

## Resistance of microorganisms in inanimate environment

The viability of micro-organisms and their survival in the external environment depends on:

- ❑ on their properties and
- ❑ on the environment in which they are located.  
(by combining - low temperatures,
  - lower humidity,
  - absence of toxic substances, and
  - the presence of colloidal substances that have a protective effect).

## Resistance of microorganisms in inanimate environment

Organisms vary in their capacity **to survive** and to withstand adverse environmental conditions, for example:

\* heat, cold, dryness.

Sporo-forming organisms, such as tetanus bacilli which **can survive for years** in a dormant state, have a major advantage over an organisms like the gonococcus which survive for only a very short time outside the human host.

## Pathogenesis of infectious diseases

1. entry of the etiological agent to a susceptible individual;
2. adherence of the agent to the target tissue;
3. reproduction and invasion;
4. host damage by toxins or other mechanisms;
5. exclusion of the agent through some of the biological materials
6. possible survival of agents for a long time in an inanimate external environment

## Pathogenesis of infectious diseases

Infection is the entry and development or multiplication of an infectious agent in the body of man or animals. An infection does not always cause illness.

- There are several levels of infection (Gradients of infection):
  - Colonization (*S. aureus* in skin and normal nasopharynx)
  - Subclinical or inapparent infection (polio)
  - Latent infection (virus of herpes simplex)
  - Manifest or clinical infection

For all pathogens are important **Infective** and **lethal** doses.

Virulence factors affecting their pathogenicity:

## Virulence factors

1. Pilli that ease attachment
2. Covers that interfere with phagocytosis
3. Exotoxins
4. Endotoxins
5. Proteases that degrade antibodies
6. Ability to change the antigens that escape the fragments



# Chain of infections (epidemic proces)

## THE CAUSATIVE AGENT OF INFECTION (bacteria, viruses, fungi, prions, protozoa)

1. the presence of rezervoir (source) of infection  
man, animal at the ende of incubation period  
acute stage  
carriers

2. the way of transmission A/ direct contact

touching, kissing or sexual intercourse (Staphylococcus spp., Gonococcus spp., HIV ...),  
- **vertical transmission** – from mother to fetus (VHB, VHC, HIV, listeria, rubella, cytomegalovirus...)

B/ indirect contact

- inhalation of droplets containing the infectious agents (TBC, measles, influenza...)  
- ingestion of food or water that is contaminated (salmonella, giardia, Norwalk virus, VHA....)  
- **biological transmission** by insects (malaria, borellia....)

3. the susceptibility of the population or its individual members to the organism concerned

Host factors: age, nutrition, genetics  
immunity – natural (nonspecific),  
- acquired

## THE INFECTION

= 1. prezenze of rezervoir (source) of infection

.....

is the site or sites in which a disease agent normally lives and reproduces.

May be classified as:

- **human** - at the end of incubation period, if is ill, reconvalescent, carriers – healthy, chronic diseases
- **animals** - at the end of incubation period, if is ill, carriers – healthy, reconvalescent, chronic



## The chain of infections

### 1. the presence of source of infection

## The chain of infections

### 2. the method of transmission

#### A/ direct contact

touching, kissing or sexual intercourse (Staphylococcus spp., Gonococcus spp., HIV ...),

- **vertical transmission** – from mother to fetus (VHB, VHC, HIV, listeria, rubella, cytomegalovirus...)

#### B/ indirect contact

- **inhalation of droplets** containing the infectious agents (TBC, measles, influenza...)

- **ingestion of food or water** that is contaminated (salmonella, giardia, Norwalk virus, VHA....)

- **biological transmission** by insects (malaria, borellia....)

## The chain of infections

3. the susceptibility of the population or its individual member to the organism concerned, and the characteristic of the organism itself.

## Host factors :

### Non specific immunity

Barrier action (natural barrier)

#### External barrier:

skin , mucosa

Secretion of skin and mucosa

Accessory organ

Internal barrier: placenta, blood-brain barrier

Phagocytosis

Humoral action :

Complement, Lysozyme, Fibronectin, Cytokines.

### Specific immunity

Humoral immunity

Immunoglobulin: IgG, IgM, IgE, IgA, IgD

Cell mediated immunity

## The chain of infections

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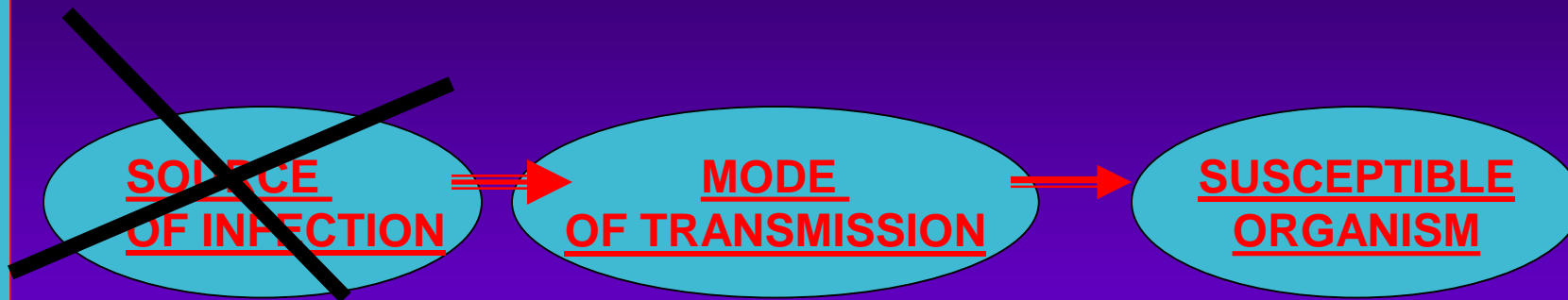
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Humoral immunity

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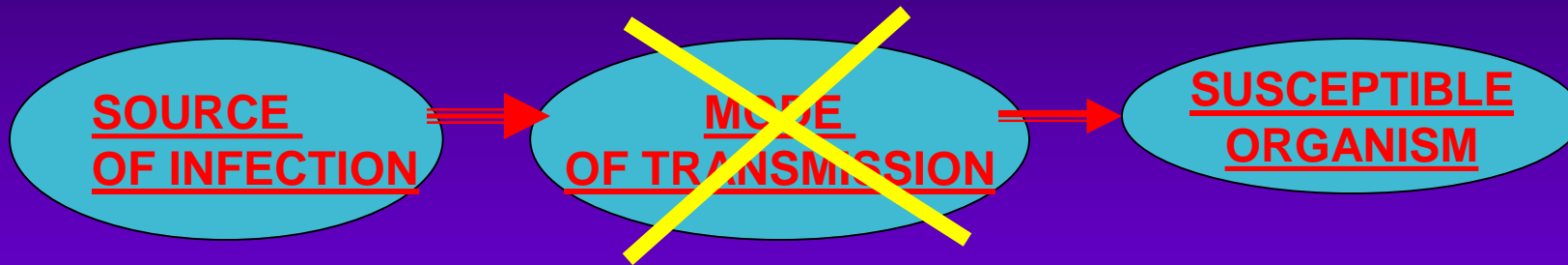
Cell mediated immunity

## Prevention of infectious diseases



### Isolation of patients:

- Dpt. of infectious diseases,
- „high degree of isolation“ (ebola)
- at home,
- barriers nursing technique



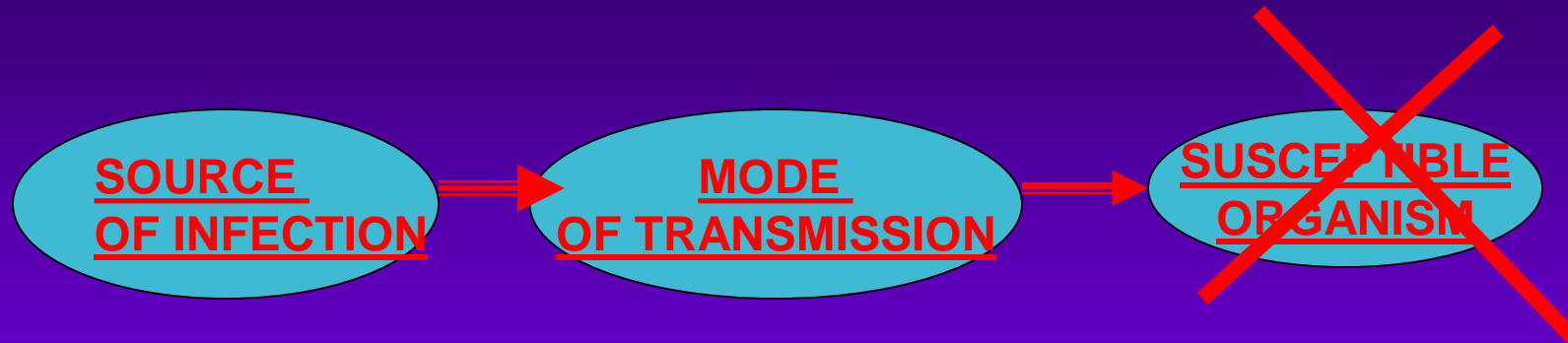
**HANDWASHING, DISINFECTION OF HANDS**

**LINEN WASHING,  
CLEANING  
GOOD PREPARING OF FOOD, SAFE  
WATER.....,  
.....**

**DISINFECTION  
STERILIZATION**

**Prevention of  
infectious  
diseases**

## Prevention of infectious diseases



*i m m u n i t y*

- natural (nonspecific),
- acquired (vaccination)



# Principles of Vaccination

## **Active immunisation**

A live or inactivated substance (e.g., a protein, polysaccharide) capable of producing an immune response is administered to the organism to target specific antibodies against that antigen.

Protein molecules (immunoglobulin) produced by B lymphocytes to help eliminate an antigen

## **Passive immunisation**

Transfer of antibodies produced by one human or other animal to another.

Temporary protection

Transplacental most important source in infancy

**Preventive,  
repressive  
measures**

If the epidemiology is known, we can interfere with transmission:

„**BREAKING THE CHAIN OF INFECTION**“

Different infections have different epidemiologies and thus require different methods of control

**Preventive,  
repressive  
measures**

In the practical part it is preoccupied with

preventive measures

repressive measures

related to infectious diseases

**The distribution of the smallpox rash is usually similar to that shown here.**

**It is most dense on the face, arms and hands, legs and feet.**

**The trunk has fewer pocks than the extremities.**



**Smallpox** is a disfiguring disease.

Three out of ten cases may die.

It is caused by variola virus.

The disease is spread by secretions from the patient's mouth and nose, and by material from pocks or scabs. It is transmitted directly from one person to the next.

Close contact with patients, or their clothing or bedding, is thus required for infection.

A patient who has developed the distinctive symptoms of smallpox will have been exposed to the virus about two weeks previously.



## Smallpox eradication

**Smallpox eradication was  
officially announced  
at the 33rd General Assembly WHO**

**8. May 1980.**