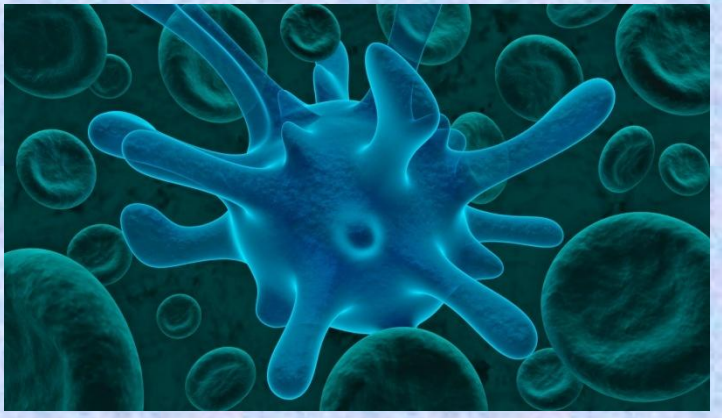
INFECTOLOGY.

CONCEPT OF INFECTIOUS DISEASE

FEATURES OF INFECTIOUS DISEASES

CLASSIFICATION

PRINCIPLES OF DIAGNOSIS, TREATMENT, PREVENTION



Actuality:

Infectious diseases are the oldest illness of mankind, but active spreading of them began with formation of the human society and development of a social lifestyle.

Infection does not lose the actuality because:

- **infectious diseases in our time remain one of the main reasons of death rate, especially in developing countries (more than a quarter of all deaths today are linked to infectious diseases);**
- **infectious diseases have various consequences for individuals, their families, as well as their communities;**
- **infectious diseases lead to:**
  - **shortening of lifetime,**
  - **numerous deaths in population (at mass outbreaks),**
  - **significant economic loss**

Actuality:

- rapid spreading and globalization;

For example, as early as humans were moving, they were taking germs with them. And looking at history, we find that diseases were spread throughout various continents.

1) For example, there was a Plague of Justinian around 541 after the common era, which killed many throughout Europe.

There was also the bubonic plague, which took the lives of 25 million people (1/3rd of the population in Europe at the time)

2) Epidemic of cholera caused the deaths of 20 million people.

3) The incidence of Typhus always increases in periods of national disasters (wars, earthquakes, floods, etc.)

4) A lot of people (500 million) suffered in the first pandemic of influenza A and 20 million of them died.

Infectious diseases are cause nearly 25% of human deaths every year

Global mortality from infectious diseases fluctuates:

-acute respiratory infections	- 3,500,000 persons
- HIV- infection	- 2,250,000 persons
-GIT – infection	- 2,250,000 persons
-tuberculosis	- 1,500,000 persons
-malaria	- 1,100,000 persons
-measles	- 888, 000 persons
-tetanus	- 410, 000 persons
- whooping cough	- 350, 000 persons
- meningitis	- 143, 000 persons
-leishmaniasis	- 42, 000 persons

Two billion people are infected with tuberculosis,

250 – 300 million people get malaria every year,

200 million are infected with schistosomiasis etc.

Long period of time the cause of infectious diseases (ID) was unknown, it led to the formation of many theories and assumptions.

Primary infection was associated with the concept of "miasma"– toxic transpirations of air.

In the16th centure has been proven that transmission of ID possible among the people ("man to man"),

that promoted to the appearance of version about existence "contagio"- pathogenic material of the onset of diseases

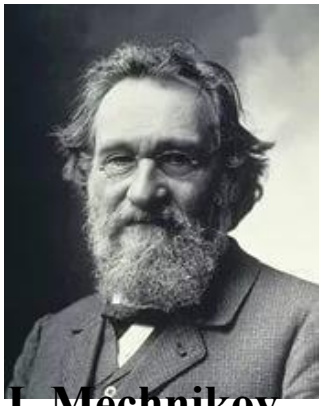
(D.Fracastoro 1546) and D. Samoylovich (1784)

R. Koch

L. Pasteur

P. Erlich

G. Minch



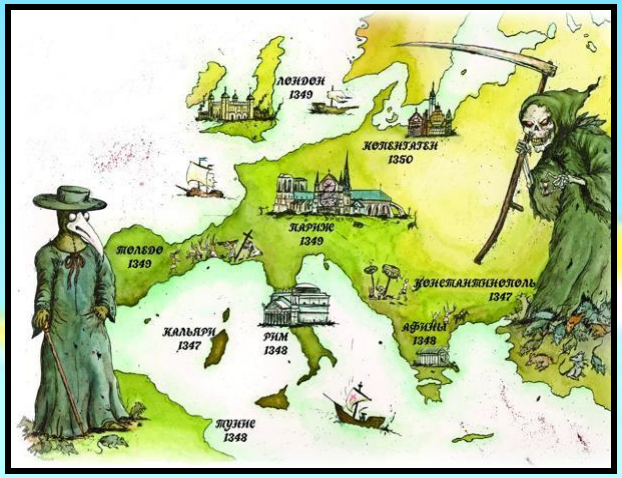
I. Mechnikov

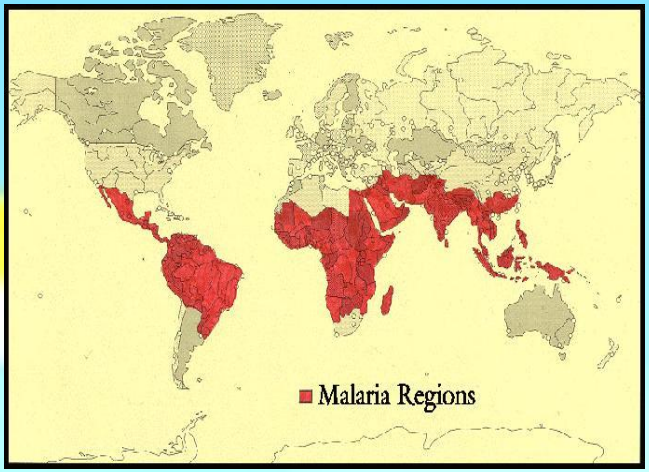
The veritable etiologic cause of many ID was detected only in the 19-th centure (It was period of fast development of bacteriology and immunology) due to discoveries of R. Koch, L. Pasteur, P. Erlich, G. Minch and I. Mechnikov and etc.

Nowadays many infectious diseases are well investigated, and methods of their diagnostics, treatment and prophylaxis had elaborated.

Therefore majority of epidemics are in the past, and can be registered as sporadic cases or morbidity.

Despite the appearance of new infectious diseases (HIV-infection, Marburg, Lassa and Ebola hemorrhagic fevers, Lyme disease etc.) many territories of earth were released from more infections capable to epidemic distribution, but there remains the constant threat of their penetration into the country from adverse regions.
There is described about 2500 infectious pathogens, but the doctor more common with 40 to 50 infectious diseases.





Infection (*infectio, pollution*) - is penetration of a pathogen (infectious agent) in sensitive organism followed by their interaction.

Infection – is a complex interaction between microorganism and macroorganism in special conditions of environment (can be physiological and pathological reactions).

Infectious process – is combination of pathological, protective, adaptive and compensatory reactions of micro - and macroorganism proceeding on submolecular, molecular, subcellular, cellular, tissue and organ levels.

Outcome depends on factors:

- **properties of the pathogen,**
- **protective barriers of the macroorganism**
- **immune status.**

Variants of outcome:

- **destruction of organs, cells and tissue,**
- **complete death of macroorganism,**
- **complete elimination of the pathogen with subsequent formation of stable specific immunity (more often),**
- **incomplete eradication of the agent and formation of carrier state or chronization**

Infection (by distribution):

- **Generalized**

(when causative agent migrates to various organs and systems during the disease);

- **Localized**

(when pathogen is located within one organ or system during the entire infectious process):

- **Epysomatic - lesions of the skin and external mucous membranes);**
- **Endosomatic – damage of internal organs (dysfunction, destruction)**

(RS, GIT, UGS, NS, system blood and lymph circulation, musculoskeletal system)

Mono-infection – infection caused by only one pathogen;

Mixed-infection – caused simultaneously by several species of the pathogen (viral hepatitis B and D);

Autoinfection - caused by conditionally-pathogenic flora of the body. It is based on a dysbiosis. Often develops in the tonsills, colon, RT and skin;

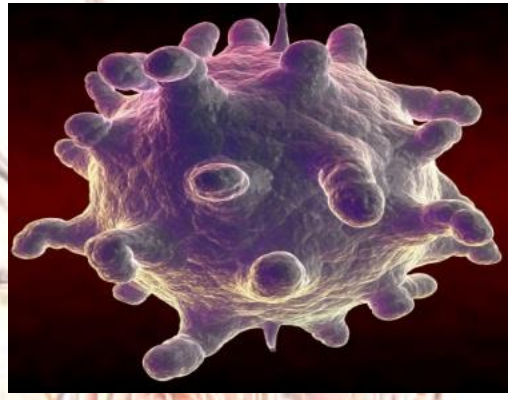
Associated infection – combined effect of multiple pathogenic agents in the body (simultaneous or sequential);

Reinfection - repeated disease that develops due to infection with the same pathogen;

Superinfection – infection caused by other agent until recovery from the primary disease.

Factors of infectious process

Pathogen



Macroorganism

Environment

Microorganism

- determines the specificity, severity, clinical course of the disease, influence the duration, complications and outcomes.

The agent causing a disease must have the following properties:

1) Pathogenicity - is ability to cause disease at optimal conditions for the agent (sufficient infectious dose, time of exposure, place of invasion).

This is usually a constant property, but is not absolute and invariable value.

To this sign mark out:

-pathogenic infectious agents;

-conditionally – pathogenic infectious agents;

- nonpathogenic infectious agents (saprophytes).

Primary factors of pathogenicity:

Virulence - is a measure of pathogenicity, individual property of a particular strain of the pathogenic agent.

Invasiveness – is ability to penetration and dispelling in tissues with the help of enzymes : neuraminidase, mucinase, hyaluronidase, fibrinolysinum, DNA- ase, collagenase etc.

Toxigenicity - is ability to synthesize of exotoxins:

diphtheria toxin - has inhibition of protein synthesis,

C. tetani and C. botulinum – have neurotoxicity,

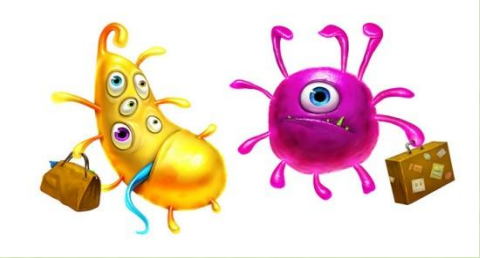
E.coly and Vibrio cholerae – have enterotoxicity

Primary factors of pathogenicity:

Adhesiveness - is ability of fixing to cells using hydrophoby, electric charge, specific receptors (HIV-infection - receptor CD4)

Tropicity - is a selective interaction and destruction of the host tissues (VH – damage of hepatocyte, at ARVI – damage of RT epithelium)

Antigenic mimicry - is presence of microbial antigens, which crossly react with antigens of the host, causing decrease an immune answer with subsequent unfavorable current of the disease (it is detected at plague, influenza, acute intestinal diseases)



Entrance gate

- the point of entry of the pathogen into the body

(Example: skin – malaria, erysipelas, typhus, tetanus; respiratory system – flu, meningococcal infection; blood - dysentery, typhoid fever).

Route of penetration of microorganism in the host:

- **skin (tetanus, rabies, erysipelas)**
- **respiratory tract (influenza, diphtheria)**
- **gastro-intestinal tract (dysentery, amebiasis)**

Route of spreading of microorganism inside the host :

- **by contact way (tick- borreliosis, diphtheria, antrax)**
- **via lymphatic vessels (erysipelas, tissue helminthiases)**
- **via blood vessels (typhus, hematosepsis, malaria)**
- **perineuraly**

Macroorganism

The organism has nonspecific and specific factors of protection against infectious agents:

Nonspecific factors of protection:

- **impenetrability of skin;**
- **normal microflora of organism (GIT, RT, UGT)**
- **high acidity of gastric juice;**
- **secretion of slime by epithelium and mechanical remove of agent;**
- **constant presence of active substance in mucosa secret (lysozyme, properdin and other enzymes);**
- **phagocytosis and complement system, interferons, lymphokines, hydrolyzing enzymes;**
- **balanced feeding, normal lifestyle and absence of chronic intoxication**

Specific factors of protection:

- Prodaction of antibodies;

- Reactions of hypersensitivity (early);

- Delayed reactions of hypersensitivity;

- Immunological memory;

- Immunological tolerance;

-Idiotype - antiidiopathic interaction.

Environment

Negative influence of environment:

On microorganism:

- high or low temperature;
- desiccation;
- radiation and insolation;
- disinfectant drugs;
- antagonism between other microorganisms

On macroorganism:

- low temperature and high humidity – promotes rapid development of ARVI;

- low acidity of a stomach – risk of development of intestinal infection;

- deterioration of an ecology;

- social factors

Infectious disease - is a human pathology caused by pathogenic microorganisms (viruses, bacteria and protozoa).

Infectious disease develops as a result of interaction between two biological systems (macro - and microorganism).

Infectious disease - the highest degree of severity of infectious process (maximum expressed manifestation), when the pathological reactions prevail over compensatory reactions therefore is broken homeostasis of organism.

FACTORS CONTRIBUTING TO THE SPREAD OF INFECTIOUS DISEASES

1) overpopulation of the planet,
2) urbanization and migration,
3) anthropogenic impact on nature,
4) ecological changes in the environment,
5) natural and social disasters,
6) increased incidence of immunodeficiency states

Features of infectious diseases

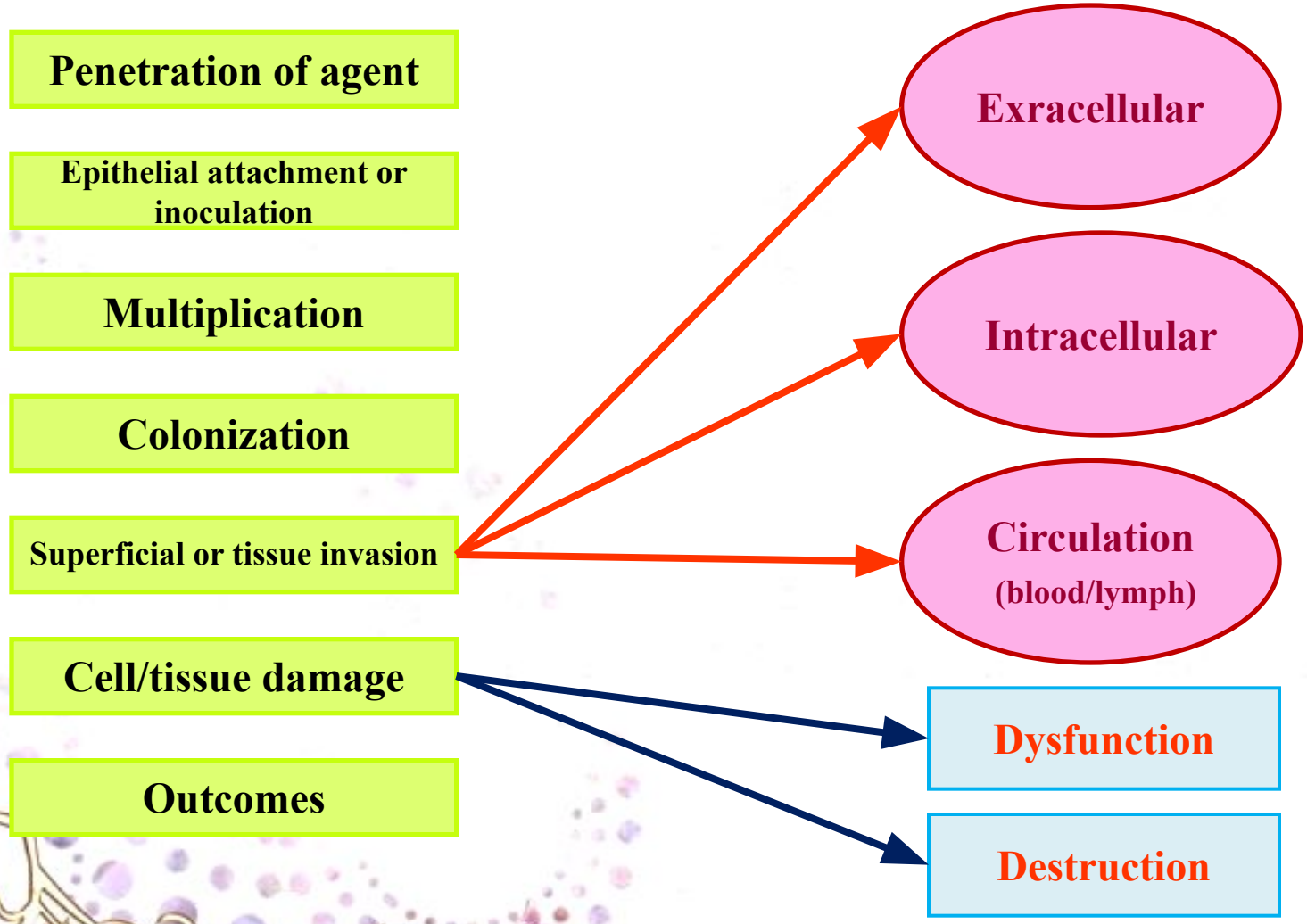
- contagiousness;

- specificity of the pathogen
(V.cholera >>> Cholera,
Salm. typhi >>> Typhoid fever);

-cyclic course of the disease
(incubation, prodromal or initial period,
period of acute clinical manifestation - climax,
period of reconvalescence,);

-formation of immunity
(cellular- humoral, specific- nonspecific, sterile- non-sterile, short- prolong- lifelong)

General pathogenesis of infectious diseases



Clinical classification of infectious diseases

By mechanism of transmission and localization of pathogen (named after L. Gromashevsky):

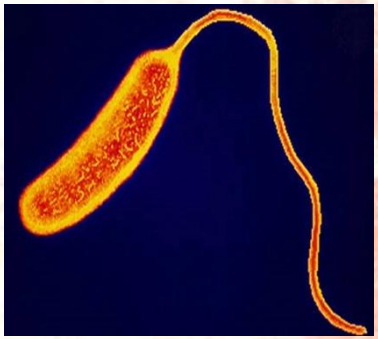
1. Intestinal infection (the causative agent is localized in the GIT),

- mechanism of transmission is fecal-oral

- routs of transmission: - watery;

- alimentary;

- contact;



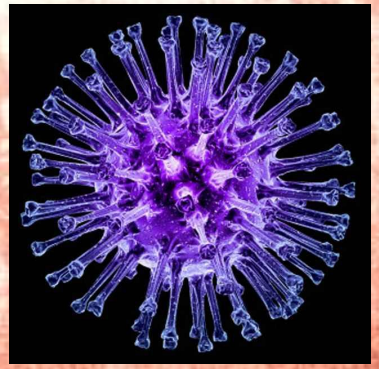
(cholera, salmonellosis, typhoid, dysentery etc.)

2. Respiratory infection (the causative agent is localized in the epithelium of the respiratory tract),

- mechanism of transmission is airborne

- routs of transmission: - air-drop;

- air-dust;



(diphtheria, meningococcal infection, ARVI).

Clinical classification of infectious diseases

3. **Blood infection** (the causative agent is localized in the blood),
   - mechanism of transmission of vector-borne
   (malaria, typhus and relapsing fever, hemorrhagic fever etc).

4. **Skin infection** of (the causative agent is localized on the skin or mucous membranes),
   - mechanism of transmission is contact
   (via injured skin).
   (rabies, erysipelas, tetanus, scabies, etc).

5. **Mixed infection** (with multiple organ localization and multiple mechanisms of transmission)
   (HIV-infection, HBV, HCV, plague)

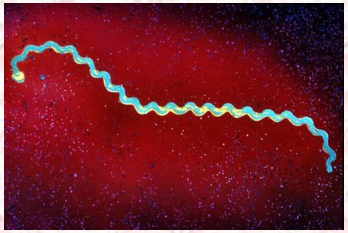
In cutaneous form of the plague pathogen is localized in the skin, and transmission mechanism is contact; in pulmonary form of plague pathogen is localized in RT, and mechanism of transmission is airborne; in intestinal form of plague pathogen is localized in the intestine and the mechanism of transmission is fecal-oral; also, in generalized forms of plague pathogen is transferred via bite of fleas

Clinical classification of infectious diseases

according the source of infection (ecologic):

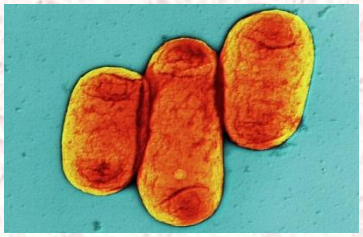
(the place of permanent residence and growth, where the pathogen enters the host)

1. Anthroponosis – pathogen parasites only in human
- source of infection - sick person or carrier
(dysentery, typhus, typhoid, scarlet fever, diphtheria, measles);



2. Zoonosis – agent is localized in animal
- source of infection - wild and domestic animals
(brucellosis, leptospirosis, anthrax, rabies);

3. Sapronosis - causative agent is localized in the soil, water
- source of infection - inanimate objects of the environment
(pseudotuberculosis and intestinal yersiniosis, tetanus);



4. Mixed infections - there are a few possible sources of the pathogen (cholera, salmonellosis, plaque)

Clinical classification of infectious diseases

-<u>according to expression of symptoms</u>:

- **manifested** - presence of typical symptoms and syndromes;

- **subclinical** - minimal manifestation with presence of nonspecific symptoms that often have mild severity;

- **latent** - prolonged asymptomatic interaction of pathogen and host (agent stay inside the cell and not released in the environment), infection becomes acute when microbe is activated by some factors;

- **slow** - long incubation (months to years), acyclic course, development of pathological changes in one organ or system, outcome is always unfavorable;
- **carrier state** - asymptomatic, subclinical or chronic interaction of pathogen and organism. May be seen as:
  - **transitory** (excretion is possible within 2 weeks),
  - **acute** (within 1 month),
  - **subacute** (up to 3 months),
  - **chronic** (3-6 months or more).

Clinical classification of infectious diseases

Manifested form

- **Acute**
  - Short-term presence of the pathogen in the organism, its intense release into the environment, high contagiousness of the patient. Can result in recovery or death of the patient
    - **Typical** - praesent all pathognomonic symptoms of the disease
      - **Mild**
      - **Moderate**
      - **Severe**
      - **Complicated**
        - **Specific complication**
        - **Nonspecific complication**
      - **Uncomplicated**
    - **Atypical** - some pathognomonic symptoms may be absent
    - **Fulminant** rapid and maximal development of symptoms
- **Chronic**
  - Prolonged presence of the pathogen with relapses, remissions, exacerbations. Can result in the recovery

Periods of infectious disease

1. **Incubation - begins from penetration of the pathogen into the body till appearance of first clinical symptoms.**

   Duration various and depends on:

   - **virulence of a microbe;**
   - **infectious dose;**
   - **immune status of the person;**
   - **location of entrance gate.**

   The average duration is 1 – 3 weeks.

2. Prodromal or initial period

- characterized by appearance (at first) of non-specific clinical symptoms or syndromes (general intoxication, hyperthermia, arthralgia);

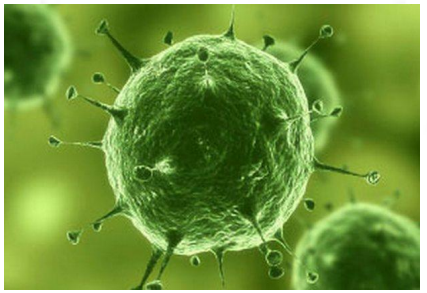
- continues till development of specific clinical picture.

- to assume the diagnosis – possible, to confirm - problematically.

- duration of the period on average 2 to 4 days.

3. **Clinical manifestation – continues from appearance of specific syndromes until their extinction.**
   The duration depends on the causative agent and reactivity of the macroorganism.

4. **Reconvalescent period - since disappearance of symptoms until their complete elimination – recovery.**
   The duration is determined by the form, severity of the disease and therapy.



Methods of diagnosis:
Specific

(for verification, confirmation of diagnosis):

- **virologic or bacteriological- isolation pure cultures of agent;**
- **microscopical- visual discover of agent in the smears;**
- **immunological- find antigens and antibodies in blood;**
- **biological - reproduce of the disease on the animals;**

Nonspecific

(for suspicion of diagnosis and to assess severity of the state)

-Clinico-epidemiological - principal method of diagnostics, simplify realization of differential diagnosis;

- Allergological - using of intracutaneous and mucous tests;

-Biochemical – discover the changes of metabolism of the organism;

-Clinical lab. study - ordinary test of blood, urine, sputum and stool

-Instrumental - X-ray examinations , rectoscopy (RRS), USE, ECG, CT

Treatment

Specific therapy – main directions:

1) destruction of the pathogen;
2) stop its multiplication;
3) complete elimination of agent;
4) inactivation of pathogen exotoxins.

Can be used: - antibiotics, antiviral, antifungal and antiprotozoan drugs;
- serum, immunoglobulins, vaccines, phages

- **Tetanus – Human tetanus immune globulin or Horse serum (prevention and treatment)**
- **Diphtheria - Horse serum (prevention and treatment)**
- **Botulism – Horse serum (only treatment)**
- **Rabies - Human Rabies immune globulin (only prevention)**

Treatment

Nonspecific therapy – main directions:

1) supportive treatment to improve a patient's state;

2) prevention of complications:

- pathogenic- affect on the some links of pathogenesis;

-symptomatic- eliminate some symptoms of illness;

- surgical treatment and palliative care when is necessary.

Methods of prophylaxis:

1. Antiepidemic measures

2. Vaccination:

- Live attenuated vaccines
(oral polio (Sabin), measles, parotitis, rubella)

- Inactivated conjugate vaccines
(VHA, typhoid, influenza, cholera)

- Recombinant vaccines
(VHB, influenza)

3. Anatoxins – diphtheria, tetanus

4. Prophylaxis with immune globulins
(measles, tick encephalitis, rabies, VHA, VHB)

5. Prophylaxis with bacteriophages (AID)

6. Chemoprophylaxis (plague, typhoid, cholera etc.)