

# Epidemiology of infectious diseases

Kolářová M., EPI Autumn 2019

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

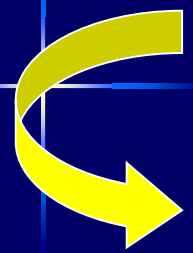


1. the presence of rezervoir (source) of infection

man, animal

at the end of incubation period

acute stage  
carriers



2. the way of transmission A/ direct contact

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

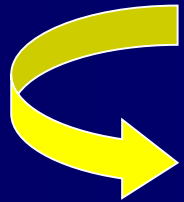
- vertical transmission – from mother to fetus (VHB, VHC, HIV, listeria, rubella, cytomegalovirus...)

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

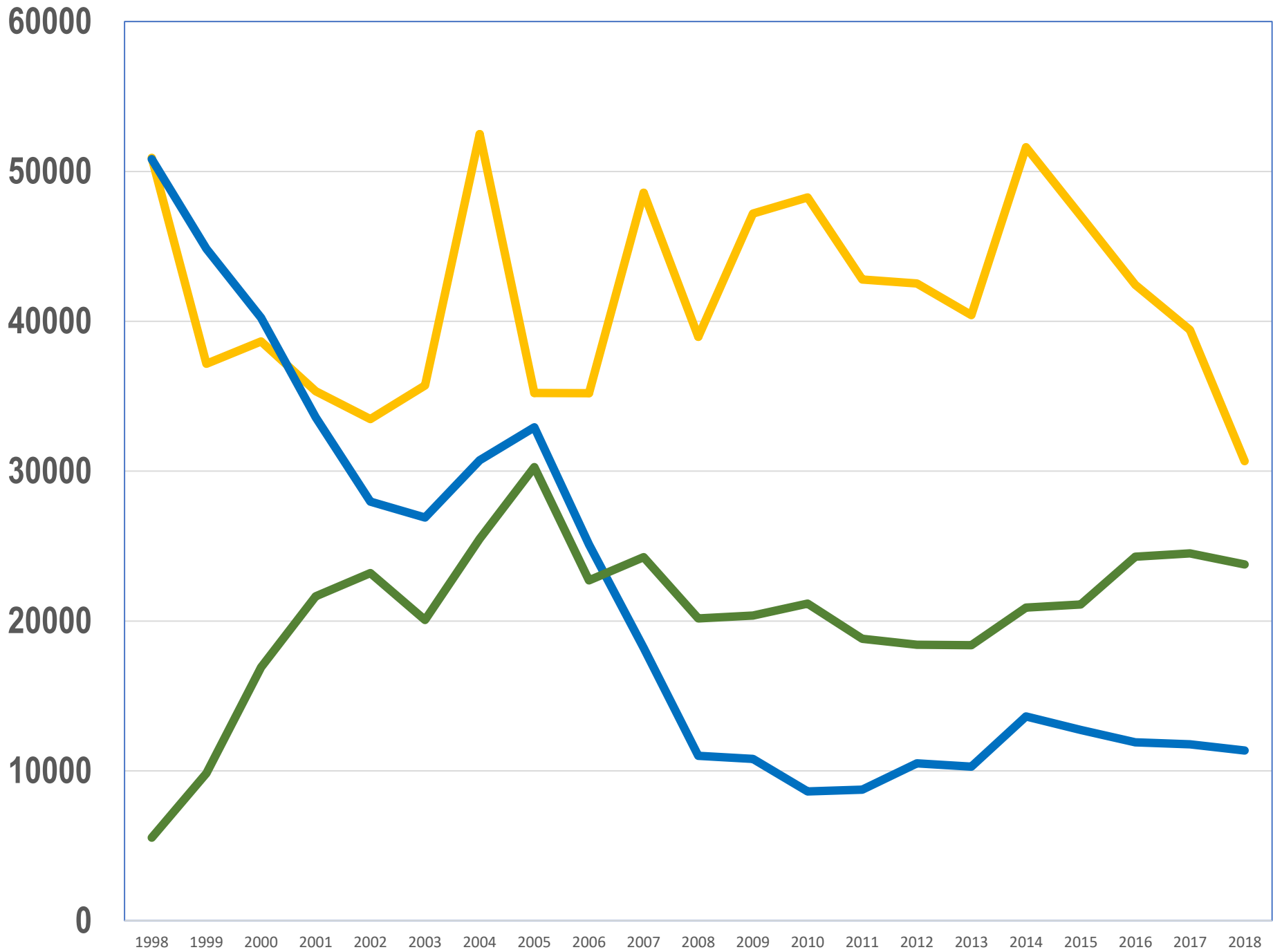


THE INFECTION

= 1. source of infection



.....



60000

50000

40000

30000

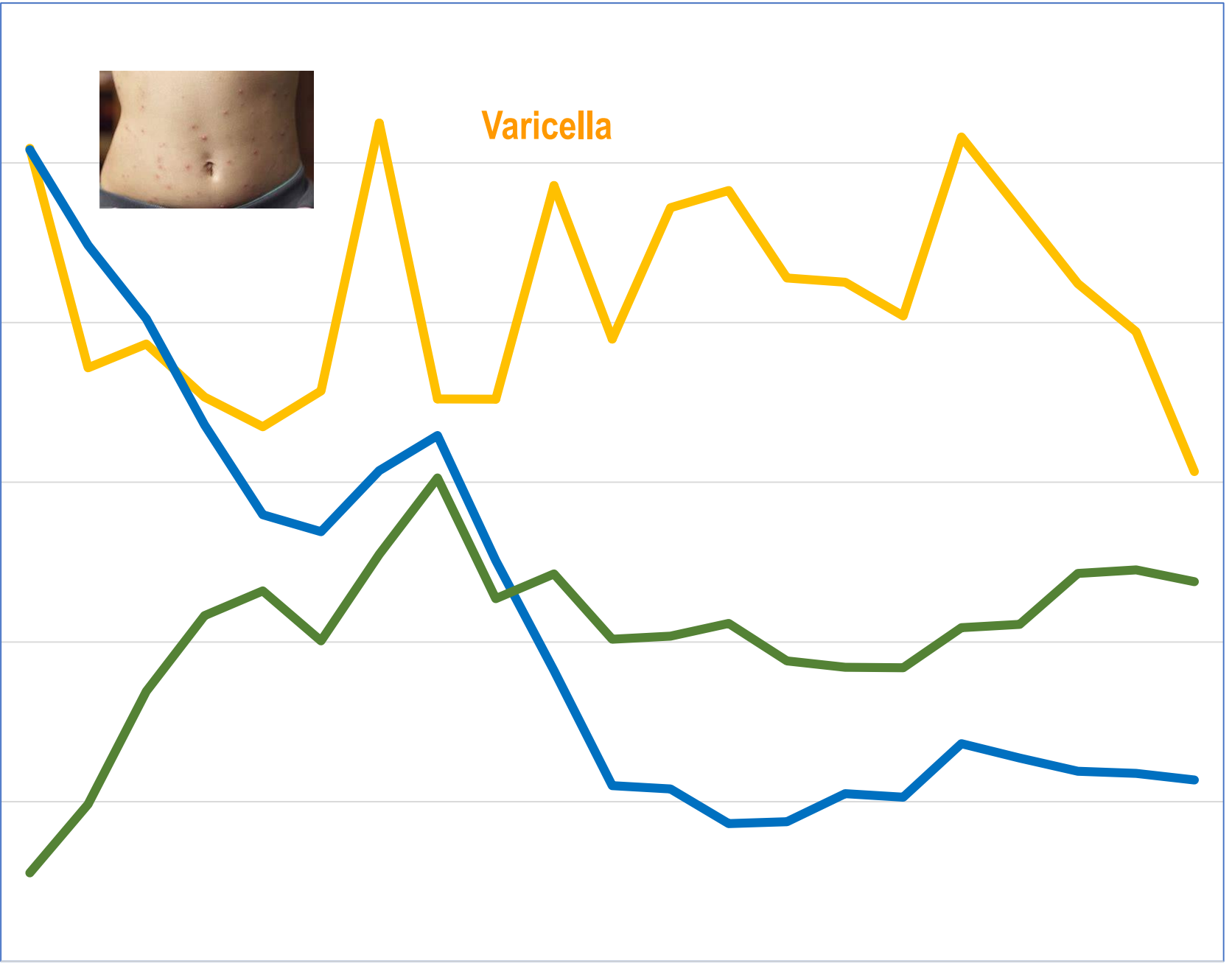
20000

10000

0



Varicella



1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

# Varicella (chickenpox)



**Varicella (chickenpox).** Lesions at various stages, including vesicles, can be seen.



60000

50000

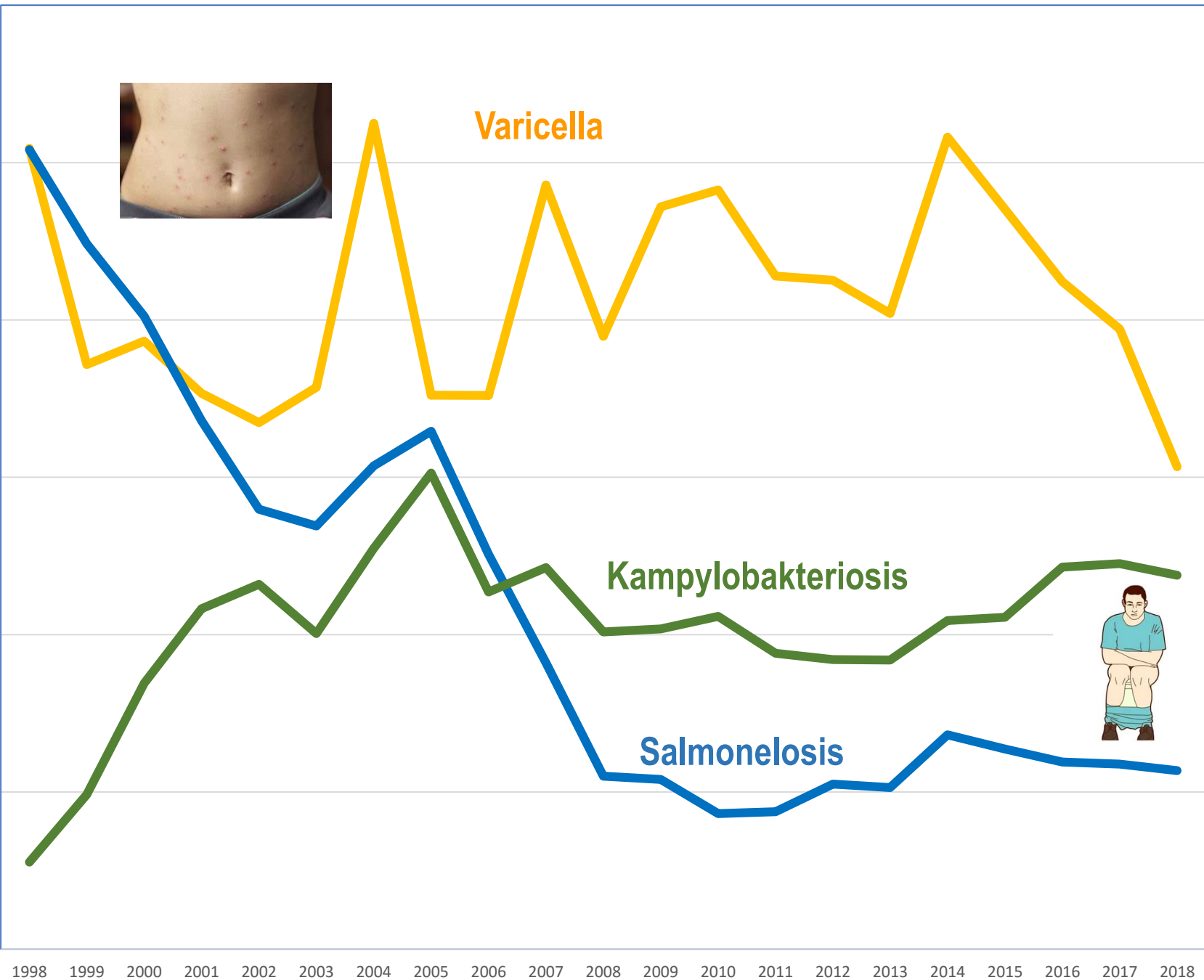
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Varicella

Kamylobakteriosis

Salmonelosis



60000

50000

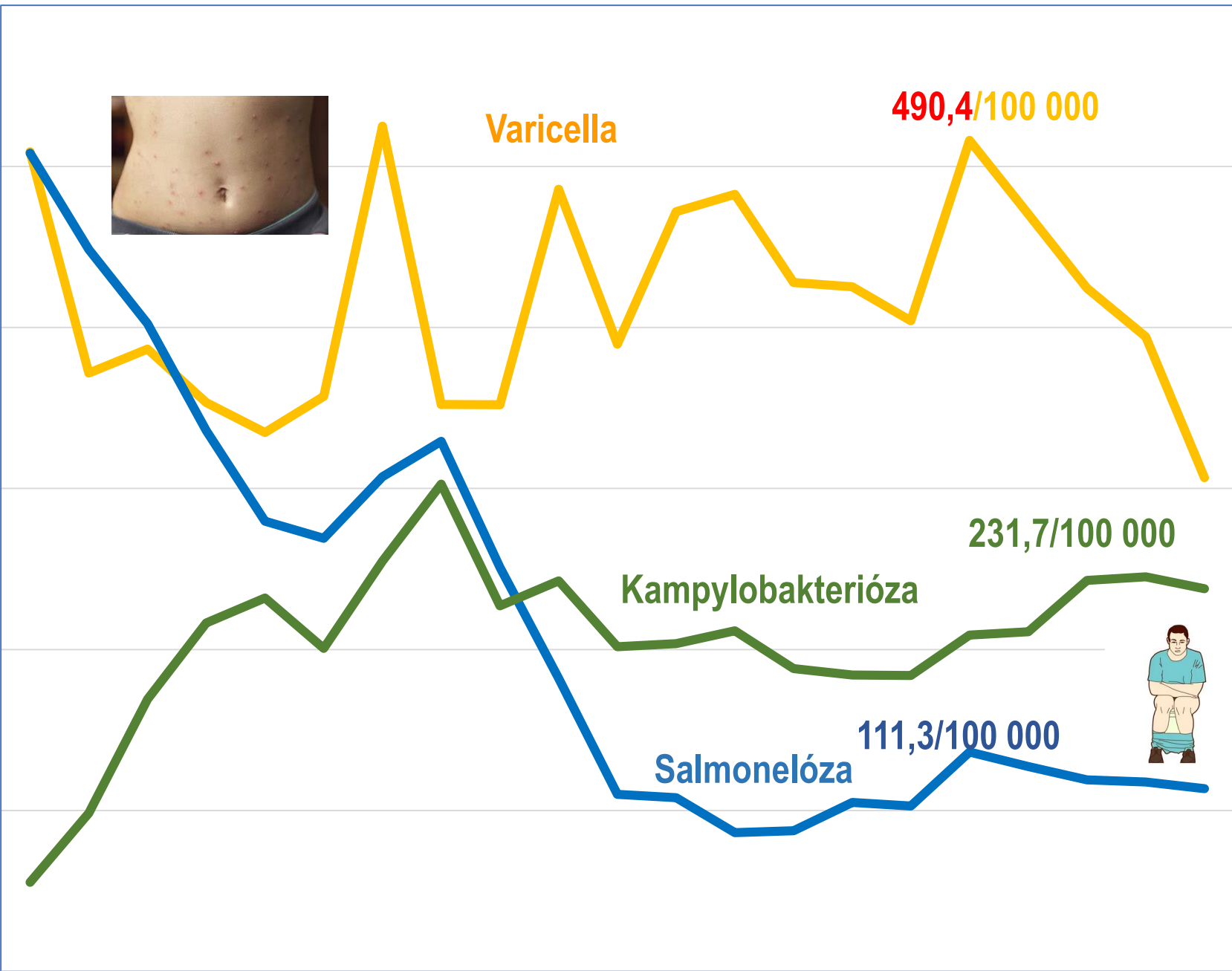
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Varicella

49,4/100 000

KamylobakteriÓza

23,17/100 000

SalmonelÓza

11,3/100 000



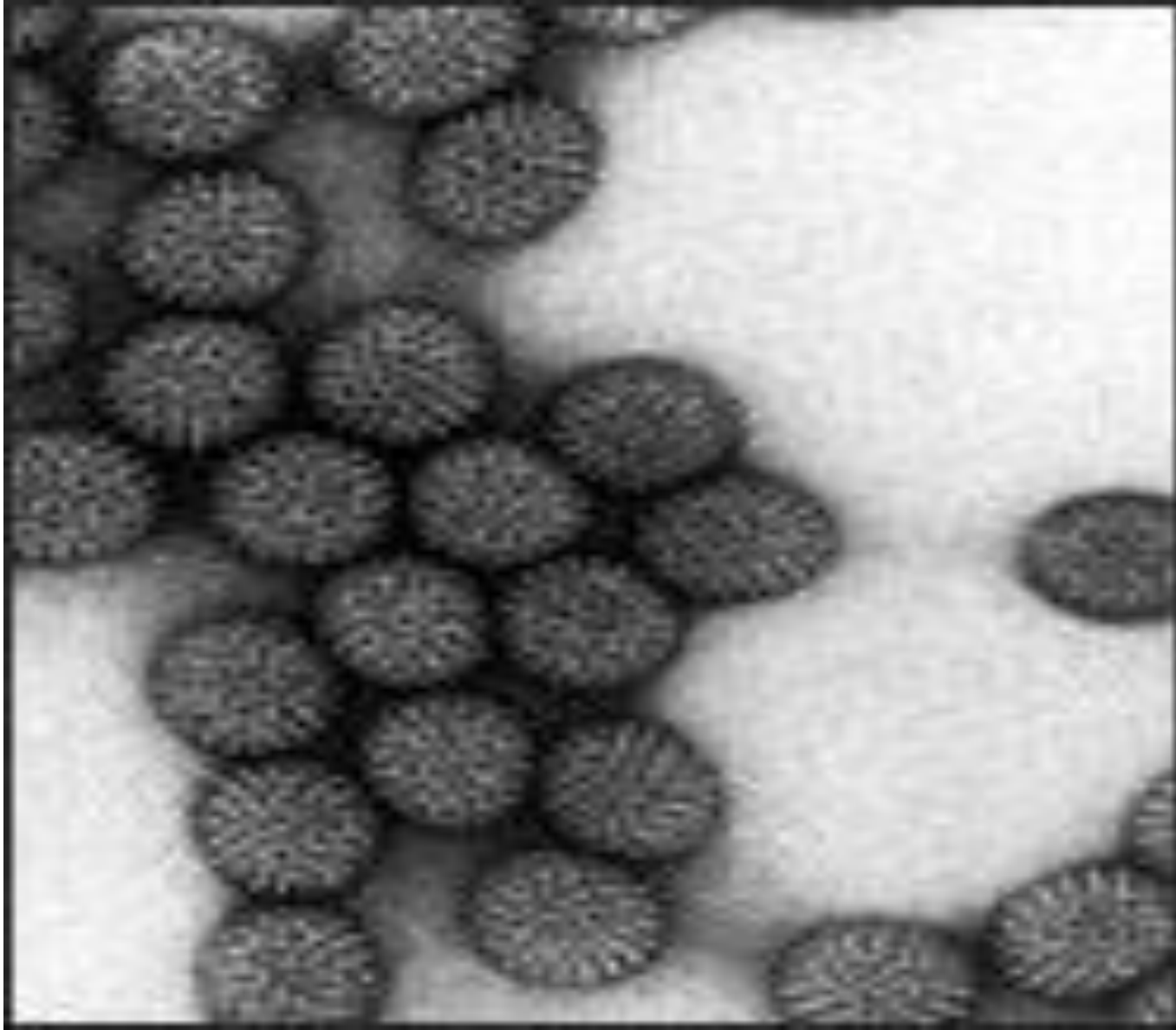
1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

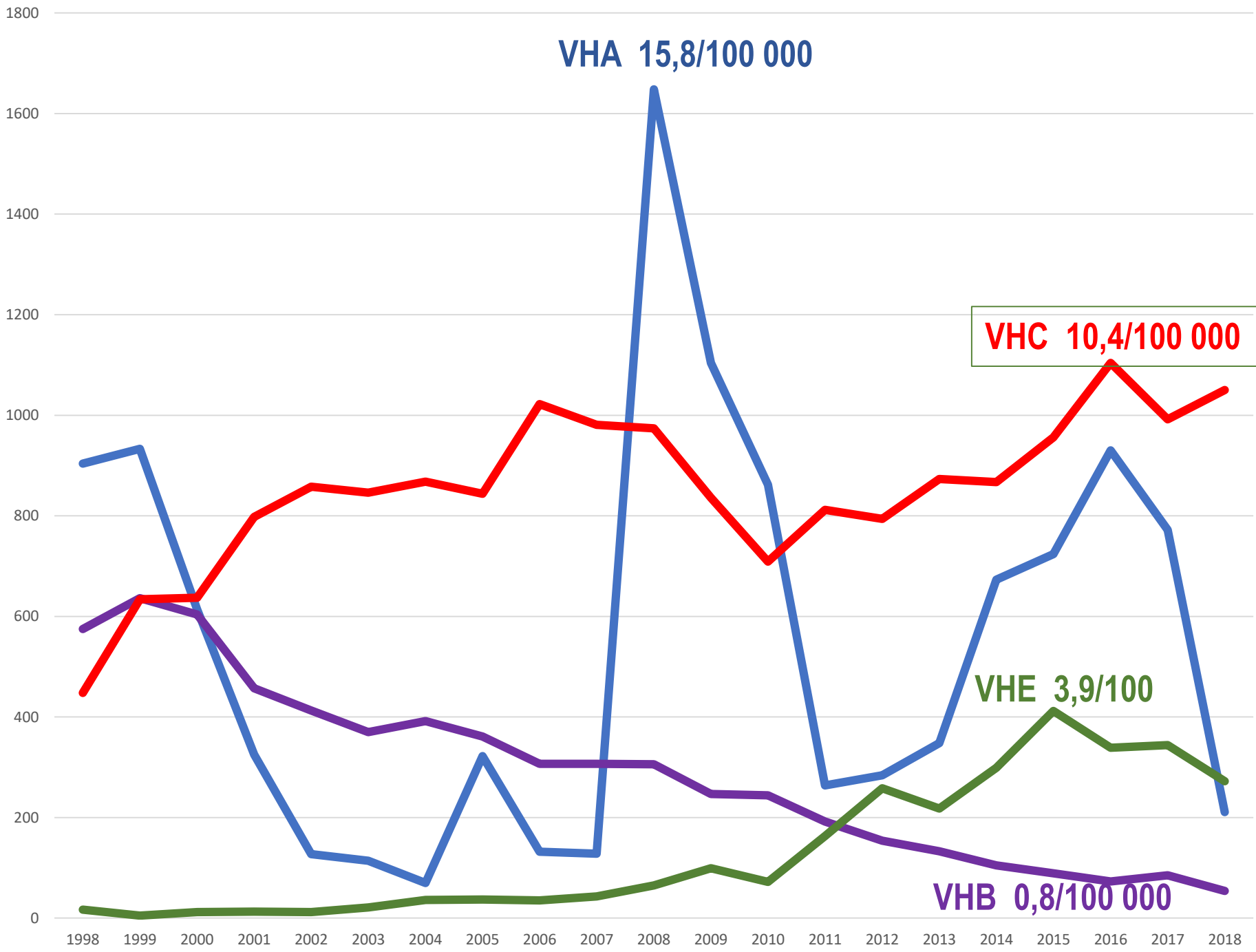


## Virové a střevní infekce



# Rotavirus





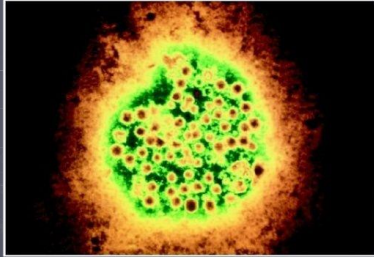
**VHA 15,8/100 000**

**VHC 10,4/100 000**

**VHE 3,9/100**

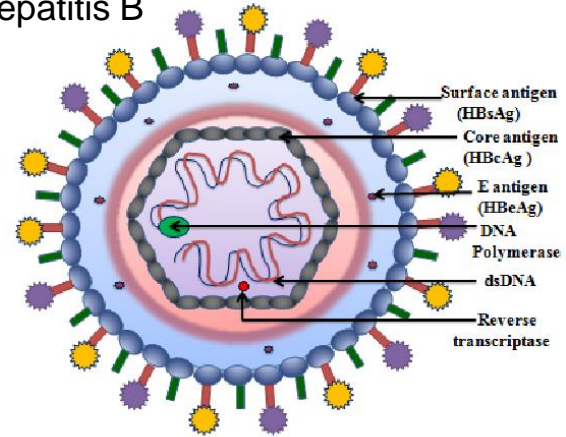
**VHB 0,8/100 000**

# Virus Hepatitis A

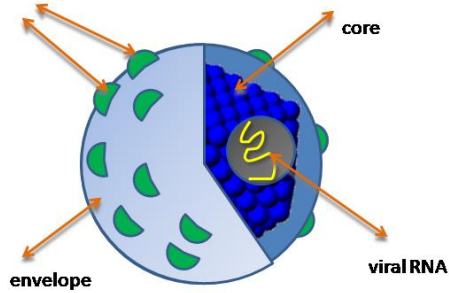


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Universidad Mayor

# Virus Hepatitis B



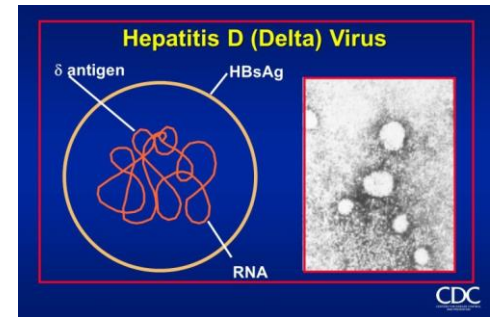
envelope glycoproteins



approx 60 nm

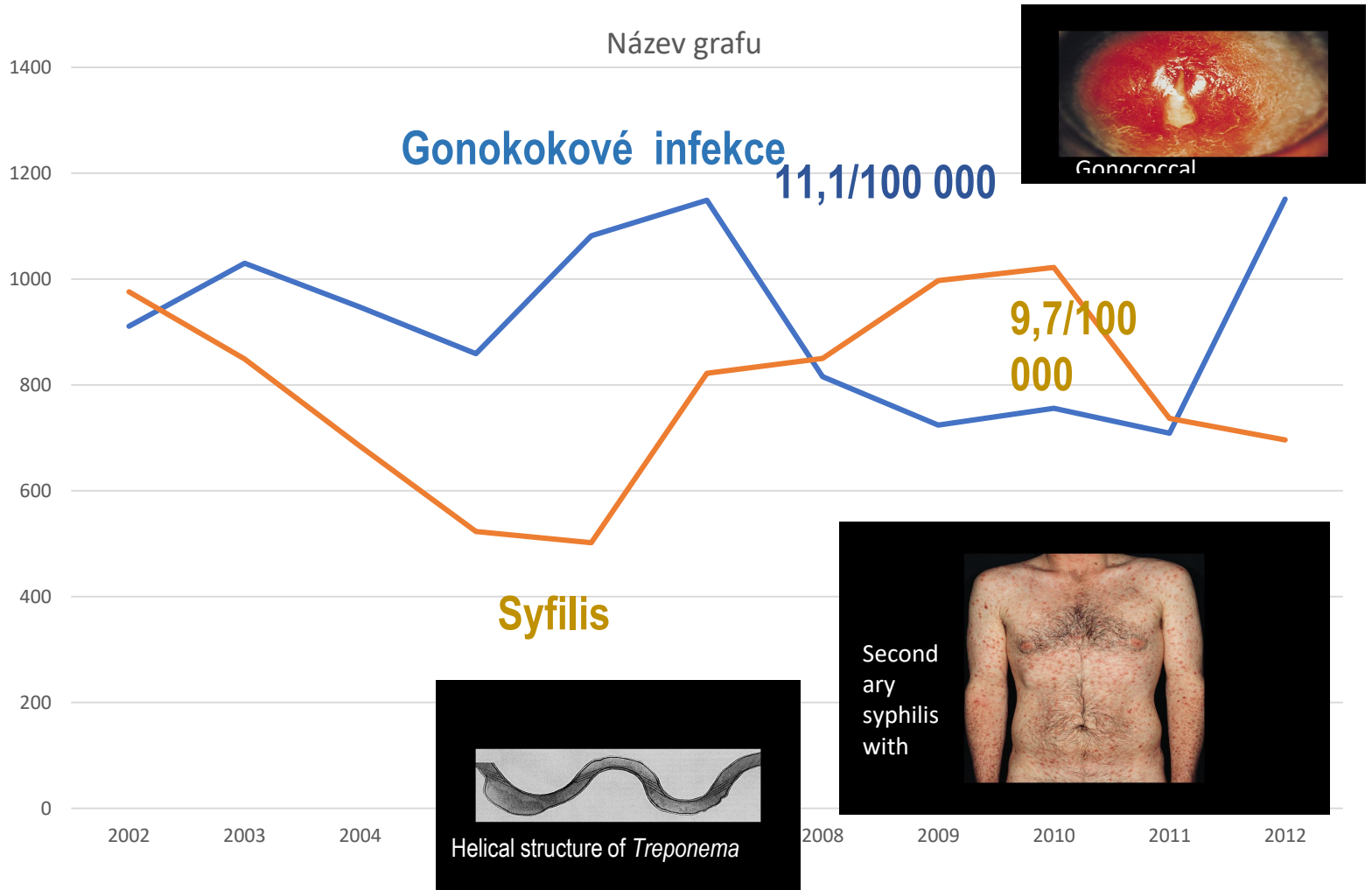
## Structure of Hepatitis C Virus

By GrahamColm at English Wikipedia, CC BY-SA 3.0,

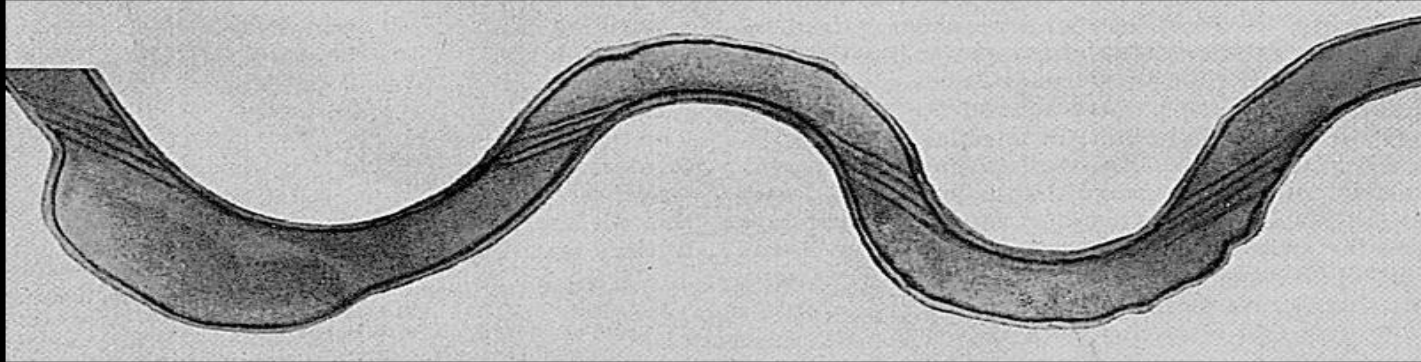


## Hepatitis E Virus





Helical structure of *Treponema pallidum* with the periplasmic flagella.



Secondary **syphilis** with typical skin rash.

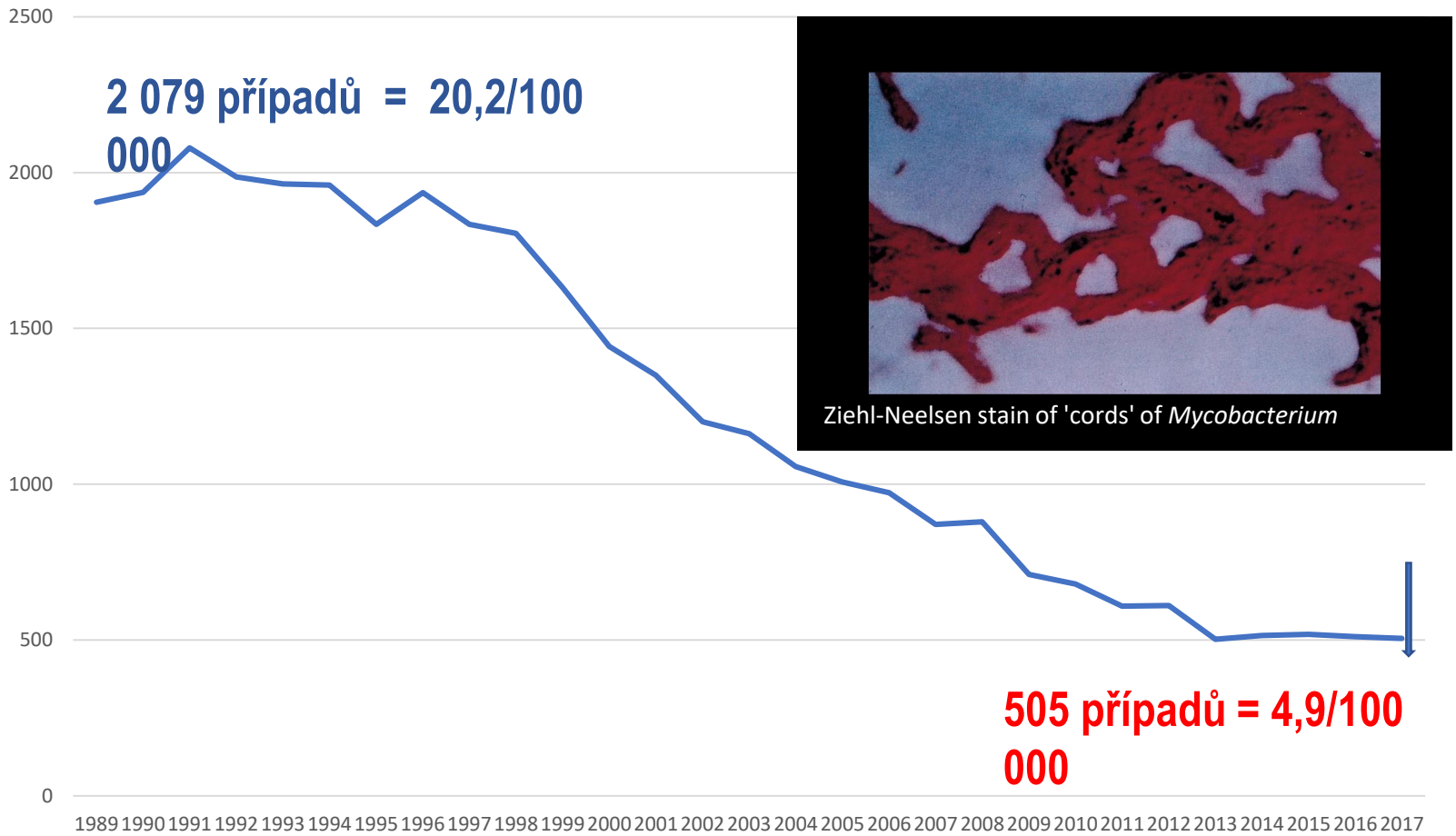


## Gonococcal urethritis.

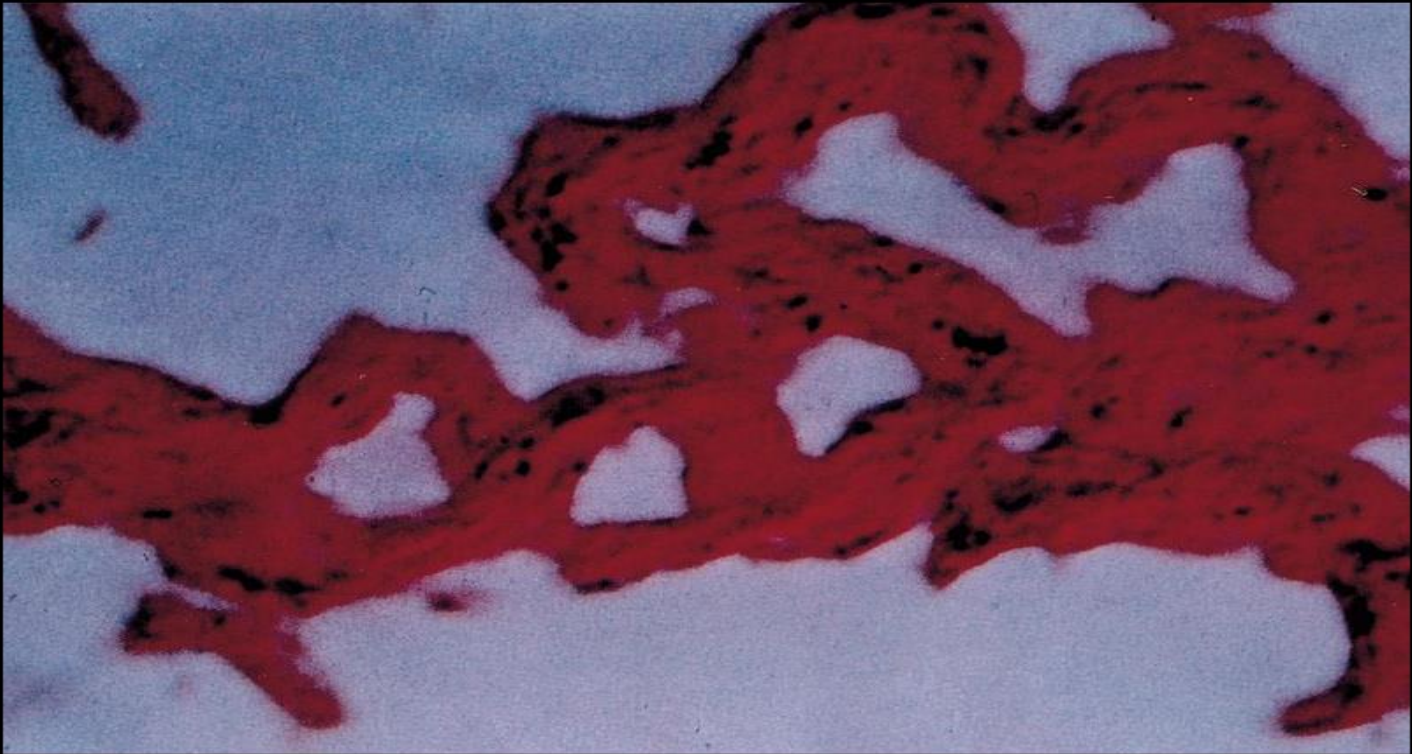




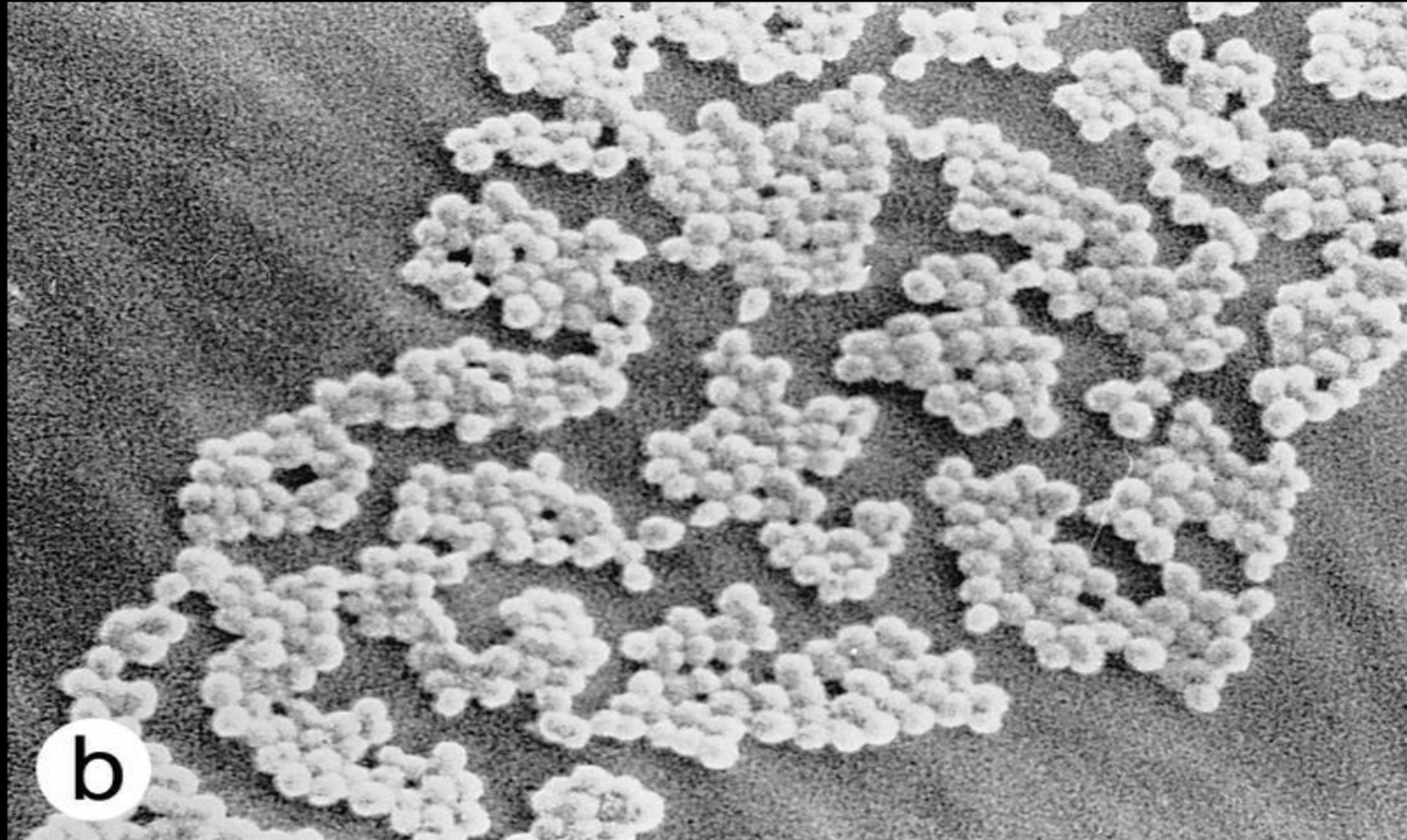
## Tuberkulóza



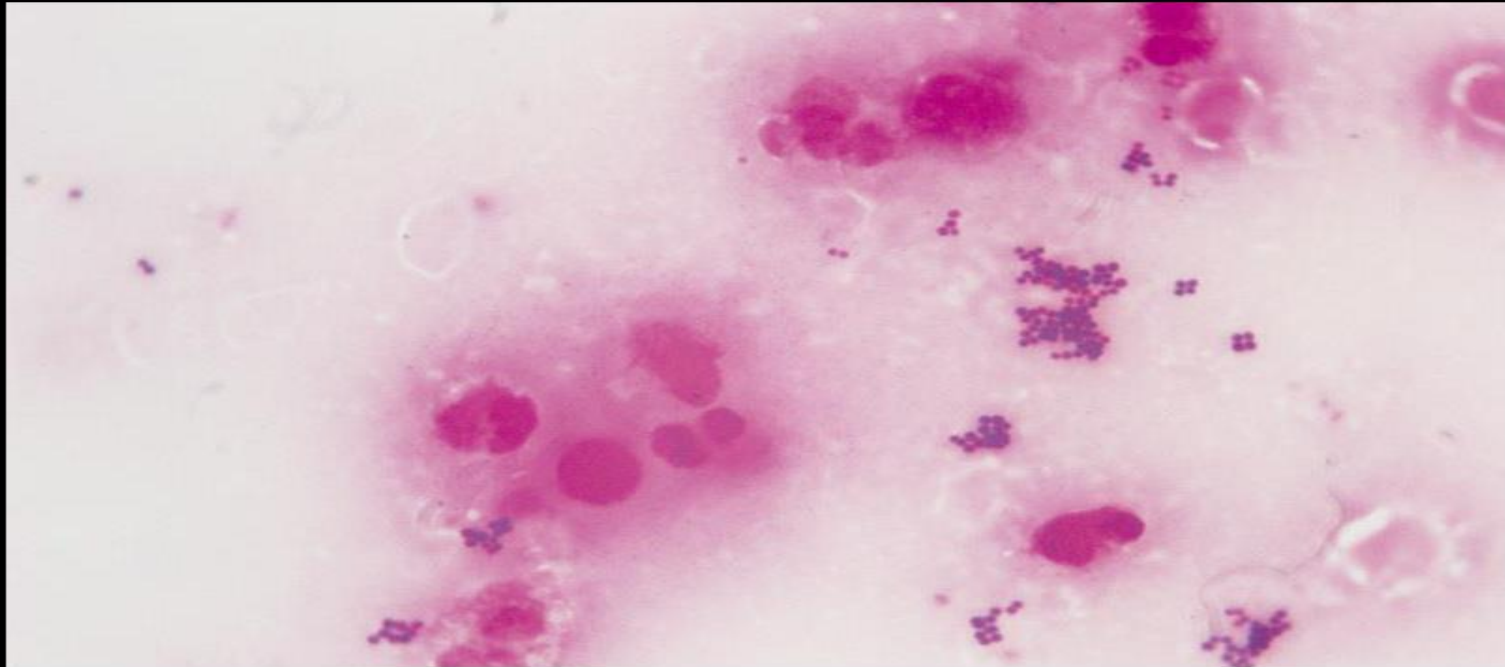
Ziehl-Neelsen stain of 'cords' of *Mycobacterium tuberculosis* isolated from a broth culture. Tubercle bacilli aggregate end to end and side to side to form serpentine cords, especially in broth cultures.



Slime-producing coagulase-negative staphylococci. Scanning electron micrograph of the surface of an intravascular catheter incubated *in vitro* with (a) slime-producing and (b) nonslime-producing strains of *Staphylococcus epidermidis*. With permission from Christensen.<sup>9</sup>



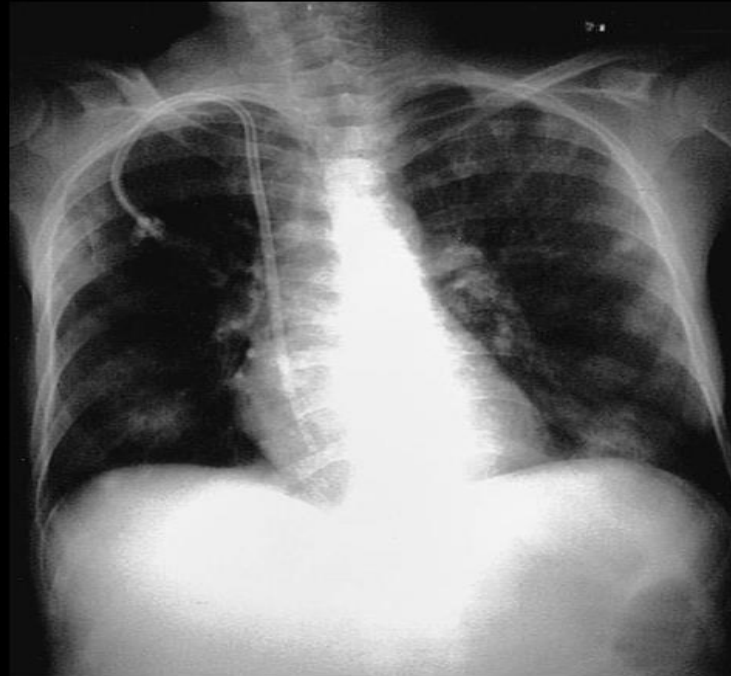
# *Staphylococcus aureus*



Staphylococcal nasal carriage. This patient had a small staphylococcal abscess beneath the mucosa of the nose, illustrating how *Staphylococcus aureus*, which colonizes the nares, can infect skin and submucosa. Intact mucosa is highly resistant to infection; such infections usually occur as a result of defects in the mucosal membranes or via hair follicles inside the nose.



Septic pulmonary emboli. Multiple nodular pulmonary infiltrates secondary to a dialysis catheter-associated infection. The patient presented with high fevers, cough and pleuritic chest pain. *Staphylococcus aureus* was isolated from multiple blood specimens.



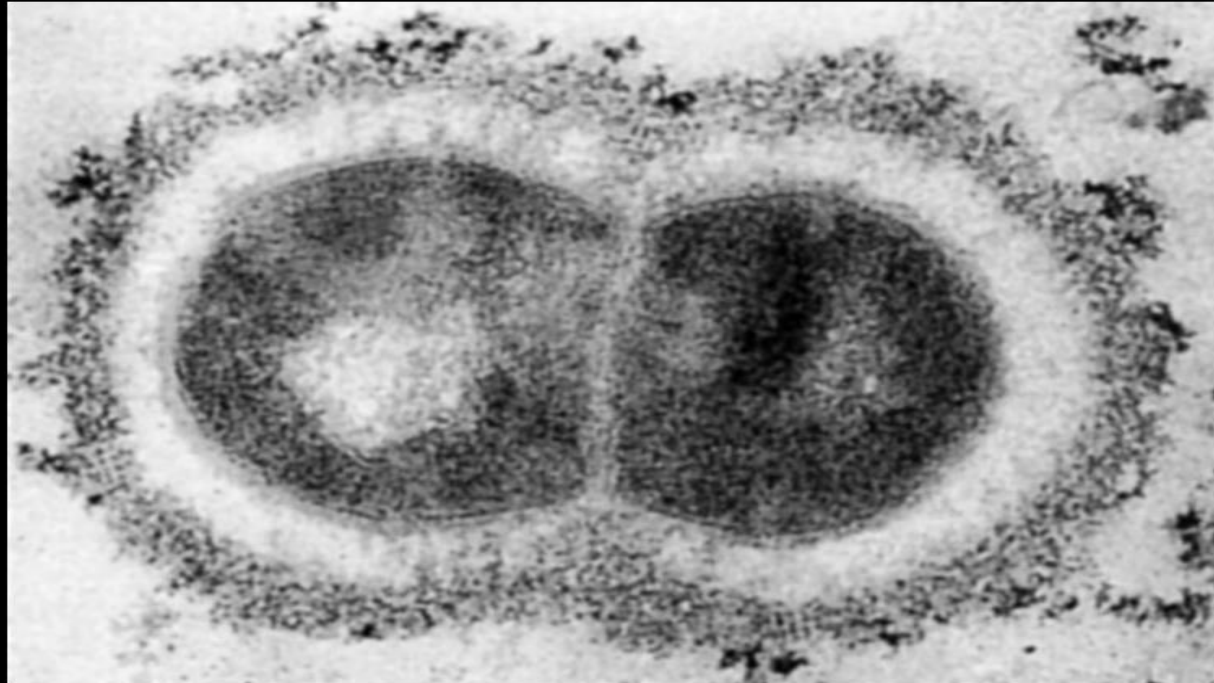


- Impetigo in a child.



- **$\beta$ -Hemolytic streptococci group A** on a blood agar plate. Note the clear  $\beta$ -hemolytic zone.





- Electron microscopy of **group A streptococcus**. The fuzzy M protein layer can be seen protruding from the cell wall..



**Erysipelas.** Note the sharp demarcation of the affected skin.

## Scarlatina (scarlet fever)



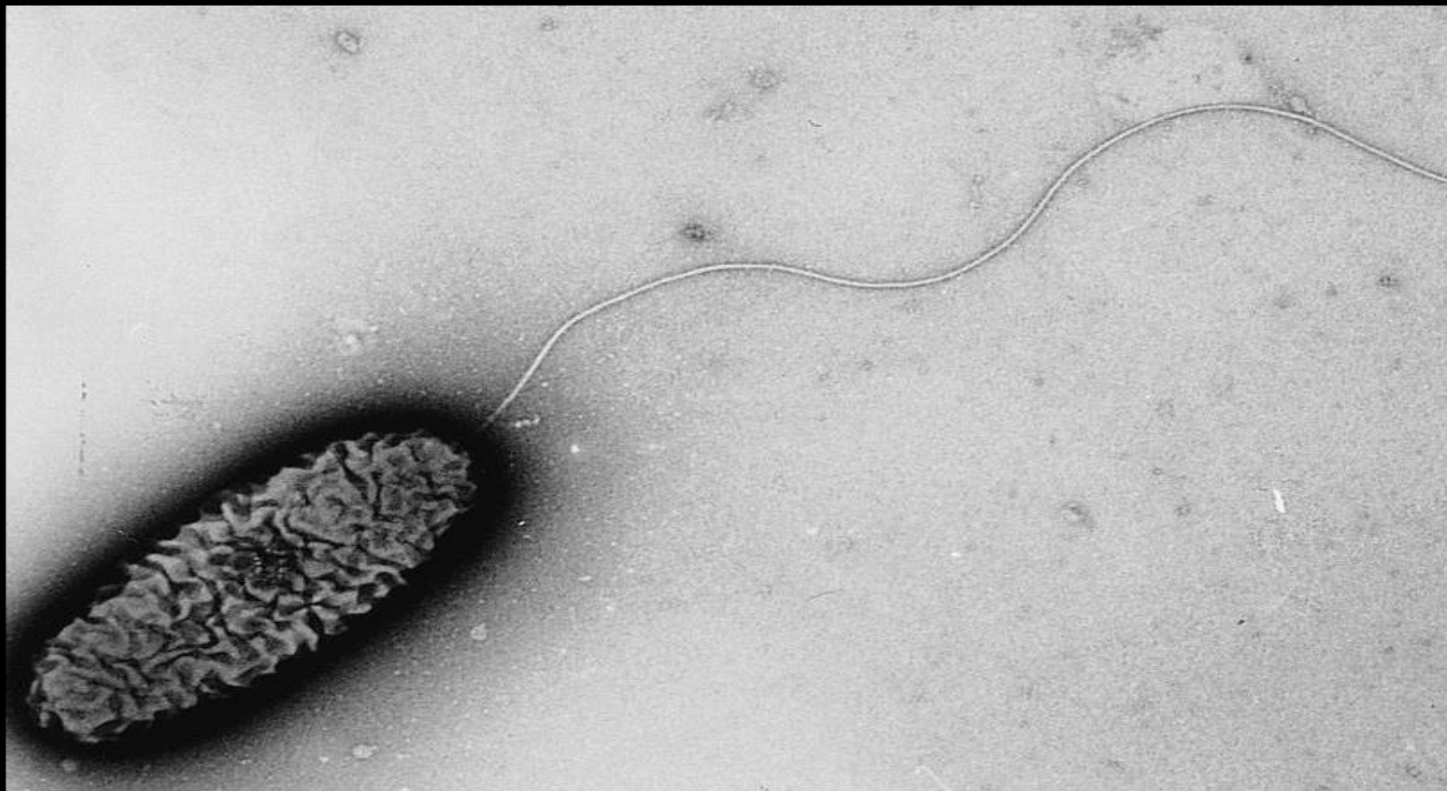


- Necrotizing fasciitis caused by **group A streptococci**. There is only moderate erythema but at surgery there was extensive soft tissue damage.

Mixed culture of two morphotypes of Enterobacteriaceae on blood agar plate (*Escherichia coli* and *Salmonella* spp.).



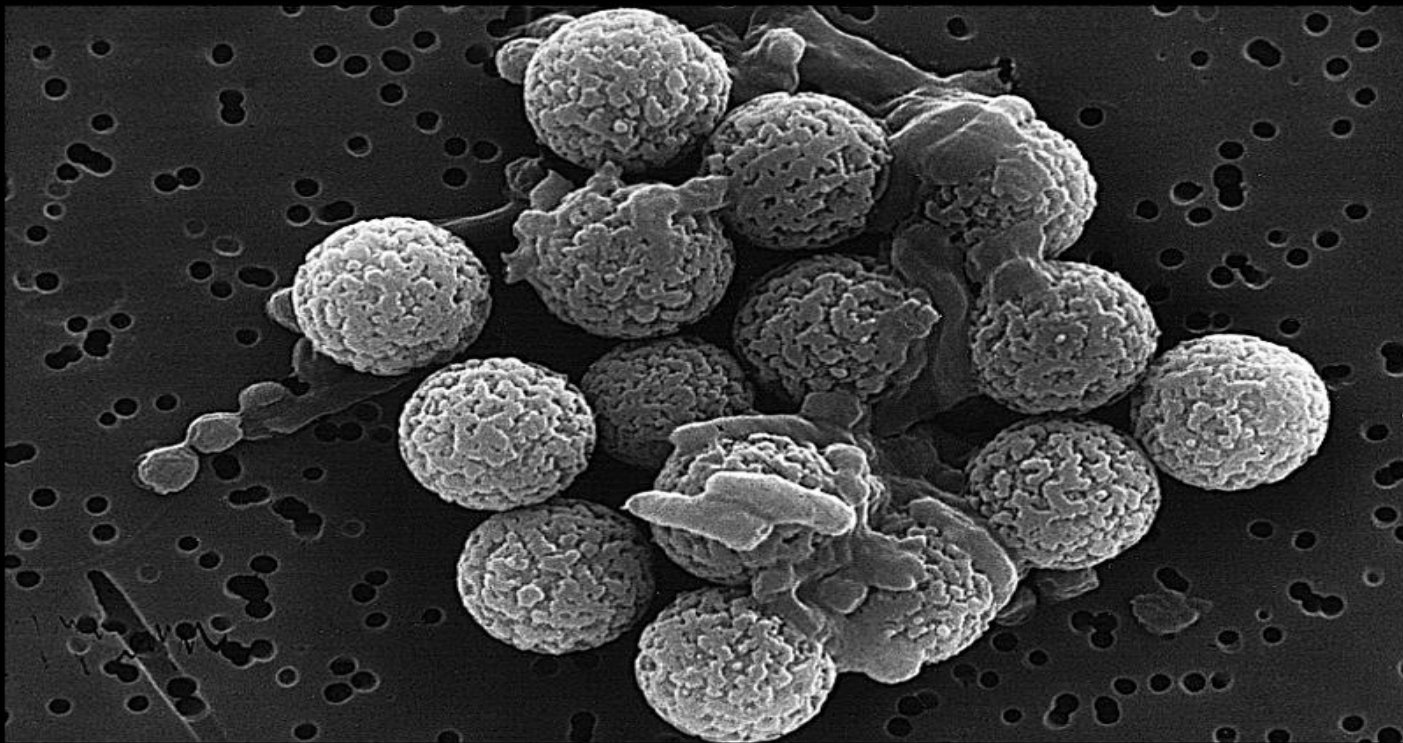
***Pseudomonas aeruginosa*** monotrichous polar flagellum  
seen on electron microscopy.



Burned leg that has been superinfected with *Pseudomonas aeruginosa*.



Cultured *Helicobacter pylori* in coccoid and bacilli forms, bound to immunomagnetic beads.



coccoid

bacilli

coccoid



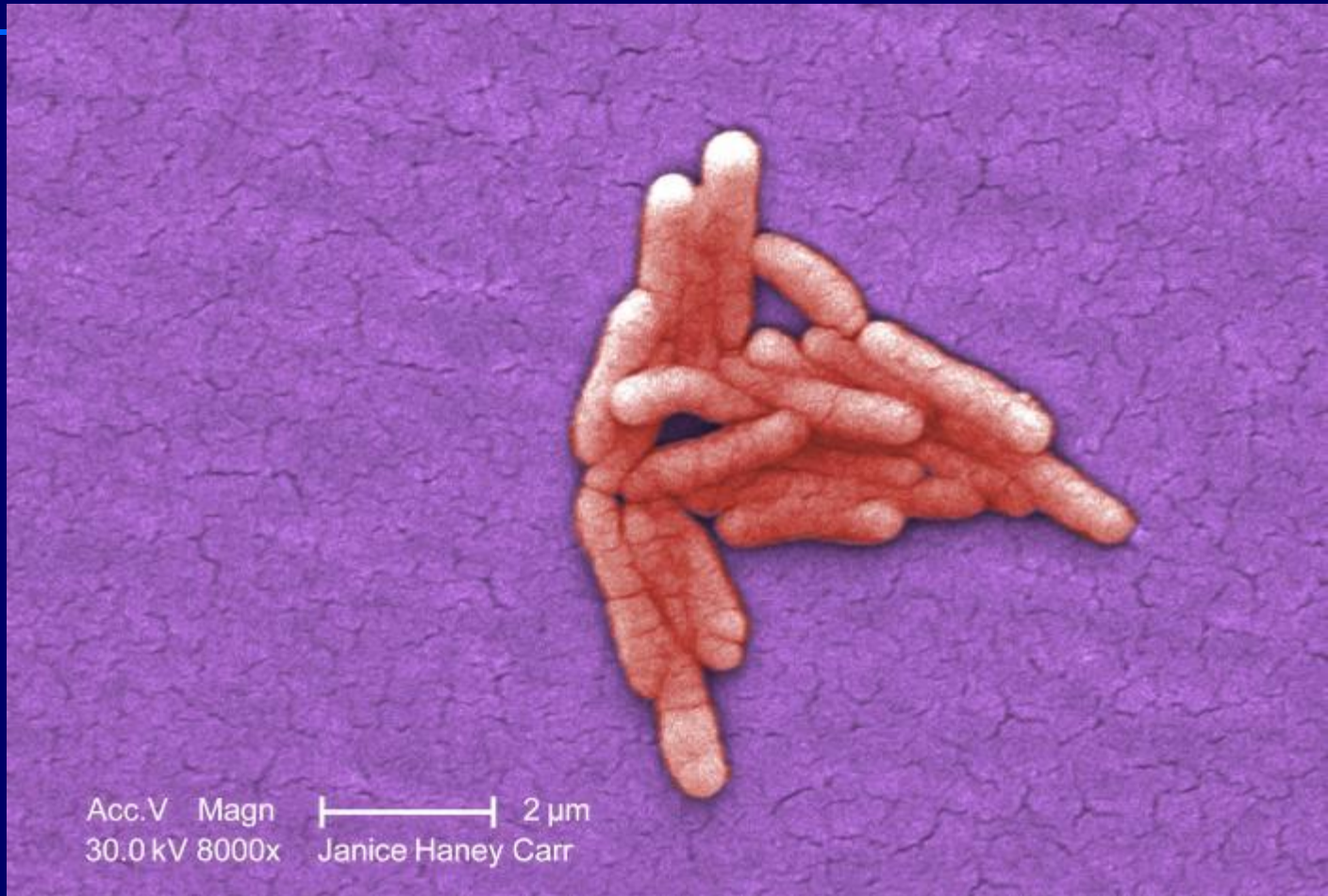
Obtained after an outbreak, this micrograph depicts Gram-positive *Clostridium difficile* bacteria.

Source: CDC

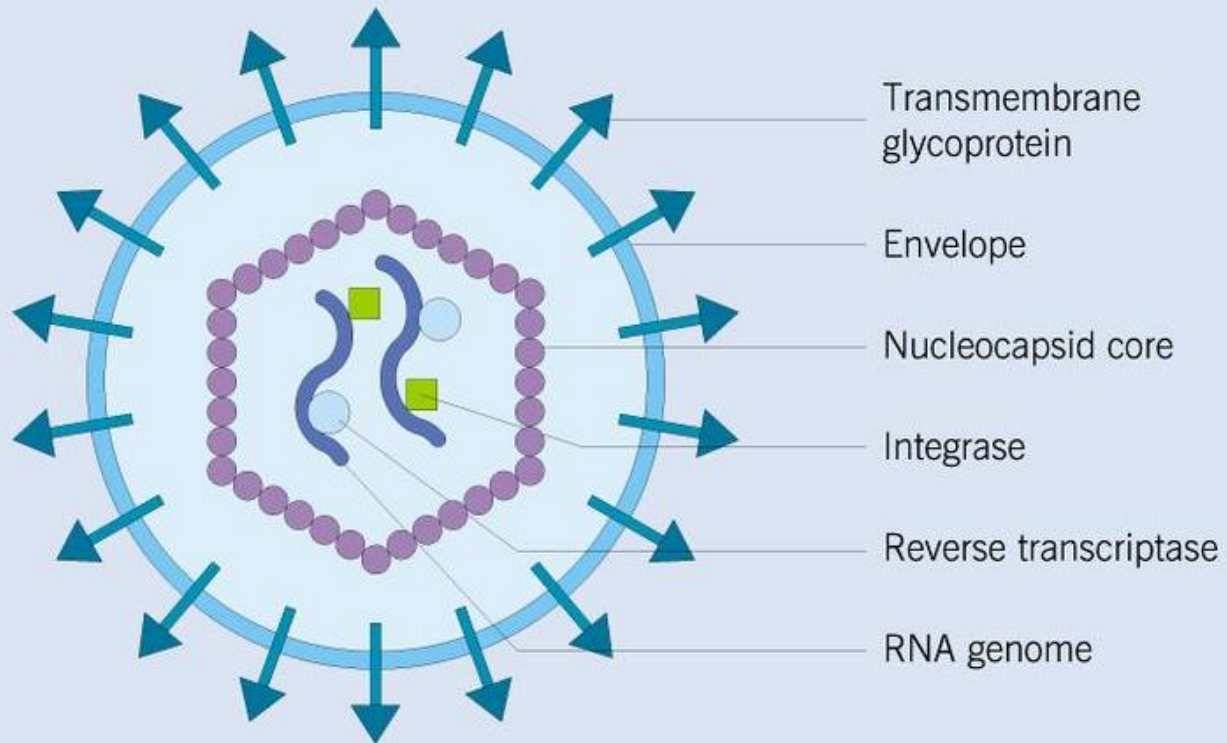


Acc.V	Spot	Magn	Det	WD	Exp
10.0 kV	3.0	4753x	SE	33.8	1

Under a moderately-high magnification of 8000X, this colorized scanning electron micrograph (SEM) revealed the presence of a small grouping of Gram-negative *Salmonella typhimurium* bacteria that had been isolated from a pure culture. See PHIL 10986 for a black and white version of this image.



## STRUCTURE OF A RETROVIRUS



# Primoinfection HIV



Colonies of *Nocardia asteroides* showing smooth chalky-white appearance.



Primary cutaneous **nocardial infection** is characteristically painless, localized and slowly progressive. (a) There is marked swelling and erythema in this child's finger. (b) However, because the finger was painless the child was not brought to medical attention until the infection had progressed to involve the entire finger.



Typical rash of **meningococcal septicemia**. Fine erythematous macules and petechiae are present in some areas.



**Morbilli (Measles).** A disseminated erythematous rash can be seen over the trunk and arms.





**Rubella.** A pink macular rash can be seen on the forearm.



# Rubella



# Parotitis epidemica ( mumps)

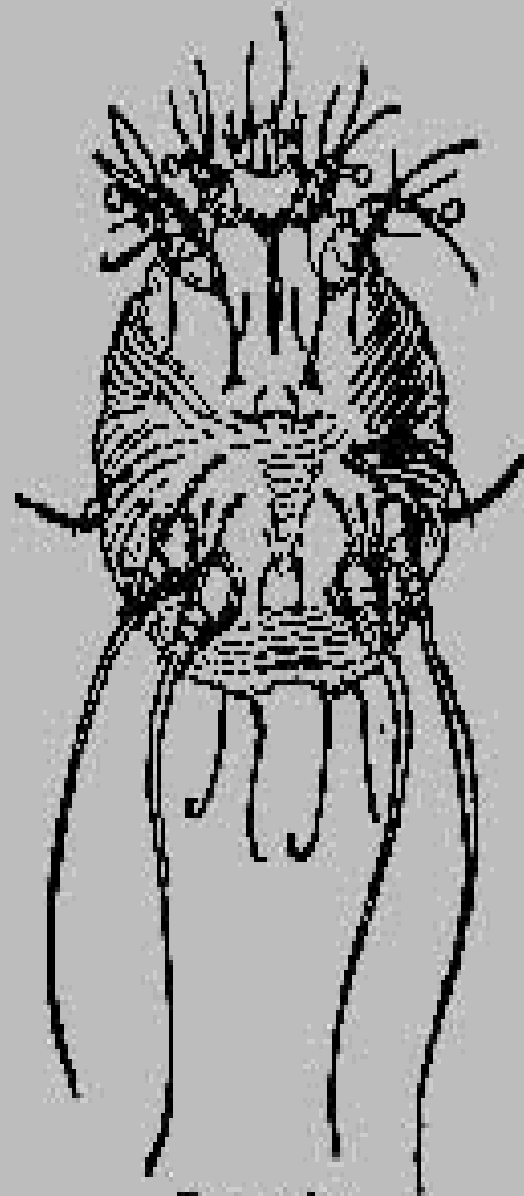


# Sarcoptes scabiei

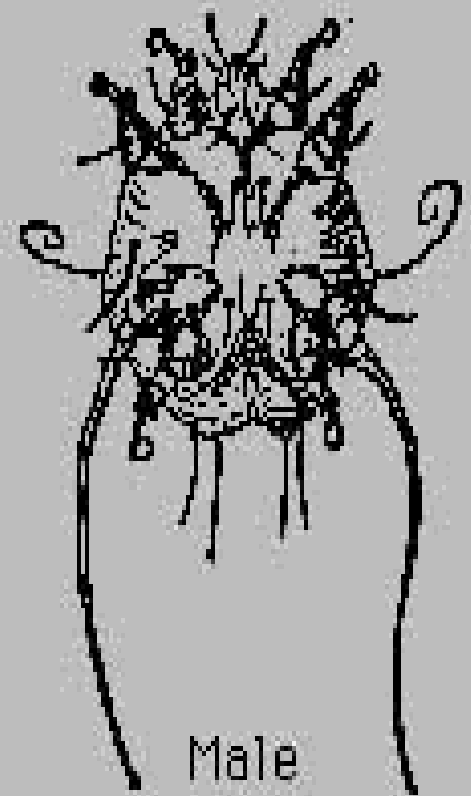




lateral



Female



Male

0.4 mm in length

# Scabies



Crusted or **Norwegian scabies** in a patient who has AIDS.



Giemsa stain of blood with *Borellia burgdorferi*.





# Tick – *Ixodes ricinus*



# Lyme boreliosis (LB)



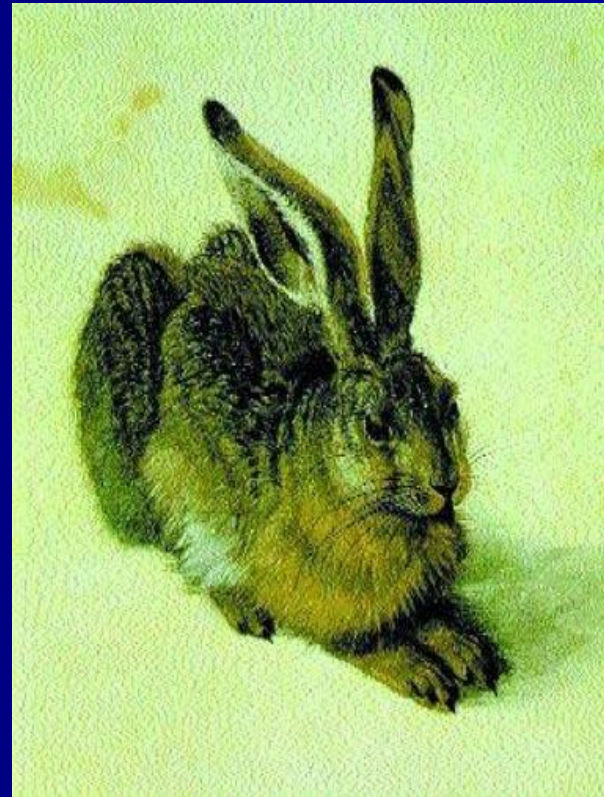
LB - Typical **erythema migrans** rash.



A blood-engorged female *Aedes albopictus* mosquito feeding on a human host.



# Francisella tularensis



# Tularemia



# Tularemia

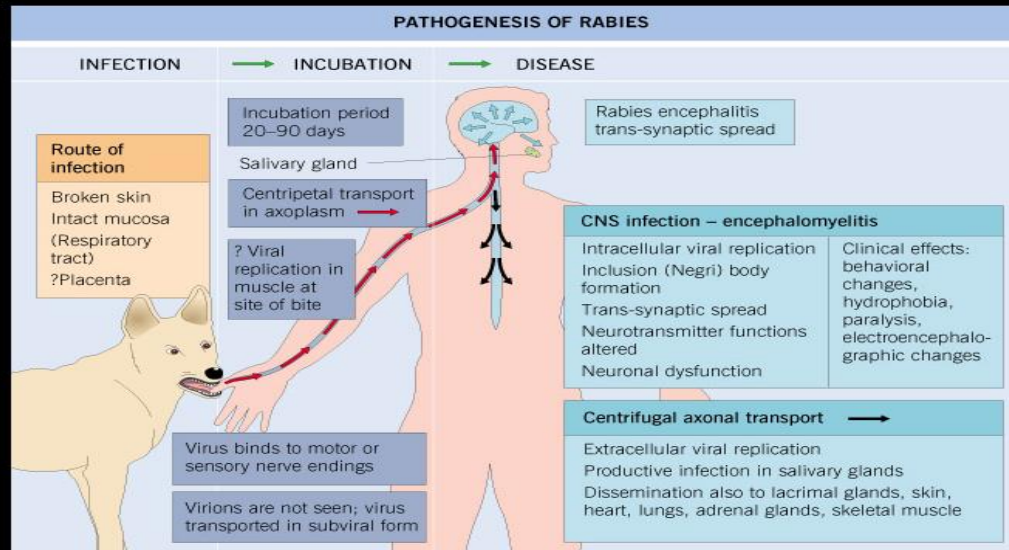


## Hístice *Trichinella spiralis*





# Pathogenesis of rabies.



# 1. the presence of source of infection

is the site or sites in which a disease agent normally lives and reproduces in different stages of a disease

May be classified as:

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

## 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....)

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

1. the presence of rezervoir (source) of infection

man, animal

- at the end of incubation period
- acute stage
- carriers

2. the way of transmission A/ direct contact

touching, kissing or sexual intercourse (Staphylococcus spp., Gonococcus spp., HIV ...),  
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3. the susceptibility of the population or its individual members to the organism

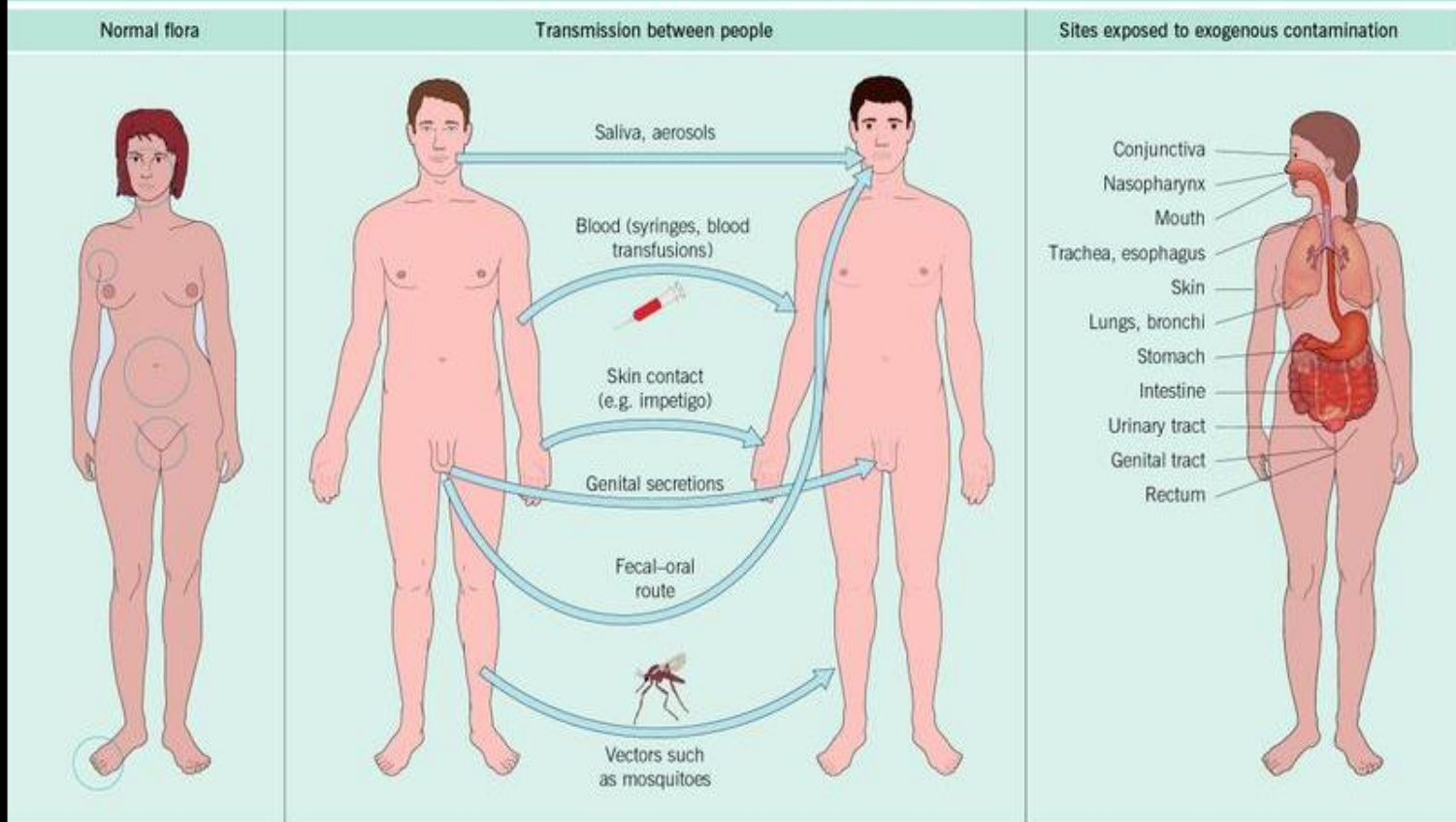
concerned Host factors: age, nutrition, genetics  
immunity – natural (nonspecific),  
- acquired

THE INFECTION

= 1. source of infection

.....

## CONTAMINATION OF HUMANS BY MICRO-ORGANISMS



Organisms vary in their capacity **to survive** in the free state 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.

# Colonisation and contamination 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.



# Routes of transmission

- Air
- Food, Drink or Water
- Direct or indirect contact
  - \* Transplacental
- Insects (Artropods)

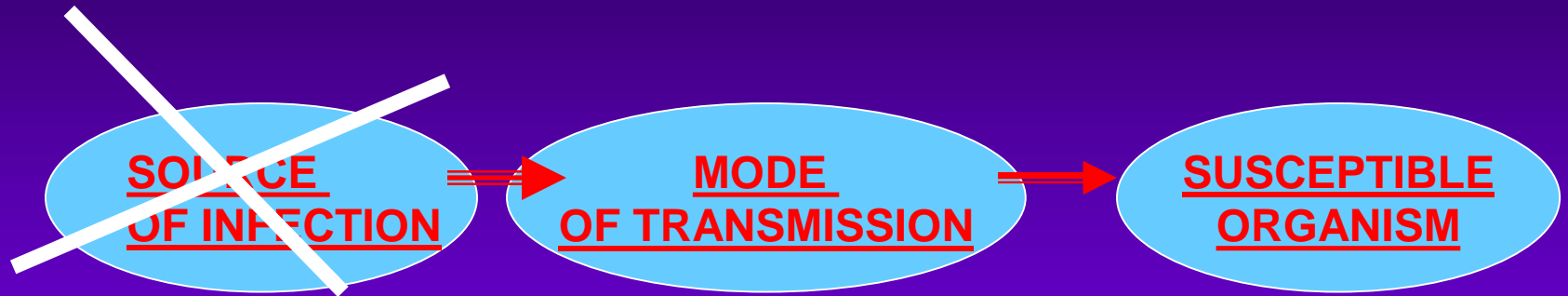
## Main portals of entry

- Respiratory tract
- Gastro-intestinal tract
- Genito-urinary tract
- Direct break through skin
  - \* surgical and wounds
- Direct into blood via needles/catheters

# The pathogenicity of pathogen is related to:

- invasiveness
- virulent
- number of pathogen (infectious dosis)
- mutation (variability)

# Prevention of infectious diseases



## Isolation of patients:

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

# Prevention of infectious diseases



**HANDWASHING, DISINFECTION OF HANDS**

**LINEN WASHING,  
CLEANING**

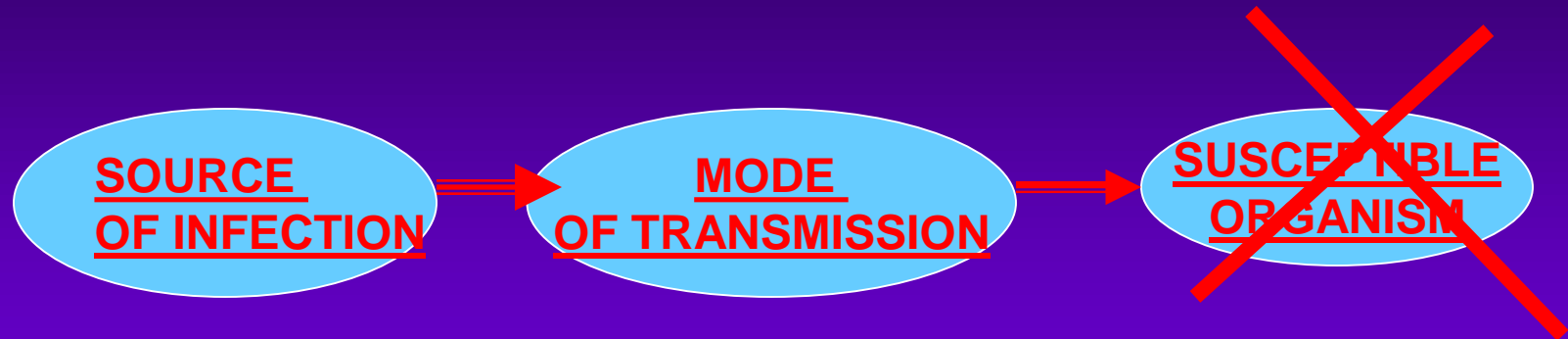
**GOOD PREPARING OF FOOD, SAFE  
WATER.....,**

**.....**

**DISINFECTION**

**STERILIZATION**

# Prevention of infectious diseases



immunity

- natural (nonspecific),
- acquired (vaccination)

- **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.





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

In the practical part it is preoccupied with

**preventive measures**

**repressive measures**

related to infectious diseases

