

EPIDEMIOLOGY OF INFECTIOUS DISEASES

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Epidemiology

The word “epidemiology” is derived from the Greek words:

—**epi** “upon”, **demos** “people” and **logos** “study”.

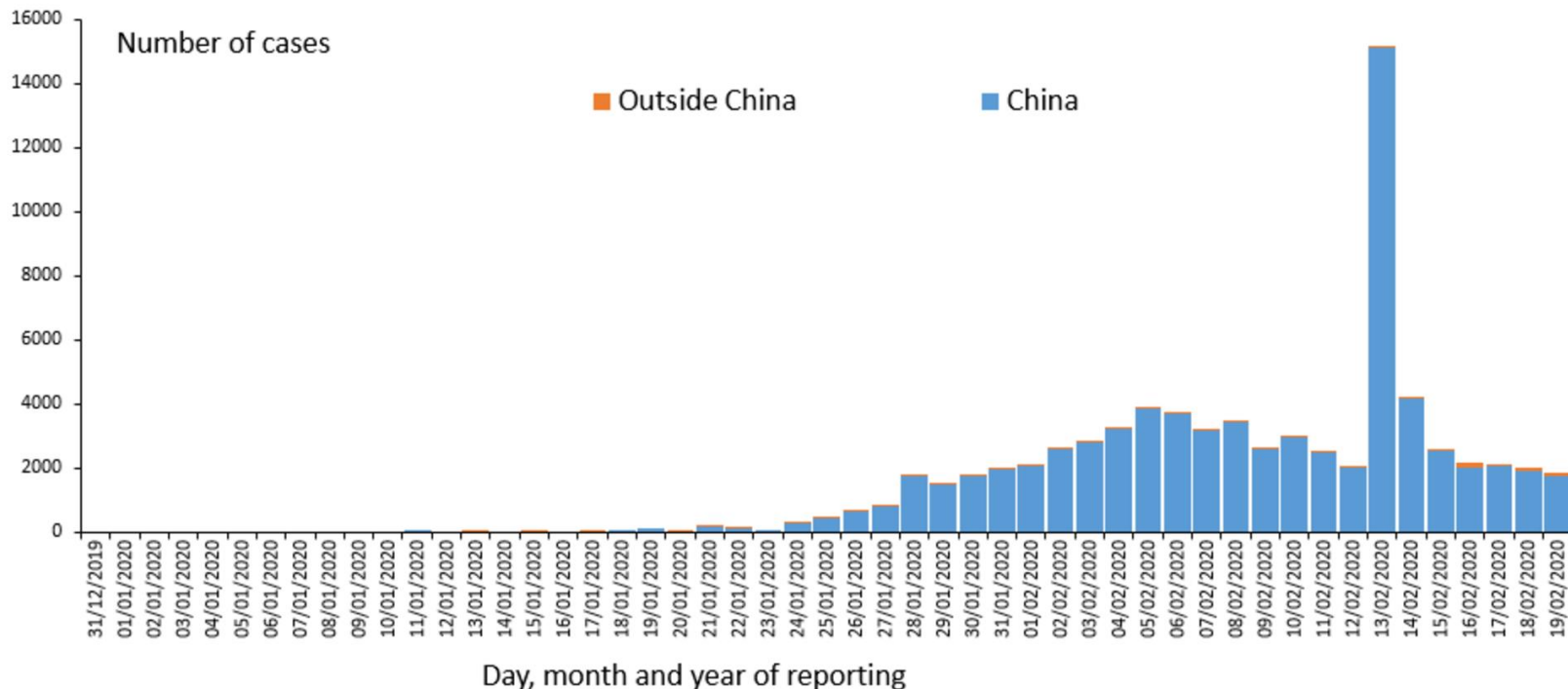
Epidemiology in its modern form is a relatively new discipline and uses quantitative methods to study diseases in human populations to inform prevention and control efforts.

Epidemiology is

the study (includes: **surveillance**, observation, hypothesis testing, analytic research and experiments)

of the distribution (refers to analysis of: times, persons, places and classes of people affected)

Distribution of COVID-19 cases worldwide, as of 19 February 2020 (according to the applied case definition in the countries)



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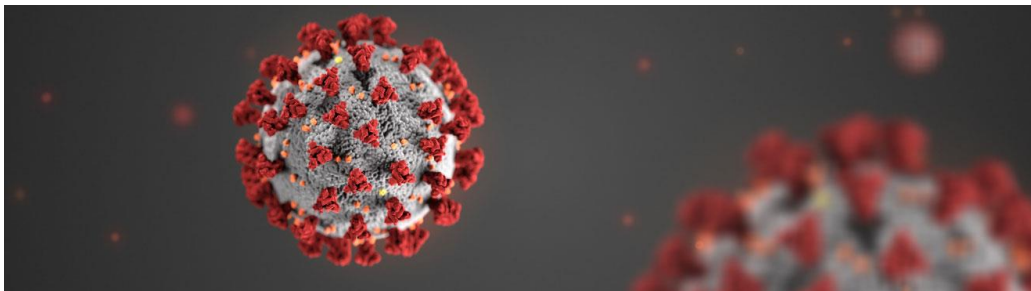
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and determinants (include factors that influence health: biological, chemical, physical, social, cultural, economic, genetic and behavioural)

COVID-19

*WHO recently announced that the official name for the disease causing the 2019 novel coronavirus outbreak is **COVID-19**.*



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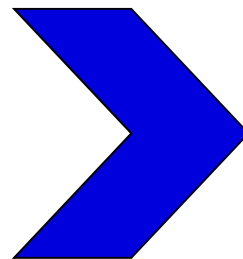
and determinants (include factors that influence health: biological, chemical, physical, social, cultural, economic, genetic and behavioural)

of health-related states (refer to: diseases, causes of death, behaviours such as use of tobacco, positive health states, reactions to preventive regimes and provision and use of health services)

– **Confirmed cases global:** 75,725

– **Recoveries** 16,330

– **Deaths** 2,128



44 days since the virus was discovered

Case definition for surveillance

- The case definitions are based on the current information available and may be revised as new information accumulates. Countries may need to adapt case definitions depending on their own disease situation.
- **Suspect case**
- A. Patients with severe acute respiratory infection (fever, cough, and requiring admission to hospital), **AND** with no other etiology that fully explains the clinical presentation¹ **AND** at least one of the following:
 - • a history of travel to or residence in the city of Wuhan, Hubei Province, China in the 14 days prior to symptom onset, **or**
 - • patient is a health care worker who has been working in an environment where severe acute respiratory infections of unknown etiology are being cared for.
- B. Patients with any acute respiratory illness **AND** at least one of the following:
 - • close contact² with a confirmed or probable case of 2019-nCoV in the 14 days prior to illness onset, **or**
 - • visiting or working in a live animal market in Wuhan, Hubei Province, China in the 14 days prior to symptom onset, **or**
 - • worked or attended a health care facility in the 14 days prior to onset of symptoms where patients with hospital-associated 2019-nCoV infections have been reported.
- **Probable case**
- Probable case: A suspect case for whom testing for 2019-nCoV is inconclusive³ or for whom testing was positive on a pan-coronavirus assay.
- **Confirmed case**
- A person with laboratory confirmation of 2019-nCoV infection, irrespective of clinical signs and symptoms.

COVID-19

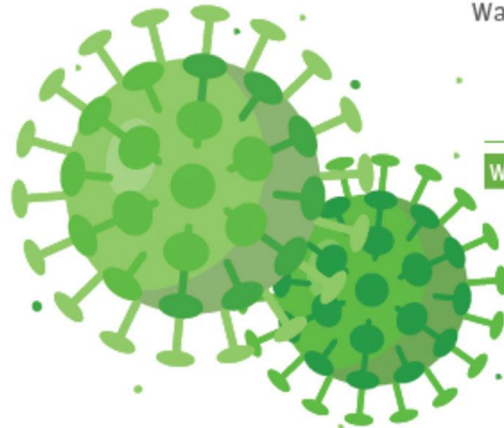
Disease caused by the SARS-CoV-2 virus



Novel coronavirus

Coronaviruses are viruses that **circulate among animals** but some of them are also known to affect humans.

The 2019 novel coronavirus was identified in China at the end of 2019 and is a new strain that has not previously been **seen in humans**.



Symptoms

 FEVER

 COUGH

 DIFFICULTY BREATHING

 MUSCLE PAIN

 TIREDNESS

Prevention

When visiting China

Avoid contact with sick people



Avoid visiting markets and places where animals are handled



Avoid contact with animals, their excretions or droppings



Wash your hands with soap and water



Apply general rules governing food hygiene



Wherever you travel apply general hygiene rules

Transmission

VIA RESPIRATORY DROPLETS

2-14 days
estimated incubation period



MUNI
MED

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in specified populations, (include those with identifiable characteristics, such as occupational groups)

Coronavirus Disease 2019 Information for Travel

Travelers from China Arriving in the United States
Interim Guidance for Airlines and Airline Crew: Ship
Sanitation Certificate Information

Information for **Healthcare Professionals**

- [Healthcare Personnel with Potential Exposure Guidance](#)
- [Inpatient Obstetric Healthcare Guidance](#)
- Coronavirus Disease 2019 (COVID-19) and Pregnancy

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and the application of this study to control health problems (the aims of public health – to promote, protect, and restore health)

World experts and funders set priorities for COVID-19 research

They discussed all aspects of the outbreak and ways to control it including:

- the natural history of the virus, its transmission and diagnosis;
- animal and environmental research on the origin of the virus, including management measures at the human-animal interface;
- epidemiological studies;
- clinical characterization and management of disease caused by the virus;
- infection prevention and control, including **best ways to protect health care workers**;
- research and development for candidate **therapeutics** and **vaccines**;
- ethical considerations for research;
- and integration of social sciences into the outbreak response.

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Surveillance represents a number of long-term and complex programmes, in which experts of various medical fields participate together, for example epidemiologists, microbiologists, hygienists, clinicians etc.

Other non-medical personnel, such as statisticians, vets and ecologists, may also participate alongside medical personnel.

The epidemiologist is usually the initiator and organiser of the program.

Surveillance was initially started in the field of infectious diseases.

The systematic

- ❖ collection,
- ❖ analysis,
- ❖ interpretation, and
- ❖ dissemination of health data on an ongoing basis,

to gain knowledge of the pattern of disease occurrence and potential in a community, in order to control and prevent disease in the community.

Surveillance is put into effect in three successive stages:

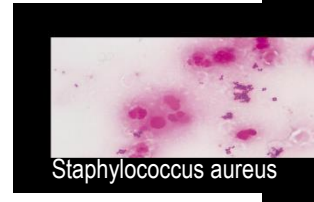
- * Obtaining the necessary data such as the number of sick, the number of dead, data from microbiological laboratories on circulation and qualities of etiological agent, clinical information on symptomatology of individual diseases, monitoring of vaccination and collective immunity of population, monitoring of infections with animals, and data of natural sciences on vectors.
- * Analysis of collected data, including evaluation of information and suggestion of measures. Long-term surveillance gives the possibility of making a prognosis of the occurrence of a given disease for the future.
- * Guaranteeing qualified information to all concerned people who can further use it for improvement of their own measures and theories.

Terminology and Definitions

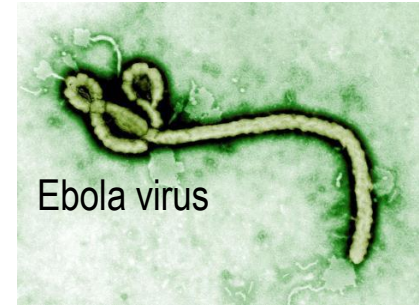
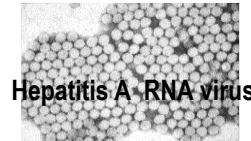
- Chain of infection
- Host (source)
- Reservoir
- Transmission
 - Direct
 - Indirect
 - Biologic
 - Vertical
- Susceptible host
- Incidence and prevalence
- Case definition
- Sporadic disease
- Endemic disease
- Epidemic(outbreak)
- Pandemic disease
- Zoonosis, epizootic and enzootic
- Eradication
- Elimination
- Nosocomial infection
- Attack rate
- Opportunistic infection
- Immunity
 - passive
 - active
- Individual immunity
- Herd immunity
- Virulence
- Incubation period
- Infectivity period
- Latent period
- Probability ratio

THE CAUSATIVE AGENT OF INFECTION

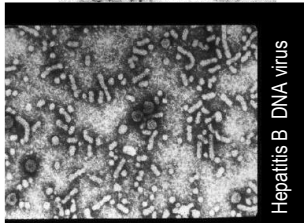
– Bacteria



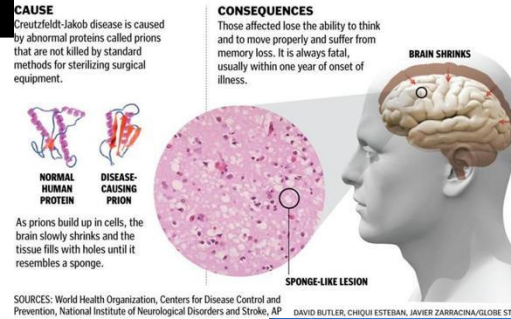
– Viruses



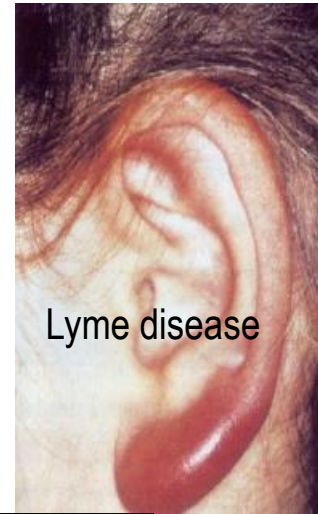
– Fungi



How Creutzfeldt-Jakob disease works



– Prions



– Spirochetes



– Parasites



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.

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

Permanent colonization, eumicrobia,

Types of bacteria event. fungi (never virus!)

are for a given system:

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

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)

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)

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

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.

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):

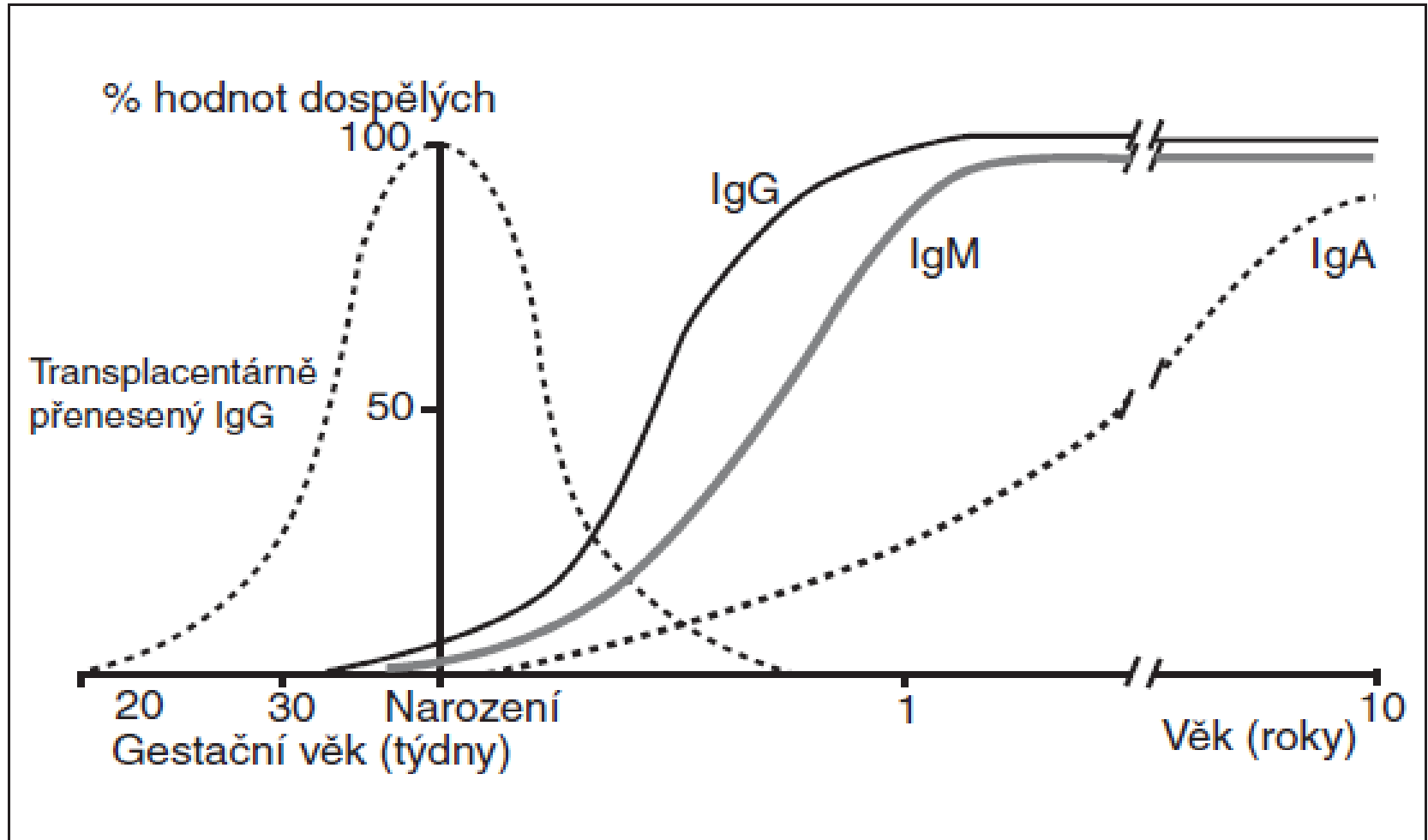
- ❖ **Colonization** (S. aureus in skin and normal nasopharynx)
- ❖ **Subclinical or inapparent infection** (polio)
- ❖ **Latent infection** (virus of herpes simplex)
- ❖ **Manifest or clinical** infection

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

Virulence factors affecting their pathogenicity:

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

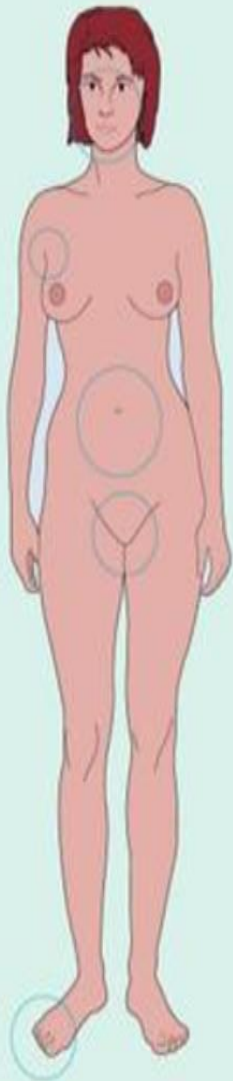
Maturation of the immune system; defense.



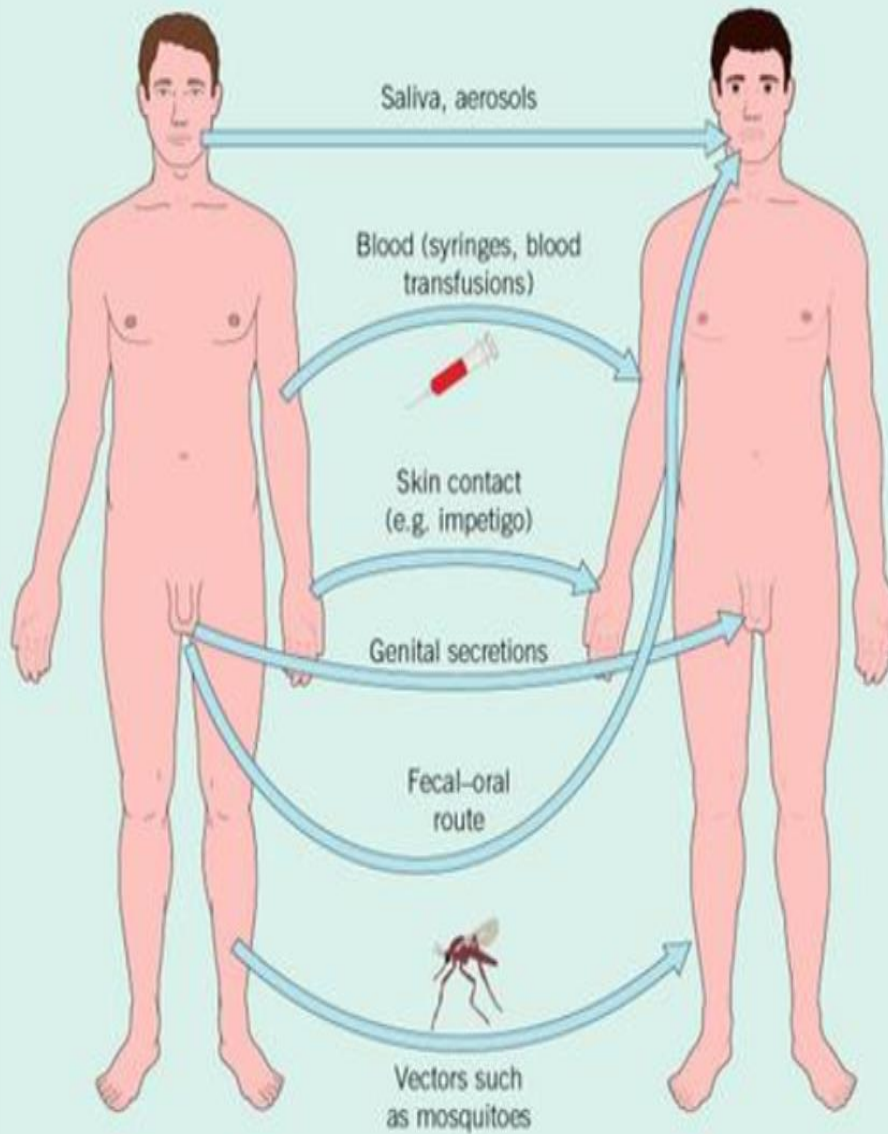
Šedivá A. Čes.-slov. Pediat., 2005, roč.60, č.11, s. 617-624

CONTAMINATION OF HUMANS BY MICRO-ORGANISMS

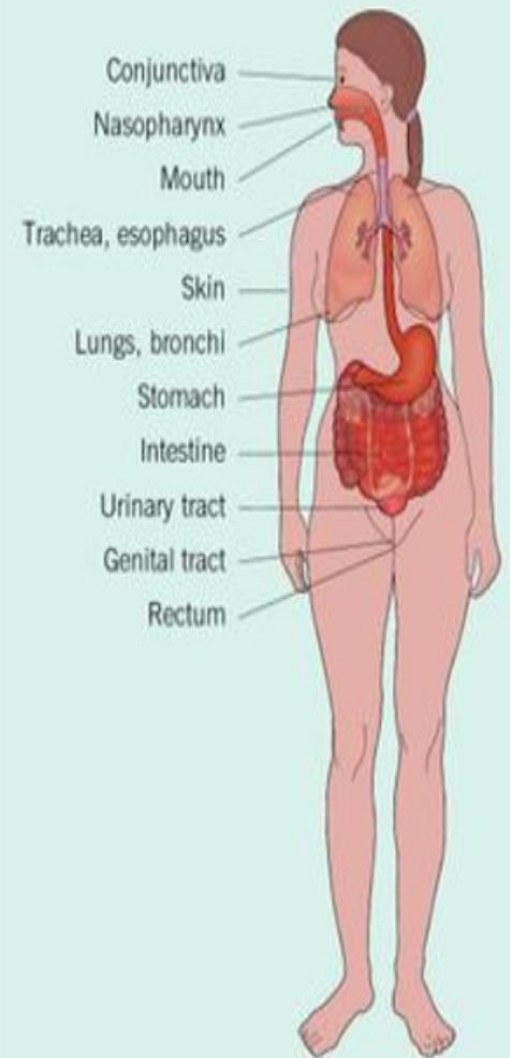
Normal flora



Transmission between people



Sites exposed to exogenous contamination



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

.....

The chain of infections

1. the presence of 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 incubation period,
 - if are ill,
 - reconvalescent,
 - carriers – healthy, chronic ill
- **animals** - at the end incubation period,
 - if is ill,
 - carriers – healthy,
 - reconvalescent, chronic ill



- ❖ **Droplets from respiratory tract (nasopharyngeal secretion)** - adenoviruses, coronaviruses, orthomyxoviruses (flu) RSV, rhinoviruses, staphylococcus, streptococcus, meningococcus, *Bordetella pertusis*, *Mycoplasma pneumoniae*, *Mycobacterium tuberculosis*
- ❖ **Saliva** -VHB, HIV, CMV, EBV, herpes virus hominis typ 1,2, morbilli, rubella virus
- ❖ **Faeces** - Enteroviruses (VHA, poliomyelitis), VHE, coxsackie viry, adenoviruses, Enterobacteriacee (*E. coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Proteus spp.*, *Citrobacter*, *Enterobacter*, *Serratia apod*, *Listeria monocytogenes*, *Clostridium difficile*, *Clostridium tetani*, *Pneumocystis carinii*.....
- ❖ **Blood, plasma, blood products** - VHB, VHC, VHA (short viremia), HIV, CMV, rare EBV, *Plasmodium malariae* , *Toxoplasma gondii*
- ❖ **Urine** - morbilli virus, CMV, VHB, papovaviry, *Listeria monocytogenes*, *Kandidy*.....
- ❖ **Liquor** — various agents of meningitis.....
- ❖ **Tears, eye secretion** -VHB, HIV, adenoviry, Enterovirus typ 70, *Coxsackie A 24*, *Staphylococcus aureus*, hemophilus, pneumokoky, moraxely, chlamydie.....
- ❖ **Vaginal secretion** - HIV, VHB, vzácně VHC, herpes virus hominis typ 1,2, *Streptococcus agalactiae*, *Neisseria gonorrhoea*, *Haemophilus Ducreyi*, *Treponema pallidum*, *Trichomonas vaginalis*, *Chlamydia lymfogramulomatosis*, *Chlamydia trachomatis*..
- ❖ **Sperma** -VHB, HIV, rare VHC, CMV.....

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...)

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- **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

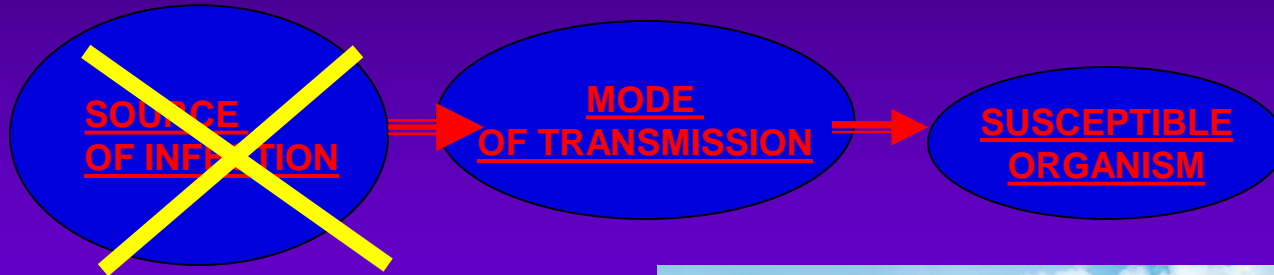
Humoral immunity

Immunoglobulin: IgG, IgM, IgE, IgA, IgD

Cell mediated immunity

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



Isolation of patients:

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





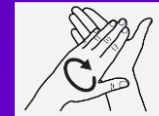
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Prevention of infectious diseases



HANDWASHING, DISINFECTION OF HANDS



LINEN WASHING,
CLEANING



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



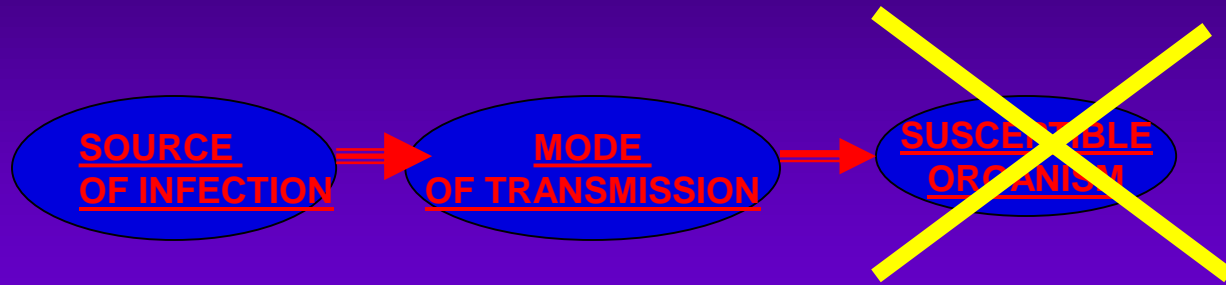
.....
DISINFECTION



STERILIZATION



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

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

KOLMA 1/07

Smallpox eradication

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 eradication

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.



Face lesions on boy with smallpox.

Public Health Images Library (PHIL) ID # 3.

Source: CDC/Cheryl Tyron





Smallpox recognition
card, c.1973, courtesy
Dr. Damodar
Bhonsule,
Panjim, Goa, India.

КПМА 1707

Smallpox lesions on skin of trunk. Picture taken in Bangladesh, 1973.

Public Health Images Library (PHIL) ID # 284. Source: CDC/James Hicks



Eradication of smallpox Czech experts

A key figure in the global eradication program smallpox was **prof. MUDr. Karel Raska, MD.**, who drove in the sixties division Communicative Diseases of the WHO Secretariat in Geneva.

He promoted the establishment of a new, independent units "Eradication of smallpox, and ensure its initial financial and material support, not only in Geneva, but also in regional offices of WHO.

With its support of the program also attended the 20 Czechoslovak health professionals (14 Czechs and Slovaks 6), mainly epidemiologists.

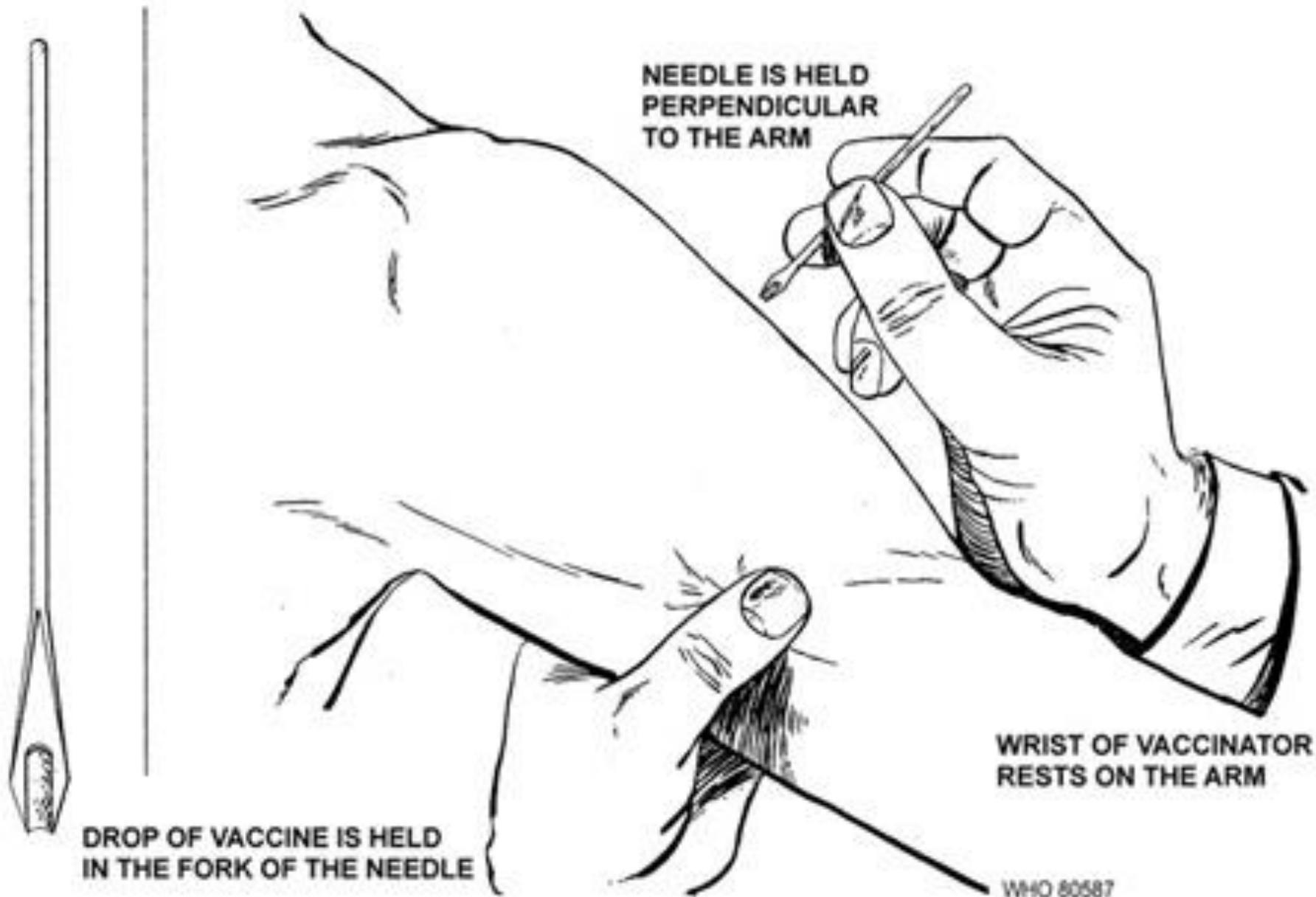
They participated in both the preparation methodology and procedures, thus working directly in infested areas.



Rural vaccinator in United Provinces, British India, c.1930, private collection of Dr. Sanjoy Bhattacharya



MULTIPUNCTURE VACCINATION BY BIFURCATED NEEDLE



Variola virus, which causes smallpox, was once the scourge of the world.
This virus passes from person to person through the air.

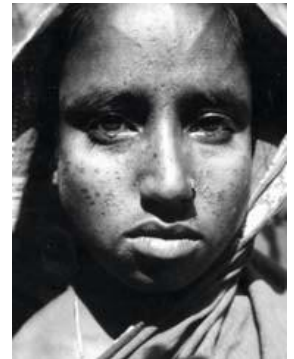
A smallpox infection results in fever, severe aches and pains, scarring sores that cover the body, blindness in many cases, and, often, death. There is no effective treatment.

Although vaccination and outbreak control eliminated smallpox in the United States by 1949, the disease still struck an estimated 50 million people worldwide each year during the 1950s.

In 1967, the World Health Organization (WHO) launched a massive vaccination campaign to rid the world of smallpox —and succeeded.

The last natural case of smallpox occurred in Somalia in 1977.

Ali Maow Maalin, cook twenty-three of the hospitals in the Somali Merce. He contracted when he showed the path of the ambulance chauffeur who drove two sick children to camp insulation.



In 1978 was ill photographer Medical School in Birmingham, England. She was killed by a virus that escaped from a neighboring lab.

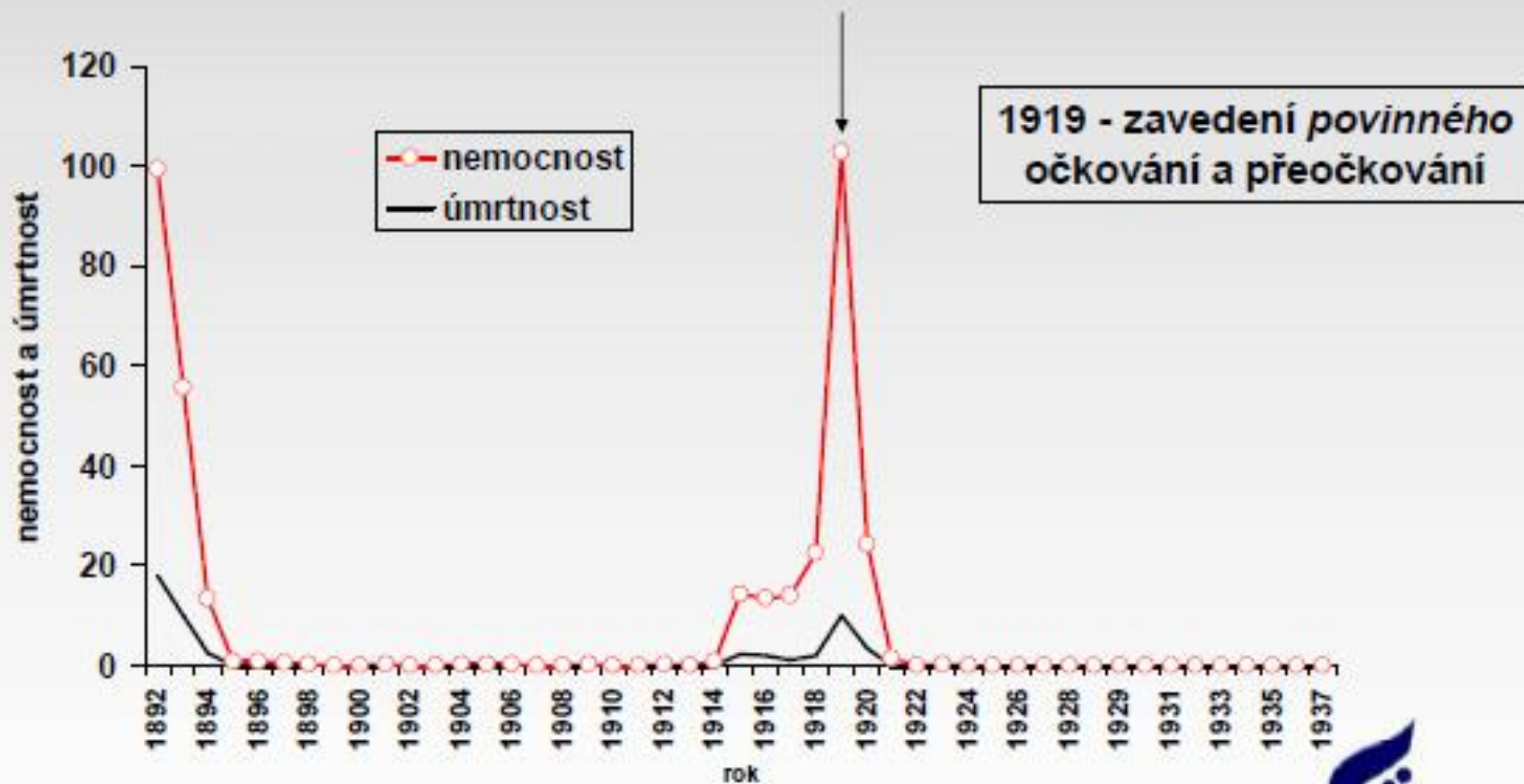
Mr. John Wickett, of the World Health Organization, with the last person to have contracted – and survived – naturally occurring smallpox in Somalia.

(1977), courtesy Mr. John Wickett.



KOLMA 1707

Variola, České země, 1892-1937, nemocnost a úmrtnost na 100 000 obyvatel



**Smallpox eradication was
officially announced
at the 33rd General Assembly WHO
8. May 1980.**

Milestones in the eradication of smallpox

1789 Edward Jenner invents a smallpox vaccine.

1966 The World Health Organization (WHO) launches a massive global campaign to eradicate smallpox.

1972 Smallpox vaccinations are discontinued in the United States.

1975 and 1977 The last cases of the two known variants of smallpox occur in the world, in Bangladesh and Somalia.

1978 Two people are sickened in a lab accident in England; one dies.

1980 The WHO declares smallpox eradicated.

1991 Smallpox virus DNA is mapped.

1999 The WHO sets this deadline, by which remaining lab stocks of the virus are to be destroyed. The deadline will be postponed again and again.

2003 Millions of doses of vaccine are produced to hedge against a biological attack.

2011 WHO's decision-making body will meet in May to again vote on whether to kill the remaining live viruses.