Preventive epidemiological measures; principles of vaccination

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Ústav ochrany a podpory zdraví LF MU

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Epidemiology

*is the **study*** (scientific, systematic, data-driven)

*of the **distribution*** (frequency, pattern)

*and **determinants*** (causes, risk factors)

*of **health-related states or events*** (not just diseases)

*in **specified populations*** (patient is community, individuals viewed collectively),

*and the **application*** (since epidemiology is a discipline within public health)*of this study to the control of health problems.*

SURVEILLANCE

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.

Diseases and special health issues under EU surveillance

- Diseases preventable by vaccination
- Sexually transmitted diseases
- Viral hepatitis
- Food- and waterborne diseases and diseases of environmental origin
- Diseases transmitted by non-conventional agents (prions)
- Airborne diseases
- Zoonoses (other than those listed above)
- Serious imported diseases
- Vector-borne diseases
- Special health issues (HAI, antibiotic resistence)

Global Disease Elimination and eradication

- During the 25 years since the certification of smallpox eradication there has been considerable debate among public health practitioners about how existing health technologies can best be used to decrease infectious disease incidence and prevalence.
- Interruption of transmission has often been envisaged as the ultimate goal, and standard public health concepts of disease reduction have been defined or re-defined.
- In 1998, Dowdle proposed a definition of control as a reduction in the incidence, prevalence, morbidity or mortality of an infectious disease to a locally acceptable level;
- **elimination** as reduction to zero of the incidence of disease or infection in a defined geographical area;
- and **eradication as permanent reduction to zero** of the worldwide incidence of infection

Eradication and Elimination

Eradication is an absolute process, an “all or none” phenomenon, restricted to termination of infection from the whole world.

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

8. May 1980.

- The term elimination is sometimes used to describe eradication of a disease from a large geographic region. Disease which are amenable to elimination in the meantime are polio, measles and diphtheria.

SURVEILLANCE

- Surveillance programmes can be carried out on a large scale such as for districts and regions.
- In the Czech Republic, surveillance programmes exist for poliomyelitis, pertussis, diphtheria, measles, viral hepatitis, alimentary infections and influenza.
- Under the general guidelines released by WHO, surveillance of influenza is carried out on an international level.

BENCKO, Vladimir, et al. *Hygiene and Epidemiology : Selected Chapters.* 2nd edition. Prague. 2008. ISBN 80-246-0793-X.

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

2. the way **of transmission**
   A/ direct contact
   B/ indirect contact

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

THE INFECTION

= 1. **source of infection**

.....

Preventive, repressive measures

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

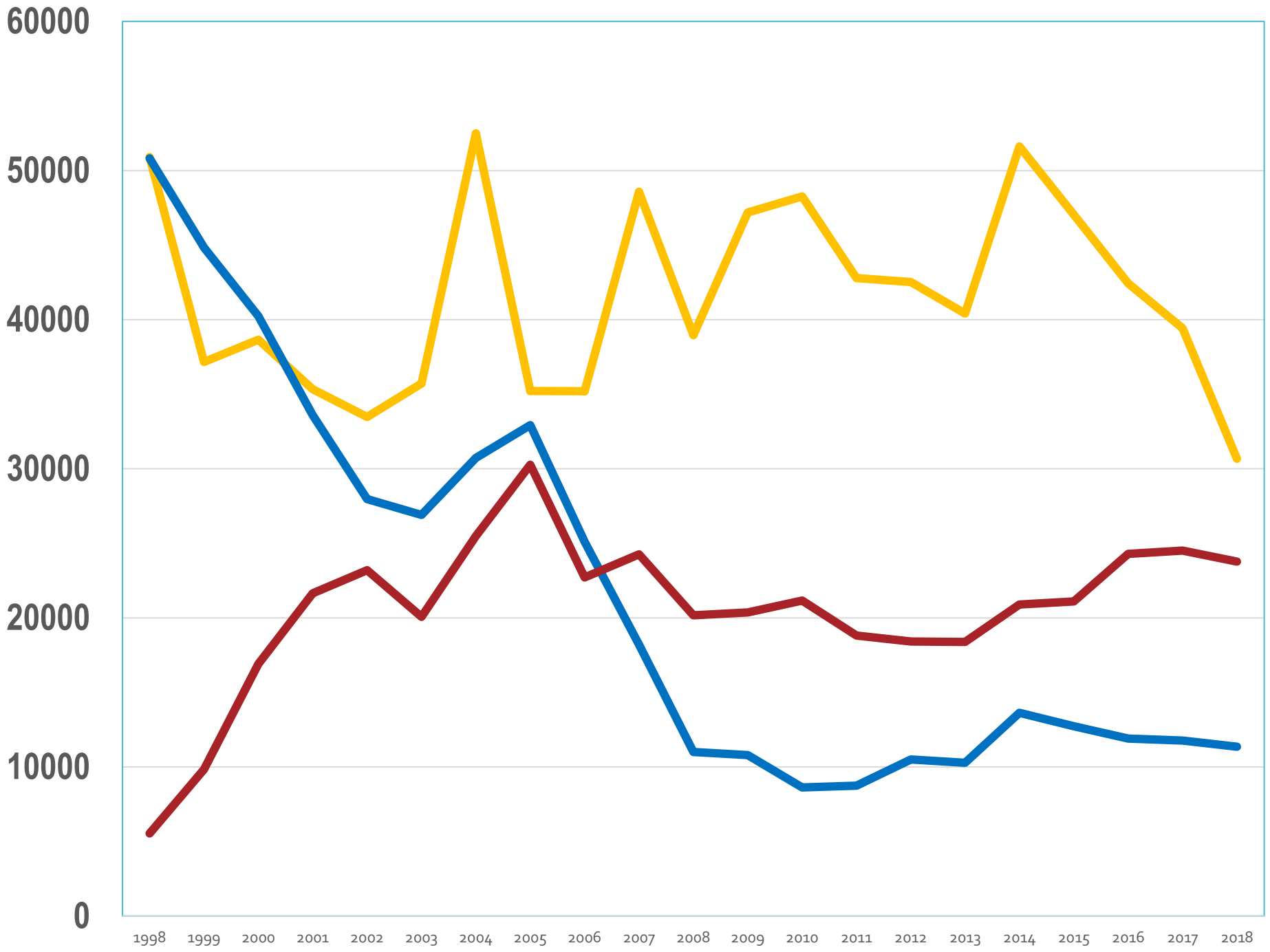
„**BREAKING THE CHAIN OF INFECTION**“

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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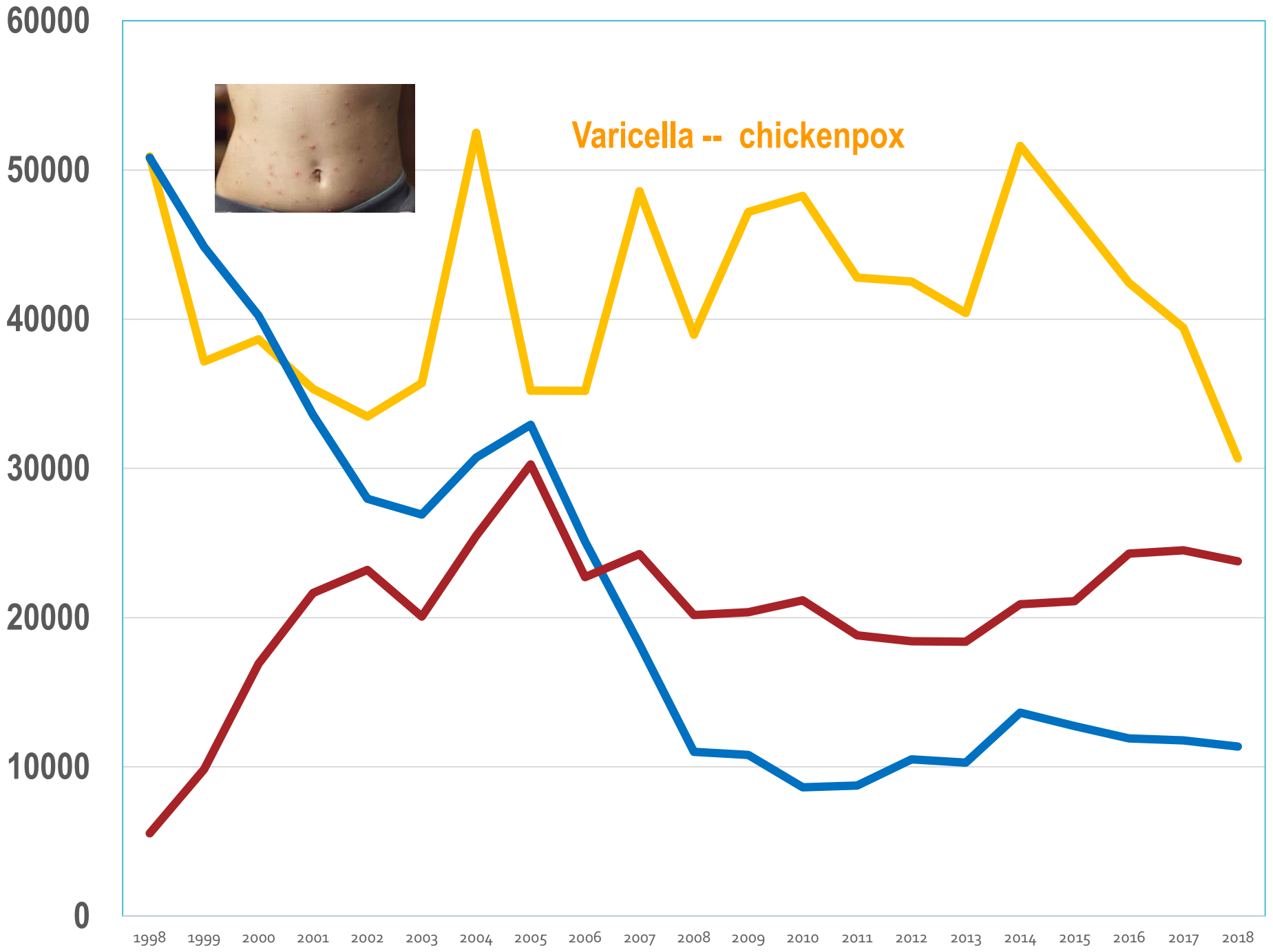
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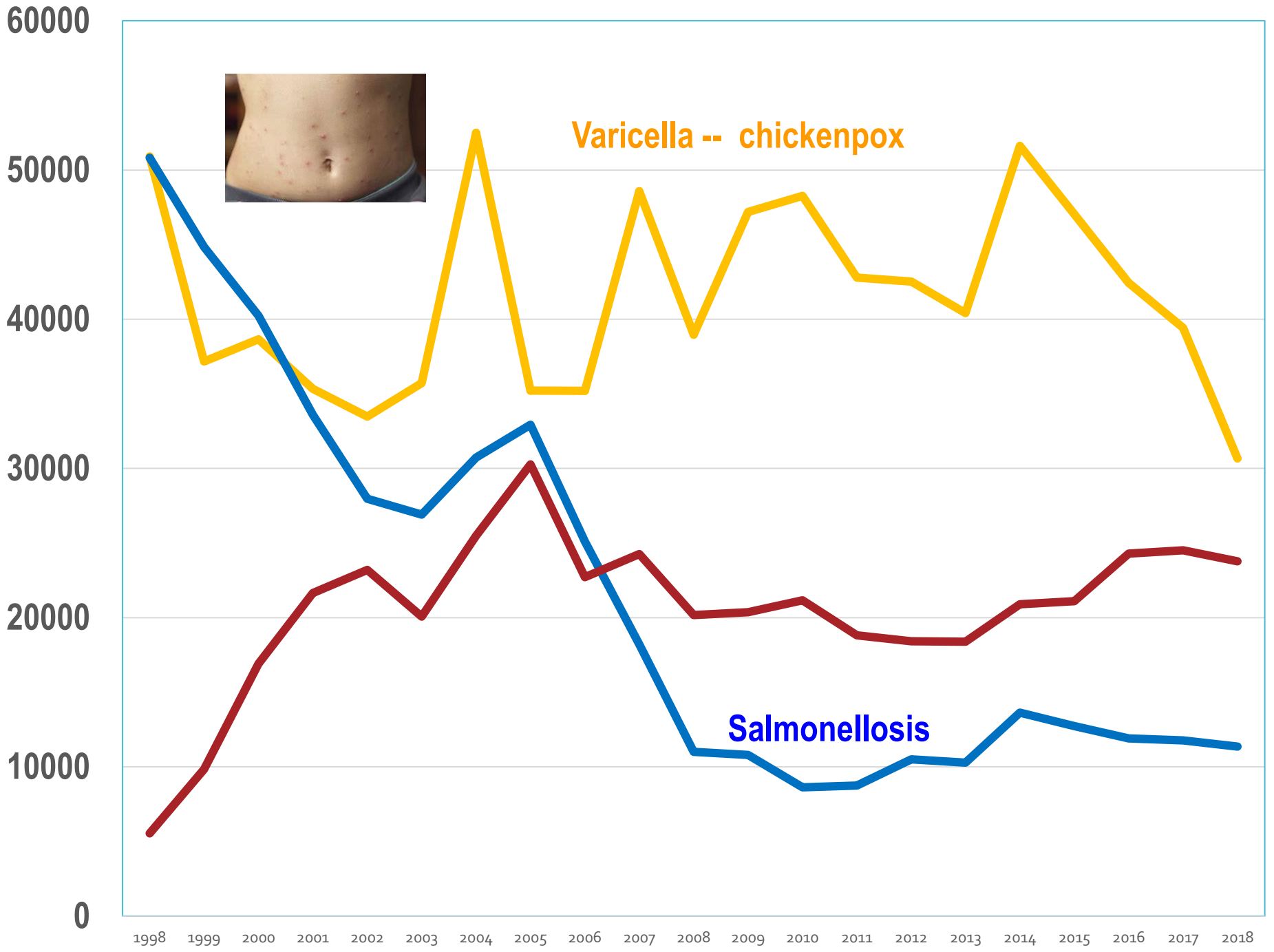
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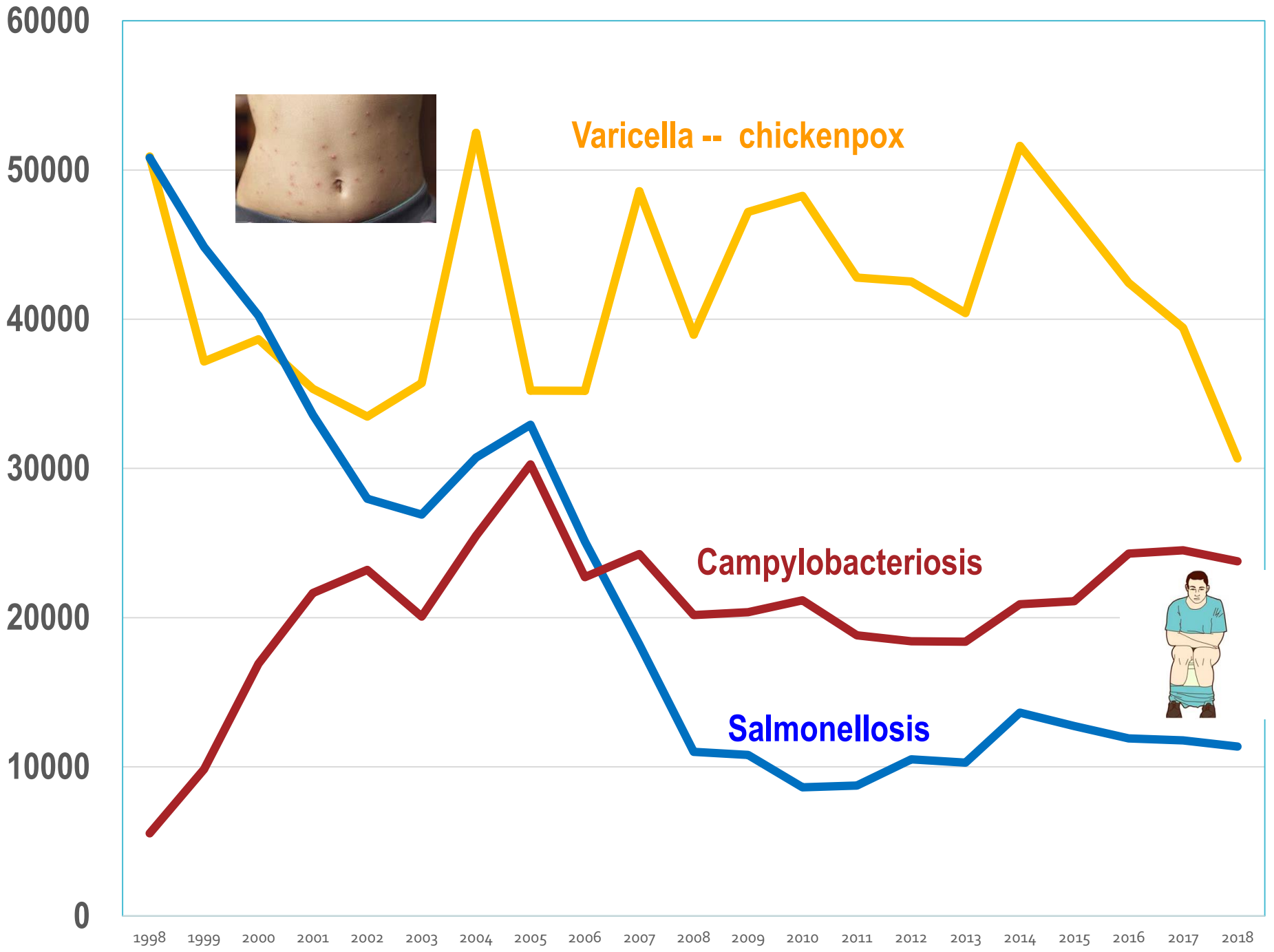
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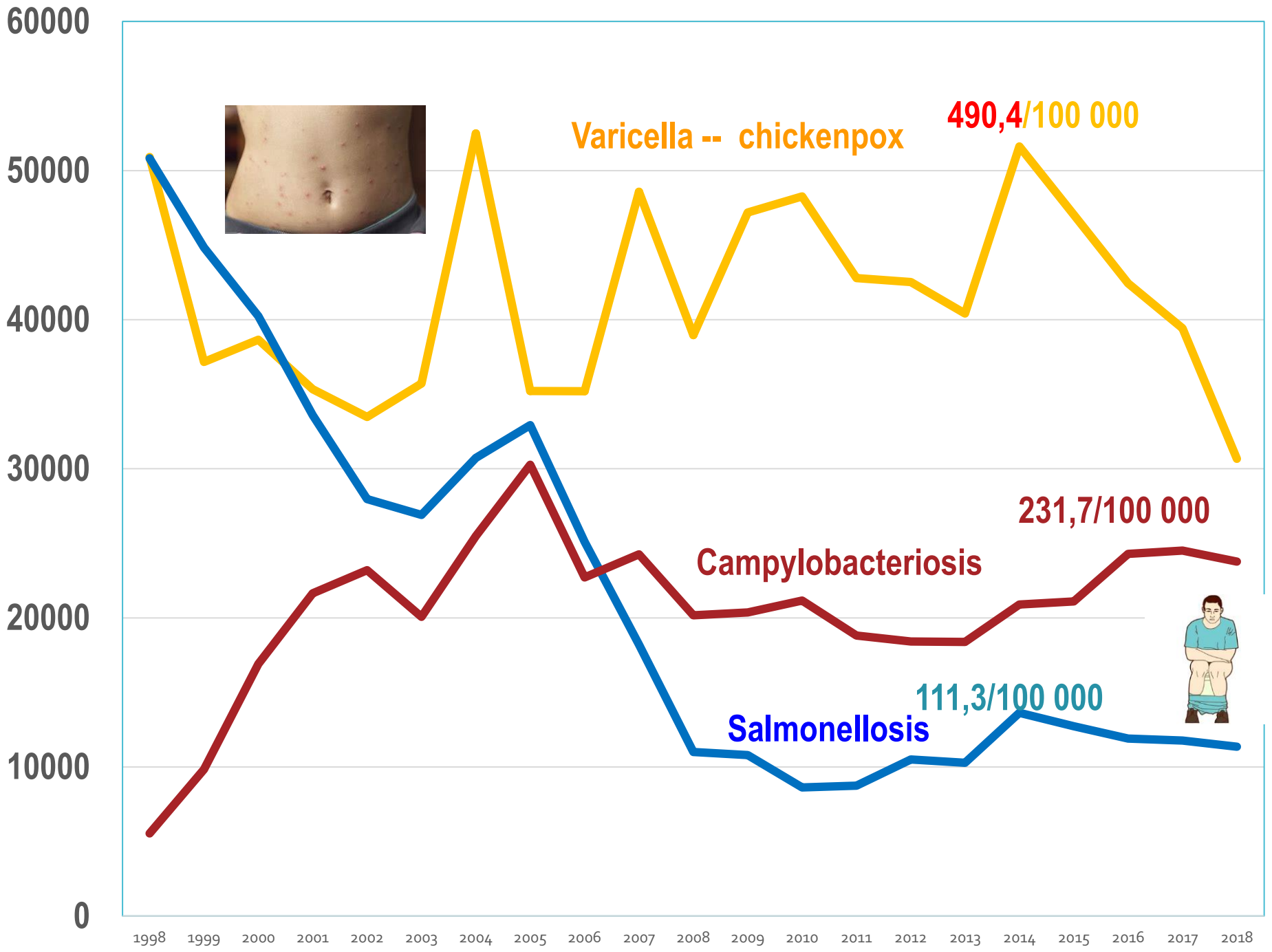
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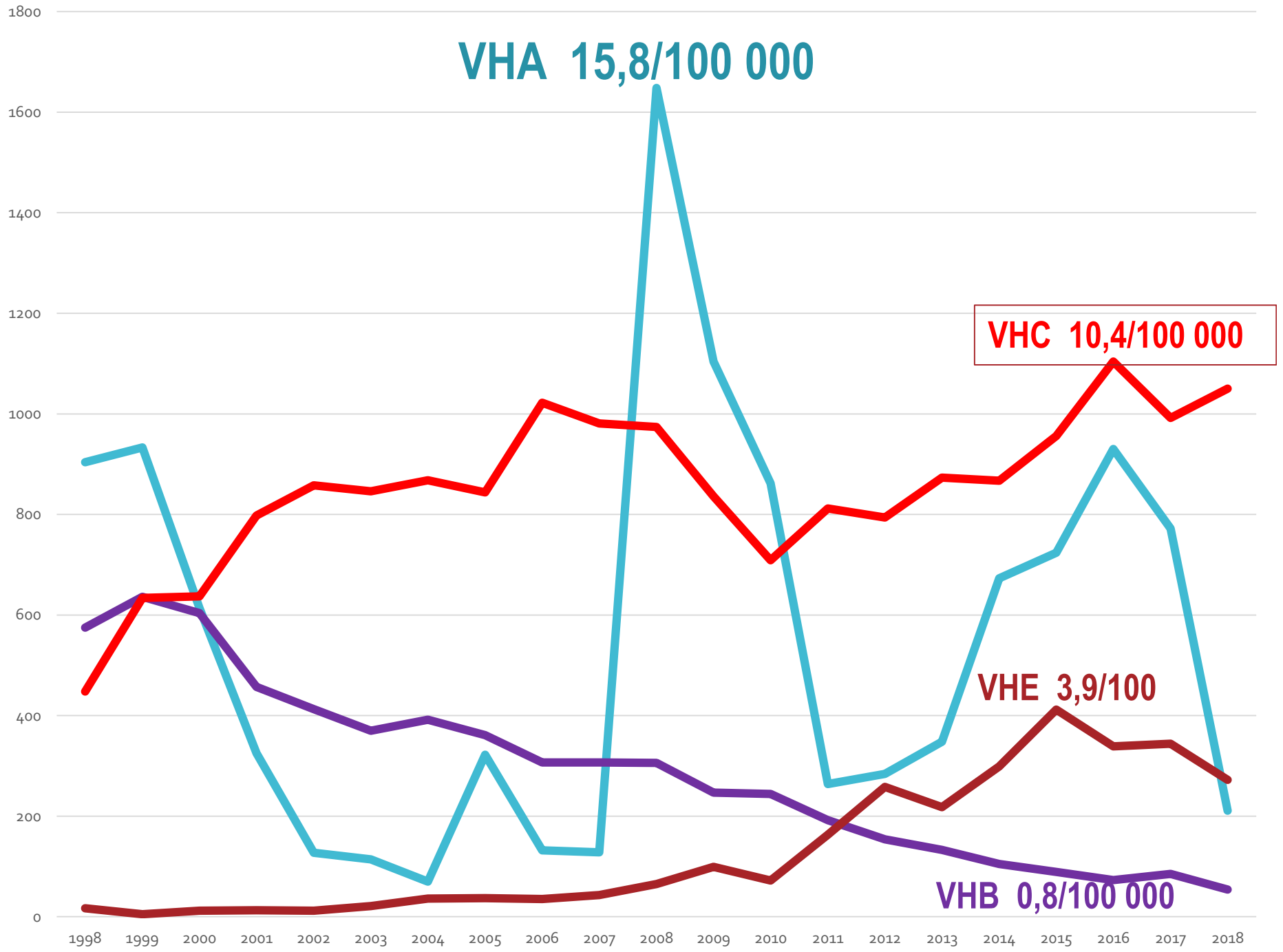
VHA 15,8/100 000
VHC 10,4/100 000
VHE 3,9/100
VHB 0,8/100 000
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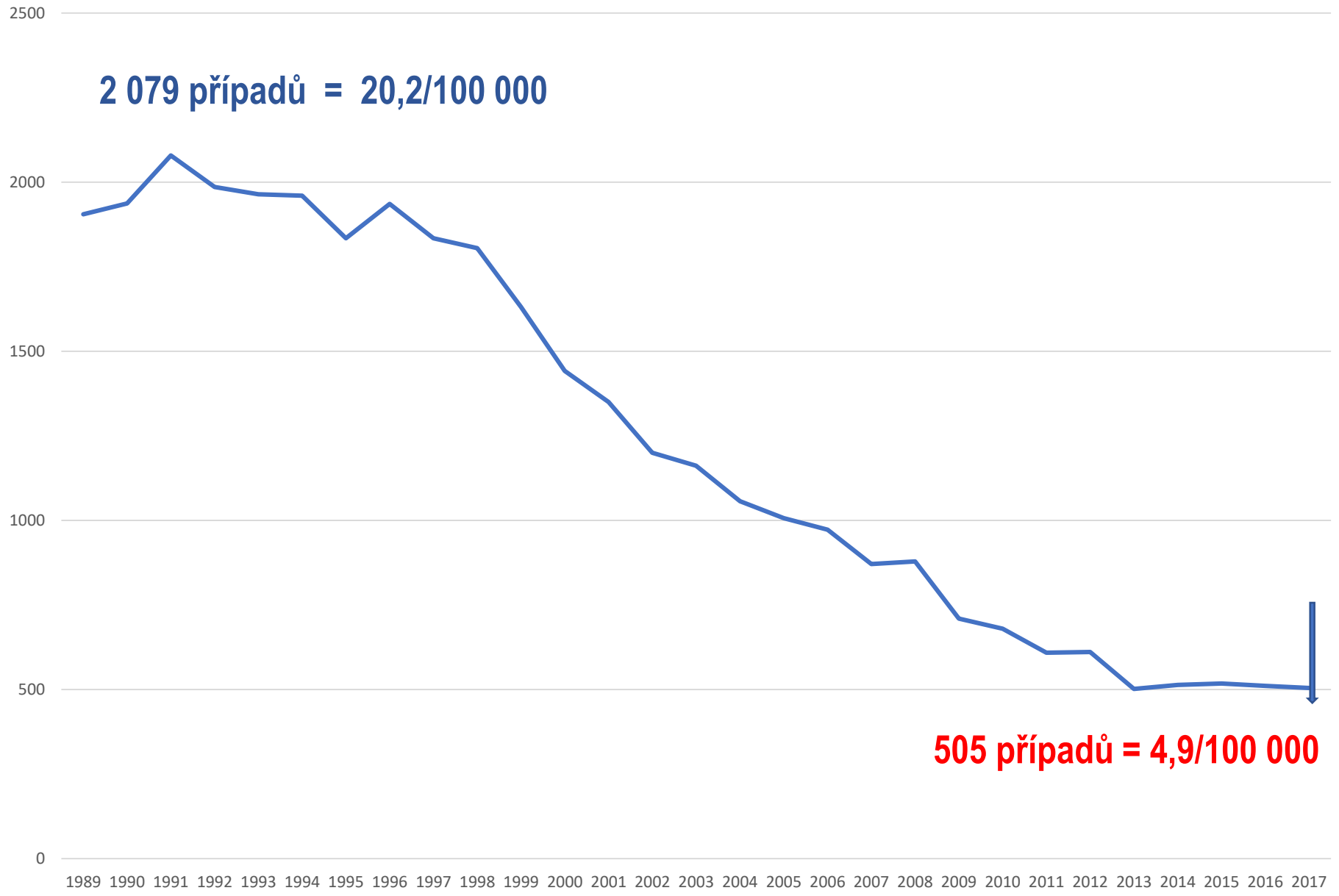
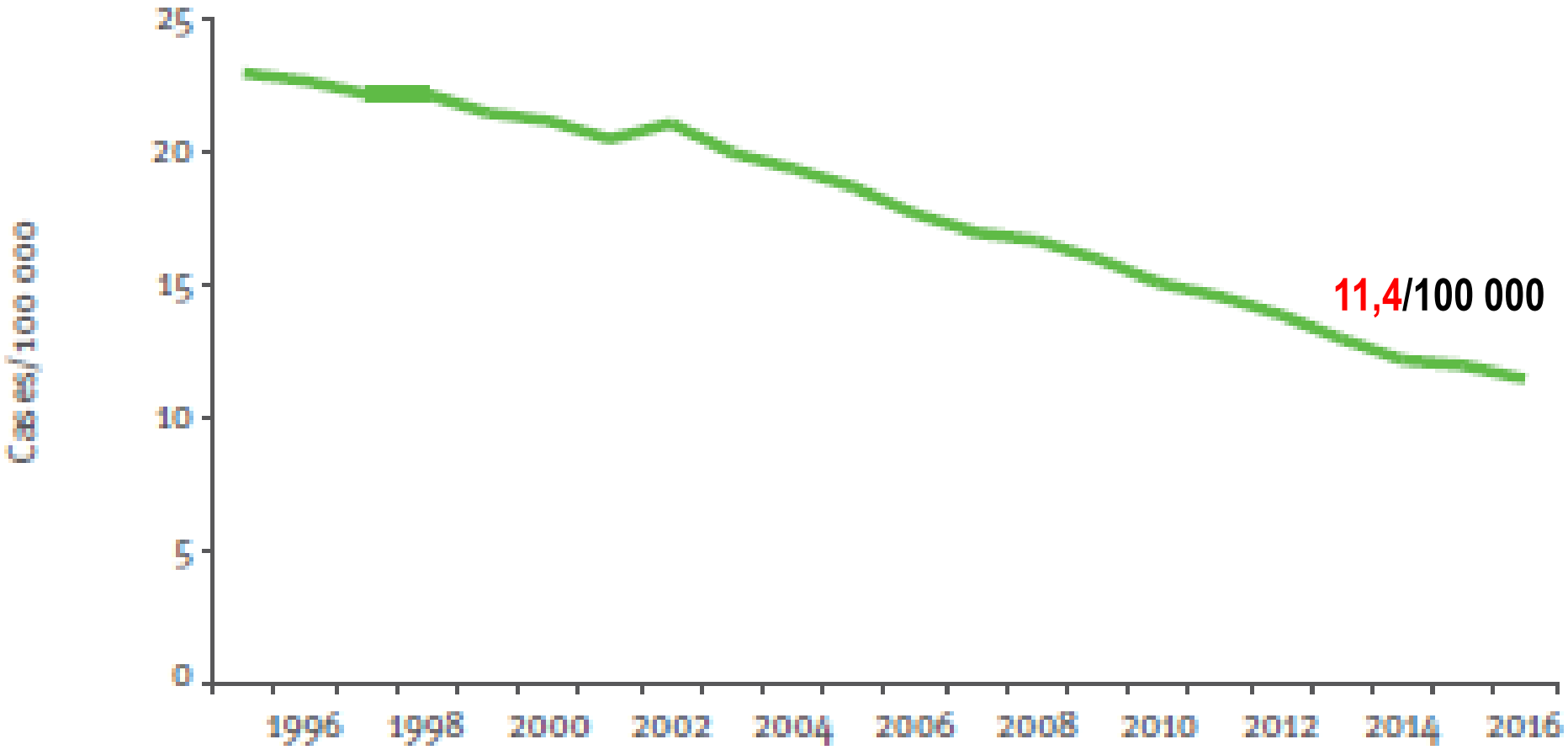
Tuberculosis ČR



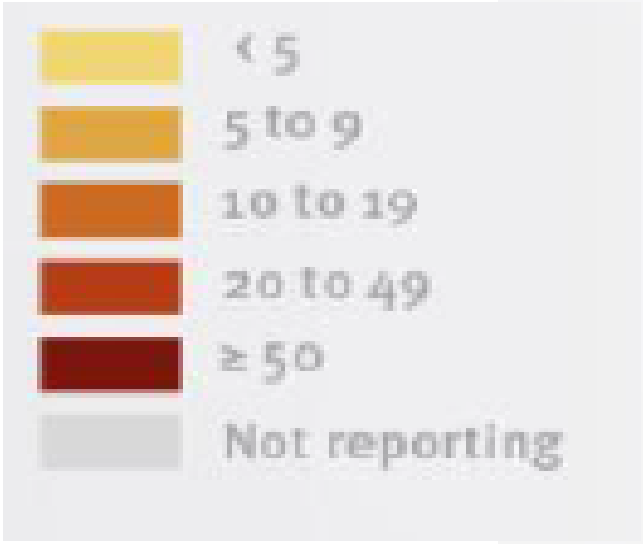
TB notification rates per 100 000 population by year of reporting, EU/EEA, 1995-2016



Tuberculosis

EU/EEA 2016

Cases per 100 000 population

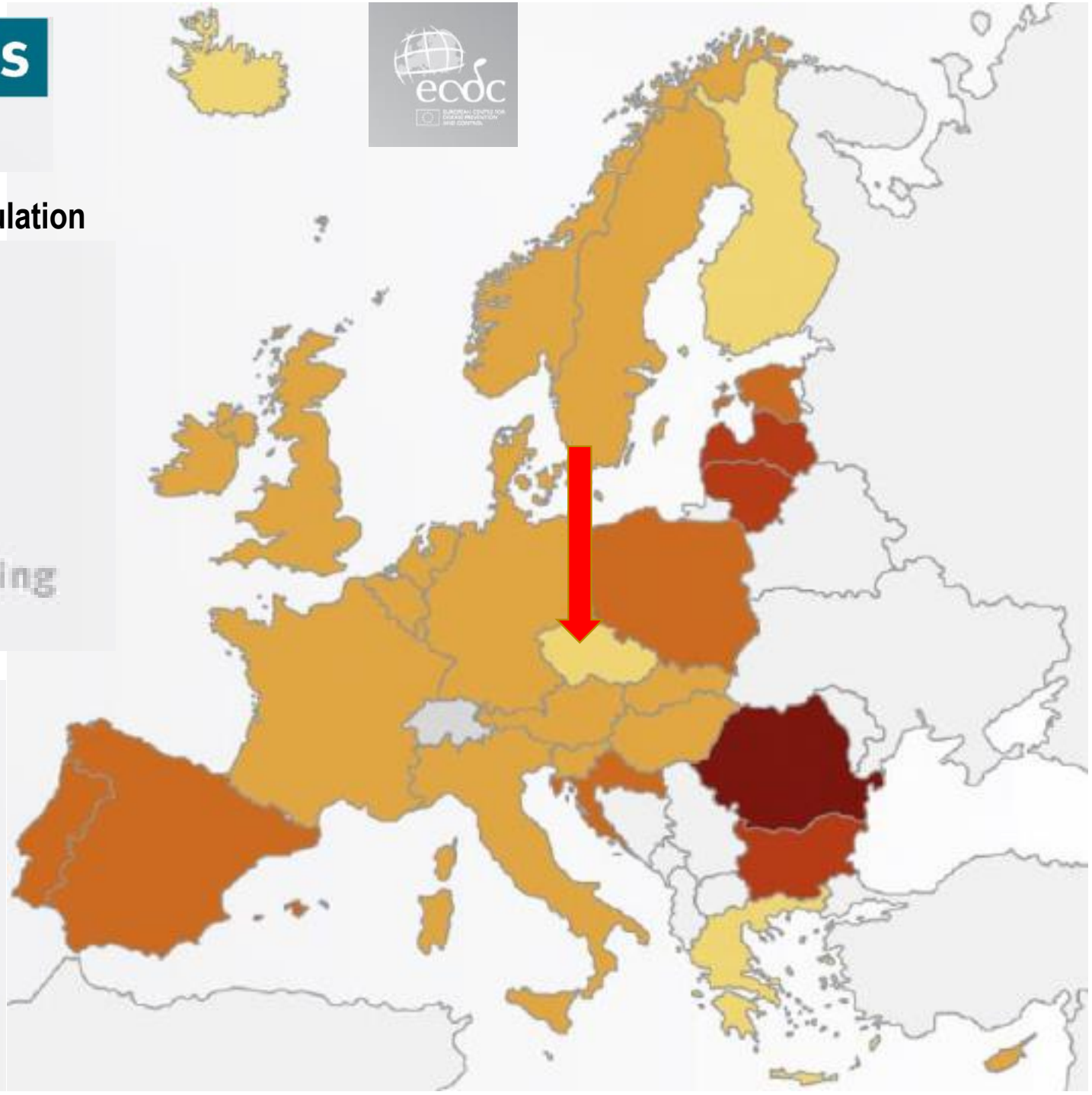


TB cases in EU/EEA countries

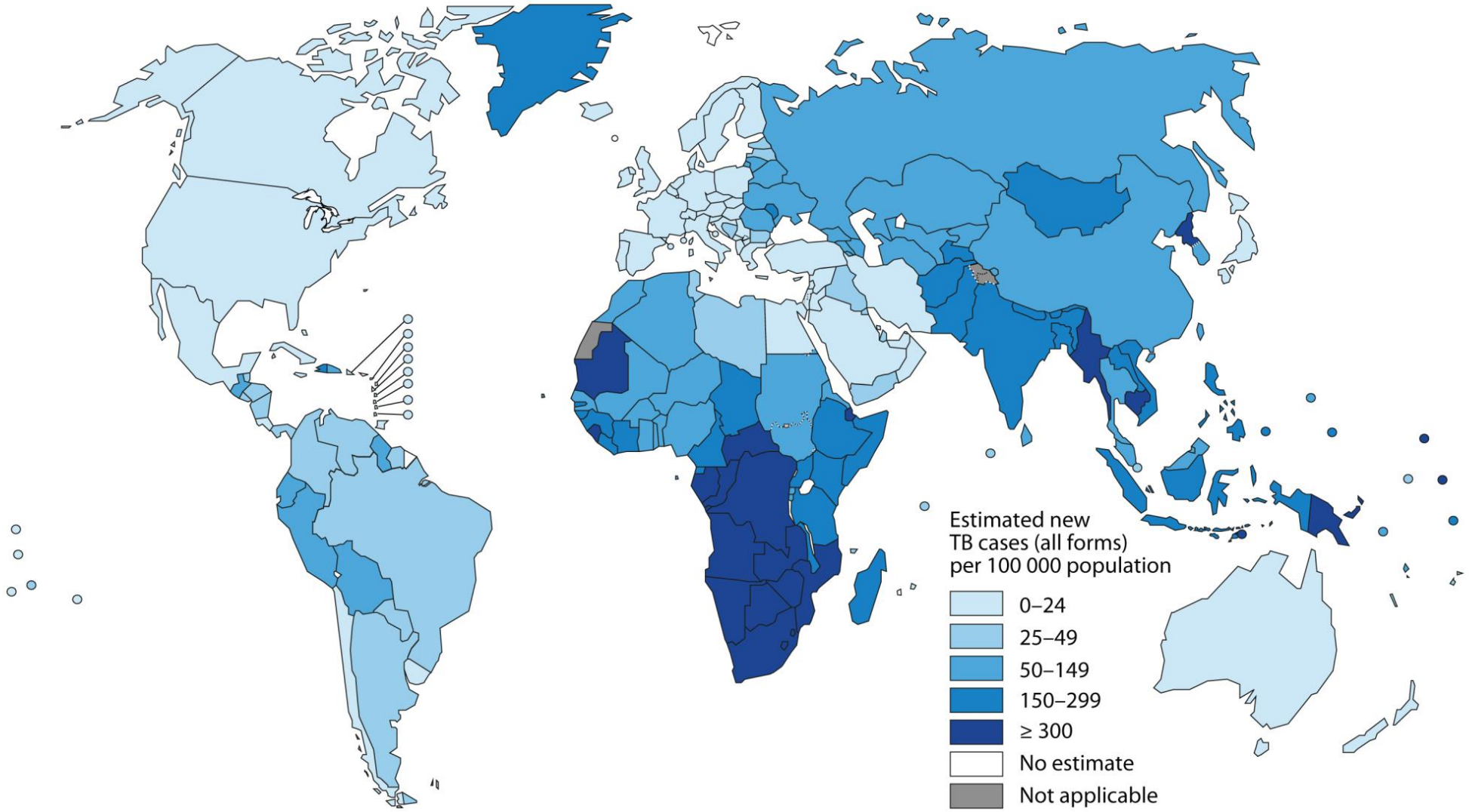
58 994

Notification rate per 100 000 population

11.4



Estimated tuberculosis (TB) incidence rates, 2011



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Source: *Global Tuberculosis Report 2012*. WHO, 2012.

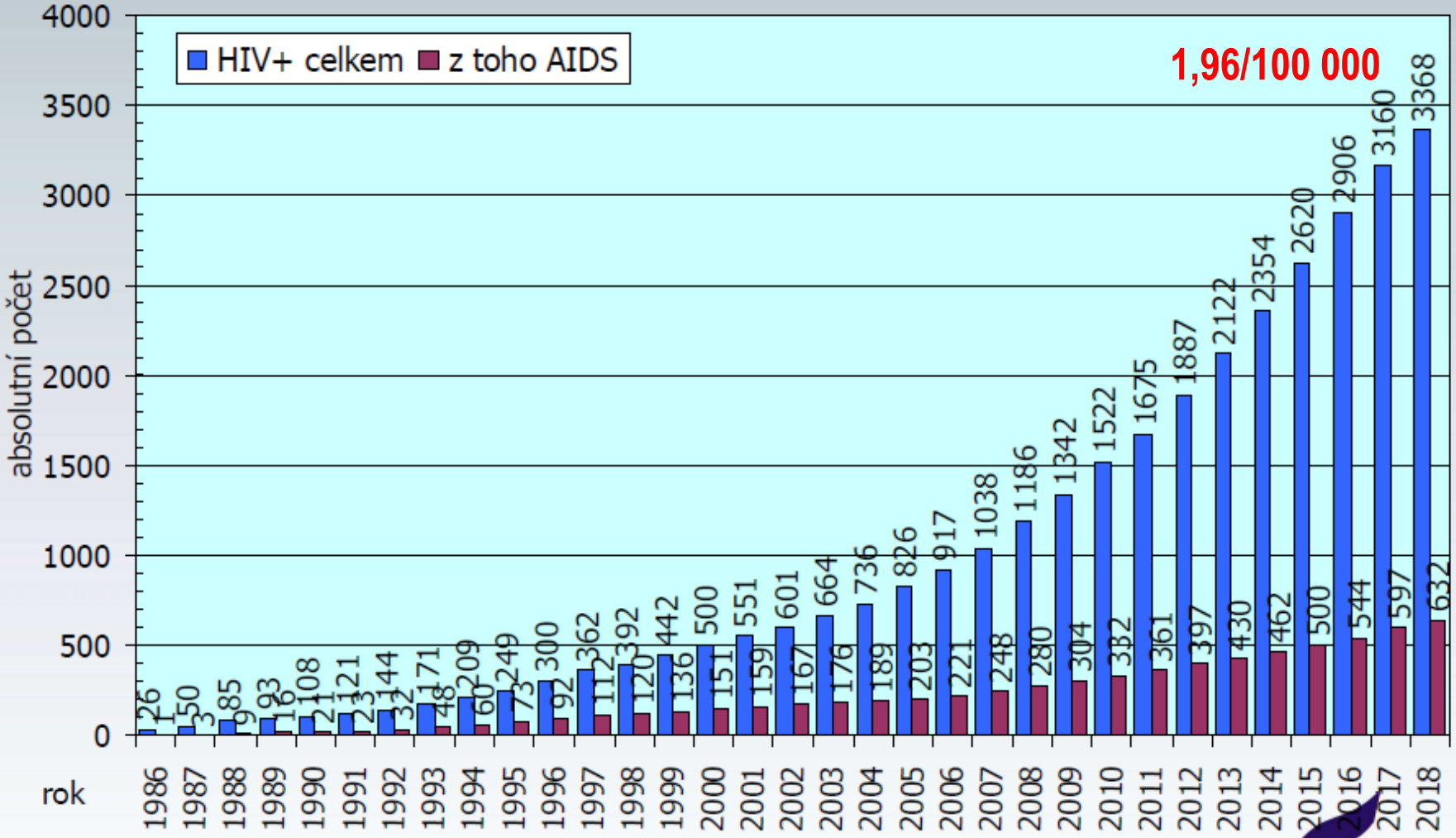
World Health Organization

HIV / AIDS V ČESKÉ REPUBLICE

(občané ČR a cizinci s trvalým pobytem)

Kumulativní údaje za období

1.1.1986 - 31.12.2018



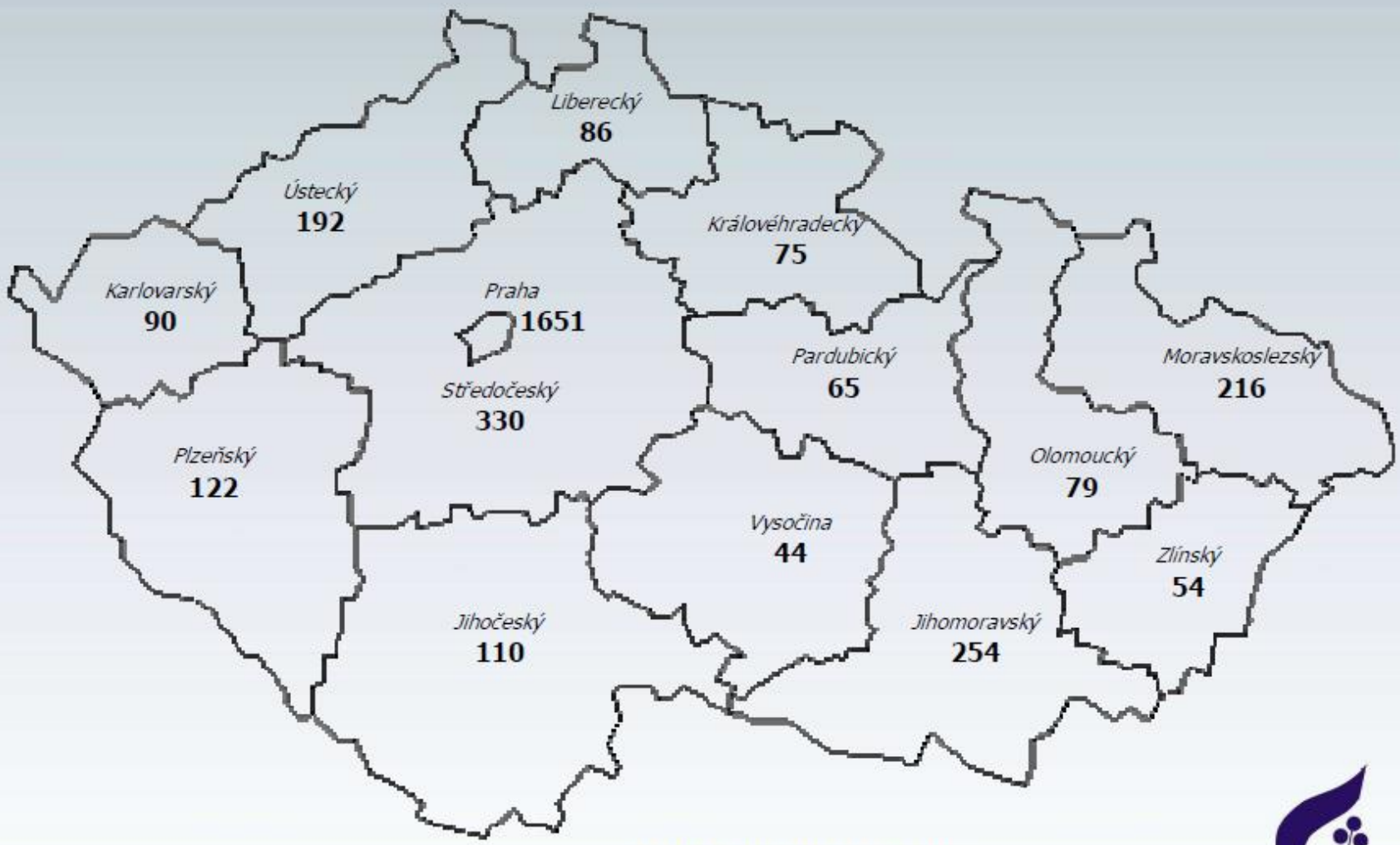
HIV INFEKCE V ČESKÉ REPUBLICE

PODLE KRAJE BYDLIŠTĚ V DOBĚ PRVNÍ DIAGNÓZY HIV

(občané ČR a cizinci s trvalým pobytem)

Kumulativní údaje za období

1.10.1985 - 31.12.2018



HIV + CELKEM 3368

NRL AIDS

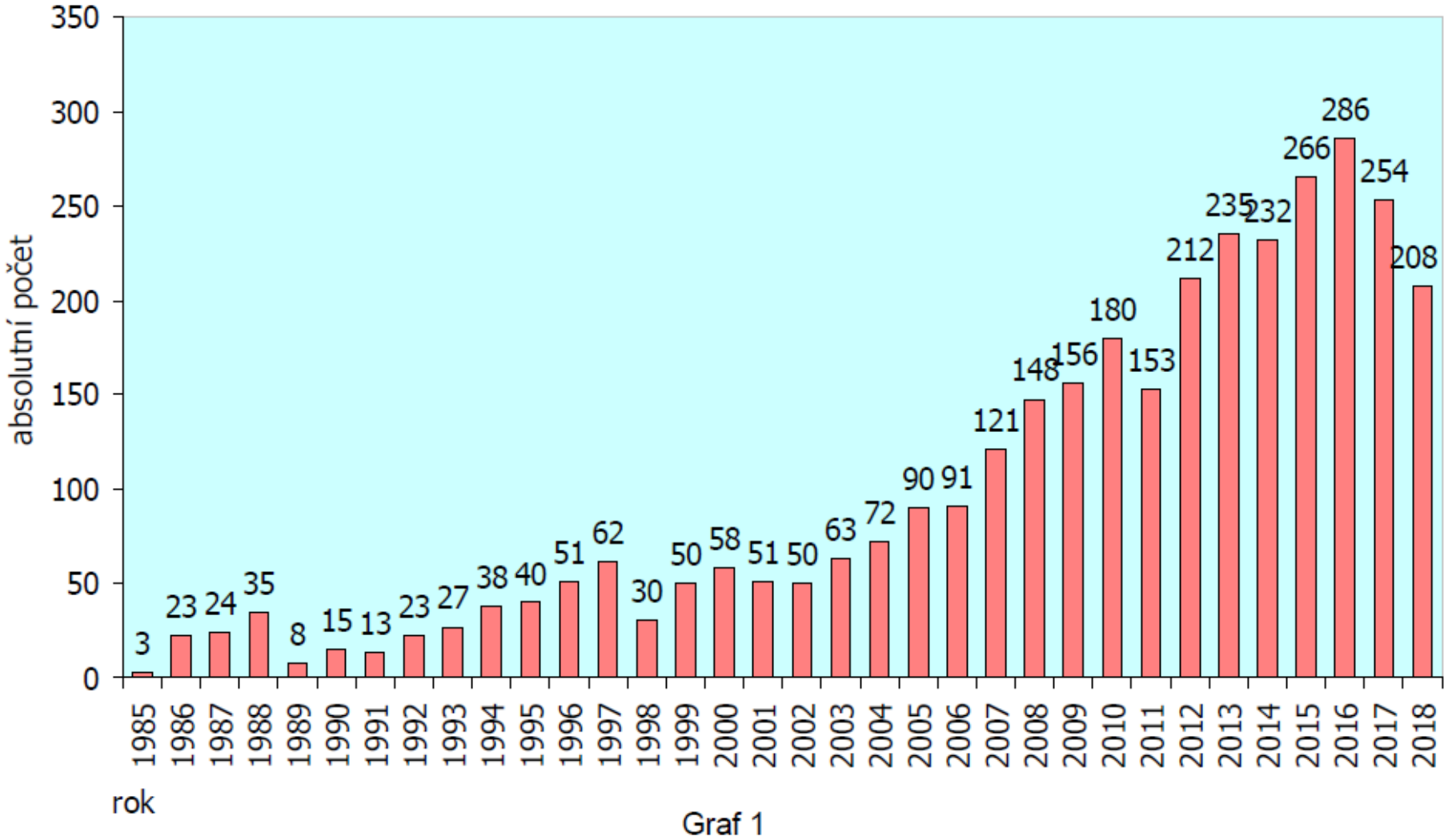
SZÚ

NOVÉ PŘÍPADY INFEKCE HIV V ČESKÉ REPUBLICE

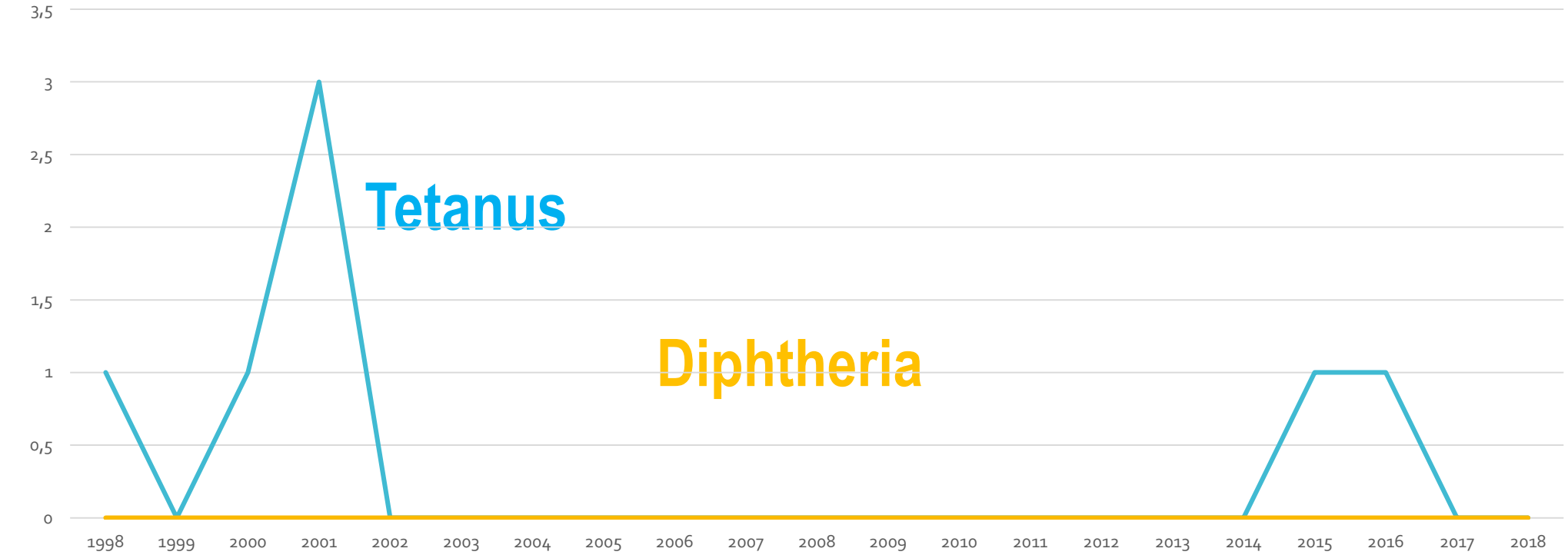
V JEDNOTLIVÝCH LETECH

(občané ČR a cizinci s dlouhodobým pobytem)

Absolutní údaje ke dni
31.12.2018



Graf 1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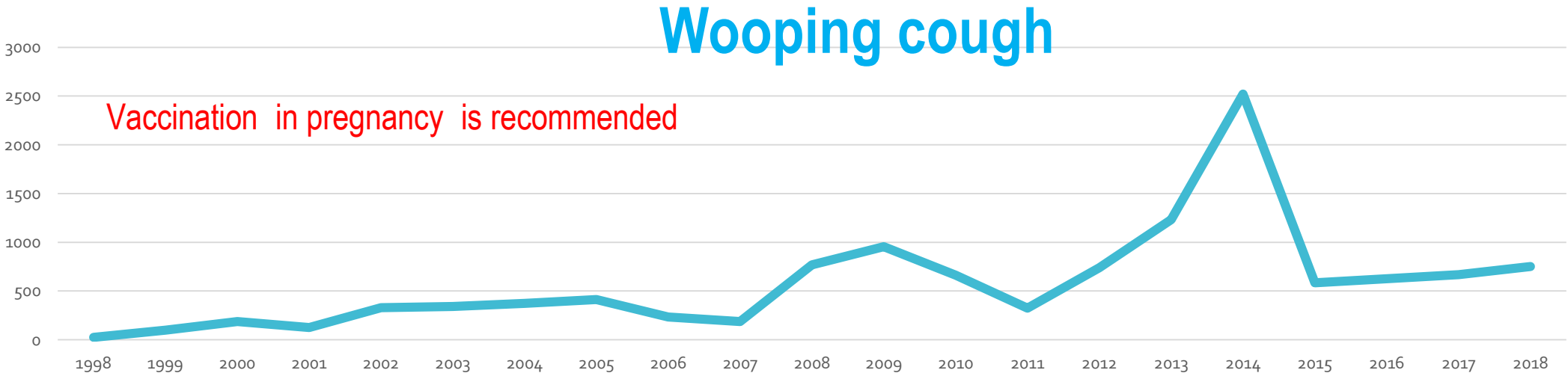
Wooping cough
Vaccination in pregnancy is recommended
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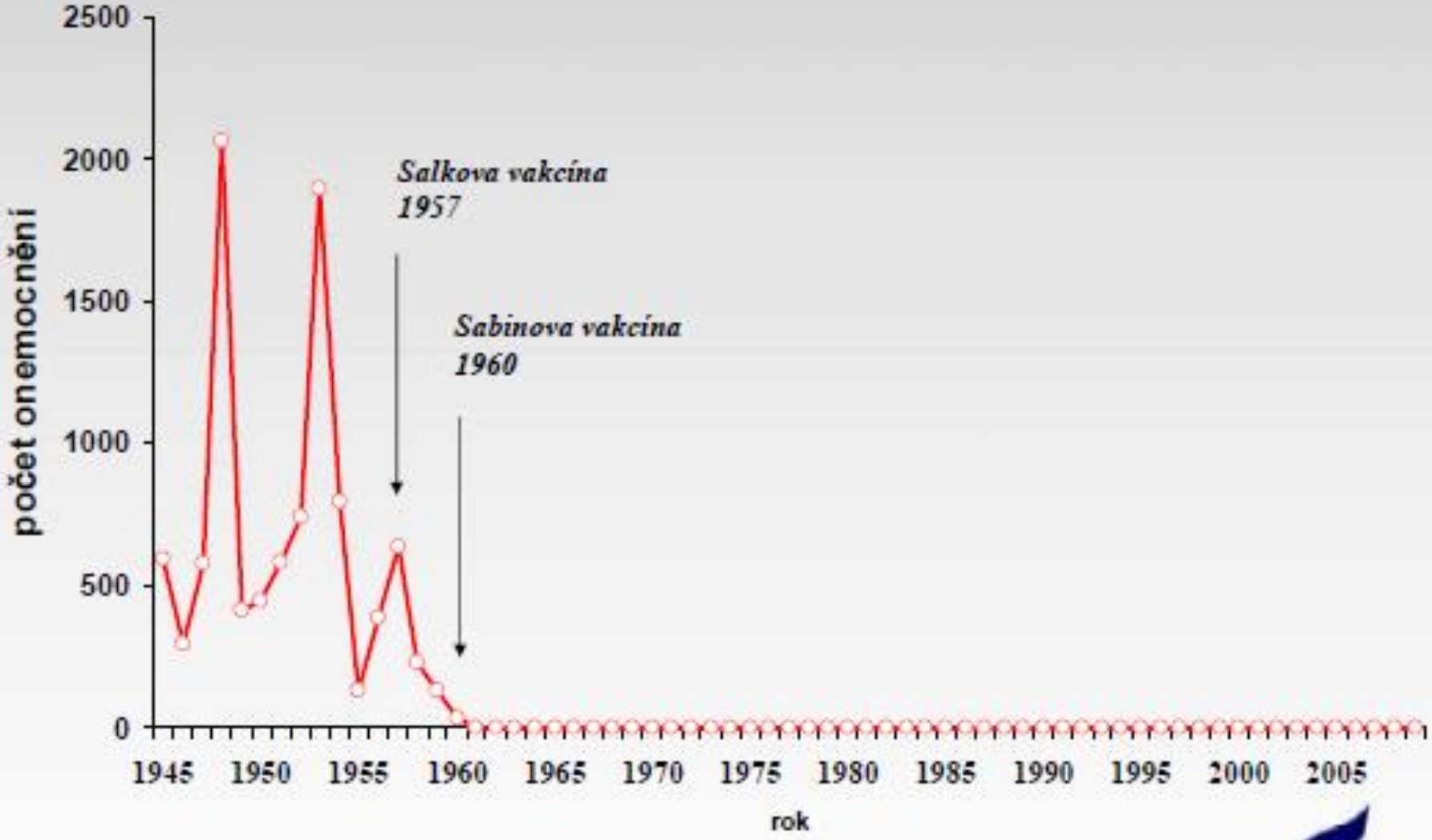
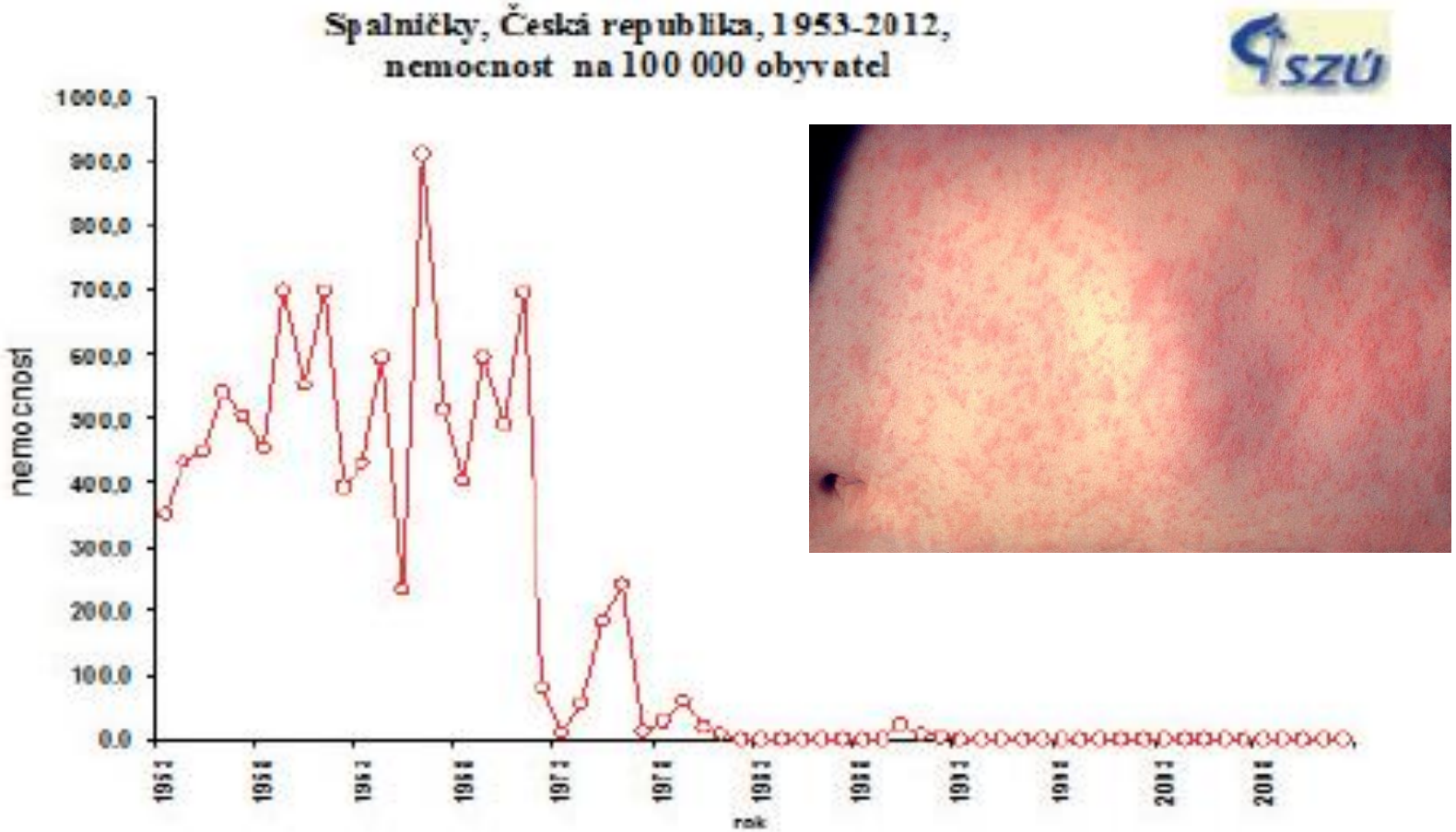
Polio (A80), Česká republika, hlášená onemocnění 1945-2009

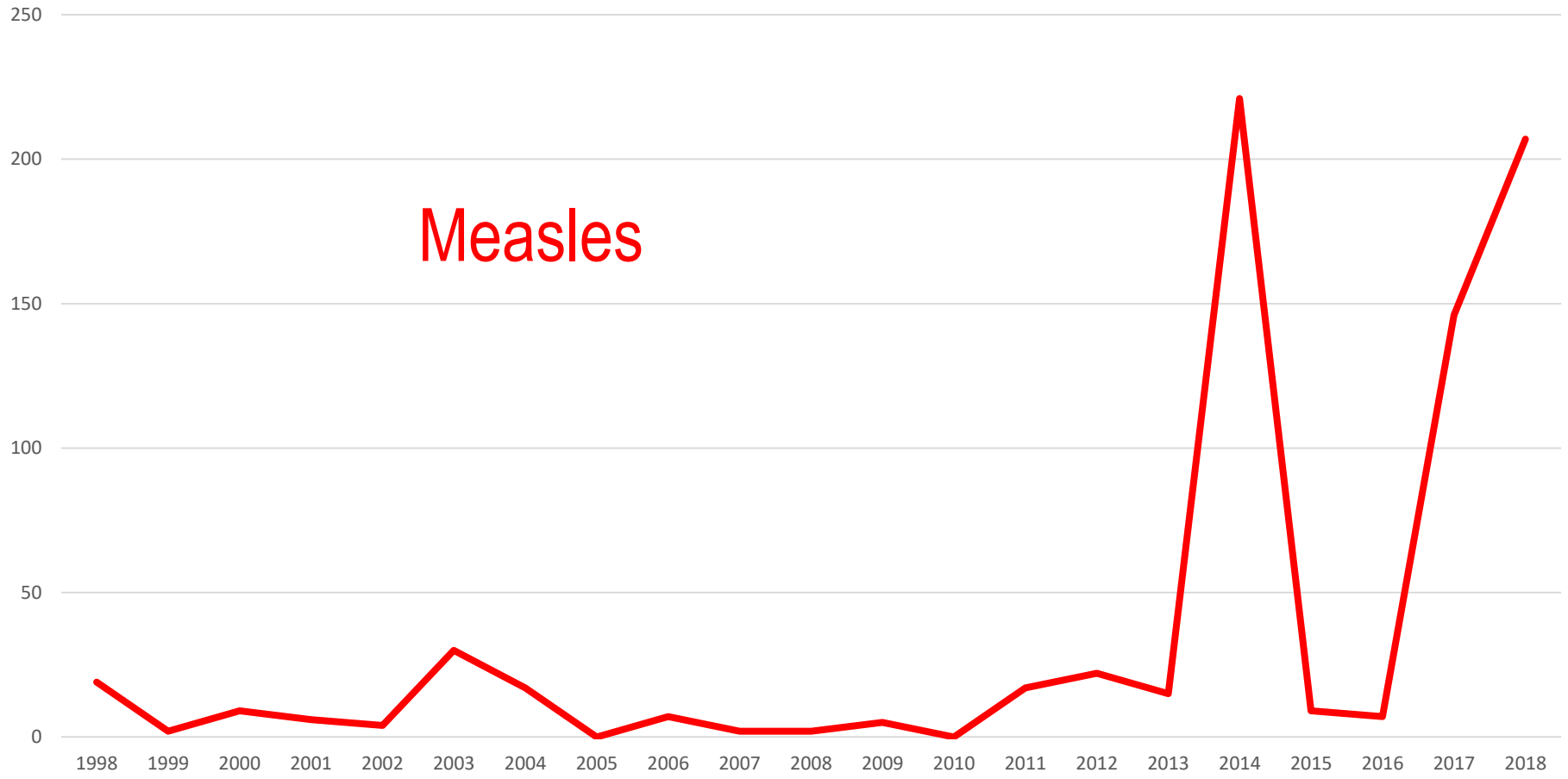


Graf č. 5 Zvládnutí spalniček očkováním

Dokud bylo očkování nepovinné, patřily spalničky mezi nejčastější příčiny smrti u dětí do 5 let. Jednalo se hlavně o navazující zápaly plic, průdušnice, mozku nebo srdečního svalu.Jedna dávka očkovací látky se ukázala jako nedostatečná, proto bylo zavedeno očkování druhou dávkou.



Zdroj: SZÚ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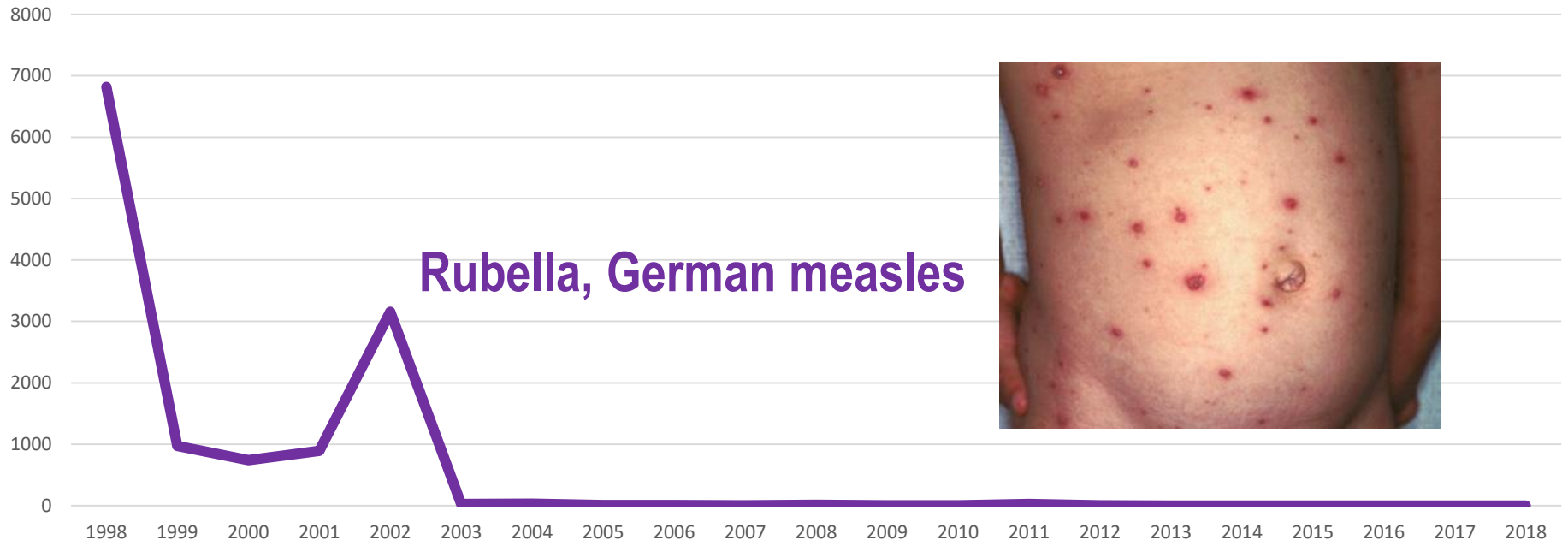
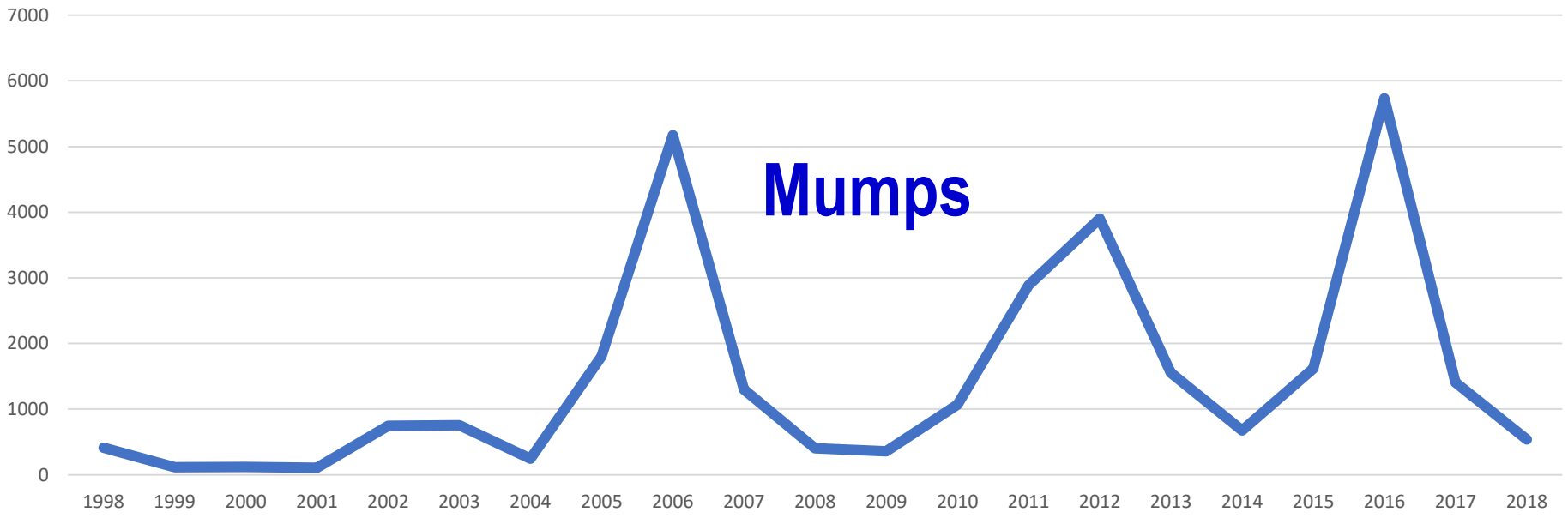


Rubella, German measles



Mumps

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
   cariers

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, 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 : a g e , n u t r i t i o n, g e n e t i c s
   i m m u n i t y – natural (nonspecific),
   - acquired

THE INFECTION

= 1. **source of infection**

……

Preventive, repressive measures

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

„**BREAKING THE CHAIN OF INFECTION**“

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

Epidemiology of Smallpox

Smallpox was a systemic disease.

After an average incubation period of 12 days,

a high fever accompanied by non-specific general symptoms abruptly appeared. The fever then receded and a characteristic skin eruption appeared. Subsequently the fever rose again, and serious complications generally developed (pulmonary, cardio-circulatory, neurological, etc.), resulting in death in up to 50% of cases.

Survivors who overcame this phase would see the rash resolving, leaving permanent scars.

No effective therapy was available.

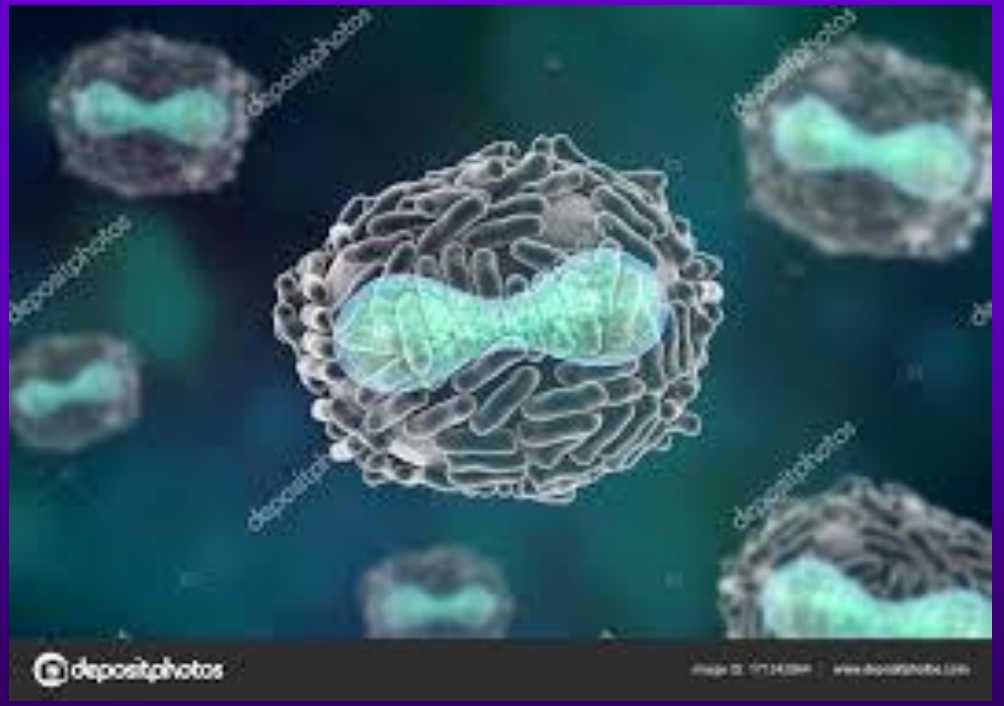
Epidemiology of Smallpox

THE CAUSATIVE AGENT OF INFECTION

dsDNA virus

Poxviridae; Chordopoxovirinae

Orthopoxvirus: Variola major virus



THE CAUSATIVE AGENT OF INFECTION: Orthopoxvirus: Variola major virus

Epidemiology of Smallpox

1.the presence of rezervoir (source):

Only infected humans

Smallpox patients became contagious once the first sores appeared in their mouth and throat.

They spread the virus when they coughed or sneezed and from their nose or mouth spread to other people.

They remained contagious until their last smallpox scab fell off.

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

THE CAUSATIVE AGENT OF INFECTION: Orthopoxvirus: Variola major virus

Epidemiology of Smallpox

1.the presence of rezervoir (source):

Only infected humans

These scabs and the fluid found in the patient's sores also contained the variola virus.

The virus can spread through these materials or through the objects contaminated by them,

such as bedding or clothing.

People who cared for smallpox patients and washed their bedding or clothing had to wear gloves and take care to not get infected.

Rarely, smallpox has spread through the air in enclosed settings,

such as a building (airborne route).

THE CAUSATIVE AGENT OF INFECTION: **Orthopoxvirus: Variola major virus**

Epidemiology of Smallpox

1.the presence of rezervoir (source):

Only infected humans

Incubation period (the length of time the virus is in a person's body before they look or feel sick. During this period, a person usually has no symptoms and may feel fine . :

This stage can last anywhere **from 7 to 19 days** (although the average length is 10 to 14 days).

The first symptoms include:

- High fever
- Head and body aches
- Sometimes vomiting

A **rash starts** as small red spots **on the tongue and in the mouth**. These spots change into sores that break open and spread large amounts of the virus into the mouth and throat.

Smallpox may be contagious during phase with first symptoms, but is most contagious during the next 2 stages (early rash and pustular rash and scabs).

Epidemiology of Smallpox

1.the presence of rezervoir (source):

Only infected humans

Once the sores in the mouth start breaking down,
a rash appears on the skin, starting on the face and spreading to the arm
and legs, and then to the hands and feet.
Usually, it spreads to all parts of the body within 24 hours.
As this rash appears, the fever begins to decline, and the person may start to feel better.
By the fourth day, the skin sores fill with a thick, opaque fluid and often have a dent in the center.
Once the skin sores fill with fluid, the fever may rise again and remain high until scabs form over the bumps.

After 10 days

The sores become **pustules** (sharply raised, usually round and firm to the touch, like peas under the skin).

- After about 5 days, the pustules begin to form a crust and then **scab**.

By the end of the second week after the rash appears, most of the sores have scabbed over.

Epidemiology of Smallpox

THE CAUSATIVE AGENT OF INFECTION: Orthopoxvirus: Variola major virus

1.the presence of rezervoir (source): **Only infected humans**

2. the way of transmission:

Smallpox was mainly spread by direct and fairly prolonged face-to-face contact between people.

Smallpox patients became contagious once the first sores appeared in their mouth and throat.

They spread the virus when they coughed or sneezed and **droplets** from their nose or mouth spread to other people.

They remained contagious until their last smallpox scab fell off.

Smallpox

THE CAUSATIVE AGENT OF INFECTION: Orthopoxvirus: Variola major virus

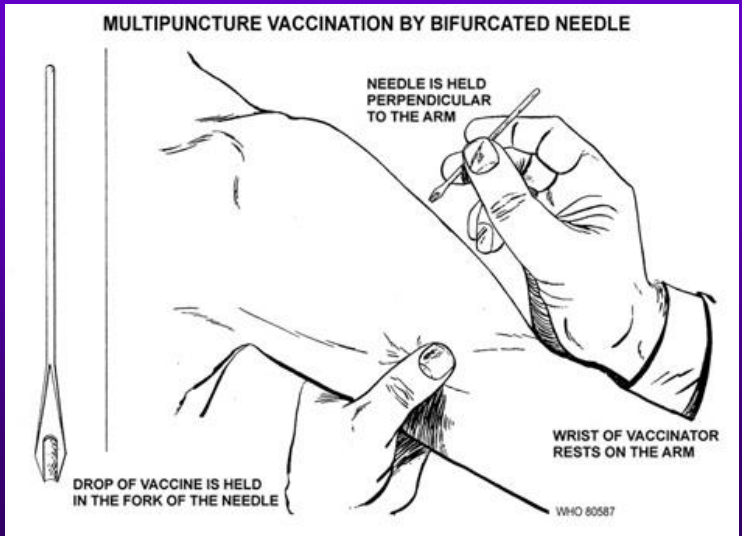
1.the presence of rezervoir (source): **Only infected humans**

2. the way of transmission: **Usually transmitted via inhalation of droplets**.

3. the susceptibility **general**

The disease **was preventable by an effective live-attenuated vaccine** whose large scale use lead **to its eradication**.

The smallpox vaccine contains live vaccinia virus, not a killed or weakened virus like many other vaccines.



THE CAUSATIVE AGENT OF INFECTION: Orthopoxvirus: Variola major virus

1.the presence of rezervoir (source): **Only infected humans**

2. the way of transmission: **Usually transmitted via inhalation of droplets**

Smallpox

3. the susceptibility

general

For most people with healthy immune systems, live virus vaccines are effective and safe. Sometimes a person getting a live virus vaccine experiences mild symptoms such as rash, fever, and head and body aches. In certain groups of people, complications from the vaccinia virus can be severe.

Smallpox vaccination can protect from smallpox **for about 3 to 5 years**. After that time, its ability to protect you decreases. If people need long-term protection, thay need to get a booster vaccination.

The vaccine has been effective in preventing smallpox infection in 95% of those vaccinated. In addition, the vaccine was proven to prevent or substantially lessen infection when given within a few days after a person was exposed to the variola virus.

Preventive, repressive measures

In the practical part it is preoccupied with

preventive measures
repressive measures
related to infectious diseases

Preventive anti-epidemic measures

is **a set of measures to prevent the infection** of susceptible individuals:

- **primary** , when *we prevent impact of external risk factors* , or *we will increase the resistance of the individual* (epidemiology)
- **Secondary** prevention is early *to find* (diagnosis), *treatment* and *prevention of further development of the disease* and *complications* (clinical medicine)
- **Tertiary** prevention monitors patients who have overcome the disease

Preventive anti-epidemic measures

- **Include:**

Increasing hygienic standards of the population - the most important is compliance with sanitary regulations relating to *water supply* , *food* , *manufacturing* and *food handling* , *waste water* , *waste* , *faeces* and so forth.

Vaccination - in order to induce maximum collective immunity.

Evidence and vector control (and the people with them living in the same household) - on the *territory concerned health authorities* must *register for* (eg. Portability typphoid, salmonella, bacillary dysentery and diphtheria); must be under *constant medical supervision* , *regular* microbiologically *examined* or *treated* . Must submit certain *restrictive measures* , always report a change of residence *must not endanger their actions of another person* .

Measures to prevent the introduction of infection into collectives - *entrance examinations* (to work, camp, army, morning filters in nurseries and kindergartens), *prevent the entry into the collective* persons that could be a source of infection (important information too).

Preventive anti-epidemic measures

Prophylactic desinfection - aims to *reduce the number of pathogens* in the external environment (public buildings, medical facilities, public transport, drinking water, waste water from hospitals, milk pasteurisation).

Border protection - a *system of measures* protecting the borders of the introduction of diseases from foreign **persons** , **materials** , **goods**, **imported animals** . It is, among other things. Persons who come *from countries with endemic or epidemic occurrence of serious communicable diseases* . Such passengers must show a valid vaccination certificate, if you do not or are not vaccinated, subjected to medical supervision, quarantine or vaccination. Quarantine diseases as plaque, yellow fever and cholera. As for the people, not absolute boundaries conserve data. More important is the **protection of imported commodities** , which must be *accompanied by a certificate of health or veterinary authorities about their health* .

Health education - raising awareness of health and culture of the inclusion of basic hygiene and epidemiology in school and extracurricular educational facilities.

Herd immunity
(also called **herd effect**, **population immunity**, or **social immunity**)

is a form of indirect protection from infectious disease that occurs when a large percentage of a population (85 – 95 %) has become **immune** to an infection, thereby providing a measure of protection for individuals who are not immune.

In a population in which a large number of individuals are immune, chains of infection are likely to be disrupted, which stops or slows the spread of disease.

The greater the proportion of individuals in a community who are immune, the smaller the probability that those who are not immune will come into contact with an infectious individual.

Individual immunity

can be gained through recovering from a natural infection or through artificial means such as vaccination.

Some individuals cannot become immune due to medical reasons and in this group herd immunity is an important method of protection.

Herd immunity (also called **herd effect**, **population immunity**, or **social immunity**)

Once a certain threshold has been reached, herd immunity gradually eliminates a disease from a population.

This elimination, if achieved worldwide, may result in the permanent reduction in the number of infections to zero, called eradication.

This method was used for the eradication of smallpox in 1980 and for the regional elimination of other diseases.

Herd immunity does not apply to all diseases, just those that are contagious meaning that they can be transmitted from one individual to another. Tetanus, for example, is infectious but not contagious, so herd immunity does not apply.

WHO - Health statistics and information system

- The **World Health Organization** (WHO) is a specialized agency of the United Nations that is concerned with international public health.
- It was established on 7 April 1948 headquartered in Geneva, Switzerland.
- The WHO is a member of the United Nations Development Group. Its predecessor, the Health Organization, was an agency of the League of Nations.

World health statistic

- The World Health Statistics series is WHO’s annual compilation of health statistics for its 194 Member States.
- WHO's annual World Health Statistics reports present the most recent health statistics for the WHO Member States.
  - *World Health Statistics 2017* focuses on the health and health-related Sustainable Development Goals (SDGs) and associated targets by bringing together data on a wide range of relevant SDG indicators.
  - In some cases, as indicator definitions are being refined and baseline data are being collected, proxy indicators are presented.
  - In addition, in the current absence of official goal-level indicators, summary measures of health such as (healthy) life expectancy are used to provide a general assessment of the situation.

European Centre for Disease Prevention and Control
An agency of the European Union

Eurosurveillance

- The European Centre for Disease Prevention and Control (ECDC) was established in 2005.
- It is an EU agency aimed at strengthening Europe's defences against infectious diseases. It is located in Solna, Sweden.
- ECDC core functions cover a wide spectrum of activities: surveillance, epidemic intelligence, response, scientific advice, microbiology, preparedness, public health training, international relations, health communication, and the scientific journal *Eurosurveillance*.
- ECDC disease programmes cover antimicrobial resistance and healthcare-associated infections; emerging and vector-borne diseases; food- and waterborne diseases and zoonoses; HIV, sexually transmitted infections and viral hepatitis; influenza and other respiratory viruses; tuberculosis; and vaccine-preventable diseases. All in all, ECDC monitors 52 communicable diseases.

Diseases and special health issues under EU surveillance

- Diseases preventable by vaccination
- Sexually transmitted diseases
- Viral hepatitis
- Food- and waterborne diseases and diseases of environmental origin
- Diseases transmitted by non-conventional agents (prions)
- Airborne diseases
- Zoonoses (other than those listed above)
- Serious imported diseases
- Vector-borne diseases
- Special health issues (HAI, antibiotic resistence)

ecdc

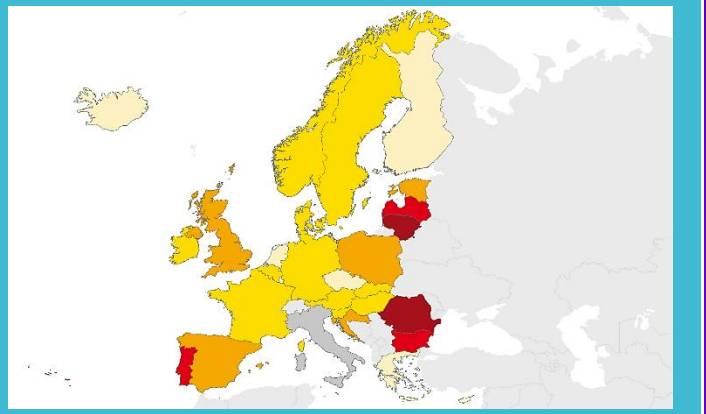
EUROPEAN CENTRE FOR DISEASE PREVENTION AND CONTROL

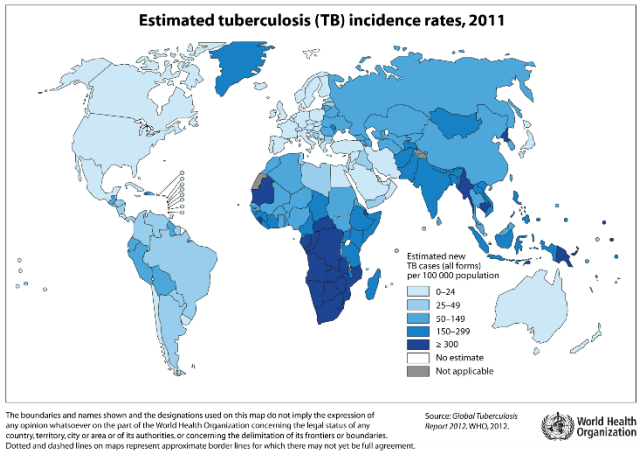
Work Programmes and long-term strategies

Eurosurveillance

- **Long-term surveillance strategy 2014–2020**
- The final strategy is divided into six priorities:
- **1** Consolidating surveillance, increasing its efficiency and enhancing the outputs and their impact
- **2** Developing standards, improving data quality and sharing best practices in surveillance
- **3** Promoting use of surveillance data
- **4** Strengthening capacity in surveillance
- **5** Controlling expansion
- **6** Monitoring the strategy.

European Tuberculosis Surveillance Network





- The European Tuberculosis Surveillance Network consists of TB surveillance experts from all 53 countries belonging to the World Health Organization's European Region, including 30 EU/EEA Member States.
- Under the joint coordination of ECDC and the World Health Organization's Regional Office for Europe, the network collects, validates, analyses and disseminates European TB surveillance data.
- The purpose of the network is to identify the epidemiological patterns of TB in the Region and monitor progress towards TB elimination, with key surveillance and monitoring findings published in an annual report.
- In addition, the network aims to further strengthen TB surveillance in Europe.

Global Disease Elimination and eradication

- During the 25 years since the certification of smallpox eradication there has been considerable debate among public health practitioners about how existing health technologies can best be used to decrease infectious disease incidence and prevalence.
- Interruption of transmission has often been envisaged as the ultimate goal, and standard public health concepts of disease reduction have been defined or re-defined.
- In 1998, Dowdle proposed a definition of control as a reduction in the incidence, prevalence, morbidity or mortality of an infectious disease to a locally acceptable level;
- **elimination** as reduction to zero of the incidence of disease or infection in a defined geographical area;
- and **eradication as permanent reduction to zero** of the worldwide incidence of infection

Health 2020: the European policy for health and well-being

- **Health 2020** is the new European health policy framework.
- It aims to support action across government and society to:
  - "significantly improve the health and well-being of populations,
  - reduce health inequalities,
  - strengthen public health and ensure people-centred health systems that are universal, equitable, sustainable and of high quality