

Surveillance of infections; pandemic plans

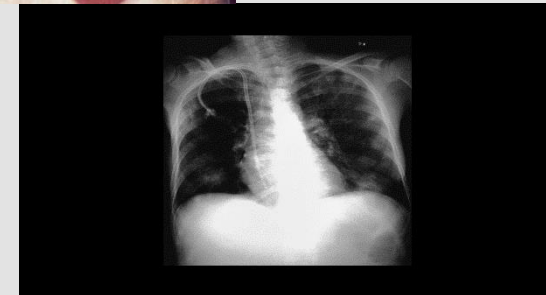
MUDr. Marie Kolářová, CSc.

Ústav ochrany a podpory zdraví LF MU

Spring 2019



Chicken Pox



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

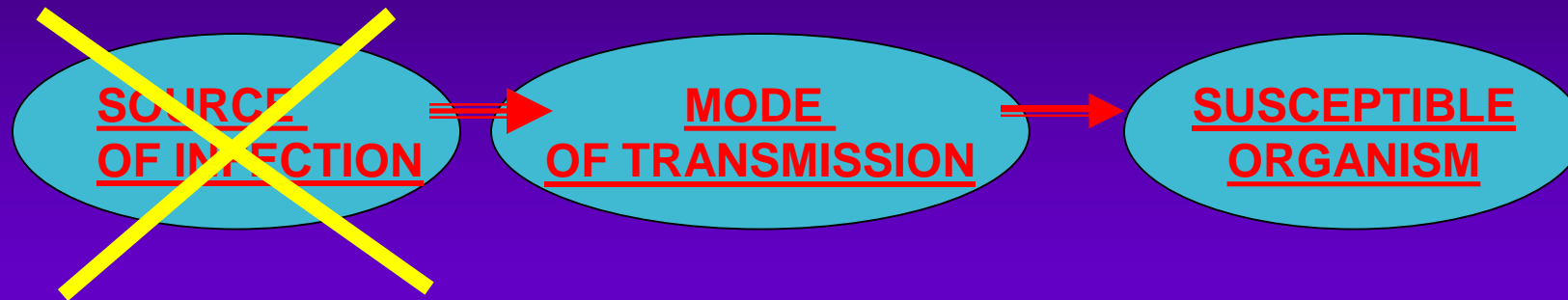
„**BREAKING THE CHAIN OF INFECTION**“



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

Preventive,
repressive
measures

Prevention of infectious diseases



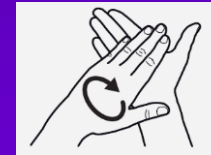
Isolation of patients:

- dpt. of infectious diseases -VHA, acute VHB, Typhus abdominalis,...
- „high degree of isolation“ - ebola,
- at home - influenza, varicella,....
- barriers nursing technique – MRSA, VRE in hospital,

Prevention of infectious diseases



HANDWASHING, DISINFECTION OF HANDS



LINEN WASHING, CLEANING



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



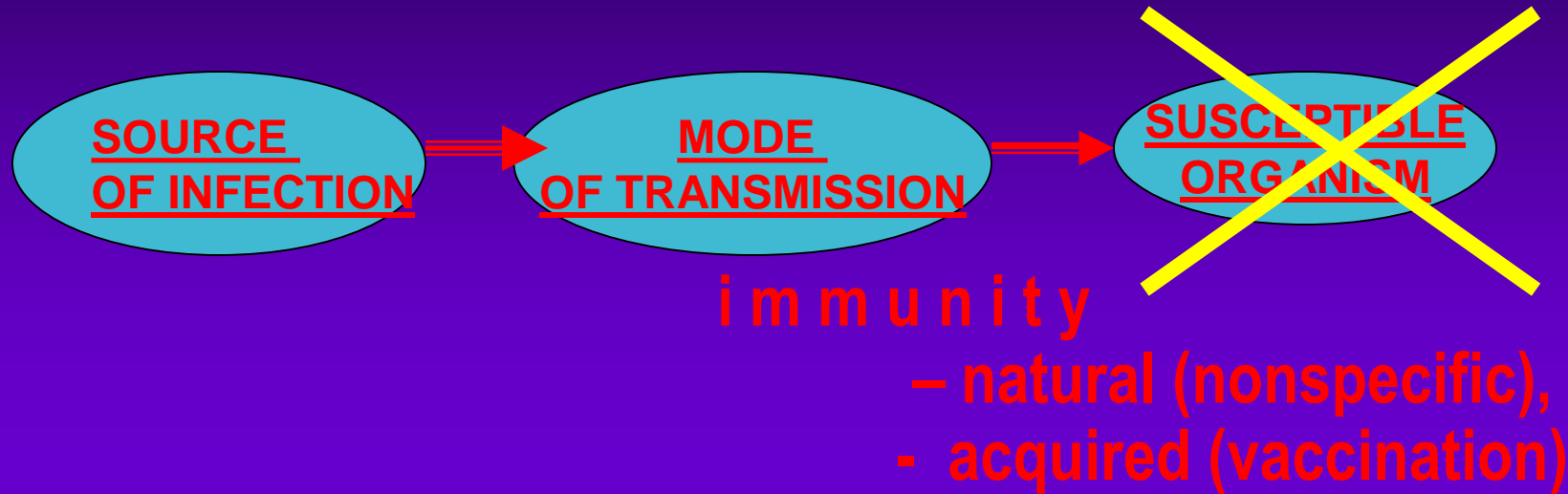
.....
DISINFECTION



STERILIZATION



Prevention of infectious diseases



Active immunisation

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

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

Passive immunisation

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

Temporary protection

Transplacental most important source in infancy

**Preventive,
repressive
measures**

In the practical part it is preoccupied with

preventive measures

repressive measures

related to infectious diseases

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.

Epidemiologic investigations are largely mathematical descriptions of persons in groups, rather than individuals.

The basic quantitative measurement in epidemiology is a count of the number of persons in the group being studied who have a particular disease.

Epidemiologic
investigations

**Solving
health
problem**

```
graph LR; A((Solving health problem)) --> B[Step 1  
Data collection]; A --> C[Step 2  
Assessment]; A --> D[Step 3  
Hypothesis testing]; A --> E[Step 4  
Action]; B --> F[Surveillance; determine  
time, place and person]; C --> G[Inference]; D --> H[Determine how and why]; E --> I[Intervention];
```

Step 1
Data collection

Surveillance; determine
time, place and person

Step 2 Assessment

Inference

Step 3
Hypothesis testing

Determine how and why

Step 4
Action

Intervention

Solving health problem

Epidemiologists arrange their data in various ways, depending on what aspect of the information they want to emphasize.

One of the most powerful tools an epidemiologist can use is case reporting:

reporting specific diseases to

- * **local**,
 - * **state** and
 - * **national health authorities**,
- who accumulate the data

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.

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.



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.

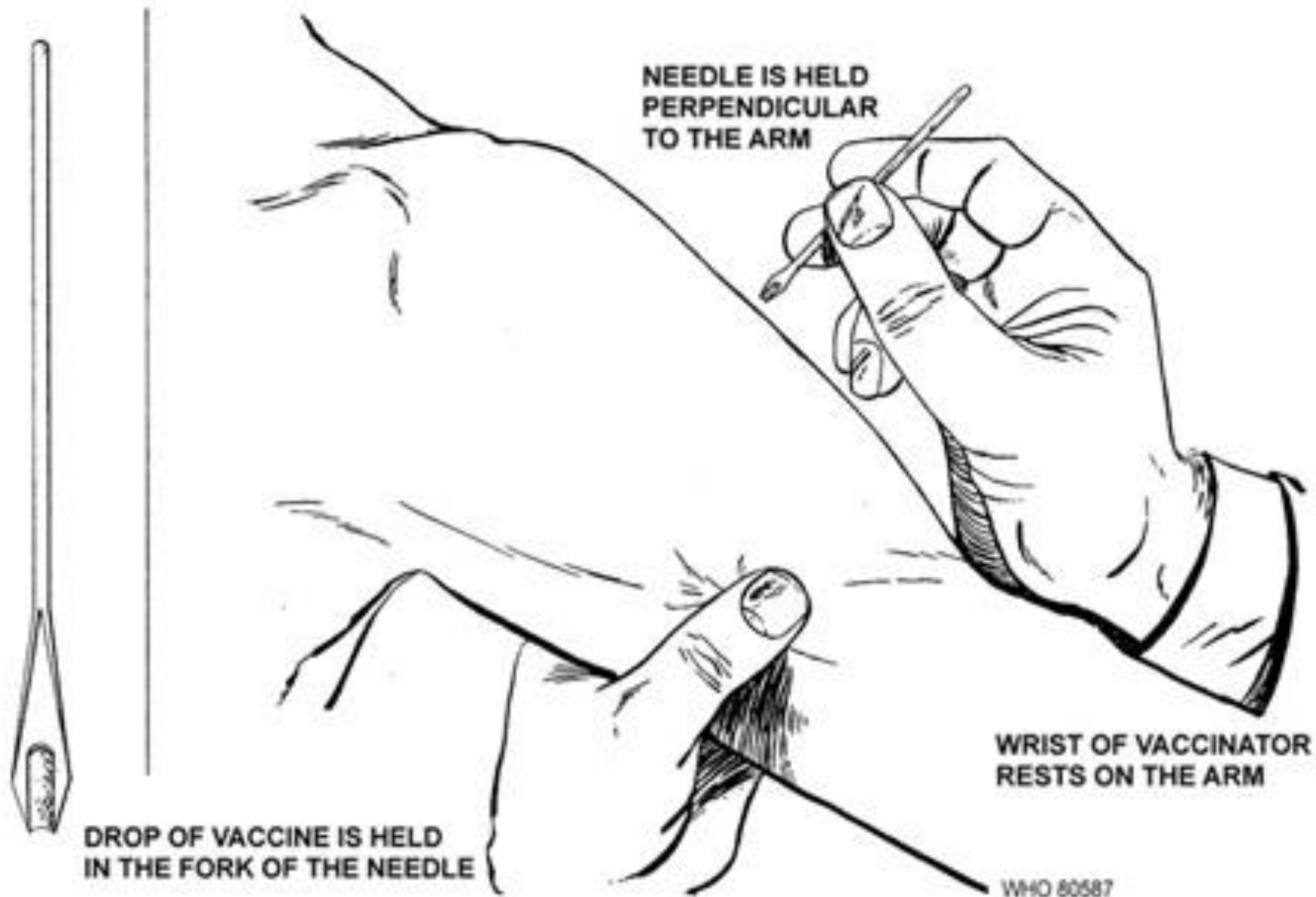
They participated in both the preparation methodology and procedures, thus working directly in infested areas.



Rural vaccinator in United Provinces, India, c.1930, private collection of Dr. S. 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

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.

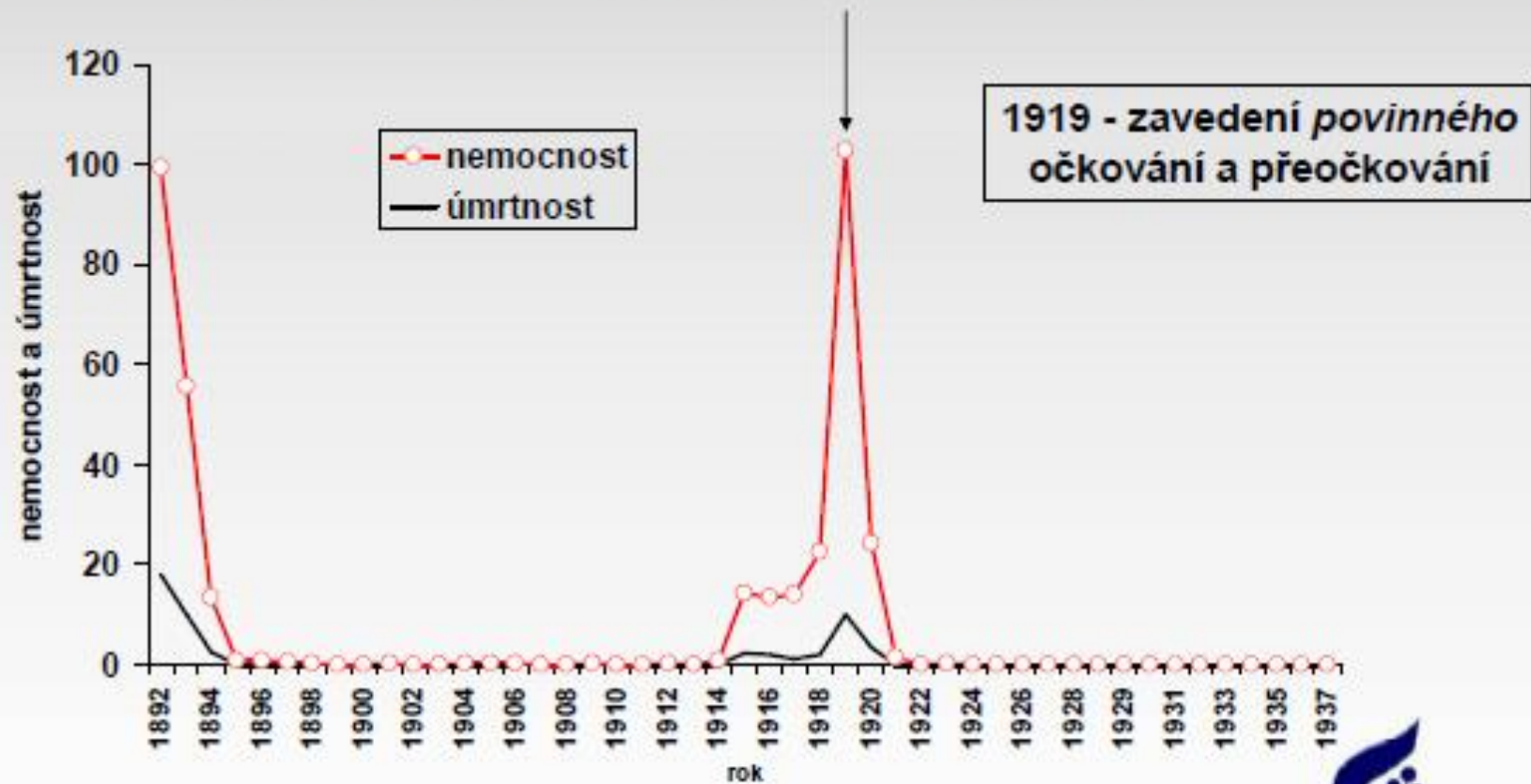


Mr. John Wickett, of the World Health Organization, with the last person to have contracted – and survived – naturally occurring smallpox in Somalia.

(1977), courtesy Mr. John Wickett.



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.

SURVEILLANCE

- **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.

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.**

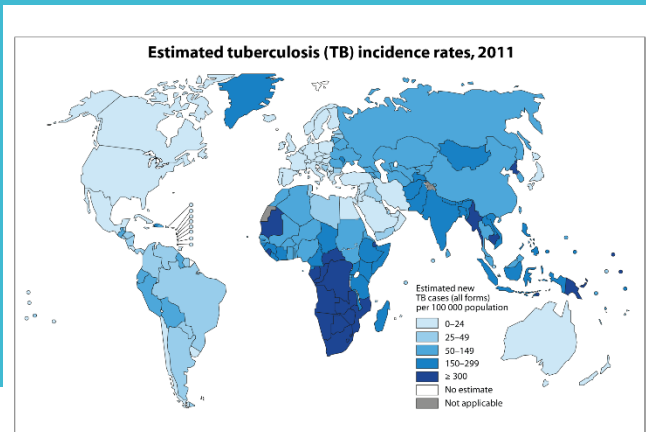
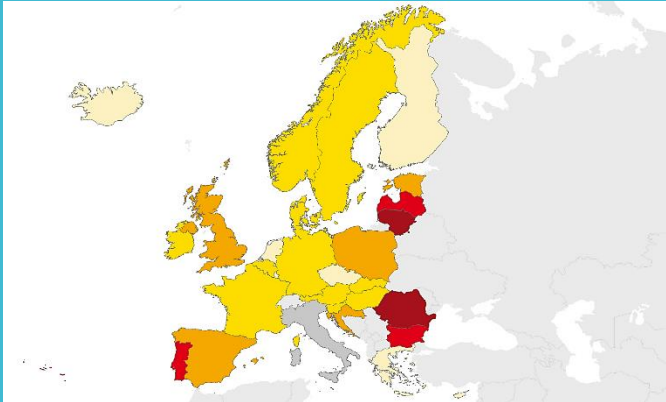
SURVEILLANCE

- **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.

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.

European Tuberculosis Surveillance Network



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.



- 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.

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

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 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

Disease trends

- **Incidence** - measures the number of new cases over time.

This number measures an individual chances of developing or contracting the disease.

$$\frac{\text{Number of new cases within a specified time period}}{\text{Total number of people in the population}}$$

- **Prevalence** – measures the total number of cases of disease in a population.

$$\frac{\text{Total number of diseases individuals}}{\text{Total number of people in the population at a given time}}$$

Terminology and definitions

- **Case definition:** a set of standard criteria for deciding whether a person has a particular disease or health-related condition, by specifying clinical, laboratory and epidemiological criteria and limitations on time, place and person.
- **Attack rate:** proportion of non-immune exposed individuals who become clinically ill.
- **Zoonosis** is an infection that is transmissible under natural conditions from vertebrate animals to man, e.g. rabies, plague, bovine tuberculosis.....
- **An epizotic** is an outbreak (epidemic) of disease in an animal population, e.g. rift valley fever.
- **An enzotic** is an endemic occurring in animals, e.g. bovine TB.
- **Nosocomial (hospital acquired) infection** is an infection originating in a patient while in a hospital or another health care facility. It has to be a new disorder unrelated to the patient's primary condition.

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.

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 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 1977 and for the regional elimination of other diseases¹ Herd immunity does not apply to all diseases, just those that are **contagious** meaning that they can be transmitted from one individual to another.¹ **Tetanus**, for example, is infectious but not contagious, so herd immunity does not apply¹.

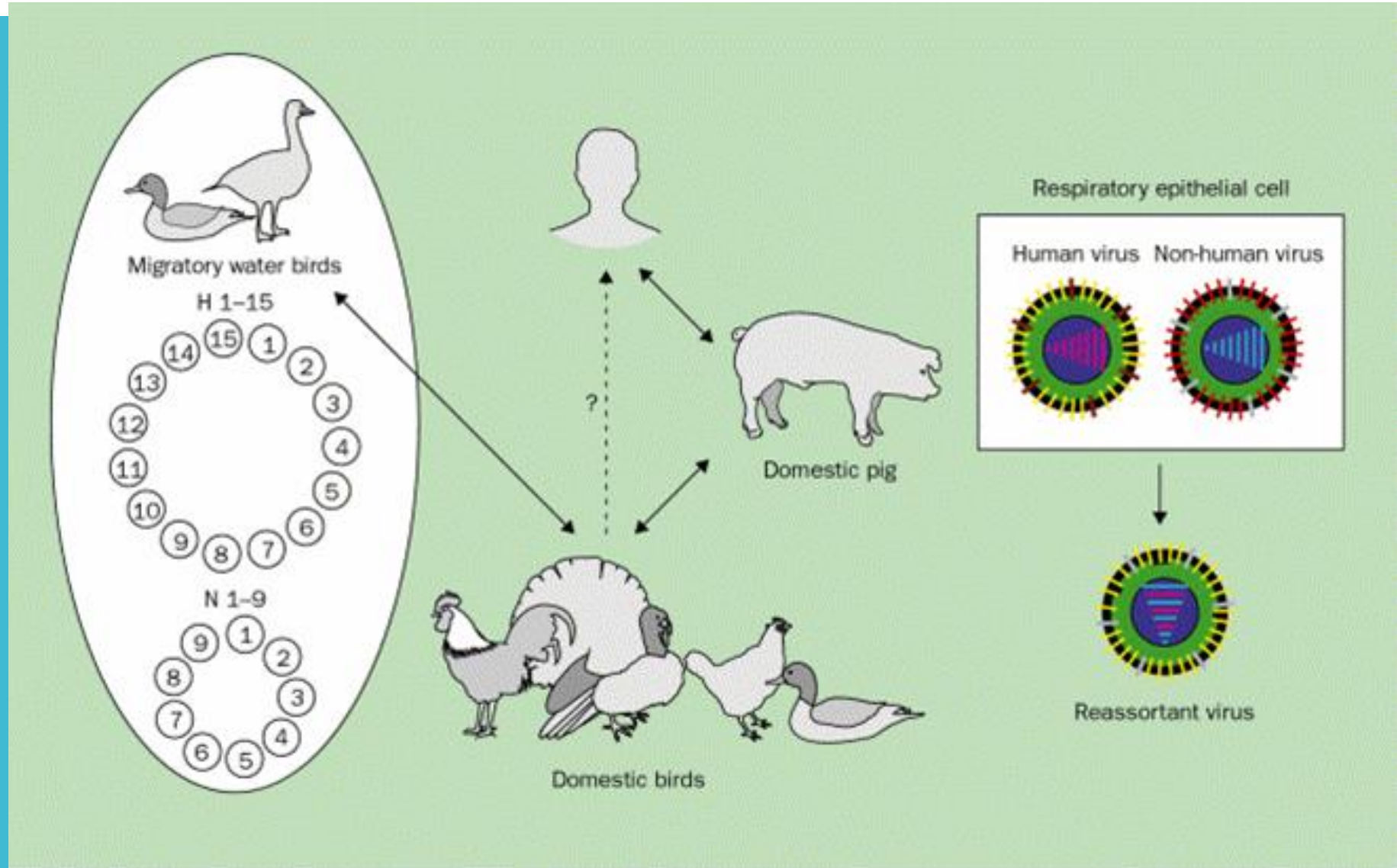
Occurrence of Diseases

- **Sporadic** Disease that occurs occasionally in a population.
- **Endemic** Disease constantly present in a population at all times – malaria is present in Africa at all time because of the presence infected mosquitos.
- **Epidemic or outbreak** Disease occurrence among a population that is in excess of what is expected in a given area in a short time – the Ebola virus in parts of Africa is in excess of what is expectes for this region.
- **Pandemic** Disease or condition that spread across world - – HIV/AIDS is one of the worst global diseases in history.

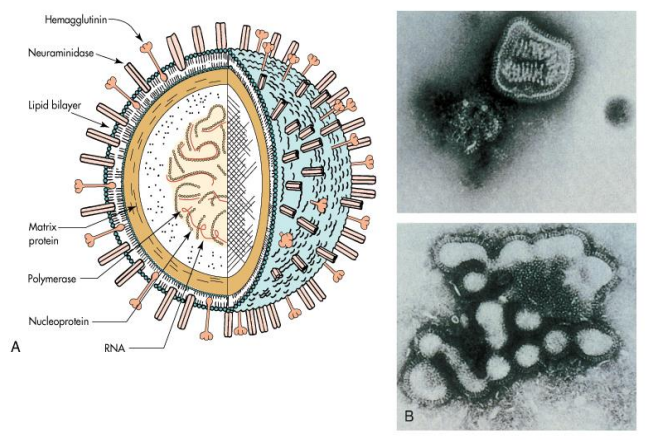
Definition of a pandemic

- A pandemic is an epidemic extending over a wide geographic area, affecting whole continents.
- It involves the high incidence of a disease over a large territory (continent) over a specific period of time.
- According to the WHO definition, an influenza pandemic is characterized by the spread of a pandemic virus within communities in at least 2 countries of a single WHO region and at least one other country in another WHO region.

The rise of the pandemic strain



The rise of the pandemic strain



Pandemic preparedness

- Pandemic preparedness is most effective if it is built on general principles that guide preparedness planning for any acute threat to public health. This includes the following:
- Pandemic preparedness, response and evaluation should be built on generic preparedness platforms, structures, mechanisms and plans for crisis and emergency management.
- To the extent possible, pandemic preparedness should aim to strengthen existing systems rather than developing new ones, in particular components of national seasonal influenza prevention and control programmes.
- New systems that will be implemented during a pandemic should be tested during the inter-pandemic period.
- Adequate resources must be allocated for all aspects of pandemic preparedness and response.

Pandemic preparedness

- The planning process, implementing what is planned, testing and revising the plan in order for key stakeholders to familiarise themselves with the issues at hand, may be even more important than the pandemic plan itself.
- Pandemic response requires that business continuity plans and surge capacity plans be developed for the health sector and all other sectors that could be affected by a pandemic to ensure sustained capacity during a pandemic.
- The response to a pandemic must be evidence-based where this is available and commensurate with the threat, in accordance with the IHR. Planning should be based on pandemics of differing severity while the response is based on the actual situation determined by national and global risk assessments.
- Not all countries will be in a position to contribute to global risk assessment, nor conduct evaluations such as pandemic vaccine effectiveness. They must all have the capacity to access and interpret data for risk assessment provided by WHO, ECDC, and from other countries or sources.

Pandemic preparedness

- Preparing for an **influenza pandemic** is a continuous process of planning, exercising, revising and translating into action national and subnational pandemic preparedness and response plans.
- A pandemic plan is thus a living document which is reviewed at intervals and revised if there is a change in global guidance or evidence-base; lessons learned from a pandemic, an exercise, or other relevant outbreak; or changes to national or international legislation related to communicable disease prevention and control :

Pandemic preparedness

Figure 1. Key elements of the pandemic preparedness planning cycle

