Sterilization, disinfection
Operation of central sterilization facility

- collection of contaminated utensils
- cleaning, drying
- packaging
- storage
- sterilization
- sterile storage
- deployment of sterile materials, utensils (for transportation)

Disinfection and cleaning of transport vehicle

One-way process!
Contaminated → clean principle!
The sterilization process 1.

1. **Collection of items:**
   Dry or wet collection (wet collection in pre-treatment solution)

2. **Cleaning:**
   a) soaking (in blood solvent, disinfectant, detergent, >60°C)
   b) mechanical cleaning
   c) final rinsing (running warm water), hollow needles 3% H₂O₂
   d) drying

3. **Sterilization:**
   a) packaging, labeling
   b) actual sterilization procedure (autoclave, dry heat, plasma, formaldehyde/ethylene oxide gas)
   c) regular quality control

4. **Storage**
# The sterilization process 2. – Important parameters

<table>
<thead>
<tr>
<th></th>
<th>Hot air</th>
<th>Steam</th>
<th>Gas</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative humidity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentration of active agent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposure time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### The sterilization process

<table>
<thead>
<tr>
<th>Material/utensil</th>
<th>Sterilization method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat-resistant items</td>
<td>AUTOCLAVE</td>
</tr>
<tr>
<td>Heat-resistant, water-sensitive items</td>
<td>DRY HEAT</td>
</tr>
<tr>
<td>Heat-sensitive items</td>
<td>ETHYLENE OXIDE (ETO), FORMALDEHYDE GAS, PLASMA</td>
</tr>
<tr>
<td>Heat-sensitive endoscopes</td>
<td>Special solution (depends on manufacturer) + equipment</td>
</tr>
<tr>
<td>Other…</td>
<td>… i.e. filters… etc.</td>
</tr>
</tbody>
</table>

*SU Department of Public Health*
Item collection
Special disinfecting washers

Hospital disinfecting washer 1.

Ultrasound washer

Hospital disinfecting washer 2.

SU Department of Public Health
Manual cleaning of utensils

Cleaning gun

Manual washer with splash-proof hood
Packaging
Autoclaves 1.
Autoclaves 2.

Benchtop cassette autoclaves
Low-temperature sterilization of endoscopes (with solution)
ONLY VERIFIED TECHNOLOGICAL SOLUTIONS THAT CONFORM TO RECOGNIZED QUALITY-ASSURANCE STANDARDS ARE ACCEPTABLE!

EACH STEP IN THE ENTIRE STERILIZATION/DISINFECTION PROCESS SHOULD BE MONITORED INDEPENDENTLY!
Quality assurance in sterilization and disinfection 2.

✓ Checking preparatory procedures (technology, blood-stain detection)

✓ Checking machinery
  1. initial (new machines)
  2. continuous (operation log)
  3. periodic (technical)

✓ Checking the sterilization process
  1. thermo-indicators
  2. chemical indicators
  3. complex indicators (combination of various parameters)

✓ Checking sterility (microbiological tests)
<table>
<thead>
<tr>
<th>Quality control procedure</th>
<th>Frequency</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check equipment functioning</td>
<td>Daily (autoclaves)</td>
<td>Steam-penetration test</td>
</tr>
<tr>
<td></td>
<td>Authorities: every 3 years</td>
<td></td>
</tr>
<tr>
<td>Control indicator on package</td>
<td>Every package</td>
<td>Process indicators</td>
</tr>
<tr>
<td>Batch control</td>
<td>Every batch</td>
<td>Chemical/biological indicators</td>
</tr>
<tr>
<td></td>
<td>Authorities: every 3-6 months</td>
<td>Spore-test</td>
</tr>
<tr>
<td>Control indicator inside package</td>
<td>Every package</td>
<td>Multi-parameter chemical indicators</td>
</tr>
<tr>
<td>Record data</td>
<td>Every package and batch</td>
<td>Sterilization log, labeling… etc.</td>
</tr>
</tbody>
</table>

**Quality assurance in sterilization and disinfection**

*SU Department of Public Health*
Indicate that the tray, package or packet has been through the process of sterilization (steam, ETO… etc.), but **DO NOT** provide information on the quality of that process; whether necessary parameters were reached during the process, or whether it was successful or not.
The above indicator has bright-red colored „contamination”. After the batch of equipment and utensils went through the cleaning / disinfecting procedure the amount of red material left indicates possible left-over contamination (blood… etc.).
Quality control of process parameters – chemical indicators
Steam penetration indicator for autoclaves

National and international standards require that every autoclave be tested daily with a process indicator, before routine use. Steam penetration indicators verify that pre-sterilization vacuum (air removal) and steam penetration are adequate.
Quality control of process parameters – complex indicators

<table>
<thead>
<tr>
<th>UNPROCESSED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
</tr>
<tr>
<td>Do not use items in pack/tray.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TST Control® Indicator proves exposure to adequate sterilizing conditions.</td>
</tr>
<tr>
<td>Purple</td>
</tr>
<tr>
<td>Indicator is bright purple.</td>
</tr>
<tr>
<td>Dark blue/purple</td>
</tr>
<tr>
<td>Indicator is completely dark blue/purple.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not use any items in tray/pack. Sterilizing conditions not achieved.</td>
</tr>
<tr>
<td>Yellow</td>
</tr>
<tr>
<td>Evidence of yellow on indicator. Do not use items in tray/pack.</td>
</tr>
<tr>
<td>Yellow</td>
</tr>
<tr>
<td>Evidence of yellow on indicator. Do not use items in tray/pack.</td>
</tr>
<tr>
<td>Yellow</td>
</tr>
<tr>
<td>Evidence of yellow on indicator. Do not use items in tray/pack.</td>
</tr>
</tbody>
</table>

Parameters:
- Time
- Temperature
- Steam quality (penetration)
Quality control for effectiveness of procedure – biological indicators
Disinfection 1. – Disinfectants by application type

- Hand disinfectants (hygienic, surgical etc…)
- General skin disinfectants
- Mucous membrane disinfectants
- Surface disinfectants
- Machine/utensil disinfectants
- Machine/utensil disinfectants for use in dentistry
- Endoscope disinfectants
- Incubator disinfectants
- Disinfectants for hemodialysis equipment
- Body-fluid disinfectants
- Disinfecting detergents
- Disinfecting soaps
- Disinfecting machine/utensil cleaners
Disinfection 2. – Disinfectants by activity spectrum

- Baktericidal
  - General
  - Special (MRSA, TB …)
- Sporocidal
- Fungicidal
- Virucidal
- Proticidal
- Parasiticidal
Disinfection 3. – Disinfection of the hands

Hygienic and surgical disinfection destroys

Surgical disinfection decreases and covers

Transient flora

Residual flora
Disinfection procedures

- **Preventive disinfection**: general hygiene, disinfectant cleaning etc…
- **Concurrent disinfection**: of the surroundings of infectious patients during period of communicability of disease
- **Terminal disinfection**: of prior environment of infectious patients after the end of communicability (convalescence, death)

**High-level disinfection** usually performed by local public health authorities!

In Hungary, high-level disinfection required in cases of: anthrax, cholera, lepra, malleus, plague, typhus exanthematicus
Guiding principles for hospital cleaning is to use wet, detergent-containing, and disinfectant-containing cleaning.

Modern hospital cleaning is performed with color-coded instruments for different parts of the facility (hall, toilets, rooms...).

Disinfectant agent should be appropriately selected according to activity spectrum (bactericidal, fungicidal, virucidal sporocidal...) depending on circumstances.

Information on activity spectrum is displayed on the container of the disinfectant.
Ectoparasites: Lice A

Head Lice
(Pediculus humanus capitis)

Source: CDC Public Health Image Library
Ectoparasites: Lice B

Body lice
- Body
- Environment
  - Household objects
    - Beddings
    - Clothes
      - Outer garments
      - Underwear

Head lice
- Head
- Household objects

Pubic lice
- Pubic area

Areas of treatment for lice

SU Department of Public Health
## Ectoparasites: Lice C

<table>
<thead>
<tr>
<th>Method of treatment</th>
<th>Area to be treated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Body surfaces</td>
</tr>
<tr>
<td>Chemical (pediculocides)</td>
<td>• rubbing in</td>
</tr>
<tr>
<td></td>
<td>• washing</td>
</tr>
<tr>
<td></td>
<td>• powdering</td>
</tr>
<tr>
<td>Physical (heat)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Agents of chemical anti-lice treatment (in Hungary):

- Hair scrubs: Nittyfor, Pedex
- Other: Nix, 2% Chresyl soap
- Powder: Coopex-B powder
Ectoparasites: Scabies (mites)

Source: CDC Public Health Image Library
Infection control
Infection control

HepB  HepC  HIV  TB

SU Department of Public Health
Triptych showing the Hôtel Dieu in Paris, about ad 1500. The comparatively well patients (on the right) were separated from the very ill (on the left). Note there were always two patients to a bed.
His discovery concerning the etiology and **prevention of puerperal fever** was a brilliant example of fact-finding, meaningful statistical analysis, and keen inductive reasoning. The highly successful prophylactic hand washings made him a pioneer in antisepsis during the pre-bacteriological era in spite of deliberate opposition and uninformed resistance.
Holmes read the existing literature, and became convinced that the condition was highly contagious, and that doctors, nurses and midwives were the active agents of its spread.

He began to speak and write on the subject, and in 1843 published his classic essay *The Contagiousness of Puerperal Fever*. The essay contains eight rules for the obstetrician, which included not only handwashing and changes of clothing, but also the avoidance of autopsies if obstetric cases were being managed.
Nosocomial infections

definition, reservoirs, autoinfection, exogenous infection

Evidence suggests that at least 5-6% of patients who go to hospitals in economically developed countries suffer some form of nosocomial infection and 1% of them die as a direct result of this infection.

Distribution of nosocomial infections:

- urogenital infections 35-40%
- pneumonias 15-18%
- postoperative wound infections 16-17%
- sepsis 7-11%
- other infections 23-24%
The frequency of nosocomial infections in certain hospital wards

(Kende Éva)

<table>
<thead>
<tr>
<th>Hospital ward</th>
<th>Frequency of nosocomial infections</th>
<th>Frequent clinical manifestations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery</td>
<td>3-10%</td>
<td>Operative infection, pneumonia, urogenital infection, sepsis</td>
</tr>
<tr>
<td>Internal medicine</td>
<td>2-5%</td>
<td>urogenital infection, pneumonia, sepsis, skin infection</td>
</tr>
<tr>
<td>Obstetrics</td>
<td>1-3%</td>
<td>Operative infection, urogenital infection, mastitis, endometritis</td>
</tr>
<tr>
<td>Chronic care/geriatry</td>
<td>5-15%</td>
<td>skin infection, urogenital infection sepsis, gastroenteritis</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>6-7%</td>
<td>Respiratory viral infection, gastroenteritis, skin infection</td>
</tr>
<tr>
<td>Neonatal care</td>
<td>0.5-2%</td>
<td>skin infection, enteritis, pneumonia</td>
</tr>
<tr>
<td>Intensive care</td>
<td>10-20%</td>
<td>Pneumonia, urogenital infection, sepsis</td>
</tr>
<tr>
<td>Neonatal intensive care</td>
<td>3-40%</td>
<td>sepsis, pneumonia, conjunctivitis, enterocolitis</td>
</tr>
</tbody>
</table>
The reported nosocomial outbreaks in the last two years *in Hungary*

<table>
<thead>
<tr>
<th>Year</th>
<th>Outbreak</th>
<th>Sick</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>143</td>
<td>3416</td>
<td>8</td>
</tr>
<tr>
<td>2007</td>
<td>128</td>
<td>2054</td>
<td>20</td>
</tr>
</tbody>
</table>
Infection control

Hospital hygiene

Goal:

to prevent infections related to health care

Environmental approach

Patient-oriented approach;
Based on epidemiological data
## Accomplishing the goal of infection control

| Source of infection or reservoir | • treatment of infected patient  
|                                | • isolation of source of infection  
|                                | • elimination of reservoirs  
| Transmission                   | • hand washing/hand disinfection  
|                                | • asepsis  
|                                | • hygiene in patient care  
| Decreasing susceptibility      | • preparation for surgery  
|                                | • antibiotic prophylaxis  
|                                | • identification of personal risk factors  
|                                | • treatment of accompanying disease  
|                                | • specific prevention (vaccination)  |
Elements of Infection control
(a part of quality assurance in health care)

- SURVEILLANCE AND REPORTING OF NOSOCOMIAL INFECTIONS (EFRIR)
- STERILIZATION AND DISINFECTION
- ASEPTICAL TREATMENT AND NURSING
- ISOLATION
- ANTIBIOTIC POLICY
- ANTISEPTIC CLEANING
- ANTISEPTIC WASHING
- HANDLING OF WASTE MATERIAL
- INSECTICIDES AND RODENTICIDES
- HEALTH PROTECTION OF STAFF
- CONTINUING EDUCATION
Infection control personnel

Regular staff:
- Hygienic physician
- Public health inspector
- Epidemiological nurse

Effective cooperation necessary

Infectologist (Infectious disease specialist physician)
- Microbiologist
- Pharmacist
Four steps for calculating a nosocomial infection rate

1. How many infections (e.g., of influenza) did your facility report during the past week? 14
2. What was the average resident census during the past week? 156
3. How many days are in the reporting period? 7
4. Calculate the nosocomial infection rate.
   \[
   \text{# of infections} \div (\text{Avg Census} \times \text{Days}) = \frac{14}{(156 \times 7)} = 12.8\%
   \]

Calculate the nosocomial infection rate.
Nosocomial surveillance 1. Reporting of nosocomial infections

In the U.S.: National Nosocomial Infections Surveillance – (NNIS) since the 1970s
(http://www.cdc.gov/ncidod/dhqp/nnis.html)

In Europe: Hospital in Europe Link for Infection Control through Surveillance (HELICS) network for harmonization of national policies (1995)
(http://helics.univ-lyon1.fr/helicshome.htm)

In Hungary: National Nosocomial Surveillance System (NNSR) part of the EFRIR (Epidemic surveillance system and supporting IT system) system maintained by the NPHMOS (operational from 2005) – online notification
Purpose:
- **National level**: to gain nationally and internationally comparative data on the incidence of nosocomial infections
- **Local level**: institutions may compare their incidence rates to other institutions
- Identification of areas for quality improvement

**Compulsory notification:**
1. Sepsis
2. Outbreaks
3. Infections caused by *multi-drug-resistant* pathogens

**Optional notification**
## Nosocomial surveillance 2. multi-resistant pathogens in nosocomial infections

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Abbreviation</th>
<th>Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus aureus</td>
<td>MRSA</td>
<td>Methicillin/Oxacillin</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>VISA</td>
<td>Moderate sensitivity to Vancomycin</td>
</tr>
<tr>
<td>Enterococcus spp.</td>
<td>VRE</td>
<td>Vancomycin</td>
</tr>
<tr>
<td>Enterobacter spp.</td>
<td>MENB</td>
<td>III.gen.cefalosporins (ESBL) and imipenem and/or meropenem</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>MECO</td>
<td>III.gen.cefalosporins (ESBL) and imipenem and/or meropenem</td>
</tr>
<tr>
<td>Klebsiella spp.</td>
<td>MKLE</td>
<td>III.gen.cefalosporins (ESBL) and imipenem and/or meropenem</td>
</tr>
<tr>
<td>Acinetobacter baumanii</td>
<td>MACI</td>
<td>imipenem and/or meropenem</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>MPAE</td>
<td>Sensitive to 2 or less of the following: (piperacillin/tazobactam, ceftazidin, cefepim, imipenem, meropenem, ciprofloxacin, gentamicin, tobramycin, amikacin, aztreonam)</td>
</tr>
<tr>
<td>Stenotrophomonas maltophilia</td>
<td>MSTM</td>
<td>Cotrimaxazol (sumetrolim)</td>
</tr>
<tr>
<td>Clostridium difficile</td>
<td></td>
<td>hyperinvasive</td>
</tr>
</tbody>
</table>

ESBL= Extended Spectrum Beta-Lactamase producing bacteria
Sterilization and disinfection

Only with validated, **officially licensed tools and substances**!

Aseptic patient care

Appropriate documentation for quality monitoring and control!

See previous practical!
If you suffer a needle stick injury:

- Encourage the wound to bleed;
- Wash the wound and surrounding area under cold running water;
- Cover the wound with a dry dressing;
- Contact your GP or visit the Hospital’s Accident and Emergency as soon as possible telling them you have sustained a needle stick injury.

The Borough Council has produced a leaflet on needle stick and syringe injuries which can be obtained from our Information Centres.

(For information of the staff from a US hospital)
Spacesaver's **In-room Patient Storage System** can help **reduce** the frequency and number of individuals that need to enter a patient's room — thus reducing the transfer of hospital acquired infections.
Antibacterial elevator handrail, handle, lift button
Methicillin-resistant Staphylococcus aureus (MRSA) bacteria thrive on stainless steel (blue) but die off quickly on copper (red) and brass (yellow) surfaces.
Occupational health regulations and infection control

- pre-employment and periodic medical examination
- personal protective equipment
- controlled work-processes
- vaccination
  - HBV compulsory (in Hungary)
  - recommended:
    - age-related vaccination boosters
    - HAV, varicella
- continuing education
**APPROPRIATE ANTIBIOTIC USE**

Unified guidelines for the treatment of bacterial infections

- protocols!!!
- specific, directed treatment of pathogens whenever possible

Reasons for choosing a given antibiotic agent should be addressed in patient documentation

Certain antibiotics only in special cases

- „reserve” antibiotics

Antibiotic committee in health care institutions

Ongoing surveillance of antibiotic-resistance in microbes
Antibiotic consumption in the EU, 2004, outpatient care
Impact of Antibiotic Resistance

- Increased rates of treatment failure
- Poor patient outcomes
- Increased mortality
- Increased need for combination therapy
- Increased cost of treatment
A hospital infection caused by *Methicillin-resistant Staph aureus* or *Vancomycin-resistant Enterococcus* can double the time a patient stays in hospital.

*Source: World Health Organization/CDS*
Hygienic / disinfecting cleaning

- only „wet” cleaning
- only with licensed substances
- color-coded for various areas
- cleaning protocol for institutions
Disinfecting washing

- collection of potentially contaminated textiles at site of use
- handling of potentially contaminated textiles with appropriate personal protective equipment (gown, glove…)
- textiles used by infectious patients: collection in yellow (biohazard) bags or special water-soluble bags.
Medical doctor tasks in case of a communicable diseases
<table>
<thead>
<tr>
<th>patient</th>
<th>contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>- reporting (notification)</td>
<td>- epidemiological supervision</td>
</tr>
<tr>
<td>- isolation</td>
<td>(quarantine)</td>
</tr>
<tr>
<td>- lab tests</td>
<td>- lab tests</td>
</tr>
<tr>
<td>- disinfection</td>
<td>- disinfection</td>
</tr>
<tr>
<td>- vaccination</td>
<td>- vaccination</td>
</tr>
<tr>
<td>- epidemiological supervision</td>
<td>- chemoprophylaxis</td>
</tr>
</tbody>
</table>
## Reporting/notification of communicable diseases

<table>
<thead>
<tr>
<th>who?</th>
<th>Doctor, who observes the case</th>
</tr>
</thead>
<tbody>
<tr>
<td>to whom?</td>
<td>Local public health authorities</td>
</tr>
<tr>
<td>what?</td>
<td>Officially listed diseases (manifest and suspected cases)</td>
</tr>
<tr>
<td>how?</td>
<td>Various, depends on national regulations (written form, phone, fax, electronic, courier)</td>
</tr>
<tr>
<td>when?</td>
<td>As soon as possible</td>
</tr>
<tr>
<td>Special cases?</td>
<td><strong>immediately:</strong> avian influenza, cholera, diphtheria, hemorrhagic fevers, lyssa, leprosy, malleus, plague, polio, relapsing fever, SARS, smallpox, typhoid fever, typhus exanthematicus, yellow fever</td>
</tr>
</tbody>
</table>
Measures at enteric infectious disease of unknown origin /in Hungary/

- **reporting** as „enteric infection” /enteritis infectiosas/

- **isolation** of the diseased person

- **stool sample** to the laboratory compulsory

- measures **with certain contacts**: 7-days epidemic supervision if they work in some sensitive occupation or visit certain communities and prohibition to work in or visit them until negative stool culture
The following slide show examples for communicable diseases which in Hungary must be reported immediately to the public health authorities.
Diphtheria

Bull neck
Diphtheria cases reported to the WHO between 1997 and 2006.

- Over 100 reported cases red
- Between 50 and 100 reported cases brown
- 1-49 reported cases green
- No cases reported grey
(Museum of Medical History, Budapest)
Cholera

- Vibrio cholerae O1 / classical and El Tor biotypes/
  Vibrio cholerae O139

- **incubation**: from a few hours to 5 days

- profuse painless watery stools /”rice-water”/,
  vomiting without nausea, rapid dehydration

**reservoirs**: humans /diseased and carriers but
environmental reservoirs also exists in brackish
water or estuaries/

- **prevention**: water and food hygiene,
environmental hygiene, vaccination possibilities
/when?/
Cholera
Cholera

Mix one litre of clean, boiled water with 8 level teaspoons of sugar and ½ level teaspoon of salt.
An oral cholera vaccine. Large phase three trial initiated in 1985 showed that the vaccine provided about 85% short term protection and about 60% protection over three years (protection among children under five lasted only about one year, suggesting booster doses may be needed for these children).
Typhoid fever
Typhoid fever
Mary Mallon (1869 –1938), also known as Typhoid Mary, was the first person in the United States to be identified as a **healthy carrier of typhoid**. (It is an example for carrier surveillance at that time.)

Over the course of her career as a cook, she infected 47 people, three of whom died from the disease. Her fame is in part due to her vehement denial of her own role in causing the disease, together with her refusal to cease working as a cook. **She was forcibly quarantined twice by public health authorities and died in quarantine.**
Yellow fever

Yellow fever-endemic zones

Yellow fever: 25 carat fancy yellow pear shape diamond
Typhus exanthematicus
(epidemic louse-borne typhus fever)
Presence of Rabies

- **Presence of rabies**
- "rabies free" in terrestrial animals
- "rabies free" in terrestrial animals and bats

© FLI Wusterhausen, IFE
Green = no risk
Yellow = low risk
Brown = medium risk
Red = high risk
Poliomyelitis
Poliomyelitis, acute /Infantile paralysis/

- Poliovirus, type 1, 2 and 3

- transmission: principally through the fecal-oral route
  but also with pharyngeal spread

- targeted with eradication, strategies:
  1. high routine infant immunization coverage with OPV
  2. supplemental mass immunization /National Immunization Days/
  3. epidemiologic and laboratory surveillance for Acut Flaccid Paralysis
  4. „mopping-up” immunization

Why are used in HUNGARY already only IPV?
Plague

-Yersinia pestis

Rats → Squirrels

Flea

Gophers

Figure A

Figure B

Figure C
Plague
Plague

Cat
Active surveillance system: patient with suspected plague identified on arrival at U.S. international airport.
Relapsing fever

1. Entry: tick or louse bite
2. Spread
3. Disease
   - Neuritis
   - Rash (erythema migrans)
   - Carditis
   - Arthritis
Relapsing fever

- Borrelia resides in:
  - Liver
  - Spleen
  - Bone marrow
  - Central nervous system

- Ornithodoros tick

- Borrelia spirochete
Relapsing fever

![Graph showing the progression of disease and relapses with peaks of spirochete antigens and antibody responses.](image-url)
Smallpox
Case fatality rates for **Ebola hemorrhagic fever** are high, ranging from 50% to 90%, with death usually occurring from shock rather than blood loss. The virus is transmitted through direct contact with blood or other body fluids of infected persons or animals, and even close contact with a deceased Ebola-infected body. Ebola viruses belong to a family of viruses termed *Filoviridae*, which are characterized by a long filamentous structure.
West Nile Virus Transmission Cycle

- Mosquito vector
- Bird reservoir hosts
- Incidental infection

West Nile virus

CDC
Leprosy is a chronic human infectious disease caused by *Mycobacterium leprae*, a slow-growing intracellular parasite mainly of cells belonging to the monocyte-macrophage lineage. In 2000, there were an estimated 1.3 million cases worldwide, mainly in India, Brazil and countries of South-East Asia and Africa.

The registered global prevalence in the beginning of 2006 was 219,826 cases.
Leprosy is a chronic disease caused by bacterium Mycobacterium leprae. It mainly affects skin, mucus membranes and peripheral nerves.

Peripheral nerve involvement (thickening) is characteristic of tuberculoid leprosy. Presentation of numbness is also a clue for the clinical diagnosis.

Leprosy is a chronic disease caused by bacterium Mycobacterium leprae. It mainly affects skin, mucus membranes and peripheral nerves.
Leprosy, Leonine facies
Lepromatous leprosy
Leprosy, Ethiopia
Most patients with leprosy can be cured with multi-drug therapy in just six months as shown in this image. WHO
The global registered prevalence of leprosy at the beginning of 2006 was 219,826 cases.
Glanders (Malleus)
Burkholderia (Pseudomonas) mallei
Glanders / Pseudoglanders

Easy to diagnose and treat -- if you think of it.

Honor the warriors... not the war.

Eye, skin, node &/or lung involvement, often years after the original exposure.

Pseudomonas mallei and Pseudomonas pseudomallei, acquired from horses, donkeys, and/or soil in the poor nations (notably Southeast Asia), resist most, but not all, of today's antibiotics.
Typhus fever (epidemic louse-borne typhus)
Isolation
(refers to patients!)

- **at home** (as the rules allowed it AND if conditions are suitable)
- **infectious department** (infectious disease hospital)
- **any hospital**
  (specific national rules apply!)
To minimize cross infections, a nurse in the patient isolation room communicates with a colleague through a glass wall – a common sight in the Intensive Care Unit. (Singapore, 2006)
A sample layout of a single patient
A sample layout for several patients
There are about 14,000 cases of TB in the U.S. every year. But there have been only 49 cases of extensively drug-resistant TB reported between 1993 and 2006.
Portable solution for temporary medical isolation facilities during a suspected or confirmed pandemic infectious disease event.
Isolation categories

1. Universal precautions
2. Strict isolation
3. Contact isolation
4. Respiratory isolation
5. Tuberculosis (AFB) isolation
6. Enteric precautions
7. Drainage/secretion precautions
Laboratory tests

Goal:

- diagnostic test
- screening test
- control test

Organization:

- mandatory
- not-mandatory

There are special laboratories to perform tests in case of communicable diseases.
Quarantine measures
(refersto asymptomatic contact persons!)

Restriction of asymptomatic contact persons (or animals) who (that) may be in
the incubation phase of an infectious disease for the duration of the
maximal incubation period

1. Absolute quarantine (absolute limitation of contact)
2. Modified quarantine (restriction on activities):
   - personal surveillance (close observation)
   - segregation (separation of part of a group)

* Special case: carrier surveillance (similar to personal)
In the USA the list of quarantinable diseases is contained in an Executive Order of the President and includes cholera, infectious tuberculosis, plague, smallpox, yellow fever, viral hemorrhagic fevers (such as Marburg, Ebola, and Congo-Crimean), and SARS. An amendment to the Executive Order of the President was added in 2005 to include influenza that is causing or has the potential to cause a pandemic. Modern quarantine lasts only as long as necessary to protect the public by (1) providing public health care (such as immunization or drug treatment, as required) and (2) ensuring that quarantined persons do not infect others if they have been exposed to a contagious disease.
Restriction on professional activities in health care

Regulations vary in different countries, but usually a Health Care Staff member, who is

- HIV positive,
- HBV infective positive, or
- HCV infective positive

is banned from certain medical activities
(invasive procedures).
Notification of cases:

WHO Member States are obliged to notify WHO for a single case of cholera, plague or yellow fever, occurring in humans in their territories, and give further notification when an area is free from infection and all events that may constitute a public health emergency of international concern.

These notifications are reported in the WHO's Weekly Epidemiological Record.
International Health Regulations (WHO) II.

Health-related rules for international trade and travel. **Health measures:** measures for **deratting, disinfecting, and disinsecting international conveyances** (ships, aircraft, etc.) are to be implemented at points of arrival and departure (ports, airports and frontier posts). The health measures called for are the maximum measures that a state may apply for the protection of its territory against cholera, plague and yellow fever.

**Health documents required:**

- requirements are included for health and vaccination certificates for travellers from infected to non-infected areas (*yellow fever and meningococcal diseases*);
- deratting/deratting exemption certificates;
- health declarations- Maritime Declaration of Health; Aircraft General Declaration.
Disease surveillance

Surveillance is defined as “the ongoing systematic collection, analysis, and interpretation of outcome-specific data for use in planning, evaluation and implementation into public health practice.”
Communicable disease surveillance

- morbidity and mortality reports
- reports about epidemics and individual cases
- identification of infectious agents by laboratories
- serologic surveillance, information about the immunity level of segments of the population
- data about the use and antoward effects of vaccines and toxoids, immune globulins, insecticides and other substances used in control
- other relevant epidemiological data

DATA COLLECTION - EVALUATION - INFORMATION, NEEDED (possible) MEASURES
Further reading


• Specific website content (see previous slides)
