

Session 4 Infectious diseases

Transmitted infectious diseases in indoor environment

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INTRODUCTION

Except skin, the respiratory tract is the only human organ directly affected by (indoor) air. Therefore it is understandable, that all pollutants from the air can evoke any trouble especially in susceptible people. Microbiological contamination of any environment is common and also indoor air or environment is rich in different microbes and it doesn't make too big difference if pathogenic or not as we must assume, that in common indoor environment will occur many people with immunodeficiency either due their age (ageing people's immune system is mostly weakened), their illnesses (e.g. hereditary malfunction of immune system or acquired immune malfunctions) or their treatment (people after transplantations, with lymphomas or other cancers). These so called immunocompromised people live with us, we are able to safe their lives in hospitals, so we have to guard them in indoor environment, not only hospitals but also in their homes, office buildings, schools etc.

Table 1: Worldwide mortality due to infectious diseases (WHO, 2004)

Cause of death	Deaths 2002 (millions)	% all deaths
All infectious diseases	14.7	25.9%
Lower respiratory infections	3.9	6.9%
HIV/AIDS	2.8	4.9%
Diarrhoeal diseases	1.8	3.2%
Tuberculosis (TB)	1.6	2.7%
Malaria	1.3	2.2%
Measles	0.6	1.1%
Pertussis	0.29	0.5%
Tetanus	0.21	0.4%
Meningitis	0.17	0.3%
Syphilis	0.16	0.3%
Hepatitis B	0.10	0.2%

Tropical diseases (6)	0.13	0.2%
<i>Other causes of death include:</i>		
<i>maternal and perinatal conditions</i>		5.2%
<i>nutritional deficiencies</i>		0.9%
<i>noncommunicable conditions (cancer, cardiovascular diseases)</i>		58.8%
<i>injuries</i>		9.1%

In second third of the 20th century people believed that infectious diseases are under control. We had got antibiotics that worked very well; vaccination programmes had fantastic effect on elimination some diseases or at least decreased a number of severe complications and total number of diseased people, especially in developed countries. One of the major killers of the world of the past centuries – smallpox – was even eradicated in the end of 70-ties.

Unfortunately beginning of eighties brought a new challenge – unknown infection agent – HIV. Other new topic followed: SARS. In last several years we are threatened with the potential avian flu mutation into epidemic one.

It seems that the Nature is still one step ahead and when we are sure of our victory, somewhere is hidden at least one new future problem. Some of these problems are results of human’s activity, medical efforts or non- responsibility like bacterial strains resistant to antibiotics or Legionnaire's disease.

Regardless of our achievements on the field of infectious diseases, there are still substantial proportions of people dying of various infectious diseases (tab.1). And some of these threats are airborne infections transmitted in indoor environment.

BASICS OF INFECTIOUS DISEASES

Infectious agents are either obligatory pathogens (microbial agents capable of causing disease) or facultative pathogens. In fact we cannot say that any agent it NOT A pathogen as for some people and in some “concentration” (infectious dose) it should be (e.g. for immunocompromised people), so we prefer to call them facultative pathogens.

Transmission of these agents should be direct or indirect from the source. Let take into account mostly the indirect transmission from the unique source: human being. Other possibilities will be mentioned later. Whether in clinical settings, homes, schools, colleges, office buildings, theatres, or airplanes, as long as infected people cough, sneeze, shout, sing, or talk, they can discharge pathogen-filled droplets from their noses or mouths. A single sneeze alone can expel many thousands of infectious respiratory droplets into the air.

Indirect transmission is mediated by contaminated objects (of daily use like towels), by inoculation (e.g. by instruments), by alimentary way and by droplets & air –

airborne infection. Although transmission via droplets is considered to be direct transmission, we can add them, for our purposes, among transmission by air. More over droplets larger than 100µm depending on their resistance to the environment can create contaminated dust. Smaller droplets can stay in air for longer or shorter time. The smaller are the droplets, the further it may be carried from the source. Small respiratory droplets that become aerosolised when people sneeze, cough, laugh or exhale can be carried by air. In addition water droplets aerosolised through air conditioning units may also spread infections. Aerosolised droplets hang in the air and are able to travel considerable distances.

With airborne transmission, direct contact with someone who is infected is not necessary to become ill. The amount of exposure necessary varies from disease to disease. Many airborne pathogens are adapted to spreading in indoor environments, where the temperature, humidity and protection from sunlight protect them in their exposed and vulnerable period when they transmit from one person to the next. For airborne infectious the main entrance of the infectious is the respiratory tract, but for some other it could be e.g. the lesion of skin (skin infectious e.g. furuncle) or mucosa (other than in respiratory tract).

Table 2: Infectious diseases – transmission.

Disease	Infectious agent	Course of illness	Transmission	Survival in indoor environment
Upper-respiratory tract	Mainly viruses	Mild	Airborne - droplets	Short
Exantematic	viruses	Mild (to severe)	Airborne - droplets	Short
Lower respiratory tract	Viruses, bacteria, etc.	Mild to severe	Airborne - droplets	Short
Pneumonia	Viruses, bacteria, etc.	Severe	Airborne - droplets	Short (to long)
Tuberculosis	<i>Mycobacterium tuberculosis, aviarum, etc.</i>	Severe	Airborne - droplets	Long
Legionnaire's disease	<i>Legionella pneumophila</i>	Severe	Airborne - droplets	Long (in water)
Pontiac fever	<i>Legionella pneumophila</i>	Mild	Airborne - droplets	Long (in water)
Pandemic flu	<i>Influenza virus</i>	Mild to severe	Airborne - droplets	Short
SARS	<i>SARS coronavirus</i>	Severe	Direct contact, airborne, droplets, oral-fecal	Long? Re-aerosolization
Anthrax	<i>Bacillus anthracis</i>	Severe	Airborne – pulmonary anthrax	Very long (everywhere)
Small pox	<i>Variola major</i>	Severe	Contact, airborne	Long

INDOOR THREATS

In indoor environment some less frequent diseases represent higher risk and higher demands on ventilation systems and environment protection not only in buildings.

WELL-KNOWN SEVERE (INDOOR) INFECTIONS

It is difficult or impossible to require these infections outside indoor environment or the main risk seems to be the transmission via ducts (air-condition systems, ventilation ducts, water ducts).

Tuberculosis

Chronic pulmonary **tuberculosis** caused by *Mycobacterium tuberculosis* is still, despite of the vaccination, severe threat. Over one-third of the world's population now has the TB bacterium in their bodies and new infections are occurring at a rate of one per second. Not everyone who is infected develops the disease and asymptomatic latent TB infection is most common. In developed countries is the prevalence low but in many of them the number of cases is slowly growing up in last years.

Unfortunately the percentage of resistant chains of mycobacterium is increasing and also those of atypical tuberculosis, which are very often multiresistant, too. In most European countries mortality from TB is decreasing but still in some countries (Baltic & Balkan states, but also Portugal, Poland, Finland) TB could be a problem in older age groups (EuroTB). Infectious dose (the amount of microbes necessary for developing an illness) of mycobacteria is in healthy people rather high, so transmission from person to person outdoors is difficult. Survival of agent in indoor environment is long (months).

Legionnaire's disease (Pontiac fever)

Legionellosis is a respiratory disease caused by bacteria *Legionellae*. Most frequently human disease Legionnaire's disease is caused by *L. pneumophila*. The clinical picture is characterized by myalgia, headache, fever, and non-productive cough developing further to pneumonia. Case-fatality rate can be high especially among elderly and immunocompromised individuals. Sporadic cases and outbreaks occur worldwide. In healthy, young people caused *legionella* mostly Pontiac fever – a common cold like disease with none or low risk. *Legionella* is an organism that resides in the environment in pools of stagnant water. Most common route of transmission is airborne. Person to person spread does not occur.

The reservoirs are aquatic systems like cooling towers, evaporative condensers, humidifiers, decorative fountains etc. Legionellosis can be treated effectively with antibiotics. Prophylactic measures include regular cleaning and maintenance of different water systems.

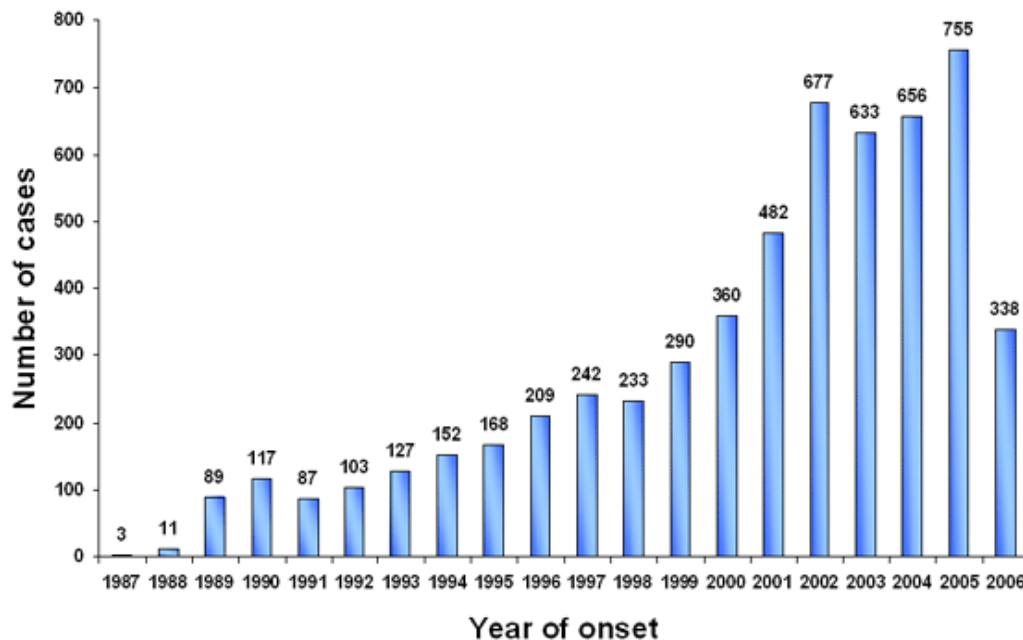
The European Working Group for Legionella Infections (EWGLI) was formed in 1986 with the co-ordinative centre in London. Its members are scientists with an

interest in improving knowledge and information on the epidemiological and microbiological (clinical & environmental) aspects of legionnaires' disease. This is achieved through international surveillance of the disease, as well as developments in diagnosis, management and treatment methods.

The European Surveillance Scheme for Travel Associated Legionnaires' Disease (**EWGLINET**) contains the European Guidelines for Control and Prevention of Travel Associated Legionnaires' Disease. Every European country has a history of *legionella* outbreaks. Sometimes it is difficult to verify the diagnose, especially because nobody believes in it and this is the reason of constitution of this guidelines.

But not only people in hotels in tourist destinations are in risk. Unfortunately other outbreaks were described in hospitals in wards were people with severe diseases were hospitalised. These people are in higher risk than any other.

Figure 1: Graph of Legionnaire's disease cases in Europe by year of onset (EWGLINET)



The disease most often affects the elderly and people with underlying illnesses such as cancer or those with a lowered immune system. Outbreaks of pneumonia have been associated with contamination of water cooling towers in large buildings, with spread of the bacteria mostly through air conditioning systems. Nowadays the new threat comes from **tap water** during shower or aerosolization the tap water, e.g. by spraying etc., so it could be a severe problem of hospital environment.

NEW THREATS

Except these well-known problems, time to time a new one arises somewhere around the world and in a short time it could become a problem of most countries. Frequently is discussing potential epidemic of flu, which is expected for several years, and completely new agent causing SARS.

Flu

Flu pandemic is one of the threats of the end of 20th century and beginning new millenia.

Influenza virus (flu virus) cause diseases with high severity especially for elderly people, with rather high proportion of complications, worsen chronic health problems. Influenza may cause worsening of coronary heart disease or congestive heart failure. Although the incidence of influenza can vary widely between years, approximately 36,000 deaths and more than 200,000 hospitalizations are directly associated with influenza every year in America (1). Every ten to twenty years a pandemic occurs, which infects a large proportion of the world's population, and can kill tens of millions of people (2).

Last several decades a new pandemic strain is expected and there are some “promising” candidates for new reassortment. Influenza reaches peak prevalence in winter. One possible explanation for this seasonal occurrence is that, because people are indoors more often during the winter, they are in close contact more often, and this promotes transmission from person to person. Another is that cold temperatures lead to drier air, which may dehydrate mucus, preventing the body from effectively expelling virus particles.

Anyway the main problem of epidemic flu is not indoor environment as it is highly contagious infectious everywhere. In case of pandemic flu ventilation and especially air-condition systems should play the most important role in transmitting viruses or isolation sick people.

Table 3: Known flu pandemics

Name of pandemic	Subtype involved	Date	Deaths
Asiatic (Russian) Flu	Possibly H2N2	1889–1890	1 million
Spanish Flu	H1N1	1918–1920	40 million (100 millions)
Asian Flu	H2N2	1957–1958	1 to 1.5 million
Hong Kong Flu	H3N2	1968–1969	0.75 to 1 million

Because of high proportion of complications and even death, vaccination is recommended especially for elderly people, people with chronic disease and other immunocompromise people. Virus is extremely variable, so vaccination is necessary every year, due to antigenic drift for every year a new vaccine is necessary.

Severe acute respiratory syndrome (SARS)

In late 2002, a new syndrome was observed in southern China (Guangdong Province). It was named **severe acute respiratory syndrome (SARS)**. The initial outbreak of SARS peaked in April 2003 and by June had tailed off. By that time, there had been about 8,000 cases worldwide and 775 deaths. Respiratory distress leads to death in 3-30% of cases. Via aeroplanes was this disease transmitted to other continents. Transmission of SARS was in most cases observed in indoor environment. In fact the first outbreak was at people living at the same floor of one hotel where doctor from Guangdong province lived. Transmission was possible only via **air-conditioning system**, even airborne spread of SARS does not seem to be a major route of transmission. Also oral-fecal transmission is possible as in other coronaviruses via **sewage systems of the buildings** as coronaviruses were found also in stool of patients.

Bioterrorism

Although most of the infectious diseases are rare in 21st century in developed countries, still it is one threat of severe infections of previous centuries. Occurrence of this new threat is dating to the end of twenty century, to the nineties. This is bioterrorism. Still it is at least theoretical chance to get highly danger strains of infectious diseases like smallpox, anthrax or plague. All these diseases were big killers of the past and are under the control in 21st century.

Yersinia pestis is the agent which causes **plague**, known also as Black Death. The three documented pandemics of plague (Black Death) have been responsible for the death of hundreds of millions of people. The organism is exhaled in cough droplets, infect other humans in close proximity and cause **pneumonic** plague, which more difficult to control and has 100% mortality. Bubonic plague is typical transmissible infection, reservoir are small rodents (well-known are rats) and vector is flea.

Anthrax is a zoonotic disease occurring in wild and domestic animals such as cattle, sheep, goats and other herbivores. It can be acquired by humans either by ingestion, **inhalation**, or skin contact with contaminated animal products. Cutaneous anthrax and gastrointestinal anthrax have lower fatality rates, but still must be treated aggressively to assure survival.

Because of the stability of the spore in the environment anthrax is one of the diseases commonly mentioned in relation to germ warfare and terrorist activity. In 2001 several postal workers died of inhalation anthrax after handling B. anthracis-laced.

Pulmonary anthrax results from inhalation of *Bacillus anthracis* spores which are phagocytized by the alveolar macrophages where they germinate and replicate. Respiratory distress and cyanosis are manifestations of toxemia. Death results within 24 hours. This form of anthrax is of significance in biological warfare.

Smallpox (also known by the names *Variola* or *Variola vera*) is a highly contagious disease unique to humans. Smallpox is caused by either of two virus variants named *Variola major* and *Variola minor*. The deadlier form, *V. major*, has a mortality rate of 3-35%, while *V. minor* causes a milder form of disease called *alastrim* and kills ~1% of its victims. Long-term side-effects for survivors include the characteristic skin

scars. Occasional side effects include blindness due to corneal ulcerations and infertility in male survivors.

Smallpox was responsible for an estimated 300–500 million deaths in the 20th century. After successful vaccination campaigns throughout the 19th and 20th centuries, the WHO certified the eradication of smallpox in 1977. In most countries the vaccination stopped around 1980, so in fact total population has no protection.

The role of indoor environment is not major but because the important route is re-aerosolization of the dust with scales from scabs, indoor environment could also play important role. Of course also special isolated wards could be highly important.

OTHER DISEASES OF CONCERN (Well-known respiratory diseases)

Some of these diseases are well-known, common, we are familiar with diagnose and treatment of them. They are not harmful, at least for immunocompetent people but could be unpleasant. Many of them are easily transmitted in overcrowded interiors, environment with low air exchange or with pure quality of mechanical ventilation /air conditioning system. In environment with low level of cleaning can persisted infectious agents in dust and can be transferred into breathing zone in consequence of any activity in the environment which can whirl the dust.

These infections are not typically connected with indoor environment and improving the quality of indoor environment probably will not decrease number of sick people. On the other hand - to stop the epidemic we have to **isolate** sick people from healthy ones. Mostly from the beginning all these diseases have symptoms of common cold and rarely are threat for the life. Occurrence of these diseases is common especially from autumn to spring.

Upper respiratory tract illnesses

Cold, common cold

The common cold is caused by a large number of different types of infectious agents, especially viruses. They all result in similar symptoms: sneezing, runny nose, sore throat and cough with or without a low grade fever, muscle aches and malaise. From the medical point of view the health effect of common cold is minor, as complications are rare.

Cause of (common) cold are e.g.: *Adenovirus*, *Coronavirus*, *Coxsackie A,B*, *Rhinovirus*, *Parainfluenza virus*, *Respiratory Syncytial Virus (RS)*.

Some symptoms could simulate common cold although the cause is different, e.g. *Listeria monocytogenes*, *Legionella pneumophilla*– Pontiac Fever.

Pharyngitis

Similar to cold is pharyngitis, inflammation of pharynx. The sore throat is highlighted; complications are also rare in immunocompetent people. Problems are usually caused by

different species, e.g.: *Adenovirus*, *Herpes Simplex Virus 1,2 (HHV1, HHV2)*, *Neisseria gonorrhoeae*, *Parainfluenza virus*, *Streptococcus pyogenes*.

Epiglottitis

Haemophilus influenzae is the main cause of life - threatened disease – epiglottitis. Its occurrence is connected with dry air, in young children, mostly younger than 3 years. As *H. influenzae* is so danger, in many countries is used vaccine against this agent.

Laryngitis

The characteristic marker of this disease is hoarseness, loss of voice and pain. Among other causes, one of the most common is *Moraxella catarrhalis*.

Bronchitis, bronchiolitis, bronchopneumonia

These diseases are mostly occurred as a complication of any other, originally upper respiratory tract disease. Course of the disease can vary from mild to severe depending on cause agent and status of the patient. Symptoms are as follow: fever, cough, dyspnoe, shortness of breath, cyanosis. Cause (apart others) are: *Moraxella catarrhalis*, *Parainfluenza virus*, *Pseudomonas aeruginosa*, *Respiratory Syncytial Virus (RS)*, *Bordetella pertussis*, *Nocardia asteroides*.

Otitis media

Otitis media is a problem mostly of young age children and often it is a complication of common cold. In very rare situation it could be danger. Chronic otitis can result in deafness and/or vertigo, in special cases can progress in mastoiditis, meningitis or encephalitis with dramatic development. The most common cause is *Haemophilus influenzae*, *Moraxella catarrhalis*, *Streptococcus pyogenes*.

Lower respiratory tract illnesses

Pneumonia has the same symptoms at the beginning but mostly is more dangerous. Typical symptoms associated with pneumonia include cough, chest pain, fever, and difficulty in breathing. Pneumonia is a common illness which occurs in all age groups, and is a leading cause of death among the elderly and people who are chronically and terminally ill. Causes of pneumonia are several and on the cause depends treatment and also prognosis. Some of the causes are: *Adenovirus*, *Bacteroides fragilis*, *Chlamydia pneumoniae*, *Chlamydia psittaci*, *Chlamydia trachomatis*, *Coccidioides immitis*, *Coronavirus*, *Coxiella burnetti*, *Cryptococcus neoformans*, *Cytomegalovirus (CMV)*, *Escherichia coli*, *Haemophilus influenzae*, *Histoplasma capsulatum*, *Influenza virus*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Listeria monocytogenes*, *Moraxella catarrhalis*, *Mycoplasma pneumoniae*, *Parainfluenza virus*, *Proteus mirabilis*, *Pseudomonas pseudomallei*, *Respiratory Syncytial Virus (RS)*, *Rhodococcus equi*, *Staphylococcus aureus*, *Streptococcus agalactiae*, *Streptococcus pneumoniae*, *Varicella-Zoster Virus (HHV3)*.

Atypical pneumonia is sometimes difficult to diagnose when doctor have no information concerning special lifestyle or hobby (e.g. breeder of parrots). Cause agent could be various like *Adenovirus*, *Chlamydia pneumoniae*, *Chlamydia psittaci*, *Mycoplasma pneumoniae*.

Laryngotracheobronchitis or **croup** is a contagious viral infection causing inflammation and swelling of the larynx and surrounding tissues. It presents with difficulty in breathing especially breathing in and a typical barking cough. It usually affects children between the ages of 6 months and 3 years. Croup can be caused by a number of different viruses. In the fall, it is usually caused by *Parainfluenza virus*. In winter and spring, it is usually caused by *Respiratory Syncytial Virus (RS)* or an *Influenza virus*. Less commonly, croup may be caused by *Measles virus* or other viruses such as *adenovirus*, *rhinovirus*, *enterovirus* and *coxsackie virus*. Symptoms are typical: fever, hoarseness, harsh, barking cough, swelling - laryngeal obstruction, dyspnoea.

Herpangina is the name of a painful mouth infection caused mainly by *coxsackieviruses A*. Usually, herpangina is produced by one particular strain of *coxsackievirus A*, but it can also be caused by *coxsackievirus B* or *echoviruses*. It is most common in children. Though herpangina can be asymptomatic, symptoms usually associated are high fever and sore throat.

Other respiratory tract illnesses

Diphtheria is caused by *Corynebacterium diphtheriae* and is characterized by an adherent membrane (a *pseudomembrane*) on the tonsil(s), pharynx, and/or nose. Diphtheria is a serious disease, with fatality rates between 5% and 10%. In children under 5 years and adults over 40 years, the fatality rate may be as much as 20%. Nowadays in most developed countries are children vaccinated against diphtheria.

Bordetella pertussis is the only organism of major clinical significance within this genus; it causes **whooping cough** in infants and young children. However, a closely related organism, *B. parapertussis* can also cause a milder form of bronchitis. Despite the vaccination, every 2 -5 years a small epidemic occurred, especially in young adult people, not at children.

Parrot fever is infection transmitted usually via the droppings of infected bird, though it can also be transmitted via feathers and eggs, and are typically either inhaled or ingested. **Psittacosis** - also known as **parrot disease**, **parrot fever**, and **ornithosis** - is a zoonotic infectious disease caused by a bacterium called *Chlamydophila psittaci* and contracted not only from parrots, but also from pigeons, sparrows, ducks, hens, sea gulls, and many other species of bird.

Meningitis

Meningitis is severe complication of various infections and despite antibiotics still kills about 170 000 persons a year (WHO, 2004). It can be caused by several agents: *Coxsackie A,B*, *Cryptococcus neoformans*, *Echovirus*, *Haemophilus influenzae*, *Herpes Simplex Virus 2 (HHV2)*, *Leptospira interrogans*, *Listeria monocytogenes*, *Moraxella catarrhalis*, *Neisseria meningitis*, *Polio virus*, *Streptococcus agalactiae*, *Streptococcus pneumoniae*.

Children's Exanthema Diseases

Some infections which used to be common, killed hundreds of people, especially children every year, nowadays, due to vaccination, don't present a big risk, at least in developed countries, with one exception – morbilli (measles). Because of travelling around the world, there is a possibility to meet them. Most of these infections are typical diseases of childhood. In younger age there are fewer complications than in adult people, more over vaccination against these “children” infections mostly doesn't assume booster in adult age, so specific immunity is low or lower in middle-age population. Beginning of these infections is similar – common cold and/or typical rash.

Scarlet fever was a threat because of rather frequent complication – rheumatic fever. The disease is caused by *Streptococcus pyogenes* and there is a characteristic rash.

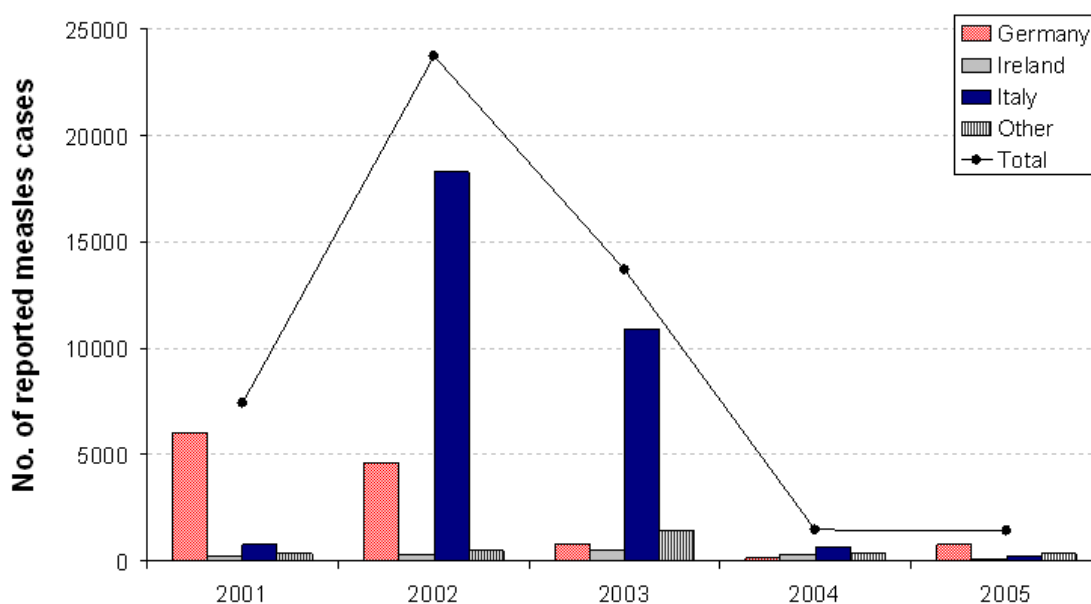
Varicella, chickenpox

Chickenpox is a highly contagious disease that spreads from person to person by direct contact or through the air from an infected person's coughing or sneezing. Chickenpox is rarely fatal but later in life viruses remaining dormant in the nerves can reactivate causing localised eruptions of shingles. This occurs particularly in people with compromised immune system, such as the elderly, and perhaps even those suffering sunburn. Unlike chickenpox which normally fully settles, shingles may result in persisting post-herpetic neuralgia pain. Because of those complications, in several countries vaccine against *Varicella-Zoster Virus* (HHV3), which causes varicella, is used to prevent these later complications.

Rubella (also known as **epidemic roseola**, **German measles**, **liberty measles** or **three-day measles**) is a disease caused by the *Rubella Virus*. It is often mild and an attack can pass unnoticed. Rubella can pose a serious risk as it can also be transmitted from a mother to her developing baby through the bloodstream via the placenta and in this case it caused teratogenic.

The **Measles** are a highly contagious airborne pathogen which spreads primarily via the respiratory system. The *Measles Virus* is transmitted in respiratory secretions, and can be passed from person to person via aerosol droplets containing virus particles, such as those produced by a coughing patient. Complication of measles even in childhood was severe and lethality was rather high. It was estimated that in 1996 about 1 million children died from measles complications.

Figure 2. No. of reported measles cases in 19 EUVAC.NET participating countries since 2001 (EUVAC.NET)



Mumps or **epidemic parotitis** is a viral disease of people caused by *Mumps Virus*. Prior to the development of vaccination and the introduction of a vaccine, it was a common childhood disease worldwide, and is still a significant threat to health in the third world. Despite the vaccination, time to time a small epidemic occurrence of mumps can be observed it is dangerous especially in young men, because in this age the dangerous complications like pancreatitis or orchitis and encephalitis.

RISK OF MOULDS, YEASTS (FUNGI)

Very often is indoor environment (or ducts) contaminated by moulds or fungi due to poor maintenance, low air exchange etc. For healthy people this contamination doesn't represent a big harm. If any, so the risk is first of all to evaluate an allergy.

For immunocompromised people moulds could represent a life threat. Generalised or pulmonary aspergillosis can cause severe complications and even death of people with specific treatment of cancer or after transplantation.

CONCLUSIONS

Indoor environment play important role in transmission – ventilation, air-conditioning, water or sewage ducts can transmit several infectious agents to rather long distances.

Also secondary source (water, dust) can play important role even in other type of infections (alimentary – e.g. water-born cholera or some viruses causing alimentary problems).

There are several other facultative or obligatory pathogens without low effect for healthy people who spent their time either in well-maintained indoor environment or mostly outdoors; these agents could be harm for immunocompromised people. One can assume that if we will be able protect ourselves against these threats, probably we will be successful also in other battles against infectious disease, either those we know or any new still unknown.

REFERENCES

1. Thompson, W; Shay D, Weintraub E, Brammer L, Cox N, Anderson L, Fukuda K (2003). "[Mortality associated with influenza and respiratory syncytial virus in the United States](#)". *JAMA* **289** (2): 179–86.
2. Beran, J., Havlik, J., Vonka, V.: Vaccination: History, Presence, Future. Galen, 2005 (in Czech).
3. Wallenfels, J.: Vaccination against tuberculosis. *Vakcinologie*, 1, 2007, pp. 28 – 45 (in Czech).
4. www.ewgli.org. The European Working Group for Legionella Infections (EWGLI) web page.
5. www.eurosurveillance.org
6. www.ecdc.europe.eu
7. www.eurotb.org. Surveillance of tuberculosis in Europe web page.