DOI: https://doi.org/10.12700/btsz.2025.7.3.209

PANDEMICS FROM AN OCCUPATIONAL SAFETY PERSPECTIVE – REVIEW HISTORY OF WORLD EPIDEMICS FROM THE POINT OF VIEW OF OCCUPATIONAL

VILÁGJÁRVÁNYOK MUNKAVÉDELMI SZEMPONTBÓL – ÁTTEKINTÉS VILÁGJÁRVÁNYOK TÖRTÉNELME MUNKAVÉDELEM SZEMSZÖGÉBŐL

SIMON Mátyás[1]

Abstract

Analyzing the history of pandemics and the procedures used to create safe working conditions and mapping the connection points. Throughout human history, the study of epidemics shows that defenses against epidemics have constantly changed and evolved. Many pandemics have put humanity and healthcare to the test, where in addition to the use of personal protective equipment, collective defenses were also of prime importance in order to reduce biological risks. Epidemics also pose serious challenges to today's advanced health care worldwide, where occupational health and safety has played a prominent role. The regulations defined in the laws, standards, and documents related to health and safety at work help to a great extent to create appropriate and safe working conditions and to choose appropriate and effective personal protective equipment.

Keywords

epidemic, biological risk, hospital safety, personal protective equipment, collective protection, vaccination

Absztrakt

A világjárványok történelmének és a biztonságos munkavégzés feltételeinek megteremtéséhez alkalmazott eljárás rendek elemzése és a kapcsolódási pontok feltérképezése. Az emberi történelem során a járványok tanulmányozása azt mutatja, hogy a járványok elleni védekezése folyamatosan változott és fejlődött. Számos világjárvány próbára tette az emberiséget és az egészségügyet, ahol az egyéni védőeszközök használatán felül a kollektív védelmek is kiemelt fontossággal bírtak a biológiai kockázatok csökkentése érdekében. A járványok a mai fejlett egészségügyet is komoly kihívások elé állítja világszerte, ahol kiemelt szerepet kapott a munkavédelem. Az egészséges és biztonságos munkavégzésre vonatkozó jogszabályokban, szabványokban, munka-védelemmel kapcsolatos dokumentumok-ban meghatározott előírások nagymérték-ben segítik a megfelelő és biztonságos munkakörülmények kialakítását, a megfelelő, hatékony egyéni védőeszközök kiválasztását.

Kulcsszavak

járvány, biológiai kockázat, kórházbiztonság, egyéni védőeszköz, kollektív védelem, védőoltás

[1] matyas.simon86@gmail.com | 0000-0002-2714-857X | PhD Student/doktorandusz | Óbudai Egyetem Biztonságtudományi Doktori Iskola

INTRODUCTION

The study of epidemics throughout human history shows that epidemics started in specific geographical areas and spread relatively quickly because the optimal conditions for spread were in place. The optimal conditions for transmission are the source of infection, the vector organism and the susceptible organism.

The emergence and spread of epidemics can be linked to the development of trade, geographical discoveries, the outbreak of wars, poverty and famine. The rapid spread and high infectiousness of pandemics was fuelled by overpopulation, poor sanitation, poor medicine and a lack of knowledge about pathogens and transmission.

In the 15th century, for example, geographical exploration brought measles, smallpox, influenza and plague to the New World, but the indigenous peoples' immune systems were immune to these infections. It is believed that the infectious diseases introduced by the conquistadors caused more casualties than the wars of conquest. discoveries brought to Europe by the return of the conquistadors include syphilis and typhoid fever.

HISTORICAL OVERVIEW OF PANDEMICS

Among the epidemics that have affected mankind, I would highlight the following, which have had a major impact on the development of medicine and the treatment of diseases, and thus on the development of occupational safety and personal protective equipment in the health sector.

The first description of the epidemic is attributed to Thucydides, who witnessed the great Athenian plague. Based on his descriptions, it was for a long time unclear to medical science what kind of infection ravaged Athens in 430 BC, because the symptoms described suggested a variety of diseases. However, a paleomicrobiological study carried out in 1995 clearly identified the causative agent of typhoid fever. Rash typhus - typhus exanthematicus - is primarily caused by the cellular parasitic bacterium Rickettsia prowazekii, which lives in the clothes mite (less commonly in the head mite). The louse sheds the pathogen in its faeces, which enters the skin through micro-wounds caused by scratching when bitten by another individual. The louse is only a vector in the infection cycle, while the host pathogen (reservoir function) is the infected individual. It typically shows winter seasonality, because in cold weather, people living in poor sanitary conditions clean less frequently, change and wash clothes less often, and live in more crowded conditions, crowded together in small spaces. Symptoms start 1-2 weeks after infection, followed by high fever, chills, headache, muscle aches. A few days later, small rashes appear on the trunk and body folds, which later spread to the limbs. Some skin lesions may bleed (petechiae) or purpurae may develop as a result of already confluent petechiae. The acute phase lasts about 2 weeks without complications. A long-term consequence of untreated or inadequately treated typhoid fever is that the infection can reactivate, which is known as Brill-Zinsser disease. Rash typhoid fever is a typical epidemic of the army and wars, sometimes referred to as "prison fever". In the 16th century, it was called the dishonourable "morbus hungaricus" or "lues pannonicus" (Hungarian disease) because it was spread throughout Europe by mercenaries who flocked to liberate Buda and then dispersed after the siege. The disease is not to be confused with Hash typhus, which is caused by Salmonella typhi. [2] [3]

The second most deadly of all the epidemics that have ever struck humanity was perhaps the plague. The Black Death has caused several epidemics and pandemics in Europe, with some estimates suggesting that nearly 200 million people have fallen victim to the plague to date. The first pandemic appeared in the mid-14th century, with bubonic plague and pneumonic plague described as spreading in parallel, taking victims in Europe, North Africa, the Middle East and Central Asia. The causative agent of plague is the bacterium Yersina pestis, which is transmitted mainly by the bite of fleas that feed on rodents. The bacterium causes a lesion in the flea's intestinal tract, causing the insect to vomit the blood it has sucked out into a wound, along with the pathogen, thus infecting the host. The bacterium can cause three types of disease. Symptoms include fever, nosebleeds, headaches, limb pain, confusion, and the appearance of painful lumps. Lymph nodes swell, black patches appear on the skin, especially on the fingertips and nose, and then turn bluish-black and fade due to haemorrhages. Septicaemic plague develops when the bacterium enters the bloodstream. Symptoms include high fever, chills, headache, malaise, haemorrhages in the skin and internal organs. Fatal within 36 hours without treatment. Pneumonic plague is spread from person to person by droplet infection - sneezing, coughing. It is faster and more severe than bubonic plague because the bacteria enter the lungs directly, bypassing the lymph nodes. Incubation period is 1-3 days with a 95% mortality rate.

The spread of the plague in the Middle Ages was facilitated by economic and demographic changes: food shortages and famine, population migration, urban migration, the arrival of overland caravans and merchants on the sea routes. There were various ways of stopping the spread of the plague: cutting the veins, opening the buboes, smoking aromatic plants, but the most effective was the quarantine and the establishment of quarantine hospitals (Lazzaretto Vecchio). Plague doctors were used to treat the sick and register the dead in the affected municipalities. Figure 1 shows the spread of the bubonic plague in 1347-51.

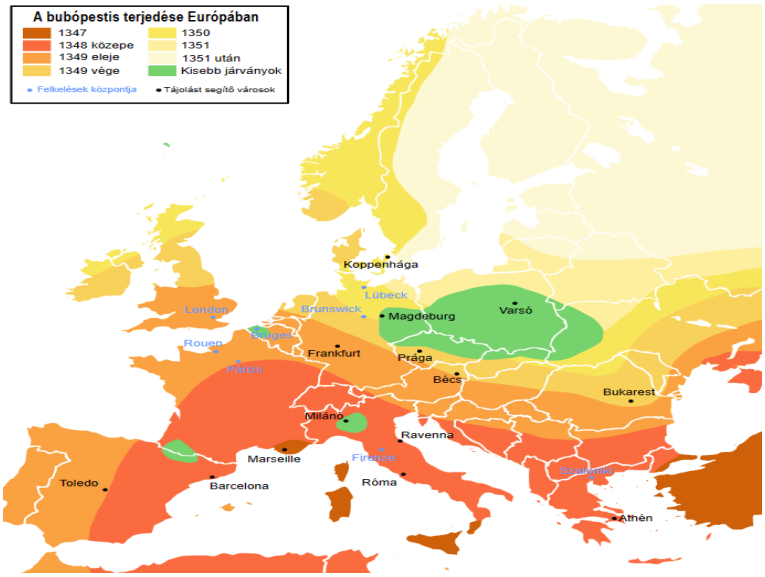

Figure 1. The spread of the 1347-51 plague in Europe [10]

The first biological warfare was linked to the plague: in 1346, Mongol troops used catapults to transport carcasses infected with the plague bacterium to the city of Kaffa (now Feodosia), which allowed them to easily occupy the plague-stricken town.

Endemic plague hotspots still occur today, with most cases in East Africa, but outbreaks have also occurred in the United States, New Mexico and Colorado; the most at risk area is the island of Madagascar. [2] [11] [3]

The third is leprosy or Hansen's disease (old Hungarian name: bélpoklosság), a chronic, infectious disease caused by Mycobacterium leprae. The incubation period varies, from a few months to up to 40 years. Several clinical forms are known:

"good-tempered", slow-moving leprosy, which mainly attacks the skin and surrounding nerves, and

the rapid-onset variant, which is highly contagious, forms nodules (leprosy) on the skin, attacks both the nervous system and the viscera. Severe nerve damage results in loss of pain sensation, often leading to loss of limbs and fingers. It is also characterised by dysfunction of the facial muscles, eyebrows falling out, destruction of the nasal cartilage (lion's face).

The origin of the disease is uncertain, with written references to it dating back to ancient Egypt, but in Europe it became a devastating epidemic during the Crusades, especially in the Middle Ages. As the disease proved to be incurable, it was used to prevent the spread of infection.

In the beginning, leprosy patients were expelled from the settlements, they had to walk around with a colomb or a sceptre in their hands, wear a dark hooded coat, gloves and a hat to be recognised and from the 12th to 13th centuries leprosy asylums - leprosariums - were established where the patients were cared for by monks.

Mass outbreaks began to disappear from the 16th century onwards, thanks to the successful isolation of infected people, the population's resistance to bacteria and improved hygiene. The disease is still present today - see Figure 1.4 for an example of new cases worldwide in 2021 - although a combination of antibiotic drugs - the first effective drug only produced in 1946 - can achieve a complete cure. Treatment is expensive and lengthy, which is why leprosy hospitals are still in operation in many countries, mainly in Africa and South America. [2] [12]

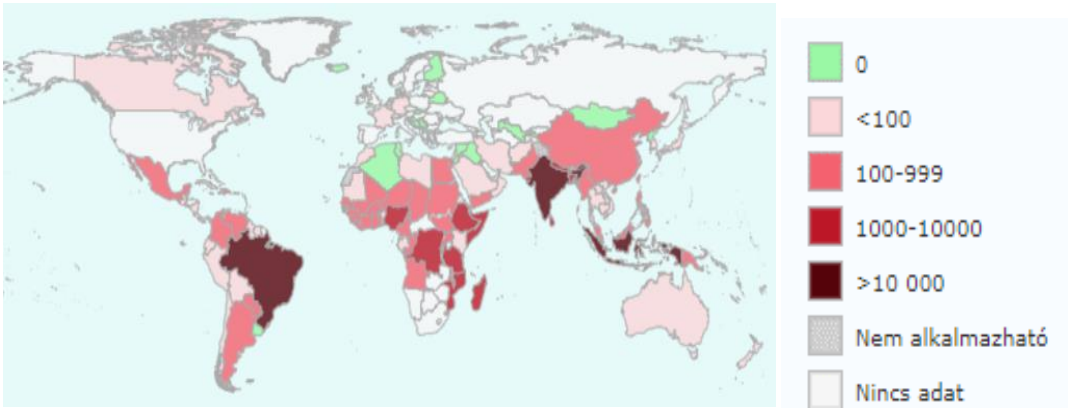

Figure 2 New leprosy cases in 2021 [13]

It is important to mention cholera, which appeared in Europe in the 1830s, until then an endemic disease mainly in subtropical India.

The disease is caused by the bacterium Vibrio cholerae. It is mainly transmitted enterally through faeces, vomit and sewage and raw food in contact with them. It usually originates in warm coastal estuaries rich in organic matter and spreads from there.

Two types are distinguished: European cholera (cholera nostras) and Asian cholera (cholera asiatica). Unlike Asian cholera, European cholera is not seen all year round, but only in the second half of summer.

The pathogen can survive for days in aqueous media, preferring alkaline media. It cannot withstand drying and even weak acid (0.1 parts per thousand hydrochloric acid) will kill it. Its mechanism of action is to alter the ionic flux in the cells of the intestinal wall, thus inhibiting the ability of the intestinal wall to absorb water. The course of the disease usually depends on the degree of weight loss suffered by the patient, which can be as much as 8-12% of the infected individual's own body weight lost within a few hours. If the body's mobilisable water reserves are depleted, vomiting and diarrhoea will temporarily cease, but with repeated intake of water these symptoms will reappear. The limbs become characteristically greyish and shrivelled, and the characteristic vox cholerica symptom develops. Death is ultimately due to the salt and water malabsorption associated with dehydration, followed by kidney failure, confusion, fever and other symptoms. Antibiotic treatment and vaccination are not fully effective, and prevention of the disease, proper hygiene and education of the population at risk are necessary.

In 1831, cholera appeared in our country, which was known in medical and popular language as contagious biliary dysentery or biliary ejaculation. According to the available data, major epidemics broke out in 1831-32 and 1872-73, during which nearly 1 000 000 people fell ill and more than 400 000 died. [2] [11]

Cholera is still present today - Figure 1.5 shows the number of cases reported in 2016 - although the last cases occurred in our country in 1916, Peru between 1991-98, Haiti in 2010 and Yemen in 2017.

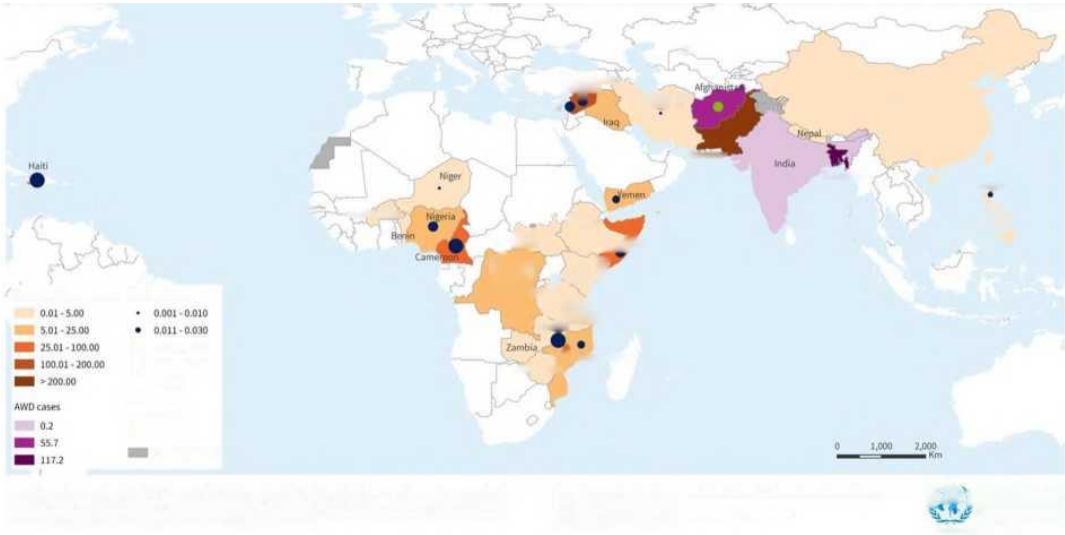

Figure 3 Case numbers of cholera cases reported in 2016 [14]

Smallpox was one of the most deadly infectious diseases known until 1977. With the development and use of an appropriate vaccine, 1979 was the first year in which no smallpox cases were recorded.

The most deadly smallpox disease is caused by Poxvirus variolae, which is transmitted from human to human by contact and has no animal vector. The virus enters the lymph nodes via the mucous membranes of the respiratory tract, where it multiplies and damages the small blood vessels of the skin, causing red rashes and spots to form all over the body, which later develop into blisters with purulent, burning pain. The blisters bleed and turn black, hence the name.

Smallpox epidemics in Europe peaked in the 18th century, with some estimates putting the death toll at 60 million. Those who survived often suffered permanent damage, as the infection attacked the nervous system, causing paralysis, convulsions, osteomyelitis, ophthalmia and blindness. The rashes only dried up weeks later, leaving lifelong smallpox scars. [2] [5]

The ancient Chinese realised that those who had been infected with smallpox had acquired immunity to possible re-infection later. This observation is the basis of variolation, a procedure derived from the Latin name for smallpox, in which a sample of the patient's rash was taken and passed through the nasal mucosa or a pointed instrument through the skin into another person's body.

In the late 1700s, vaccination, a newer form of protection against smallpox, appeared. Like variolation, the method was based on observation: in England it was recognised that dairymaids and cows who had contracted cowpox (variola vaccina), a much milder form of cowpox than smallpox, which appeared on the skin and udder of cattle, became immune to smallpox after the disease. In this spirit, the next step in artificial immunisation was vaccination against cowpox. [15]

In the early days, smallpox secretions were passed from "arm to arm", using "smallpox couriers", which meant that the secretions from the body of one vaccinated person were passed on to another. Its effectiveness is debatable, because 'smallpox couriers' often recovered before they could pass on the 'vaccine'. A more effective method has been found to be the placing and transporting of dried smallpox pellets in a bottle and vaccinating with it.

Smallpox is the only infectious disease eradicated worldwide. Today, it is only found at the CDC - Center for Disease Control and Prevention - in Atlanta and the Vektor Virology and Biotechnology Institute in Koltsovo. In our country, vaccination against smallpox was carried out between 1876 and 1980. [2]

In 1918, the world's most devastating epidemic to date was the Spanish flu, caused by the H1N1 influenza A virus, which was neither Spanish nor a flu. Its name is linked to World War I, as the countries at war learned of the epidemic from the press in neutral Spain, hence its name. Its point of origin was Kansas, and the virus arrived in the spring with American troops in southern Europe and spread from there. Initially the pandemic was mild, characterised by weakness, lethargy and fever lasting 3-4 days. The epidemic peaked in October and November 1918, and from December onwards the number of victims declined, with an estimated 3-5% of the world's total population killed, more than in World War I. The Spanish flu was characterised by three waves in one year, was severe and rapid, with high fever and head and limb pain. Most patients got better after a few days, but in some it

rapidly progressed to haemorrhagic pneumonia, often leading to death in just a few hours. Viral pneumonia particularly affected 20-40 year olds, which was explained by the victims' immune systems overreacting to the infection and destroying lung tissue. Deaths in older people and those in risk groups - people with chronic diseases, metabolic disorders, etc. - were more likely to be caused by secondary bacterial pneumonia.

The third wave was not uniform, it was more of a post-epidemic and was much milder than the second wave, with the exception of China. [2] [3] [5]

Of all the pandemics, influenza viruses are the ones that cause the highest number of cases of illness worldwide each year. The reason is that the antigen of the virus is highly variable, with new variants emerging periodically, against which the human body cannot defend itself. It typically evolves very rapidly, and can make someone ill in a matter of hours. It is an infectious respiratory disease with common symptoms (e.g. lethargy, fever, muscle aches), can have serious complications (e.g. lung, myocarditis, meningitis) and can be fatal. It is estimated that around 50 million people died from influenza or complications of influenza in the 20th century.

The flu virus has 3 major groups A, B, C and D:

Pandemics are caused by virus A because the surface antigens of the virus are in a constant state of flux. The change is usually slow and partial (drift), but can also be rapid and complete (shift). The previously acquired immunity of the population is ineffective against the new pathogen with the changed antigenic structure. The A virus occurs in two major variants in nature in human and avian strains.

Type B flu is rarer, mainly affecting humans (seals and ferrets have been shown to be susceptible), and mutates more slowly than type A, making those who have had it immune for a time, thus not causing a pandemic.

"Type C: most commonly spread in children (dogs and pigs are also susceptible to C virus infection), usually causes mild illness, but rarely more severe illness and local outbreaks can occur.

"Type D: spread among pigs and cattle, not yet detected in humans.

Influenza is easily spread from person to person, mainly through direct contact with infectious patient secretions, such as liquid droplets released into the air when coughing or exhaling. It is also spread by secretions on hands, handkerchiefs and surfaces touched by patients. [2] [6]

The seasonal presence of influenza is illustrated in Figure 4, which shows the continuous presence of the virus in temperate and cold climates, typically in winter, and in the tropics almost all year round.

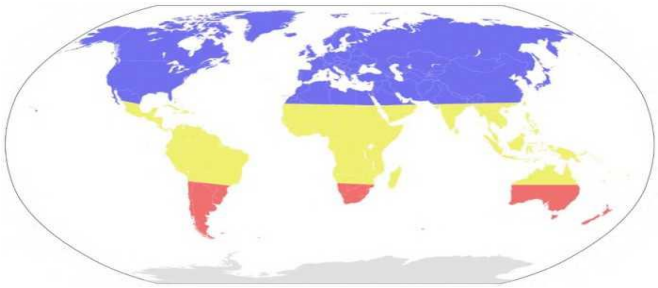

Figure 4 Influenza season: November-April (in blue), April-November (in red), and rainy season (in yellow) [16]

Coronaviruses are RNA zoonoses with a lipid envelope. There are (currently) 7 known species of human coronaviruses:

4 species are almost constantly present in the human environment and therefore immune to them, usually causing a mild disease with mild symptoms and a moderate to mild course. The disease, which has symptoms similar to colds and respiratory illnesses, mainly affects the elderly and children, especially in winter.

However, 3 species - SARS (Severe Acute Respiratory Syndrome) CoV; MERS (Middle East Respiratory Syndrome) CoV, and SARS-CoV-2 (Coronavirus Disease-19) - can cause serious and even life-threatening illness, such as SARS, which caused a pandemic in 2003, and MERS-CoV, which emerged in the Middle East in 2012.

The Covid-19 virus can spread intensively in both dry, cold and tropical, high humidity environments, typically through droplet infection, direct or indirect contact with infected secretions. The virus can survive for a few hours on some surfaces (copper, cardboard) and up to several days on others (plastic and stainless steel). However, the amount of viable virus decreases over time and is rarely present on surfaces in sufficient quantities to cause infection. Infection can occur if someone touches their nose, mouth or eyes with their hands and their hands have been contaminated with virus- contaminated fluid or surfaces. The incubation period is usually 5-6 days, but it can be detected in respiratory samples after 1-2 days, and is infectious 48 hours after the onset of symptoms. Patients with mild to moderate COVID-19 remain infectious for up to 10 days after the onset of symptoms, while severe or critical patients may remain infectious for up to 20 days after the onset of symptoms. [17]

The clinical picture can be most often mild to moderate, with symptoms ranging from mild respiratory tract infection to non-severe pneumonia, or severe to critical - 5% incidence - in cases such as respiratory failure, septic shock.

The disease may also be associated with mental and neurological symptoms (e.g. loss/temporary loss of sense of taste, smell, confusion, depression, sleep disturbance) and complications (e.g. acute pulmonary embolism, stroke, delirium).

Their resistance is low, dying within minutes at 50 ºC and within a few days in the outside world, but they can remain infective for 1-2 weeks in cold, winter weather. They are inactivated within minutes by common disinfectants. Both alcohol and hypochlorite-based agents are effective against them. [2] [17] [7]

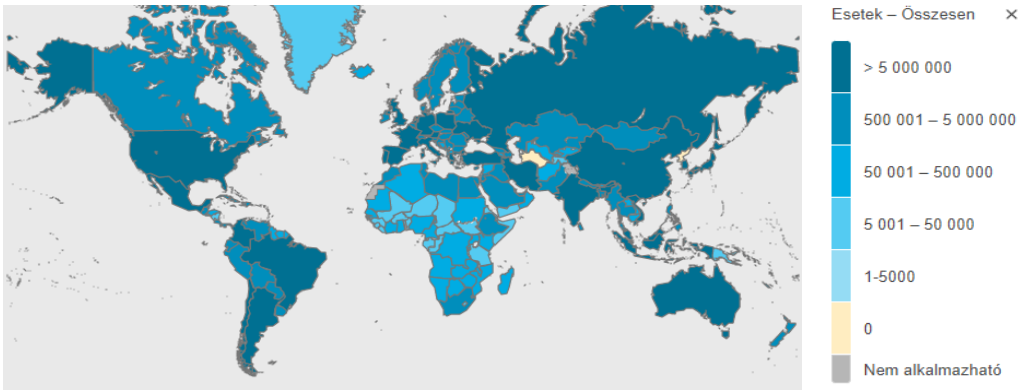

Figure 5 Registered Covid-19 case numbers [18]

Although their pathogenic factors are different, parallels can be drawn based on their emergence, spread and epidemiological factors and their prevention and treatment. The epidemics described above are summarised in Figure 6.

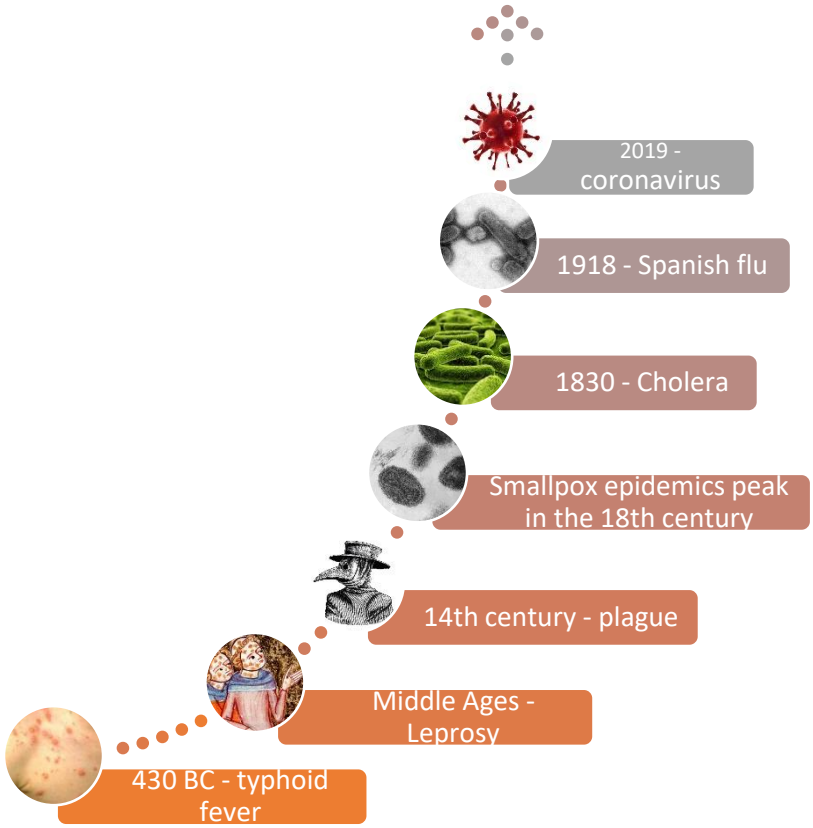

Figure 6 Time scale of epidemics (author's own editing)

PREVENTION OPTIONS PAST AND PRESENT

In antiquity, and later in the Middle Ages, the appearance of infectious diseases was seen as a punishment from the gods for having committed some kind of blasphemy. Prevention was therefore not common at the time. The Greek historian Thucydides (460 BC - 395 BC) made many valuable observations during the Peloponnesian War, which were later useful for medical science. He noted, for example, that crowding plays a role in the spread of disease, that personal contact and encounters cause further infections, and that infected people acquire a certain immunity to disease. However, it was only centuries later that these findings became facts about the incidence and spread of infectious and communicable diseases.

One of the earliest preventive measures was to keep people away from the sick, often in the form of exile or expulsion from settlements. Written records of the isolation of the sick date to the plague epidemic of 549 BC, when the Emperor Justinian ordered the isolation of people from infected areas. The spread of infectious diseases from person to person was recognised as early as the time of Hippocrates. Hippocrates (460 BC - 377 BC), the famous physician of his time, believed that many diseases were caused by polluted and toxic air, and fire was developed to purify the air in line with the thinking of the time. Fragrant grasses such as cypress, juniper and spruce were often burned as firewood. Another effective method was to rub them with essential oils.

According to the medical theory of the time, diseases were caused by changes in the ratio of body fluids - blood, bile and mucus - and were treated by cutting the blood vessels or by spitting [2] [3]

The primary task of prevention today is to prevent an epidemic from developing, which is only successful if one of the primary drivers is eliminated, which it can be:

- identification of an infectious agent
- stopping the spread of
- general prevention procedures:
    - personal hygiene - hand washing, cleaning
    - environmental hygiene - disinfection, rodent control
    - health education
- specific protection - medicines, vaccines

Faragó's study and research found that employers have made significant efforts to protect the health of their employees and prevent the spread of the coronavirus epidemic, which required a significant amount of fundamental change from the way companies operated before the epidemic. [1] As Simon puts it in his study: 'the new procedures, instructions and professional documentation that were created as part of the pandemic response confirmed that the risks to workers in the health sector are complex and that the occupational safety, occupational health and occupational hygiene disciplines need to work together and rely on each other to identify risks effectively and determine the necessary employer actions'. [4]

Quarantine

The method of controlling imported epidemics by not only isolating but also monitoring suspected infected persons during the incubation period (quarantine) began during the great plague epidemic of the Middle Ages. It was recognised that it was not only contact with sick persons that posed a threat, but also the clothes and personal belongings of the sick person. During the epidemics of the 14th century, the authorities of the Italian cities ordered the isolation of the cities and areas affected by the epidemics for public health reasons, the control and observation of travellers before they could enter the city; sanitary decrees were issued, doctors were employed and the cleanliness of the cities was regulated. From the 1350s onwards, quarantines began to be established in coastal towns in places far from settlements, in many cases on separate islands or enclosed by moats with drawbridges. When the quarantine appeared, crews of ships arriving in port had to stay on a remote island or small settlement for 30 days before being allowed to enter the city. In 1464, the Venetian Senate decreed that two men of noble birth from each sestieri (town hall) should be selected,

who, on regular income, should transport suspected plague sufferers to the island of Lazzaretto and arrange for the evacuation of the infected person's house. This decree also defined the duties of the epidemiologists: to examine and isolate suspected patients, to search for persons in contact with the infected person (nowadays called contact tracing) and, naturally, to treat them. The island of Lazzaretto was divided into two parts: one part was the quarantine itself and the other part was the "convalescent" area, where citizens released from quarantine had to stay for another 40 days.

The first quarantine decree was made in 1377 in Ragusa (now Dubrovnik), during the plague epidemic, when places declared quarantine were closed to residents for 30 (later 40) days and local residents were not allowed to approach, with only the town physician-in-chief having the right of access to observe the quarantined. The very word quarantine - guarded isolation - refers to this, deriving from the Italian 40 days: 'quaranti giorno'. The buildings were surrounded by high walls and a beach, and guards were often posted to prevent escape attempts by those inside. In the quarantines, medicinal herbs were often smoked, used to make decoctions and to boil the patients' clothes. The curative effect of herbal decoctions is questionable, but 'disinfecting' clothes and fumigation, e.g. against lice, may have been one of the most effective methods.

Written material on quarantine measures in Hungary only survives from the 18th century. A sanitary decree issued by Maria Theresa in 1770 regulates in detail the duration of the quarantine, the order of the guard duty and the location of the "quarantine stations". In the neighbouring countries, 'plague spies' were often sent to watch for the spread of the epidemic, and in the event of an increased risk of epidemic, plague doctors and plague officers were appointed to inspect and supervise the quarantine stations (quarantine house, contumacy house, quarantine).

In London in the late 18th century, a signal was introduced on ships entering port if there was a sick person on board: a yellow rectangular flag with the letter "Q" had to be placed on the mast. During yellow fever, suspicious ships arriving in Philadelphia were fumigated or even burned, which proved effective against the mosquitoes that caused the epidemic.

Quarantine measures can seriously infringe on the freedom of some citizens, so from 1851 onwards, International Public Health Conferences were held to standardise the rules on quarantine - especially to prevent the spread of cholera, plague and yellow fever; to define the principles of control of epidemic diseases; to standardise the operation of quarantines and to establish international cooperation. These conferences were the forerunners of the World Health Organization (WHO), which was established in 1946.

In the second half of the 20th century, the sheer volume of international travel, the huge traffic at airports and ports, the fact that an epidemic from anywhere in the world could appear anywhere in the world in a matter of hours, called into question the use and effectiveness of quarantines.

During the 2019 pandemic COVID-19, the concept of quarantine and "home quarantine", which could be in our country, came to the fore again:

- Epidemiological surveillance: observation of an individual suspected of being infected (e.g. in their home). No contact is allowed.

- Epidemic lockdown: a special form of epidemiological surveillance where patients or suspected infected persons are isolated in a special room or ward and can only enter with appropriate protective equipment. It can be partial or total isolation.
- Epidemiological surveillance: surveillance of an infectious person for the duration of a vector clearance. During this period, the person may be prohibited from certain activities, such as work or school visits, and may be required to undergo laboratory testing. [2]

Personal protective equipment

Nowadays, personal protective equipment is defined as any device worn by the worker to reduce the risks arising from the work or technology to a level that does not endanger health.21 The "first personal protective equipment" was the face mask, which was first worn during the plague epidemic of the 1350s,

although the face mask with a long nose ("beak") did not really serve a protective function. According to the 'miasma' theory of the time, the disease was attributed to bad, noxious air, against which the elongated nose, worn by doctors and sanitary workers in the presence of the patient, was the appropriate 'protection'. The beak often contained scented plants (e.g. myrrh, thyme, cloves), which were an adequate protection against 'bad smells'.

Figure 7 Face mask used during a plague outbreak [19]

Medical history dates the first appearance and wearing of medical protective clothing to the 16th century. Charles de Lorm, a French doctor, was the first to wear a long goatskin coat, knee breeches, a hat, gloves, boots and a red stick, in addition to a 'beak' mask, to draw attention to the risk of infection. The first surgical gloves, operating caps, gowns and gowns made of sterile materials were first worn in 1896 by Jan Mikulicz-Radecki, a Polish-Austrian doctor. The rubber glove was invented in 1902 by American surgeon William Halstead. The use of masks began to spread in operating theatres in 1905, but their importance and effectiveness was proven during the Spanish flu epidemic of 1918-1919.

Figure 8 Personal protective equipment used during the Spanish Flu [20]

The personal protective equipment of the present day is not even comparable to the above mentioned equipment, as protective equipment has undergone a huge evolution and the requirements, testing and marking are laid down in harmonised standards.

Figure 9 Personal protective equipment used in modern times during a coronavirus epidemic [21]

Vaccinations

Artificially-acquired immunity is achieved by vaccination, which involves the introduction of killed or weakened pathogens into the body, triggering the same immunological process as natural infection, but without symptoms or complications.

The first written documentation of the "vaccination" comes from a book on medicine by Li Shizhen, a Beijing physician. This cannot yet be considered an actual vaccination, because at that time inoculation was used in two different images:

- using a piece of cotton to take a sample of nasal secretions from a patient who had already had smallpox, drying and grinding them, or
- the dried stitches on top of the smallpox were ground into a powder and blown into the nostril of the person to be vaccinated.

The procedure following inoculation is scarification, whereby the surface of the skin is broken and the smallpox powder is rubbed into the resulting open wound.

The history of vaccination actually began with the introduction of the smallpox vaccine, which initially caused much controversy. The breakthrough came when Edward Jenner, MD, took a sample from a child who had been cured of smallpox.

The first vaccine to be produced in a laboratory setting was developed by Pasteur in 1897, when he discovered that hens treated with a weakened vaccine did not become ill after an experiment with the poultry cholera pathogen. He then began experiments with the rabies virus - Rabies lyssavirus - and paved the way for the development and production of vaccines. The real preventive vaccine was Pasteur's colleague Gaston Ramón, who in 1923 added formaldehyde to diphtheria toxin, causing it to lose its toxicity. When inoculated into the body, it stimulated the production of antibodies but did not cause serious illness.

In the domestic context, we should mention Endre Hőgyes (1847-1906), a doctor whose merit is the perfection of the vaccination method. Instead of Pasteur's 'dehydration' method, which was used to weaken the virus, he used the 'dilution' method still used today.

In 1905, the paediatricians Clemens Pirquet (1874-1929) and Béla Schick (1877-1967) discovered a symptom called "serum sickness" (allergy), which followed the administration of a vaccine. Pirquet observed that a person who had received the horse serum vaccine a second time would become violently itchy, flushed and have difficulty breathing. In the course of their research, they discovered the role of proteins in triggering allergy and antibody production. [2]

The most effective way to prevent epidemics is immunisation, which can be:

- active: they release killed or killed pathogens into the body, stimulating the body's defences in a process that mimics natural infection. The vaccine, which can be:
  - live, weakened - e.g. measles,
  - inactivated - e.g. influenza,
  - subunit (purified surface antigen) and split (cleaved),
  - containing a weakened toxin,
  - conjugated,
- passive: where immunisation is achieved by the introduction of specific antibodies against a particular pathogen.
- There are different types of vaccinations:
  - age-related, compulsory
  - mandatory in case of disease risk - e.g. rabies
  - recommended to avert the risk of disease - e.g. hepatitis
  - job-related - e.g. for healthcare workers: hepatitis B
  - travel-related - e.g. malaria
  - other - e.g. HPV

In the 18th century, the effectiveness of vaccines was questioned and people distrusted them because of their poor purity and contamination with other pathogens. These factors have now been eliminated by modern medicine, but vaccines administered can still have risks and contraindications:

- dangers:
  - vaccine reactions: local and general symptoms - e.g. itching, fever, scarring
  - complications
  - extinguishing accident:
- the vaccine does not contain a sufficiently attenuated pathogen,

- vaccination administered incorrectly,
- administration of other vaccines
- contra-indications, which are not recommended for vaccination:
  - febrile illness,
  - an immunodeficiency condition,
  - pregnancy,
  - previous vaccine-related complications - e.g. anaphylaxis [8]

Disinfection and sterilisation

The use of high temperatures - "sterilisation" - in medicine was already seen in ancient Rome, but in the Middle Ages it was less common. The pioneer of antiseptic surgery was the English surgeon Joseph Lister (1827-1912), who observed that patients who underwent surgery often developed infections and had a high mortality rate. Pasteur's studies led him to conclude that bacteria had to be destroyed before they could enter the surgical wound. To disinfect hands and surgical instruments, he used carbolic acid - nowadays phenol. In a domestic context, we should mention the name of Ignác Semmelweis (1818¬1865), who made it compulsory to wash hands with chlorme lime solution in the obstetrics department of the Szent Rókus Hospital, after he realised that puerperal fever was caused by doctors and medical students, because they examined women in labour with the same hands as the dead without disinfection.

Nowadays, disinfection includes all procedures and methods aimed at destroying pathogens that have escaped from the infectious source into the external environment, or at eliminating (inactivating) their infectiousness.

The disinfectant effect is defined as those chemical, physical, physico-chemical factors which, in direct contact with micro-organisms, at an appropriate intensity and activity, cause their destruction or inactivation during a defined period (exposure time or exposure period). In terms of the magnitude of the effect, it can be:

- physical process - use of thermal and radiant energy
- chemical process - compounds with antimicrobial properties
- combined process - a combination of physical and chemical effects

The procedures are shown in the figure below.

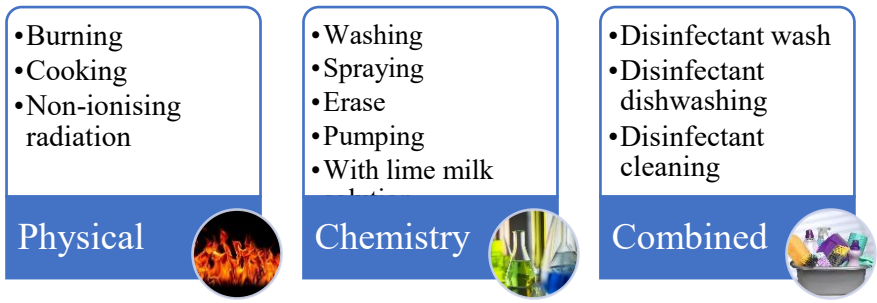

Figure 10 Types of disinfection procedures (edited by the author)

Sterilisation is an antimicrobial process that uses physical, chemical or a combination of these to irreversibly inactivate microorganisms and all their dormant forms on the material or substance to be sterilised. Sterilisation can be carried out in many ways: heat, filtration, radiation, chemical agents. The choice of method must be made according to the requirements, taking into account the quality of the materials and equipment used and the effect of the sterilisation process on them. The decisive criteria are to preserve the quality and function of the materials to be sterilised and to ensure sterility. [9] [22]

Sterilisation procedures to be used:

- autoclave
- heat sterilizer
- gas sterilizer with ethylene oxide, formaldehyde
- plasma sterilizer
- in a solution of antimicrobial substances
- filtering

SUMMARY

In today's advanced, fast-changing world, an infection can cause a pandemic much sooner than in the pre-20th century, one reason being unrestricted travel and free access to countries. The most common pandemic today is caused by viruses of the influenza family.

Epidemics pose serious challenges to today's advanced healthcare systems worldwide, and governments and hospitals must act with similar speed to stop infection and care for seriously ill patients. Fighting the virus is made more difficult by the fact that health workers are frequently infected.

Alongside health, occupational safety and health has been given a prominent role. The requirements laid down in legislation, standards and documents relating to occupational safety and health - risk assessments, the provision of personal protective equipment and the organisation of occupational health examinations - greatly help to ensure that the right working conditions are created and that the right, effective personal protective equipment is selected. Personal protective equipment has evolved enormously over the centuries.

In addition to the use of personal protective equipment, collective protection is also a priority in the health sector and to reduce biological risks. Examples of this are the sterilisation and disinfection procedures described, and the use of vaccines against the various viruses that cause epidemics. Thanks to today's modern medicine and the development of research laboratories, attempts to develop vaccines against viruses can be started quickly and vaccination can be carried out as soon as possible after the virus emerges.

LITERATURE USED

[1] Faragó F. (2021): COVID-19 and occupational safety: a quantitative survey of the coronavirus control practices of Hungarian companies, SAFETY STUDIES 3 : 4 pp. 113-131. , 19 p.
[2] Felkai P. (2022) The History of Epidemics Budapest.
[3] Czefener D., Fedeles T. (2021): Pécs-Budapest: birding guide - PTKE-Kronosz Kiadó.

[4] Simon, M. (2022) Occupational safety of COVID-19: Occupational safety measures and consequences of the coronavirus pandemic in the health care sector.
[5] Szakály S., Kincses K. M. (2021): From leprosy to the Spanish flu, Scientia et Securitas - Scientific Bulletin, Vol. 2, No. 3, 332-341.
[6] Katalin Meglécz (2012):The history of pandemics and the reasons for their emergence - journal article in Military Engineer Vol.VII No.1: 91-98.
[7] Miklós Kásler (2020):Manual for the prevention and therapy of infections caused by the new coronavirus (SARS-CoV-2) (COVID-19) identified in 2020 - Ministry of Human Resources, Budapest.
[8] Venyingi B., Vitályos Á. G. (2018). Epidemiology for BA students in Infant and Young Child Education – Eötvös Publishing, Budapest
[9] Z. Pechó, M. Milassin (2000):Information on disinfection (Details from the third, revised, expanded edition) - "Johan Béla" National Centre for Epidemiology, Budapest, Hungary
[10] Roger Zenner, Ogodej, https:// commons.wikimedia.org/wiki/File:Pestilence_ spreading_1347- 1351_europe.png, downloaded 23.03.2025.
[11] Epidemics of Everyday Life - Diseases of Historical Times https://ri.abtk.hu/images/letoltes _publ/mende.balazs/jarvanytan.pdf, downloaded 23.03.2025.
[12] THE TRUST, https://semmelweismuseum.blog.hu/2020/04/29/a_belpoklossag, retrieved 23.03.2025.
[13] LEPRA, https://apps.who.int/neglected_diseases/ntddata/leprosy/leprosy.html, downloaded 23.03.2025.
[14] LEPRA,https://cdn.who.int/media/images/default-source/emergencies/disease-outbreak-news/ map_global_cholera_don.jpg?sfvrsn=424d2ed9_5, retrieved 23.03.2025.
[15] THE BLACK SKY'S FIRST ISSUE, https://semmelweismuseum.blog.hu/2020/04/29 /a_belpoklossag, downloaded 23.03.2025.
[16] INFLUENZA, https://commons.wikimedia.org/wiki/File:Influenza_Seasonal_Risk_Areas.svg, retrieved 23.03.2025.
[17] ECDC - European Centre for Disease Prevention and Control, https://www.ecdc.europa.eu/en/covid-19/questions-answers/questions-answers-basic-facts, downloaded 23.03.2025.
[18] WHO Coronavirus (COVID-19) Dashboard, https://covid19.who.int/, retrieved 23.03.2025.
[19] Plague Doctor in the Early Modern Era, https://mnl.gov.hu/mnl/szszbml/a_pestis, retrieved 23.03.2025.
[20] Study on Spanish Flu Debunks Equal Vulnerability Theory, Highlights Environmental, Social, Nutritional Factors, https://weather.com/en-IN/india/health/news/2023-10-11-new-study- contradicts-that-spanish-flu-impacted-healthy-and-frail, retrieved 23.03.2025.
[21] PHOTOREPORT: COVID-ELLATAS AT AITK-N, https://semmelweis.hu/hirek/2021/03/18/ fotoriport-covid-ellatas-az-aitk-n/downloaded 23.03.2025.

[22] Health education materials for all - Disinfection 2023, http://egeszsegugy.hupont.hu/ Viewed 23.03.2025.