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FACULTY OF BIOLOGY
DEPARTMENT OF PHYSIOLOGY, HUMAN HEALTH AND SAFETY,
AND NATURAL SCIENCES EDUCATION

ACTIONS OF THE POPULATION IN CASE OF THREAT OR OCCURRENCE OF A BIOLOGICAL OUTBREAK AREA

ELECTRONIC GUIDELINES

for practical and individual classes
in disciplines Civil Defence,
Civil Safety and Bases of Disaster Medicine,
and Life Safety and Fundamentals of Occupational Safety and Health
for students of all specialities and forms of study

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Compilers:

Svitlana GVOZDII, Doctor of Pedagogical Sciences, Full Professor, Professor at the Department of Physiology, Human Health and Safety, and Natural Science Education;

Liubov POLISHCHUK, Senior Lecturer at the Department of Physiology, Human Health and Safety, and Natural Science Education;

Vadym PIENOV, Candidate of Pedagogical Sciences, Associate Professor, Associate Professor at the Department of Physiology, Human Health and Safety, and Natural Science Education;

Iryna RYZHKO, Candidate of Biological Sciences, Associate Professor, Associate Professor at the Department of Physiology, Human Health and Safety, and Natural Science Education;

Olha USTIANSKA, Candidate of Biological Sciences, Associate Professor, Associate Professor at the Department of Physiology, Human Health and Safety, and Natural Science Education.

Reviewers:

Viacheslav BEREZUTSKYI, Doctor of Technical Science, Professor, National Technical University "Kharkiv Polytechnic Institute";

Tetiana HUDZENKO, Candidate of Biological Sciences, Associate Professor, Odesa I. I. Mechnikov National University.

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The methodological recommendations cover protection mechanisms and methods of responding to biological threats in Ukraine, Europe, and Asia, as well as a detailed algorithm of actions and services involved in each situation. The methodological recommendations include recommendations on organizing practical and independent work for applicants and test questions for self-assessment of knowledge.

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CONTENT

INTRODUCTION

The development of biosafety systems, the creation of strategic reserves of vaccines and antibiotics, and international cooperation are key factors in countering biological threats. It is important not only to prevent the possible use of biological weapons, but also to have effective response strategies in case of infectious disease outbreaks. That is why considering mechanisms of protection and methods of dealing with biological threats is extremely important for ensuring the security of both individual states and the world as a whole.

In today's world, there is a growing risk of biological emergencies caused by both natural factors and the possible use of biological weapons. Pandemics, outbreaks of highly dangerous infections, and the threat of terrorist acts involving biological agents pose serious challenges to civil protection and public safety systems.

Such cases require an informed population that is aware, prepared, and able to act in accordance with established rules and recommendations. Knowledge of behavioural algorithms, skills in using personal protective equipment, and understanding of the principles of self-organization reduce the risks of spreading infections and protect people's health and lives.

Guidelines on “Actions of the population in the case of a threat or outbreak of biological contamination” are an important tool for increasing citizens' preparedness for such emergencies. They are aimed at systematising knowledge, developing practical skills and forming conscious behaviour in emergency situations, which is the subject of study in the academic disciplines «Civil Defence», «Civil Safety and Bases of Disaster Medicine» and «Life Safety and Fundamentals of Occupational Safety and Health».

Objective:

Provide systematic knowledge and practical recommendations on how the population should act in the event of a threat or outbreak of biological attack; promote preparedness for rapid response and minimization of the negative consequences of biological contamination.

Tasks:

1. Explain the concept and classification of biological outbreak areas.
2. Introduce the main types of biological agents that pose a threat to human health and life.
3. Describe the ways in which infectious disease pathogens spread.
4. Identify the signs and characteristics of biological infection.

5. Provide an algorithm of actions for the population when receiving a report of a biological contamination threat.
6. Consider the rules of personal and public hygiene, prevention of infectious diseases in emergencies.
7. Develop skills in the use of personal protective equipment and the implementation of self- and mutual assistance measures

Resources and equipment

The necessary equipment and resources are required to efficiently conduct training, develop practical skills, and familiarize participants with protective equipment.

Equipment for the educational process

1. Personal protective equipment (PPE)
   Medical masks (surgical)
   Respirators (e.g., FFP2, FFP3)
   Safety glasses or goggles
   Disposable gloves
   Protective suits or gowns (if possible)

2. Training and demonstration materials
   Models or simulators for the correct wearing of PPE
   Demonstration posters, infographics with algorithms of actions
   Area maps or evacuation plans with marked infection zones
   Posters or stands with instructions on hygiene and behaviour

3. Technical equipment
   Projector or large screen for showing presentations and videos
   Computer or laptop with training materials
   Audio system for playing alarm signals (siren, signal recording)
   Camera or smartphone for recording practical exercises (optional)

4. Materials for practical exercises
   Sets of items for an emergency bag (first aid kit, water, documents, etc.)
   Timer or stopwatch for practicing quick actions
   Cards with scenarios and instructions for role-playing games

THEORETICAL PART

Historical background

History knows examples of the use of biological agents in military conflicts and terrorist attacks, which have led to numerous casualties and large-scale epidemics. In addition, the risk of accidental leakage of dangerous pathogens from laboratories is a cause for concern for the international community. The history of biological weapons is a history of turning nature into an instrument of war. Even in ancient times, armies used poisonous substances, dead bodies, or contaminated water to weaken their enemies.

Ancient Chinese and Indian warriors used poisonous substances from natural sources to destroy their enemies. For example, Chinese armies could contaminate wells with poisonous substances, while Indian troops used poisoned arrows.

In the 17th and 18th centuries, European colonizers used biological weapons against indigenous peoples. In particular, the British in North America (1763) gave blankets infected with smallpox to Native Americans, which led to significant casualties among the local population.

With the advancement of microbiology and medicine, biological weapons evolved from a primitive means of warfare into a powerful tool capable of causing mass casualties.

- ***Japan (1930–1945)*** – During World War II, Japan conducted large-scale biological experiments in Unit 731. Japanese scientists tested plague, cholera, and anthrax on prisoners of war in China. Some researchers suggest that the Japanese military used biological weapons in Manchuria and other regions in the 1930s and 1940s (experiments involving infecting prisoners with plague, cholera, and tularemia). The Japanese dropped infected bombs on Chinese villages.
- ***The USA and Soviet Union (1945–1991)*** – After the war, both superpowers began active research in the field of biological weapons. The US tested the aerosol dissemination of pathogens as part of Project SHAD, while the USSR, according to Western sources, developed strains of anthrax and smallpox in secret laboratories.

In medieval Europe, during the siege of Caffa (1346), the Tatars threw the bodies of people who had died of the plague over the walls—this case is considered one of the first documented biological attacks. It was from Caffa that the plague could have reached Italy and caused a pandemic that destroyed up to a third of Europe's population.

A breakthrough in international law, thanks to the efforts of the UN, was the adoption of the Biological Weapons Convention (BWC) in 1972. It officially banned the development, production, and stockpiling of biological weapons. Despite this, experts suggest that some countries secretly continued such research. In the 21st

century, fears have not disappeared. After the events of September 11, 2001, a series of bioterrorist attacks using anthrax spores were carried out in the United States, which were sent by mail (the so-called “Anthrax Letters”), causing the deaths of five people and widespread epidemiological panic. These events radically changed biosafety policy not only in the United States but throughout the world.

With the development of synthetic biology, the risks of biological weapons are only increasing. Governments of various countries, including the US, UK, Germany, and China, are actively developing biodefense strategies to prevent potential threats.

As part of the former Soviet Union, Ukraine had a large number of scientific and military facilities involved in biological research and the development of biological weapons. After gaining independence, Ukraine joined international agreements banning biological weapons, such as the Biological and Toxin Weapons Convention (1975). However, against the backdrop of the military conflict with Russia since 2014, the issue of biosafety has become even more relevant for the country. Ukraine has numerous laboratories engaged in biosafety research, including within the framework of international programs that help ensure the safety of such facilities.

Biological weapons: features of use

Biological weapons have a number of unique characteristics that make them extremely dangerous. Besides affecting the enemy, they can spread through infected people, animals, or water.

Modern biological weapons are highly accurate instruments based on the use of live pathogens (viruses, bacteria, and fungi) or biotoxins. Their main feature is their invisibility at the moment of use, which makes them extremely dangerous: the disease can spread for days or weeks before it is noticed.

In the US, Canada, and Israel, the focus is on preventing the spread of biological pathogens through aerosols. Many studies focus on the fact that viral agents, such as smallpox or Ebola, can be modified to be resistant to treatment and vaccines. Therefore, Israel's security strategy involves constantly updating antibiotics in civil defence warehouses, creating mobile response teams, and having a rapid bio-diagnostic system in place.

The G7 countries have launched the Global Partnership against the Spread of Weapons and Materials of Mass Destruction initiative, which focuses on limiting the spread of biotechnology for terrorist purposes. In particular, Germany has a law that regulates even genetic engineering experiments in private laboratories.

The greatest risk today is the emergence of new diseases due to the achievements of synthetic biology, which allows the creation of new pathogens that have never existed in nature. The US has already included developments in synthetic

biology in the list of strategic threats at the national security level (DARPA report). Such pathogens can mimic natural infections or specifically target certain ethnic groups. The UN has condemned projects of this type.

Use of biological agents is related to the properties of pathogenic microbes in natural cases to penetrate the human and animal body ***in the following ways***:

1. Through the air via the respiratory organs – aerogenic, airborne route.
2. Through food and water via the digestive tract – alimentary route.
3. Through damaged skin because of bites from infected blood-sucking arthropods (lice, fleas, mosquitoes, midges, ticks) or sick rodents – transmission route.
4. Through the mucous membranes of the mouth, nose, eyes, as well as through intact skin – contact route.

For military purposes, the following methods of combat use of biological agents have been studied and proposed:

1) **spraying** biological formulations to contaminate the ground layer of air with aerosol particles – the ***aerosol method***;
2) **dispersal** of blood-sucking vectors artificially infected with biological agents, release of infected rodents and birds – ***transmission method***;
3) **contamination** of air and water in enclosed spaces (volumes) with biological agents using sabotage equipment – ***sabotage method***;
4) **use of biological munitions** (explosive devices).

The spread of a mass disease among people over a large area in a short period of time is called an ***epidemic***. If the disease affects many countries, parts of the world, or entire continents, it is called a ***pandemic***. The spread of plant disease over large areas is called an ***epiphytotic***, and the mass infection of animals over large areas is called an ***epizootic***.

Key features of biological weapons:

- ***Long incubation period*** – most pathogens have a latent period of development, which makes it difficult to detect an attack in a timely manner. For example, symptoms of anthrax may only appear several days after infection.
- ***High mortality rate*** – some biological agents, such as the Ebola virus (mortality rate up to 90%), can have catastrophic consequences.
- ***Complicated treatment*** – the use of genetically modified microorganisms may make them resistant to existing vaccines and antibiotics.
- ***Mass panic and destabilization*** – biological weapons affect not only the military, but also the civilian population, which can paralyze entire states and economies.

The following biological agents are used:

1) Bacteria: spore-forming microorganisms, gram-positive and gram-negative bacilli. Spore-forming bacteria can survive in water and soil for 1 month to tens of years, creating capsules (spores) that are resistant to drying out, high and low temperatures. The incubation period lasts 1–6 days (anthrax (*Bacillus anthracis*), tetanus (*Clostridium tetani*), etc.) In addition to the above, the main bacteriological agents include the pathogens of plague (*Yersinia pestis*), brucellosis (representatives of the genus *Brucella*), typhoid fever (*Salmonella enterica*), tularemia (*Francisella tularensis*), cholera (*Vibrio cholerae*), and melioidosis (*Burkholderia pseudomallei*). Out of the large number of bacteria found in nature, only a small number of species cause disease, i.e. are pathogenic (*Staphylococcus, Streptococcus, Vibrio cholerae*, etc.). The pathogenicity of bacteria lies in their ability to penetrate the body's protective barriers and release toxic substances that cause infectious diseases.

2) Viruses non-cellular infectious agents that are obligate intracellular parasites, i.e., they can reproduce only inside living cells of host organisms, using their resources. Viruses are the causative agents of *smallpox, yellow fever, various types of encephalitis, Dengue fever, psittacosis, influenza, foot-and-mouth disease, foot-and-mouth disease, etc.* The incubation period of viral diseases is 4–12 days;

3) Rickettsiae is a group of pleomorphic bacteria-like intracellular organisms, pathogenic species of which live in the body of arthropods of various types, as well as mammals and birds, and cause various diseases in animals - rickettsiosis. The typical genus of the family, Rickettsia, is represented by polymorphic, often coccoid or rod-shaped, stationary cells. They are the causative agents of *typhus, Rocky Mountain spotted fever, Q fever, and Tsutsugamushi fever*. The incubation period for these diseases is 4–23 days.

4) Fungi (mycoses) are pathogenic microscopic fungi. Mycosis is a human disease caused by pathogenic fungi. Fungal spores are highly resistant to drying, low temperatures, and sunlight. They cause serious infectious diseases such as *blastomycosis, histoplasmosis, nocardiosis, and coccidioidomycosis*.

The most dangerous biological agents for humans are zoonotic diseases and a group of acute, particularly dangerous infectious diseases.

Anthropozoonotic diseases are common to both humans and animals. These include bacterial diseases such as plague, anthrax, tularemia, glanders, and melioidosis; viral diseases such as psittacosis, encephalomyelitis, and foot-and-mouth disease; rickettsial diseases such as Q fever and Rocky Mountain spotted fever; and fungal diseases such as coccidioidomycosis.

The most dangerous diseases

The international community recognizes a group of infections that pose an

extremely high level of biological threat: ***plague, anthrax, cholera, tularemia, Ebola fever, Marburg fever, SARS, MERS, and smallpox***. These diseases are characterized by high mortality rates, rapid spread, and limited treatment options. Various countries have created systems for classifying biological agents according to their level of danger:

Canada, for example, has a mandatory isolation policy for all contacts when a case of SARS or MERS is detected. The UK has a "Red Alert" system that automatically blocks all entry/exit points in the outbreak region.

United States (CDC – Centers for Disease Control and Prevention):

- Category A – the most dangerous biological agents (anthrax, plague, smallpox, Ebola and Marburg viruses, botulism, tularemia).
- Category B – less deadly, but still dangerous (salmonellosis, Q fever).
- Category C – potential threats that can be modified into biological weapons (various viruses, including hantaviruses, encephalitis).

The EU (European Centre for Disease Prevention and Control, ECDC) has a similar system that allows it to respond quickly to biological threats and develop biosecurity measures.

In Ukraine, there are organizations for the control and prevention of diseases and an organization for the provision of emergency medical care in an emergency situation caused by biological agents (centers for disease control and prevention).

Examples of the most dangerous infectious diseases

Anthrax (*Bacillus anthracis*) is an acute infectious disease of farm animals and humans. Humans can become infected while caring for sick animals, coming into contact with objects, products, hides, wool contaminated with spores, consuming contaminated meat, or inhaling dust containing spores of the pathogen. In summer, you can become ill from the bite of an infected horsefly or gadfly. The incubation period is 1–3 days.

Depending on how the pathogen enters the body, anthrax can be cutaneous, pulmonary, or intestinal. The cutaneous form of anthrax begins with the appearance of a red, itchy spot at the site of microbial penetration, which then turns into a hard nodule with a blister forming on top. The blister gradually fills with bloody fluid, then bursts, and a black scab appears in its place—an area of dead skin. New blisters appear around this area, which go through the same cycle of development. This is how a carbuncle of anthrax is formed.

In the *pulmonary* form, pneumonia develops as a result of the pathogen entering the respiratory tract. Symptoms: fever, temperature of 40 °C or higher, chest tightness, cough, sharp pain, lacrimation, hoarse voice, runny nose. The cough is accompanied by the discharge of bloody sputum. Without treatment, the disease often

results in the death of the patient. The pulmonary form has a high mortality rate if not treated with antibiotics in the early stages.

The intestinal form of anthrax occurs when infected through the mouth. The patient develops severe inflammation of the intestinal tract, more often the small intestine, and ulcers form. The disease develops acutely: severe sharp pain in the abdomen, vomiting of bile mixed with blood, bloating, and frequent bloody diarrhea appear. In the pulmonary and intestinal forms, the temperature is high and the disease often ends fatally on the 3rd-5th day. Antibiotics are administered to patients for treatment. To prevent anthrax, live vaccines containing weakened bacterial spores that stimulate the development of immunity in animals are used, as well as anthrax gammaglobulin (serum), which provides passive immunity. Antibiotic therapy is used for treatment. In the pulmonary form, antitoxins. There are vaccines and serums against anthrax. The quarantine period is set at 8 days. Vaccines and serums are used for prevention.

Case of a bioterrorist attack: United States, 2001 (mailing of spores).

Plague (*Yersinia pestis*) is an acute infectious disease affecting humans and animals. The incubation period lasts 1–3 days. Fleas, airborne droplets, contaminated water, food, and feed spread it. The pathogen is resistant in the environment. A sick person is very dangerous to others. It is the most contagious and severe disease among the group of infectious diseases caused by pathogenic bacteria. Plague is characterized by high fever, lethargy, damage to the cardiovascular system, and pronounced inflammatory changes in the lymph nodes, lungs, and other organs. The main forms of plague are bubonic, pulmonary, septic, intestinal, and cutaneous. Intestinal and cutaneous forms of plague rarely occur independently.

Without treatment, pulmonary and intestinal plague quickly lead to the death of the patient, and cutaneous plague progresses to cutaneous-bubonic plague. If patients are not treated, death may occur. If treatment of bubonic and cutaneous forms of plague with antibiotics is started in a timely manner, patients recover. When treating the pulmonary form of plague, mortality is reduced to 5–15 %. The quarantine lasts 6 days. It was used as a biological weapon in the Middle Ages (Mongol siege of Caffa). Natural outbreaks have been recorded in China and Madagascar.

Cholera *(Vibrio cholerae)* is an intestinal disease of humans that is highly contagious. Infection occurs through water, food, insects, and airborne droplets. The incubation period lasts 1–5 days. The pathogen survives in water for up to one month and in food for 4–20 days. The disease is characterized by severe poisoning with microbial toxins, exhausting diarrhea and vomiting, and severe dehydration. The patient loses weight rapidly, cyanosis appears, the temperature drops to 35 °C and below, convulsions and clouding of consciousness occur. The mortality rate is up to 30%. The quarantine period is 6 days. The cholera outbreak that was known in the

post-Soviet space occurred in Odesa in 1970.

Typhoid fever *(Salmonella enterica)* is an urgent infectious disease caused by the penetration of the pathogen into the gastrointestinal tract through contaminated water and food. The pathogen is excreted from the patient's body into the environment through urine and feces, where it can survive for several days to several months, especially on food products. The incubation period is 7–23 days. The disease is accompanied by high fever, general intoxication, abdominal pain, diarrhea, clouding of consciousness, and a rash on the chest and abdomen in the form of small pink spots. If left untreated, the mortality rate reaches 20 %. A vaccine is used for prevention.

Typhus (*Rickettsia prowazekii*) is an acute infectious disease in humans. Infection is transmitted from a sick person to a healthy person by lice. The patient has a high fever, severe headache, rash, and pain throughout the body. The rickettsia pathogen can survive in a dried form for up to 3–4 weeks. The mortality rate without treatment is up to 40 %, and with treatment, it is 5 %.

Natural smallpox (smallpox virus belongs to the family *Poxviridae*, subfamily *Chordopoxvirinae*, genus *Orthopoxvirus*) is an highly contagious epidemic disease in humans. Infection occurs through the respiratory tract, damaged skin and mucous membranes, through contact with an infected person and contaminated objects, with an incubation period of 13–14 days. The disease begins acutely with fever and a temperature rise to 40 °C. On the 4th-5th day of the disease, nodules appear on the face and body, which turn into blisters, then they fester with blood (black smallpox). The blisters dry up, forming scabs, which fall off, leaving behind traces in the form of pockmarks. Mortality reaches 40 %, among those vaccinated – up to 10 %. Quarantine lasts up to 17 days.

The last natural case of smallpox was diagnosed in October 1977. In 1980, the World Health Organization declared the disease globally eliminated.

Coccidioidomycosis (fungi of the genus ***Coccidioides*)**, affects humans and animals. The incubation period lasts 8–45 days. The patient is very dangerous to those around them. It is difficult to treat. Biological contamination of food, feed, and water with microscopic molds or their toxins can cause infection for humans and farm animals.

Potatoes, vegetables, fruits, fish, meat, and milk can be contaminated with pathogens that cause cholera, plague, tularaemia, rat fever, melioidosis, typhoid fever, dysentery, glanders, anthrax, and other dangerous diseases.

Unprotected products, feed, and water are most intensively infected with pathogens when used in the form of aerosols. Infection is possible through secretions from sick people and animals, insects (parasites), rodents that carry infectious diseases, and contaminated items used to care for the sick. The nature and degree of

contamination of food, feed, and water, as well as the depth of penetration of pathogenic microbes into them, depend on the type of pathogens, the routes of their entry into food, feed, and water, the density of contamination, the type of food and feed, their moisture content, temperature, and storage conditions.

The pathogens of many infectious diseases multiply rapidly, especially those such as cholera, anthrax, and typhoid fever. For example, even if they enter the water in a small section of a river, they can infect it far downstream. Contamination of small and stagnant water bodies and unprotected wells can lead to serious diseases in humans and animals and cause the formation of a biological hazard.

Ebola virus (genus *Ebolavirus*, family *Filoviridae*) and Marburg virus (genus *Marburgvirus*, family *Filoviridae*). These viruses are transmitted through biological fluids and have a high mortality rate (50 % to 90 %). They caused epidemics in Africa, particularly in West Africa in 2014–2016. Experimental vaccines are being developed (e.g., rVSV-ZEBOV).

Smallpox (*Variola virus*) is a viral disease whose causative agent has been completely eliminated but samples are stored in two laboratories (the US and Russia). In the event of a bioterrorist attack, it could cause a global catastrophe due to the lack of natural immunity in the modern population.

Botulism (*Clostridium botulinum*) is a microorganism that produces a toxin that is one of the most potent toxins known, with a lethal dose of only a few nanograms. It affects the nervous system, causing paralysis. It can potentially be used in the form of an aerosol or food contamination. The disease is most often associated with the risk of eating dried, smoked, salted, and canned fish, especially those made at home with violations of cooking technology or sold at spontaneous markets.

Zoonotic infections - those transmitted from animals to humans - are becoming the most relevant. Studies show that more than 75 % of new viral infections in recent years (including COVID-19) are zoonoses. Therefore, the control of wild animals, exotic trade, and livestock farms is already an element of national security.

Governments around the world are investing in biosecurity and building up stocks of vaccines and antibiotics, as well as developing new technologies to monitor and contain biological threats.

- **The USA** – creates a strategic stockpile of smallpox vaccines and botulism antitoxins. Biodefense programs are also actively developing, such as Project BioShield, which provides funding for research in the field of biological defence.
- **Europe** – has developed a centralized response system through the **ECDC** and a civil protection mechanism. In addition, there is the **HERA (Health Emergency Preparedness and Response Authority)** program, which coordinates preparedness for pandemics and biological threats.

- **China** – is actively researching viruses as part of biotechnology programs. Particular attention is paid to the development of vaccines and the creation of a powerful biocontrol system, including the construction of high-tech **BSL-4** laboratories.
- **Ukraine** - like many other countries, Ukraine has a number of diseases that pose a threat. These include highly contagious viral and biological infections that can be used as biological weapons. In wartime, when populations are displaced and health care systems are disrupted, such diseases can spread rapidly. In Ukraine, in particular, there have been outbreaks of diseases associated with worsening sanitary conditions in the occupied territories.

In addition to government initiatives, international organizations play an important role in preventing the spread of infectious diseases, particularly the **WHO,** which coordinates global biosafety measures, and the **Global Health Security Agenda (GHSA),** which brings together the efforts of different countries to prevent biological threats**.**

Biological outbreak areas

Biological outbreak areas are territories where a biological agent has spread widely, leading to the infection of humans, animals, or plants. Such a site may arise as a result of the deliberate use of biological weapons, man-made accidents, or natural epidemics.

A biological contamination zone is an area contaminated with pathogens that are dangerous to humans, animals, or plants. Pathogens of infectious diseases can spread, increasing the contamination zone, by humans, insects, especially bloodsuckers, animals, rodents, and birds. Humans, farm animals and poultry, wild animals and birds, air, land, water bodies, wells, drinking water reservoirs, fodder, agricultural crops, harvest stocks, food products, equipment, livestock facilities, pastures, and residential premises can become infected.

According to scientific research, the ideal atmospheric conditions for the use of biological weapons are ***temporal inversion*** (from Latin inversio – reversal, rearrangement), and the most favourable time of day is after sunset, when direct sunlight does not affect bioagents. Based on this, it is believed that large-scale use of biological weapons is more likely to occur in the evening and at night.

In the event of a biological contamination outbreak, ***quarantine and observation*** are imposed to prevent the spread of infectious diseases from the primary source.

Quarantine is a system of state measures carried out in an epidemic (epizootic, epiphytotic) focus to prevent the spread of infectious diseases from the focus of infection and to completely isolate and eliminate it. Quarantine involves isolating the

community in which infectious diseases have arisen, hospitalizing patients, observing those who have been in contact with them, and providing medical and veterinary supervision for the rest. To this end, the following administrative and economic measures are taken: the entry and exit of people, the removal of animals, livestock and crop products, and the receipt of parcels are prohibited. Anti-epidemic, veterinary and sanitary, sanitary and hygienic, anti-epizootic, and medical and preventive measures are taken. Security is established around the outbreak. Through special points under the control of the civil defence medical service, supplies are organized for people in the outbreak area. Quarantine is lifted after the end of the maximum incubation period of the disease (from the moment of detection and isolation of the last patient).

Observation is a system of measures for monitoring isolated people or animals who have arrived from a quarantined area or are located in a threatened area, i.e., an area bordering the affected area. These measures include restrictions on entry and exit, removal of property, crops, and livestock products from the outbreak area without prior disinfection and permission from medical and veterinary services, and enhanced medical control of food and water.

The duration of quarantine and observation is determined based on the maximum incubation period of the disease.

A biological hazard may arise in peacetime when infectious diseases of humans, animals, and plants occur as a result of the introduction or transfer of a pathogen from other countries or as a result of a violation of epidemiological standards.

Classification of biological outbreak areas

Biological outbreak areas are divided into:

- **Natural** – arise due to natural outbreaks of dangerous infections (e.g., Ebola virus epidemics in Africa).
- **Technogenic** – caused by leaks of dangerous pathogens from laboratories or industrial facilities (e.g., the incident in Sverdlovsk in 1979).
- **Intentional** – the result of bioterrorist attacks or military use of biological weapons (e.g., the anthrax attacks in the United States in 2001).

Biological outbreak areas in different regions of the world

- **The USA and Western Europe**. Developed countries have effective mechanisms for combating biological threats. For example, after the anthrax attacks in 2001, the United States established the **National Biodefense Center**, which coordinates measures in the event of a biological threat. The EU has a civil protection mechanism that allows member states to respond quickly to biological threats.

- **Africa**. Biological outbreak areas often arise due to natural epidemics. For example, **Ebola** outbreaks in West African countries (Guinea, Liberia, Sierra Leone) in 2014–2016 demonstrated the critical importance of international assistance in containing diseases.
- **Asia**. China is implementing large-scale biosecurity measures following the COVID-19 pandemic, including the creation of a national rapid response program for new biological threats. China is also believed to have some of the most advanced **BSL-4** laboratories researching dangerous pathogens.
- **Russia** has considerable experience in researching biological agents. The anthrax leak in Sverdlovsk (1979) was one of the most famous cases of a man-made biological attack. Despite international commitments, Western analysts suspect that Russia continues to conduct covert research into biological agents.
- **Ukraine**. There are several laboratories and scientific institutions in Ukraine that research potentially dangerous biological agents. During the armed conflict with Russia, these facilities could become targets for attacks, increasing the risk of pathogens being leaked or used as weapons. Ukrainian laboratories working within international programs actively cooperate with international partners to ensure the control and security of such facilities.

Combating biological contamination hotspots

- **Rapid detection and quarantine measures** (mobile laboratories, biomonitoring systems).
- **International cooperation** (joint programs of WHO, CDC, ECDC).
- **Development of a biosecurity system** (creation of strategic vaccine reserves, training of medical personnel).

In general, biological warfare agents remain a serious threat to global security, and their effective containment depends on international cooperation and modern biodefense technologies.

Case studies for discussion during class

1. An unknown disease has broken out in the city. Students must determine what type of outbreak is it and which services to involve. How does a natural outbreak differ from an artificially created one?
2. The situation with the plague epidemic in the past and its elimination. The task of the students is to determine which signs indicate the type of outbreak and which measures were most effective.
3. Three cases with the same symptoms have been detected in a district hospital. The group must identify the probable pathogen and propose actions.

4. Imagine that you are epidemiologists who have arrived in a remote village. You have identified five cases with unusual symptoms. Determine which pathogen could be the cause.
5. 1346, siege of Caffa (Theodosia). Historians believe that during the siege, the Mongols threw the bodies of those who had died of the plague over the city walls, causing an epidemic.
   Questions for discussion
   Can we consider this one of the first recorded cases of biological weapons use? How would modern civil defence services respond?
6. 1918, the Spanish flu epidemic. The disease affected millions of people without modern means of communication and air travel.
   Question: Could such an epidemic spread faster or slower in today's world? Why?
7. 2001, anthrax letter attacks in the United States.
   Question: What changes in the biological safety system would be necessary to prevent such incidents?
8. Several cases of a rare infection that has not been seen for decades have been reported in your city. Doctors suspect that the pathogen is man-made.
   Question: How can we determine whether this is a natural outbreak or the result of biological weapons?
9. Unverified reports have appeared in the media about a dangerous virus being "sprayed" from a drone over a crowded area.
   Question: How should the authorities and the population act in the first hours after such information becomes available?
10. Hypothetical situation: the enemy uses biological weapons with an incubation period of 10 days without external symptoms.
    Question: What difficulties arise in detecting and localizing the infection?
11. A case of Ebola fever has been detected in the region. The nearest international airport is 50 km away.
    Question: What immediate measures should be taken to prevent the spread of the disease beyond the country's borders?
12. Several cases of anthrax have been reported among livestock and humans in rural areas.
    Question: Which services should be involved and how should cooperation between them be organized?
13. During a large music festival, visitors began to experience the same symptoms – high fever, cough, and rash.
    Question: How can medical evacuation and quarantine measures be organized quickly?

14. A source of biological contamination was detected in one of the city's districts. The district was isolated.
    Question: How can life support be organized for the population remaining in the quarantine zone?
15. During the investigation, it was established that the infection could have spread through the air conditioning system in a large building.
    Question: How to localize and disinfect in such a situation?
16. A person suspected of having a particularly dangerous infection who had contact with a large number of passengers was detected at the border.
    Question: How to establish the circle of contacts and prevent further spread?

PRACTICAL PART

Procedures in case of a 'Biological Contamination' alert

Many countries have special protocols for responding to biological threats, which include both preventive measures and rapid response methods to minimize the consequences of an infectious outbreak.

The *"Biological Contamination"* signal is broadcast over the radio network if the enemy has used bacterial agents. The signal warns the population of contaminated areas about the type of pathogen, methods of protection, and procedures to follow. When the "Biological Contamination" signal is sounded in Ukraine, as in other countries, established procedures must be followed: personal protective equipment such as masks and protective suits must be used, contact with contaminated objects must be avoided, and medical assistance must be sought. In wartime, these actions may be complicated by damage to infrastructure and disruption of communications, which increases the risks to the population in combat zones.

In the US, the CDC has developed instructions for the population in the event of a biological threat – these include immediate shelter in sealed rooms, turning off ventilation, and air filtration. The National Wireless Emergency Alerts system sends messages to all mobile phones with recommendations.

In Canada, special antibiotic distribution points called "PODs" (Points of Dispensing) are set up for such cases, where the population can receive preventive treatment. In the event of a threat of anthrax infection, ciprofloxacin is most often used, and for smallpox, vaccination is given even "post-factum" for 3–4 days.

Scandinavian countries maintain an "emergency stockpile" of filter masks, potassium iodide (in case of nuclear or biological contamination), as well as mobile laboratory tents that can be set up within 20 minutes in the disaster area.

In the US, according to FEMA and CDC, a biological attack site is classified according to the level of population exposure, the rate of infection spread, and the type of pathogen. If a biological threat is confirmed, a "Hot" (red) zone is created, where maximum isolation is in effect, and only fully protected rescue workers are allowed. Next is the "Warm" zone, where disinfection is carried out, and the "Cold" zone, where medical stations are deployed.

The German model (BBK – Federal Office for Civil Protection and Disaster Assistance) provides for the modular deployment of biological control points, mobile laboratories, and patient waiting areas. All data is stored in the RESCUE-WEB system, which is accessible to government services in real time.

According to a report by Tokyo Metropolitan Security, sensors that respond to aerosol bioagents have been installed at all subway stations in Japan, where there is a real risk of bioterrorism during mass events. If a sensor is triggered, access to the

station is blocked and passengers are evacuated along predetermined routes.

The population in the center of bacteriological contamination must strictly follow all the requirements of the civil defense medical service. In quarantine and observation zones, the authorities may decide to suspend classes in educational institutions and work at some enterprises and institutions, restrict the movement of people and vehicles, and partially or completely ban trade in markets. Entertainment venues are closed for the time being. An important protective measure is to keep homes, yards, and public areas clean at all times. Personal hygiene requirements should be followed very carefully: bathe weekly, change underwear and bed linen, keep hands and hair clean, and clean clothes, shoes, etc. daily.

One of the main sources of many highly infectious diseases is a sick person, so the presence of a sick person in an apartment or at work is dangerous for those around them. If the first signs of an acute infectious disease appear (a sharp rise in temperature, headache, fever, general weakness, nausea, vomiting, diarrhea), you should notify the nearest medical facility.

Before you visit the doctor, you should take steps to stop the disease from spreading:

1) Isolate the patient in a separate room or screen off their bed with a screen or sheet.
2) Do not allow strangers into the apartment.

All family members are required to strictly follow the instructions given by the doctor after visiting the patient.

Rules of behaviour and actions for the population in the center of infectious diseases:

1) Do not leave your place of residence without special permission;
2) Do not leave your home unless necessary;
3) Avoid places with large crowds of people;
4) Take your temperature and the temperature of your family members twice a day. If your temperature has risen and you feel unwell, you must isolate yourself from others in a separate room or screen yourself off with a screen. Immediately report your illness to the doctor on duty at your place of residence. In certain cases of infectious diseases, follow the recommendations of health authorities.
5) When leaving the house, wear a cotton-gauze mask.
6) Be sure to wet clean the rooms daily using disinfectants and household detergents. Garbage must be burned.
7) Destroy rodents and insects, which are possible carriers of disease.
8) Strictly follow the rules of personal and public hygiene.
9) Wash your hands thoroughly with soap, especially before eating.

10) Use water from reliable sources and drink only boiled water. Pour boiling water over raw vegetables and fruits after washing them.

11) When caring for a sick person, wear a gown, a scarf, and a cotton-gauze bandage. Provide the patient with a separate bed and towel, wash them regularly, and wash the dishes.

If you do not know what illness your family member has, treat it as if it were contagious. After the patient has been hospitalized, disinfect the apartment: boil bedding and dishes for 15 minutes in a 2 % soda solution, then wash the dishes with hot water and iron the bedding, clean, wash, and ventilate the room and other areas. *Simple and reliable methods of disinfection include boiling and ironing with a hot iron.*

Key response measures

- ***Rapid notification of the population*** through official sources of information (television, radio, mobile applications, government websites).
- ***Organization of quarantine zones*** and establishment of sanitary control at borders, train stations, and airports.
- ***Issuing personal protective equipment*** (masks, antiseptics, respirators, protective suits for medical workers).
- ***Restrictions on movement*** and social isolation in infection hotspots to prevent the spread of infection.
- ***Conducting mass vaccination*** (if an effective vaccine against a specific pathogen is available).
- ***Disinfection measures*** in public places, hospitals, and transport.
- ***Monitoring of healthcare institutions*** to prevent nosocomial outbreaks of infections.

International response experience

- **France** uses **Plan Biotox** system, which provides for the mobilization of military medics in the event of a biological threat, as well as control over laboratories working with dangerous pathogens.
- **Germany** relies on the **Robert Koch Institute,** which is responsible for coordinating measures during infectious disease outbreaks, providing epidemiological data analysis and scientific support to the government.
- **The USA** has a **CDC Response Program**, which includes a task force for responding to biological attacks and pandemics.
- Japan actively uses digital technologies to track contacts of infected individuals, which allows for rapid localization of the virus spread.
- During the COVID-19 pandemic, Canada introduced a financial support program for citizens, which helped mitigate the economic impact of quarantine measures.

An example of an effective response was the actions taken by governments during the COVID-19 pandemic, when the introduction of such measures helped to control the spread of the virus and protect healthcare systems.

Rules of behaviour and actions of the population in an infectious disease outbreak area

If a biological threat is detected, it is important to follow clear recommendations to reduce the risk of infection and help authorities cope with the crisis. In wartime, particularly in Ukraine, the actions of the population in areas affected by infectious diseases are of particular importance. It is necessary to follow the recommendations of medical institutions, use personal protective equipment, and isolate oneself from the source of the disease. It is important that in such situations, local authorities and international organizations provide prompt assistance to control the spread of infections, especially in areas where conditions for the population are difficult.

Israel, with one of the most effective civil defence systems in the world, has developed a mobile app called "Home Front Command," which provides real-time information about biological threats, quarantines, area closures, and evacuation routes. Citizens are instructed not to leave without permission, to keep their premises sealed, and to contact only designated medical services.

In the UK, the principle of "STAY–ISOLATE–REPORT" applies: stay at home, isolate your family, and notify the health authorities. At the same time, schools and public institutions have behavior scenarios for each type of infection.

In Japan, children learn how to respond to infectious threats as early as elementary school: there are drills on wearing masks, sealing off classrooms, disinfecting hands, and behaving in shelters.

Basic rules of conduct

- Stay home and avoid contact with potentially infected persons.
- Use personal protective equipment such as masks, gloves, and antiseptics.
- Follow the instructions of the authorities regarding quarantine, movement restrictions, and sanitary measures.
- Wash your hands regularly with soap or use disinfectants.
- Avoid large crowds and maintain a safe distance (1 to 2 meters).
- **Ensure that you have sufficient supplies of water, food, and medicine** in case of a prolonged quarantine.
- **Notify medical services** if suspicious symptoms appear (high temperature, cough, shortness of breath, rash, etc.).
- **Do not panic and do not spread unverified information** to avoid misinformation and chaos.

Examples of effective strategies in different countries

- **Japan** uses a **digital contact tracing system** that allows potential carriers of infection to be quickly identified and isolated.
- **The USA** uses **telemedicine**, which allows citizens to receive remote medical consultations without having to visit hospitals.
- **Canada** implemented **social and financial support** for citizens during quarantine, which helped reduce the negative impact of the pandemic.
- **Australia** has implemented a strict quarantine control system for foreigners entering the country, which has reduced the risk of new pathogens entering the country.

Following these rules is key to fighting biological threats, because the right behaviour from people can really cut down on how much infectious diseases spread.

Cases for discussion and practical work

- You have received an SMS message from the State Emergency Service about a possible biological threat in the city. What are your first steps?
- A family with two children receives a warning about the threat of infection. Describe how they should act during the first hour.
- In an emergency situation, you only have 2 liters of water per day. How would you organize its use to avoid infection?

Cases for practical work:

1) Use of personal protective equipment (15 min)

Teacher's actions:

1. Demonstrate the correct way to put on and take off PPE (personal protective equipment).
2. Each participant repeats the actions.
3. Discussion of common mistakes.

Case: You must enter the room where the infected person is. Put on PPE within 2 minutes.

Equipment: respirators, masks, goggles, rubber gloves, protective suits.

2) Describe the ways in which pathogens spread

Method: demonstration experiment/role play.

Use safe markers (e.g., fluorescent powder/powder) to show how quickly "infection" spreads from person to person through touch.

Case: Students receive a scenario: a case of dangerous infection has been detected at the enterprise. Determine which chains of contact need to be isolated to stop the spread.

3) Provide an algorithm of actions for the population in case of threat

Method: simulation of the situation "from the first report to the completion of measures."

Use the action checklist: receive the signal – take cover – use PPE – disinfect – evacuate.

Case: Civil defense alert about the threat of biological contamination. Each group develops a step-by-step action plan for: a) families with children; b) independently for a healthy adult; c) for the elderly.

4) Review hygiene and prevention rules.

Method: training + demonstration.

Teacher's actions:

Demonstrate proper hand washing (using fluorescent powder and a UV lamp to show mistakes).

Discuss how to handle food and water.

Case: In an emergency situation, you only have 2 liters of water per day. How would you organize its use to avoid infection?

Equipment: fluorescent powder, lamp, bowl of water.

5) Situational simulation "The First Minute"

The instructor turns on an audible signal or reads aloud a message about "Biological contamination." Participants have 60 seconds to decide where to go, what to take with them, and what PPE to wear.

6) Contents of an emergency bag.

Various items are laid out on the table (masks, documents, water, food, toys, unnecessary items).

Task: pack a bag in 2 minutes, explaining why these particular items were chosen.

7) Determining a safe route.

Participants are given a map of the area with contaminated zones marked.

They must choose the fastest and least risky route to shelter.

8) "A day in quarantine."

Participants receive a list of conditions: restrictions on leaving the house, minimal contact, and a shortage of resources.

They must draw up a daily plan of action that takes into account nutrition, hygiene, communication, and safety.

9) Identification of violations.

Photos or short videos are shown where people in the quarantine zone make mistakes (removing their masks in a crowd, touching their faces, disposing of garbage incorrectly).

Task: find and explain why this is dangerous.

10) Safe travel route.

On the map of the settlement, listeners must plot a route from home to the aid distribution point, avoiding places where large numbers of people gather.

11) Communication during quarantine.

Participants develop a short message for neighbours/relatives that explains the rules of conduct and reduces panic.

Test questions for the practical part for self-assessment

1. Actions to take when the "Biological Contamination" signal is sounded

1.1. What does the "Biological Contamination" signal mean?

A. The start of quarantine
B. The threat of biological weapons being used or the fact that they have been used
C. An outbreak of seasonal flu
D. A fire hazard

Correct answer: B

1.2. What should you do in the first few minutes after the alarm sounds?

A. Turn off the lights
B. Turn on the TV or radio, put on PPE, and prepare for evacuation
C. Go outside and see what is happening
D. Call your neighbours and go to them

Correct answer: B

1.3. What should be included in a minimum emergency bag?

A. Documents, water, first aid kit, PPE
B. Only documents and money
C. Food for a week and a laptop
D. Any personal belongings

Correct answer: A

1.4. Why is it important to plan your route to the shelter?

A. To avoid getting lost
B. To avoid contaminated areas
C. To have time to pick up relatives
D. To reduce travel time

Correct answer: B

1.5. Which document regulates the actions of the population in the event of biological contamination in Ukraine?

A. The Constitution of Ukraine
B. The Civil Protection Code of Ukraine
C. The Law on Disaster Medicine
D. The Resolution of the Cabinet of Ministers on Sanitary Standards

Correct answer: B

1.6. What is NOT allowed to do after receiving the signal?

A. Use personal protective equipment
B. Leave the room if necessary
C. Obtain official information
D. Spread unverified rumours

Correct answer: D

1.7. Which personal protective equipment is a priority?

A. Any outer clothing
B. Respirator or mask, safety goggles, gloves
C. Surgical gown
D. Any headgear

Correct answer: B

1.8. What should you do if you are in an open area when the alarm sounds?

A. Continue working so as not to waste time
B. Protect your respiratory organs, quickly leave the danger zone, and enter a building
C. Lie down on the ground
D. Call the police

Correct answer: B

2. Rules of behaviour in the center of infectious diseases

2.1. What is the main purpose of quarantine restrictions?

A. To minimize economic losses
B. To prevent the spread of infection
C. To check the work of medical services
D. To force people to stay at home

Correct answer: B

2.2. How to properly dispose of a used mask?

A. Throw it in any trash can
B. Throw it in a general waste bin, after packing it in a bag
C. Burn it in the yard
D. Leave it for reuse

Correct answer: B

2.3. What should you do if you develop symptoms of an infectious disease in a quarantine zone?

A. Go to the hospital without warning
B. Call a doctor or notify local authorities
C. Purchase medication yourself
D. Ignore it if the symptoms are mild

Correct answer: B

2.4. Why is it important to maintain distance in public places during an outbreak of infection?

A. To reduce the burden on transportation
B. To avoid direct transmission of the pathogen
C. To create comfort for yourself
D. It is simply an official requirement

Correct answer: B

2.5. What is an “epidemic area” ?

A. Any place where there is a medical facility
B. An area where cases of infectious disease have been detected and there is a risk of its spread
C. An area where vaccinations are carried out
D. A place with increased radiation

Correct answer: B

2.6. What does the term “isolation” mean during an epidemic?

A. Relocation to another area
B. Restricting contact between sick people and others
C. Treatment with antibiotics
D. Closure of educational institutions

Correct answer: B

2.7. What distance is considered minimally safe when in contact with other people during an outbreak of infection?

A. 0,5 м
B. 1 м
C. 1,5–2 м
D. 3 м

Correct answer: C

2.8. What is the most effective measure for preventing the spread of most infections?

A. Frequent hand washing with soap
B. Using scented candles
C. Taking vitamins
D. Eating spicy food

Correct answer: A

SELF-TEST QUESTIONS TO CHECK YOUR KNOWLEDGE

1. What does the “Biological Contamination” signal mean and which services transmit it?
2. What are the first steps to take after receiving the signal?
3. What items should be included in the minimum contents of an “emergency bag”?
4. How should personal protective equipment be put on? In what order?
5. Why is it important to plan a safe route to shelter?
6. What are the typical mistakes people make in the first few minutes after the signal?
7. How can you check the tightness of a respirator or mask?
8. What are the main rules of conduct to follow in a quarantine zone?
9. How can you properly organize your daily life at home during quarantine?
10. Why is it important to minimize physical contact during an outbreak of infectious diseases?
11. What actions help reduce the risk of infection in public places?
12. How to properly dispose of used masks and gloves?
13. What methods of communication with neighbours or relatives reduce panic?
14. What to do if you have symptoms of an infectious disease in a quarantine zone?
15. Name the major historical events related to biological attacks.
16. What methods of biological warfare have been used in the past?
17. What lessons from the history of biological epidemics are relevant today?
18. Why are biological weapons considered particularly dangerous compared to other types of weapons?
19. What are biological weapons and what are their main characteristics?
20. What are the main types of biological agents that can be used in biological weapons?
21. How do biological weapons differ from natural infections?
22. What characteristics of biological weapons should be considered when responding to a threat?
23. What prevention and protection measures are effective against biological weapons?
24. Which diseases are classified as extremely dangerous?
25. What are the most common routes of transmission for these diseases?
26. What are the characteristic symptoms of certain extremely dangerous infections? (at the student's choice).
27. How are the control and treatment of such diseases organized?
28. What preventive measures are used to prevent outbreaks?

29. What is a biological outbreak area?
30. What types of areas exist?
31. What factors influence the spread of infection in an outbreak?
32. How are the boundaries of an outbreak determined?
33. What measures are used to localize and eliminate an outbreak?
34. What are the main biosafety measures implemented by the United States?
35. Which structures in Europe are responsible for coordinating the response to biological threats?
36. What features of biosafety in China distinguish this country from others?
37. Why is there an increased risk of biological threats spreading in Ukraine under current conditions?
38. What role do international organizations, in particular the WHO and GHSA, play in countering biological threats?
39. What are zoonotic infections and why are they relevant in the context of modern biological threats?

CONCLUSION

Biological weapons remain a serious threat to global security. Modern technologies pose new challenges, particularly in the field of synthetic biology, which can be used to create new pathogens. However, international cooperation, the development of effective response methods, and the implementation of biosecurity technologies can significantly reduce the risks.

Global practice shows that the most effective approach is preventive measures, including strengthening international control, improving legislation, and increasing biosafety. It is important that countries continue to work together to eliminate threats that know no borders and can pose a danger to all of humanity.

Today's biosecurity challenges call for coordinated action at both the national and international levels. Different countries, taking into account their own characteristics and risks, are developing protection strategies, including the creation of vaccine reserves, the development of biotechnology, and the infrastructure for controlling biological threats. Ukraine, given the current difficult conditions, is particularly vulnerable to the spread of especially dangerous infections, which requires strengthening measures at both the national and international levels. A special focus is on zoonotic infections, which make up most of today's new viral diseases and can spread quickly among the population. Effective biosecurity is only possible if governments, international organizations, and civil society work together.

In the modern world, with growing biological threats that can arise from natural factors as well as man-made or terrorist acts, it is extremely important to ensure that the population is effectively prepared to respond quickly and correctly to alarms and outbreaks of biological contamination.

The guidelines are meant to help people learn the rules, get some hands-on experience, and be aware of how to use personal protective equipment and what to do in a biological emergency. The use of interactive techniques, practical tasks, and scenarios helps not only to better understand the theoretical material, but also to practice the skills necessary to preserve life and health in real-life threatening situations.

Effective training of the population is part of the state's overall civil protection system and helps to reduce the negative consequences of biological hazards for society. Therefore, the implementation of these methodological recommendations in the educational process is an important step towards strengthening the security and resilience of communities in the face of new challenges.

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Навчальне видання

ДІЇ НАСЕЛЕННЯ В УМОВАХ ЗАГРОЗИ АБО ВИНИКНЕННЯ ОСЕРЕДКУ БІОЛОГІЧНОГО УРАЖЕННЯ

ЕЛЕКТРОННІ МЕТОДИЧНІ РЕКОМЕНДАЦІЇ

до практичних занять та самостійної роботи
з дисциплін «Цивільний захист»,
«Цивільна безпека та основи медицини катастроф»,
«Безпека життєдіяльності та основи охорони праці»
студентам усіх спеціальностей та форм навчання

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Укладачі:
Гвоздій Світлана Петрівна
Поліщук Любов Миронівна
Пєнов Вадим Васильович
Рижко Ірина Леонідівна
Устянська Ольга Володимирівна

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вул. Університетська, 12, м. Одеса, 65082, Україна
Тел.: (048) 723 28 39, e-mail: druk@onu.edu.ua