

REVIEW ARTICLE

COUNTER-PANDEMIC ACTIVITIES CONDUCTED BY THE POLISH ARMY FORCES. LESSONS LEARNED AFTER ONE YEAR OF THE COVID-19 PANDEMIC

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**The article is dedicated to those who risk their health and lives
in the difficult times of pandemic to help those in need**

Summary

The aim of the article is to review activities of selected European armies during the Covid-19 pandemic aimed at protecting their own forces and supporting societies in danger. The attention is drawn to the importance of protection against the pandemic and its legal and organizational conditions. The analysis is based on the example of the Polish Armed Forces. The method of information exchange in the case of an outbreak of infectious diseases among soldiers and civilians in NATO is presented, taking into account various national solutions. The scope and methods of using chemical troops during disinfection of people, equipment, and infrastructure are analyzed in detail.

Key words: pandemic; Covid-19; chemical troops; disinfection

1. Introduction

The first information concerning a previously unknown lung disease in Wuhan, China, which appeared in the mass media in mid-November 2019, went almost unnoticed in the flurry of other major news. Only a handful of virologists, who study coronaviruses, predicted that the world might be facing a new epidemic. The World Health Organization (WHO) and medical journals, including The Lancet and New Medicine, assumed that the first documented infections of the SARS-CoV-2 virus, which causes COVID-19 disease, occurred in early December 2019. The rapid spread of the virus outside of China (a case of infection was reported in Thailand on January 13, and in France on January 24) and the scale of the outbreak led WHO to declare, on March 11, that the development of the disease could be considered as a pandemic. Since then, tens of millions of people have been infected worldwide (Worldometer, 2021 (1)). Unfortunately, the numbers are still growing

Although it is not possible to determine when pandemic will come to an end, it is widely recognized that it has affected all areas of human life: social, mental, and biological (Czarnecki 2006, p. 72 (2)). The pandemic caused a global humanitarian and economic crisis. Moreover, the development of COVID-19 has an impact on the armies in some countries, which contributes, for instance, to a significant increase of non-military tasks carried out in order to support public administration, medical, and rescue services. It should be noted that the legal systems of many countries allow for participation of the military groups in the implementation of tasks within the scope of crisis management, as well as maintenance (restoration) of the law and anti-terrorist activities. These solutions are legitimate and generally accepted given that the armed forces have a significant potential, which can be used relatively quickly to assist civilians.

The current pandemic also brings reflections related to the broad spectrum of threats posed by pathogens. This complex collection of microorganisms has caused numerous diseases in people, animals, and plants since time immemorial. Some of them, due to their fast spread and high virulence, are classified as potential biological warfare agents that can be used in military operations and acts of terror (bioterrorism). Counteracting biological threats is the basic activity of many international organizations, specialized institutions, and research centers. This issue is also crucial for governments and the public opinion, which at the same time aim at improving systems for prevention and control of infectious diseases in national and international dimensions.

In this context, the purpose of this article is to present the role of the Polish Armed Forces, in particular their specialized formation, which is the chemical forces, during multidimensional counter-epidemic and preventive actions conducted on a large scale. It should be emphasized that solutions implemented in Poland, including methods of "mass" disinfection, do not differ from the principles adopted in other European Union countries and the North Atlantic Treaty Organization. The use of the generalization method - linking facts, grouping them, and then indicating similarities - along with abstraction, also serves as a tool to systematize and categorize characteristic groups of tasks performed by a number of European armies (the analysis covered solutions introduced in nine countries) to help societies in danger. Thus, the article is a voice in a broader discussion of the lessons learned.

The purpose of the article and the assumptions presented above, formed the basis for a number of research problems. The key ones were formulated in the form of the following questions:

- What measures have been taken by the armed forces of selected European countries to protect against SARS-CoV-2 infection and to support public administration and emergency services?
- How is the protection against the pandemic system organized in the Polish Armed Forces and what role does it play during the current pandemic?
- What sanitary and hygienic tasks and undertakings against the pandemic are performed by chemical troops subunits, and what is the effectiveness of these activities?

2. Vulnerability of troops to infectious diseases. Historical and epidemiological determinants

The interdependence of epidemics and war, perceived already in antiquity, probably inspired the symbolic representation of these two cataclysms as horsemen of the Apocalypse (Pestilence and War). Throughout history, infectious diseases have repeatedly affected campaigns, causing losses among soldiers much more serious than troops in direct combat. There are also many historical examples of chief commanders becoming infected, resulting in them being unable to make decisions or even losing their lives. Of course, this topic will be limited to a few selected examples of epidemics (pandemics), which even today are considered extremely dangerous and arouse concern in medical circles and military commanders.

In 164 AD smallpox, which probably broke out in the Roman legions stationed on the eastern borders of the empire and continued to spread until 180, contributed greatly to weakening Rome's military power. This was exploited by the Germanic tribes of the Markomans and Quads who launched an eight-year war against Italy (Cartwright and Biddiss, 2002, pp. 20-21 (3)).

The plague, which swept through Europe several times beginning in the 14th century, was brought to the continent by infected Tartar armies. It is also believed that it was the Tatars, who in 1346, used plague as a biological weapon during the siege of the Black Sea city of Kaffa (now Theodosia) by catapulting infected corpses over the city walls

(Croddy et al., 2003, p. 273 (4)). The most tragic plague pandemic of 1348-1361, known as the “Black Death”, killed an estimated 24 million people. During its duration, the high mortality rate among soldiers forced a six-year truce during the Anglo-French War (1349-1355).

A disease that was very common in many armies over the centuries was typhoid fever (also known as spotted fever, rash fever, caused by *Rickettsia prowazekii*, transmitted by lice and fleas). The development of the disease was fostered by poor sanitation, which was difficult to maintain in large military formations, especially during prolonged wars. The first documented examples of its occurrence among fighting armies can be considered the illnesses of the participants of the Crusades (Gulisano, 2006, p. 14 (5)) and the typhus epidemic in the Spanish army (1489-1490). Typhus was also the reason why Maximilian II’s army broke off its campaign against the Turks in 1566. A significant increase in this disease was also noted during the Thirty Years’ War (1618-1648). Typhus caused colossal havoc in Napoleon’s army during the campaign of in 1812, despite the fact that the French army was a pioneer in medical care for the wounded and sick on the battlefield. It is noteworthy that the Napoleonic army and auxiliary units of the Polish Legions, which suppressed the anti-French slave uprising in San Domingo (Haiti) in 1790-1804, had the percentage of yellow fever cases as high as 88% (Michalski, 2011, p. 551 (6)).

A variant of typhus was called trench fever (five-day fever, caused by *Bartonella quintana*) widely spread among soldiers fighting in the trenches during World War I, with clothing lice being the vector. The disease was not reported very often between the wars; however, there was a recurrence during World War II, but at a lesser epidemic rate (Ibid., p. 552).

The enteric fevers, a group of diseases caused by contaminated water and food, invariably contributed to high troop losses. These include typhoid fever (*Salmonella typhi*), typhoid fever (*Salmonella paratyphi* A, B, and C), bacterial dysentery (*Shigella*), and cholera (*Vibrio cholerae*).

3. Task convergence of European armies during the Covid-19 pandemic

Despite the pandemic, the priority tasks of the armed forces in various countries are still linked with the maintenance of operational capabilities, continued participation in peacekeeping missions, and fulfilment of commitments to NATO and the EU, in particular ensuring the continuity of duties of NATO Response Forces, EU Battle Groups, and the NATO Readiness Initiative (4 x 30). The analysis of the activities of selected armies in the way they fight with the pandemic allows us to indicate similarities of the tasks, regardless of the specific legal regulations in some countries, for example, the state of an epidemic or state of emergency. It should be emphasized that activities undertaken to fight with the pandemic are carried out both within their own structures in order to protect soldiers and military personnel, as well as to assist civilians with crisis response. Limiting the spread of the coronavirus is to reduce the number of people in central institutions, commands, and headquarters to the necessary minimum. This is achieved by introducing remote or shift work. In the majority of armies, external official contacts have been suspended (in general, visits of small groups are allowed) and replaced with video conferences. In military universities and training centers, remote learning has been introduced for all possible subjects. Similarly, as in civilian education, there has been a rapid development of methods and forms of remote training with the use of various platforms and educational tools. Training in military units is generally conducted according to the decisions of commanders, taking into account the current epidemiological situation in the unit (region). There are orders to wear protective masks during exercises and increased distance between soldiers in every possible situation. Quarantine for soldiers is carried out in designated facilities in military units, specially prepared centers and in some cases in private homes. Following the infection of the crew of the French aircraft carrier Charles de Gaulle in May 2020, isolation rooms were also designated on ships.

There is a diversity of support for the sick and those in quarantine. For instance, French commanders maintain ongoing contact with sick people and their families. This is intended to create a community, which is particularly important during a crisis that has affected the families of soldiers on an equal level with the rest of the society (Note, 2020 (7)).

In a few European armies, which are still based on universal military service, an increased risk of disease occurred during the recruitment and basic training of conscripted soldiers. It is worth noticing that in the Norwegian Armed Forces all conscripts and medical personnel were subjected to compulsory tests.

When analyzing the activities of the armed forces during the pandemic aimed at supporting public administration and providing assistance to societies, one should observe the exceptionally large variety of tasks. The momentum of these activities, as well as systematic information by the press services about the performed tasks, contributed to high ratings of the previous involvement of the armed forces in all described countries.

Generally, all types of armed forces participate in the fight against the pandemic – not only ground forces, but also the air force and navy. Regardless of the involvement of operational forces, one can see an increased effort of the National Guard troops or territorial defense troops. A frequently used solution is the creation of military task forces (including reserves) intended to conduct long-term crisis response operations, for example, Hygea (Italy), Winter Support Force (Great Britain), Balmis and Baluarte (Spain), Corona (Germany). The most typical tasks of the armed forces include:

- participating in border protection, taking care of internal order, supporting air and sea traffic control, and patrolling high-risk areas, such as airports, train stations, ports, etc.
- logistical support, including the identification of needs and management of human and material resources, distribution of materials and equipment, as well as supply of medical personal protective equipment and organization of central logistics or vaccine storage facilities (e.g. the complex in Pratica Di Mare near Rome)
- medical support:
 - the construction of different field hospitals, such as the National Health Service Nightingale in the United Kingdom for the treatment of previously intubated and ventilated patients, Role 2 in Romania, which was previously used during the Ebola virus threat in 2015 and during NATO exercises in 2019
 - development of field emergency rooms, helping with epidemiological segregation before civilian hospitals (Notes, 2020 (8))
 - support with swab collection for coronavirus testing - the variation in testing programs and tests that are in use, such as the UK mass testing pilot program introduced after the second lockdown to identify asymptomatic cases (Ibidem (9)), or the “smart quarantine” program in the Czech Republic (Note, 2020 (10)), the use of military mobile testing groups can be considered as a common solution as well
 - localizing outbreaks and measures to interrupt transmission routes (Note, 2020 (11))
 - nursing care in social welfare homes and for the homeless in care centers
 - participation of soldiers in blood donation actions and donation of blood plasma used to treat severe cases of COVID-19
- organizing specialized medical and emergency units and military personnel for civilian health care needs, for example:
 - in Spain – The Spanish Emergency Military Unit (Spanish: *United Militar de Emergencias* –UME), which consists of about 3.5 thousand soldiers that are ready to provide assistance in case of natural disasters and technical failures, also in conditions of exposure to CBRN agents. The unit, which is composed of 5 rescue battalions, support units, communications, and an air group, is equipped with field hospitals, medical evacuation vehicles, mobile command and communications centers, and firefighting and specialized vehicles used by the fire department, as well as 5 ships capable of serving as hospital units - Galicia, Juan Carlos, Castilla, Patino, Cantabria - (Note, 2020 (12))
 - in the United Kingdom, the Czech Republic, Poland, Romania, Bulgaria, Germany, and Italy: doctors, paramedics, nurses, and even students from military medical schools, have been asked to assist national medical systems
- transportation and evacuation: the use of aircraft, delivery of equipment, medical supplies, food, especially to inaccessible areas, conducting medical evacuations, organizing temporary morgues on military bases
- fighting against fake news
- advising and maintaining relations with crisis management centers at various levels.

The list presented above shows that the most substantial range of tasks is associated with medical and logistical support. Assistance needed in this area also arises during various disasters and mass events, in which the demand for help exceeds the capabilities of local (regional) units. Therefore, one can conclude that in the future many countries will initiate programs to expand military medical services. Undoubtedly, the lessons learnt during the pandemic will justify both the development of national capabilities to respond to biological threats and increased international cooperation.

4. Anti-epidemic protection in the Polish Armed Forces. The role of medical intervention units

Historical conditions, national legislation, allied commitments, as well as involvement in operations outside of the country, including increased risk areas, are the main reasons why prevention and control of infectious diseases in the Polish Armed Forces play such an important role. In the organizational units, which are subject to the Ministry of Defense, the body appointed to perform sanitary supervision (preventive and current) is the Military Sanitary Inspectorate (Journal of Laws of 2019, 59, Article 22 (13)). The following tasks performed by the Inspectorate are noteworthy: conducting epidemiological analyses and assessments, developing plans for preventive and anti-epidemic activities, determining the scope and timing of preventive vaccinations, providing advice on sanitary-epidemiological matters, and directing sanitary actions (Ibidem, Article 5). The aforementioned tasks are carried out by the Military Preventive Medicine Center, which are medical entities financed from the state budget and at the same time military units (Ibidem, Article 22. b). The centers are located in five cities: Bydgoszcz, Gdynia, Kraków, Nowy Dwór Mazowiecki and Wrocław. They cover assigned zones, which are determined on the basis of the administrative division of the country (Journal of Laws, 2020.432, §. 2 (14)). Due to the activities performed in the field, the structure of the Military Preventive Medicine Center includes mobile Biological Reconnaissance Teams. Their main duties include taking samples of infectious (or suspected) material, securing it and delivering to the laboratory at the Military Preventive Medicine Center or another accredited one (Ibidem, §. 4). It is worth emphasizing that teams have the possibility of preliminary identification of selected biological agents, for example, anthrax, cholera, tularemia, Q fever, brucellosis (Kępka, 2009, p. 86 (15)). The high specificity of the tasks performed in emergency conditions translates into the specific equipment, which can be divided into essential groups:

- personal protective equipment (e.g. gas-tight suits of protection level A)
- kits and equipment used for identification purposes, including sampling kits, equipment and reagents for classical microbiology techniques as well as for genetic and biochemical tests
- decontamination equipment, in particular: decontamination tent, high-pressure devices, autoclave, disinfectants (Kępka, 2007, p. 82 (16)).

The Epidemiological Response Centre of the Armed Forces of the Republic of Poland is a medical, mobile unit designated to take action in case of a biological threat. The Centre was established in 2005 on the basis of the then reformed 74th Anti-epidemic Battalion. The decision to establish the Centre was influenced by the increased threat of bioterrorism at the beginning of the 21st century as well as the need for epidemiological protection of Polish Military Contingents participating in operations outside the country. The most important tasks of the Centre include:

- collecting and analyzing information on health and epidemiological threats from theatres of operation and areas where Polish troops are stationed, taking into account medical intelligence needs;
- testing of samples for the diagnosis and identification of outbreaks, including agents classified as biological weapons;
- forecasting the epidemiological situation for decision-making process during emergency response;

The specificity of the tasks performed translates into the unit's equipment, including: microbiological laboratories (mobile - KLM20 type and stationary), a modular infectious disease hospital and decontamination sets, including a Mobile Mass Biological Decontamination Set (17).

5. Epidemiological investigation and information sharing

Timely and accurate exchange of data concerning the occurrence of infectious diseases among soldiers and civilians allows to conduct epidemiological investigation (and consequently, to make optimal decisions to reduce the threat). It also helps to assess whether the epidemic was caused deliberately due to the spread of pathogen, or its background was natural. An epidemiological investigation, conducted whenever a communicable disease is suspected or contracted, aims at identifying an epidemic outbreak and to interrupt established pathways of disease spread. Apart from establishing the disease symptoms and probable source of infection, it includes collecting, storing and delivering to accredited institutions the material for bacteriological, virological and serological tests. Positive infections are registered and reported within the national and international reporting systems.

In the European Union countries, a network for the epidemiological surveillance and control of communicable diseases was established by a decision of the Parliament and the European Council in 1998, providing a permanent link between the Commission and the competent public health authorities in individual countries. (OJ EU, L 293/1 of 22 October 2013, Articles 1-2 (18)). An initiative that greatly improved the efficiency of the information flow was the creation in 2004 of the European Centre for Disease Prevention and Control (ECDC), whose mission is to “identify, assess and communicate current and emerging threats to human health from communicable diseases” (OJ EU L142/1, 30 April 2004, Article 7 (19)).

The key tasks of the Center encompass quality management by monitoring and evaluation of the activities of the epidemiological surveillance network, maintenance of databases, development of scientific expertise, and identification of emerging health threats (Ibid., Articles 5 - (10)).

In Poland the The National Institute of Public Health – National Institute of Hygiene is the most important body which cooperates with European Centre for Disease Prevention and Control and acts as the national contact point. It is the oldest public health institution in Poland and continues the traditions of the National Central Epidemiological Institute, which was established on 21 November 1918. State Central Epidemiological Institute, renamed five years later as the State Institute of Hygiene (NIZP-PZH, Kalendarium, 2018 (20)). The Institute as a state organizational unit, within the meaning of the Act on research institutes (Journal of Laws of 2020, item 1383 (21)) conducts scientific research, development and implementation works in the field of health sciences, including monitoring and analyzing the state of health of the population, epidemiology, diagnosis of infectious diseases, epidemiological surveillance, immunization and many others. NIZP-PZH is the central link of the EPIMELD system, designed to collect, analyze, interpret and archive data concerning infectious diseases in Poland. In accordance with the act of 5 December 2008 on prevention and control of infections and infectious diseases in people, 57 types of infections and infectious diseases are subject to systematic analysis (Journal of Laws of 2020, item 1845, 2112 (22)). There are some dangerous microorganisms and toxins, considered as potential biological warfare agents, suitable for use in acts of terror, for instance, cholera, plague, smallpox, tularemia, viral hemorrhagic fevers, anthrax, botulinum (Jawetz et al., 1991, p. 18 (23)).

6. Sharing information about suspected or diagnosed infections

The exchange of information on suspected or diagnosed infections and infectious diseases between the National Sanitary Inspectorate and the NIPH-NIV is carried out by means of strictly defined electronical forms. On the basis of these forms, daily notifications of cases and collective reports are prepared - bi-weekly, quarterly, semi-annually and annually, including the place of residence, age and sex of the patients and administration of vaccines.

In the North Atlantic Alliance, as part of ongoing operations, transmission of reports on the occurrence of infectious diseases is done using the EpiNATO system. It is designed for epidemiological reporting by medical personnel at all levels of medical security (from 1 to 3). The purpose of the system is to detect cases of infectious diseases, their outbreaks, and to monitor the health situation and the availability of medical resources (Manual, p. 14 (24)). In preliminary assessments of the practical use of the EpiNATO system during the pandemic, some experts emphasized that the transmitted data are underestimated because many soldiers and armed forces personnel are tested in civilian facilities. Thus, incidence information (transmitted in separate systems) does not reach EpiNATO or is recorded late. It is estimated that in some timeframes, the reliability of reports coming from the EpiNATO network may have been as low as 22% (Note, 2020 (25)).

7. The meaning and importance of disinfection

As part of the epidemiological investigation, an anti-epidemic procedure is implemented, which includes elimination of the source of infection, cutting the pathways of disease spread and then eliminating its outbreak. These actions are closely related to disinfection (dis- + infection). This term, according to Article 2, item 7 of the Act of 5 December 2008 on prevention and control of infections and infectious diseases in humans means “the process of reducing the number of biological pathogens through the use of physical and chemical methods” (Journal of Laws of 2020, Item 1845, 2112). However, it should be noted that disinfection does not kill the spore forms of microorganisms. Full sterility is achieved only by sterilization.

The primary goal of disinfection is to interrupt the spread of germs from the source of infection to healthy individuals and to neutralize as many microorganisms as possible, for example, on the skin, in wounds and body cavities. Disinfection activities can be divided into three groups:

- disinfection of human skin and mucous membranes
- disinfection of the environment around a sick person (secretions, linen, equipment, appliances, household items, etc.)
- disinfection of the everyday environment (well and tap water, sewage pits, garbage cans, infrastructure, e.g. means of transport, railway stations, airports, etc.).

Another classification includes:

- preventive (prophylactic) disinfection, which is not directly related to an outbreak of a communicable disease, but relates to elements of the environment that are at risk of infection because they may contain diseased people or carriers
- focal disinfection, which is carried out in foci close to the patient or vector (continuous focal disinfection) or after removal of the infected person from the premises or at the end of the infectious period (terminal focal disinfection).

Destroying microorganisms became possible in the second half of the 19th century with the significant development of microbiology. The research of Pasteur, Koch, Lister, Ehrlich and many others led to the development of disinfection methods and to the emergence of chemical preparations suitable for this purpose. Since then it has been proven that the effectiveness of disinfection is affected by such factors as: the type of disinfectant, its concentration, time of exposure, susceptibility of the microorganism, temperature - an increase in temperature increases the strength of action (e.g. calcium hypochlorite at 37° C kills *Escherichia coli* after only 2 minutes, while at 0° C temperature it is not effective even after several minutes) (Zdzienicki, 1985, p. 83 (26)) - simultaneous presence of organic substances, which significantly reduces the effectiveness of disinfection, the reaction of the environment and the method of solution preparation. Nowadays, the most commonly used chemical disinfectants are aldehydes (glutaric, formic), halogens and chlorine-releasing compounds, phenolic compounds, biguanidine derivatives, alcohols, detergents.

The pandemic we are facing now has caused a significant increase in demand for disinfectants, the search for optimal preparations and effective methods of their application. It is worth observing that the rules for the marketing of biocidal products - substances intended to destroy, repel, neutralize, prevent the action of (...) harmful organisms (...) - is contained in the Act of 13 September 2002 on biocidal products (Journal of Laws of 2015, item 242 (27)). However, a detailed division of these products was made in the Regulation of the Minister of Health of 17 January 2003 on categories and groups of biocidal products according to their purpose (Journal of Laws 2002, No. 16, item 150 (28)). Within Category 1 (disinfectants and biocides for general use, excluding cleaning and washing products, which are not intended for biocidal activity) five groups of products were distinguished, intended for:

- human hygiene
- disinfection of rooms and facilities (including hospitals, industrial facilities, swimming pools, toilets, sewage, medical waste, soils, etc.)
- veterinary hygiene
- disinfection of surfaces which are close to food and animal feedstuffs
- disinfection of drinking water (Ibidem, § 1).

Placing biocidal products on the market requires obtaining a relevant permit (issued by an EU Member State or a state which is a party to the European Free Trade Agreement), and their use is subject to strict safety conditions. It is required, among others, to draw up safety data sheets for high-risk biocidal products or active substances composing them - similarly as in the case of registration, evaluation, authorisation and restriction of chemicals (OJ L 396 of 30 December 2006 (29)) - to use only original, properly labelled and leakproof packaging, and above all, the rational use of biocidal products.

8. Use of chemical troops during the COVID-19 pandemic

In contemporary armies, chemical troops carry out specialized tasks concerning defense against weapons of mass destruction. Their scope of activity includes the protection of troops from a wide range of CBRN threats, going beyond the problems associated with the effects of chemical contamination. This is noticeable in the nomenclature used - in the Czech and Bulgarian armed forces these are the units of Radiological, Antichem and Biological Protection, in Serbia - Defence Against Weapons of Mass Destruction, in the Bundeswehr - ABC, in Great Britain and Italy - CBRN.

In the Polish army, despite using the “traditional” name - chemical troops – there is a comprehensive approach to protection against CBRN threats, including non-military ones, which are related to industrial accidents, acts of terror, natural disasters, etc. Tasks in this area are undertaken in situations where the potential of civilian rescue services is insufficient. The tasks are specified in the Act of 26 April 2007 on crisis management (Journal of Laws of 2020, item 1856, Article 25, paragraph 3 (30)). These tasks include elimination of chemical contamination and biological infections, removal of radioactive contamination, as well as participation in sanitary-hygienic and anti-epidemic undertakings. The above mentioned tasks can be performed both in cooperation with sub-units (specialists) of other types of troops, such as engineering troops, Military Police, health service within ad hoc task groups, as well as independently by full-time chemical troops sub-units.

Conducting disinfection by chemical troops, practiced during training carried out in garrisons and on military training grounds, has been repeatedly verified during operations performed in areas of southern and south-western Poland affected by floods in 1997 - 2013. In this case, disinfection of public buildings, private homes, roads and plots of land was aimed at reducing the risk of infection that may occur after the passage of a flood wave. A number of conclusions, affecting the organization of disinfection during the COVID-19 pandemic, were also developed in 2005-2006 during the preventive disinfection of Polish Military Contingents (soldiers, equipment, supplies) that returned from missions in Africa and Asia (Chad, Congo, Pakistan).

The assignment of chemical troops subunits to support the activities of public administration and emergency services in combating the pandemic occurred on the basis of order No. 80 of 2 March by the Commander General of the Armed Forces (DG RSZ) on the preparation of troops for actions associated with combating epidemiological threats in the Polish Armed Forces and to support civilian health services. In the units of chemical forces (4th and 5th Chemical Regiment) a total of 12 Disinfection Task Forces were created, consisting of 6 to 27 soldiers, assigned to carry out disinfection of equipment, furnishings, rooms, grounds and infrastructure.

In addition, in selected military units of the 18th Mechanized Division, 3rd Flotilla and the Land Forces Training Center, 6 Disinfection Groups (5-20 soldiers) were formed to conduct preventive disinfection in quarantine centers. The basis for solutions concerning the organization, equipment and principles of operation of disinfection teams was the experience gathered in February 2020 during the prophylactic disinfection at selected airports, to which Polish citizens returning to Poland from areas of increased coronavirus risk were subjected (Conception 2020 (31)).

The specific features of the virus and the diversity of disinfection conditions made it necessary to equip Disinfection Groups with equipment ensuring the safety of soldiers and the effectiveness of the treatment. In order to protect the body and respiratory tract of soldiers, various suits of the required 3 or 4 safety level were used, as well as military gas masks with F 21/80-P3 filter absorbers (so-called industrial ones) or biological filters (ABEK P3 XL, PRO2000). Classical decontamination chambers (single- and multi-section), shower frames and various types of portable sprayers, which were used to distribute suitably selected disinfectants, proved to be useful (Table 1).

For disinfection of objects, devices and surfaces sensitive to the impact of solutions (e.g. computers, communication equipment, interiors of combat vehicles) ozonators were used, in which the biocidal agent is the chemical form of oxygen with strong aseptic properties (required concentration of 1 g of ozone per 10 m³ of surface), foggers (fumigators) used to produce dry fog, in which the active substance is usually hydrogen peroxide and also portable UV lamps (Dudziński, 2020, p. 28 (32)).

Table 1. Products used for disinfection by chemical troops

Market name	Market name	Purpose		Comments
		General	Specific	
Perhydrol	30% hydrogen peroxide technical solution - H ₂ O ₂	X		Used in H ₂ O ₂ generators and solution preparation
HyPro technical	7% stabilized hydrogen peroxide solution - H ₂ O ₂	X		
Perhydrol (solution 1 i 2)	Composed of perhydrol (30% technical solution of hydrogen peroxide - H ₂ O ₂) and surfactant	X		Requires mixing perhydrol with surfactant and water
Saiko Max	Concentrate (0.5% solution). Mixture based on non-ionic and cationic surfactants and cationic*	X		Required exposure time - 15 minutes
Trisept Complex	Solution containing 70% ethanol	X		Ready to use
Saiko Zid	Solution containing 64% ethanol and 6% propane 2-ol	X		Ready to use
Virkon S	Mixture of disinfectants in powder form**	X		Solution preparation required (working concentrations 0.5, 1 or 2%). Exposure time dependent on concentration.
Chirosan Plus	Base product in powder form	X		
Perform	Base product in powder form	X		Solution preparation required (working concentrations from 0.5 to 2%). Exposure time dependent on concentration.
Sodium hypochlorite	As a concentrate for solution	X		1% of solution must be prepared
Orlen disinfectant	Solution containing 70% ethanol		Hand disinfection	Ready to use
Bioseptol 80	Solution containing 80% ethanol and 8% propane 2-ol		Hand disinfection	Ready to use

Own study

Source: data from the Armed Forces General Command Weapons of Mass Destruction Defense Board and the Central Contamination Analysis Center Particulars:

* [https://saiko-med.pl/userdata/public/assets//Safety data sheet of 'SAIKO MAX'.pdf](https://saiko-med.pl/userdata/public/assets//Safety%20data%20sheet%20of%20SAIKO%20MAX.pdf)

** <https://www.mccaskie.co.uk/media/1498/virkons-data-sheet.pdf>

The Disinfection Groups operating procedures (continuously modified) include the following main steps and consideration of safety conditions:

- a reconnaissance including, but not limited to, verification of data on infected persons, familiarization with the layout of the facility to be disinfected (access and evacuation routes, area), identification of sources of water for working solutions and waste disposal sites
- preparation for action - designation of safety zones, application of personal protective equipment, checking their fit, preparation of disinfectant, assignment of tasks to individual soldiers, taking into account their rotation
- disinfecting with a variety of biocides (table), checking effectiveness, reporting completion of activities
- safety conditions - soldiers working in pairs, knowledge of alarm signals, the obligation to carry out self-disinfection (paying attention to the correct removal of the mask, protective clothing, gloves, and also to disinfect footwear and surfaces at the wrists), handling of disinfectant waste (placing it in marked plastic bags)
- disinfectant waste (placing them in labeled plastic bags and then in metal boxes labeled with the Biohazard symbol, UN 2814 with the packing bags).

For planning purposes, it has been assumed that a single Disinfection Group can disinfect up to 20 light vehicles (weighing 3-5 tons) or 10 heavy vehicles (over 6 tons) per hour, possibly up to 800 m² of space (Concept, 2020, p. 5 (33)). In practice, the composition of the group is adjusted each time to a specific task. In the event that the capabilities of the Disinfection Group are insufficient, it is envisaged to use full-time contamination elimination subdivisions from Chemical Regiments.

9. Military Task Forces

The wide variety of specialist tasks performed by the army during the pandemic made it necessary to create ad hoc Military Task Forces. In general, apart from chemical subunits, they include units of Military Health Service, logistic and aviation subunits (planes C-295M, planes C-130E, helicopters from Medical Evacuation Air Unit). The formal basis for the creation of Military Task Forces is Article 25 item 5 of the Act of 26 April 2007 on crisis management (Journal of Laws of 2007, item 590 (34)). Of particular importance are the activities of the Military Health Service (carried out within the framework of the Military Task Forces or independently) aimed at ensuring maximum protection of soldiers and supporting the Ministry of Health. As part of civil-military cooperation with the health sector, the Polish Armed Forces launched container field hospitals, intended primarily for patients with respiratory insufficiency, as well as allocated: mobile medical teams (with the task of securing quarantine and providing assistance to the sick throughout the country), sanitary vehicles of various types with staff and medical personnel (doctors, nurses, paramedics). The high consumption of disinfectants, medical materials and protective measures (e.g. HEPA filter masks) made it necessary to look for optimal solutions regarding the Military Task Forces supply system. The identification of the main suppliers, which are: Military Pharmacy and Medical Technology Centre and the Material Reserves Agency) has contributed to the reduction in delivery times. Further observations are related to the transport of disinfectant waste, which according to the International Convention concerning the Carriage of Dangerous Goods and Goods by Road (ADR) is classified as dangerous goods (class 6.2 – infectious materials). Due to the risk posed by these materials, their transport is carried out by specially prepared and equipped Hazardous Material Transport Groups. Their commitment is evidenced by the fact that since the beginning of the pandemic, they have transported about 6 tonnes of waste in 126 convoys of disinfectant waste (Data of 2nd Regional Logistic Base (35)).

A specific group of tasks performed by the armed forces for the benefit of society is taking swabs for testing for the presence of the SARS CoV-2 virus. This task is performed by appropriately prepared elements of the Military Health Service and specially created, within the Territorial Defence Forces, Swab Groups (Decision, 2020 (36)). The types of tests to be used (genetic, antigenic and for detection of antibodies to SARS CoV-2), as well as the procedures for taking swabs and transporting them, are specified in the recommendations of the National Institute of Public Health – National Institute of Hygiene (Recommendations, 2020 (37)).

Summary

In Poland, since the beginning of the outbreak of the pandemic, every day several thousand soldiers have been involved in various activities aimed at reducing the impact of the pandemic. Specific disinfection tasks, with the use of appropriate preparation and equipment, are performed by soldiers of the chemical army. As of January 2021, the balance of these activities is about 5,000 people treated, as well as 9,000 vehicles, 170 aircraft, 240 tons of Cargo, and 900,000 m² of various surfaces (Operational Materials, 2021 (38)). Equally important are the effects of the activities of the Swab Groups, which translate into about 35.3 thousand RT-PCR genetic tests and about 3 000 rapid tests (Data of Epidemiological Response Centre of the Polish Armed Forces (39)). However, these numbers do not reflect the intangible effects of these actions - increased safety of people, especially sick or vulnerable: hospital patients, medical personnel, residents of Nursing Homes, uniformed services officers, officials, etc.

At this stage of the pandemic, it is not possible to fully collect, categorize and compile Lessons Learned on the role of the armed forces in counter-epidemic operations, both to protect their own units and to support the civilian sector. However, one might be tempted to initiate the creation of a database of lessons of experience in this field. Regardless of how extensive the segments of this database will be, the problems related to the improvement of procedures for the use of chemical troops to perform mass decontamination tasks should be among the priorities. Although procedures of sanitary-hygienic and anti-epidemic tasks presented in the article refer to the Polish realities, they are so universal that they can be taken into account in the process of preparing next sets of Multinational Chemical, Biological Radiological and Nuclear Defence Battalion – MN CBRN BN, as well as to improve the rules and forms of cooperation with civil emergency services to protect the population from both biological and chemical and radioactive agents.

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Adherence to Ethical Standards

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