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MILITARY PHARMACY AND MEDICINE

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Military Pharmacy and Medicine is quarterly interdisciplinary journal of Military Centre of Pharmacy and Medical Technique in Celestynów, Poland published in English on scientific, socio-professional and training issues of Military Pharmacy and Medicine.

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Article, no author given:
Cancer in South Africa [editorial]. S Afr Med J 1994;84:15.

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Book, editor(s) as author:
Norman IJ, Redfern SJ, editors. Mental health care for elderly people. New York: Churchill Livingstone; 1996.

Book, Organization as author and publisher:
Institute of Medicine (US). Looking at the future of the Medicaid program. Washington: The Institute; 1992.

Chapter in a book:
Phillips SJ, Whisnant JP. Hypertension and stroke. In: Laragh JH, Brenner BM, editors. Hypertension: pathophysiology, diagnosis, and management. 2nd ed. New York: Raven Press; 1995. p. 465-78.

Conference proceedings:
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Physiology

The role of physical activity in the primary and secondary prevention of atherosclerotic cardiovascular diseases

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Summary:

The paper contains a review of actual information about the role of physical activity as a prophylactic and therapeutic agent in atherosclerotic cardiovascular diseases. It was emphasized that physical activity reduces risk of cardiovascular diseases, diabetes and obesity. The recommended norms and forms of physical activity for healthful training were presented as well.

Key words: physical activity, cardiovascular diseases, prevention of diseases

The importance of physical activity for maintaining health is obvious. Its role as a prophylactic and therapeutic agent of many diseases was emphasized not only by physicians in contemporary times, but also by the great ancient physicians such as Herodicus, Hippocrates, Galen, Avicenna and many other enlightened people. Appropriate physical activity, fitness and endurance are the positive measure of health [6].

Starting from the seventies of the last century, numerous epidemiological researches indicated the significant increase in morbidity and mortality related to cardiovascular system secondary to atherosclerosis and cancer in the industrially and civilizationally developed countries [8, 16, 18, 19]. It may be spoken about the epidemic of such diseases in the developed countries in Europe, North America and Asia. World Health Organisation (WHO) has defined them as diseases of civilisation including obesity, type II diabetes, allergic diseases, mental diseases and some degenerations of the musculoskeletal system. Nowadays, those diseases are classified as non – infectious chronic diseases. These diseases are a high price to pay for the development of human civilization (economic, industrial, urbanization, etc.).

Currently in Poland and developed countries over 50% of all mortalities is linked to complications and acute cardiovascular events secondary to atherosclerosis (myocardial infarction, stroke, atherosclerosis in large arteries). Special place among non – infectious chronic diseases is occupied by metabolic syndrome distinguished by simultaneous occurrence of arterial hypertension, ischaemic heart disease, dislipideamia, type II diabetes and overweight or obesity [2, 21]. The syndrome affects several percent of the adult population in Poland and causes high risk of death. Second place in mortality statistics in developed countries is occupied by cancer (19 to over 20 percent of all deaths

The aim of the paper is to emphasize the role of physical activity in prophylaxis and treatment of selected non – infectious chronic diseases, especially of atherosclerotic diseases of the cardiovascular system.

It is estimated, that our health to the greatest extend depends on us i.e. on our life – style (over 50 %). Physical activity is an important component of life – style in addition to diet, addictions, stress management, quality of leisure and sleep.

Researches has revealed, that physical activity of Poles in different groups according to age and sex is insufficient [5].

There are many well – documented papers indicating, that ischaemic heart disease (IHD) occurs twice as often in physically inactive people compared to active ones, regardless of other risk factors. Dislipideamia (increased level of total cholesterol, LDL cholesterol and blood triglycerides, and reduced level of HDL cholesterol), smoking, hypertension are the other risk factors of IHD. It is assessed, that the risk factors are slightly stronger comparing to the risk of low physical activity [20]. In Poland circa 10 million people suffer from IHD, over 80 % of them is constituted by patients with acute, subacute or chronic coronary insufficiency secondary to atherosclerosis [14]. The diagnosis of IHD is based on the demonstration of prior myocardial infarction, exertional pain or other triggered by strong emotions, or based on the results of the coronary angiography.

Lack of exercise common in the developed countries, sedentary lifestyle and low physical endurance are the risk factors not only of cardiovascular diseases, but also other chronic metabolic diseases, diabetes, hypertension, obesity, metabolic syndrome, colorectal cancer, breast cancer, prostatic cancer and endometrial cancer [3]

Regular physical activity results in many positive changes in the circulatory system and other organs and tissues that have a decisive impact on primary prevention and treatment of chronic atherosclerotic and other metabolic diseases.

According to Jegier [12], direct effect of systematic physical activity on the cardiovascular system includes:

- slowing down resting and maximum heart rate for submaximal workload
- cardiac enlargement and physiological cardiac hypertrophy
- obtaining lower arterial blood pressure at the same workload
- prolongation of diastolic period
- the increase of maximal cardiac output and stroke volume
- the increase of arteriovenous oxygen difference
- increased myocardial capillarisation and dilation of the main coronary arteries
- better physical endurance and improvement of exercise tolerance
- improvement of vascular endothelium function.

The indirect effects of the systematic physical activity on the circulatory system include:

- reduced output of catecholamines
- favourable changes in the haemostasis system
- beneficial modifications of other risk factors of cardiovascular diseases
  - lipid profile (HDL, LDL cholesterol and triglycerides concentration
  - obesity/overweight
  - diabetes/ pre – diabetic state
  - the level of anxiety, the depth of depression

There are various metabolic and physiologic mechanisms, which determine the positive effect of the physical activity on the non – infection chronic diseases.

Physical effort helps maintaining the right body mass and reduces the risk of type II diabetes, hypertension, dislipideamia and metabolic syndrome. In other words, it has a therapeutic and prophylactic significance in these diseases [1, 7, 9, 10, 11, 12, 13,15].

Systematic physical training of moderate intensity increases fibrinolytic activity of plasma, reduces the platelet activity, the level of factor VII and fibrinogen. On the other hand, it has been determined that in untrained people large workloads cause increased activity of coagulation system [1].

In terms of carbohydrate metabolism in physically active people, abnormal blood glucose level on the empty stomach, low tolerance of glucose and insulin are observed. Lower level of insulin in active people results from lower pancreatic secretion and the increase of the rate of its capturing and decay in the tissues [1].

Physical effort influences the sensitivity of adipose tissue to lipolytic agents, increases the activity of lipoprotein lipase, reduces the size of fat cells and as a consequence reduces the adipose tissue mass [1].

Except from increased physical endurance, people who train regularly, have blood volume, haemoglobin concentration and the level of 2,3 – Diphosphoglycerate (2,3 – DPG) in red blood cells increased, what contributes to a better oxygen supply of tissues.

Moderate and regular physical training is beneficial for the immune system, especially for the nonspecific one. After physical effort, the increase of properdin concentration, IgM and IgG concentration, higher phagocytic activity of granulocytes and monocytes is observed. On the other hand, large workload weakens the immune mechanisms. Taking into consideration the functioning inflammatory theory in atherosclerosis etiopathogenesis, beneficial effects of physical activity herein may be expected [13].

In terms of respiratory system, regular physical exercise increases the vital capacity of lungs and improves the ventilation of the lungs.

Moderate exercise improves mood and strengthens the psyche. Such people are able to cope easily with stress and are less prone to addictions (smoking, alcoholism, drug addiction, caffeine substances). They are also less prone to depression and have lower level of anxiety.

According to WOBASZ researches published in 2005, hypertension is a disease that affects 42 % of men and 33 % of women in Poland, [19]. According to other NATPOL PLUS studies [16] conducted in 2002, hypertension affected 29 % of Poles aged 18 – 94 years, with no differences between men and women.

In adults, blood pressure above ¹⁴⁰⁄₉₀ mmHg in resting condition indicated hypertension. The so – called 'White Coat Syndrome' should be taken into consideration, because it may falsify the reading. Physical activity influences normalisation of arterial blood pressure. Given the fact that an organism may respond to the physical effort in a hypertensine way, adequate physical training for people with hypertension should be scrupulously designed.

Mechanisms of systematic physical activity influence on arterial blood pressure lowering in patients with hypertension (according to Jegier) [12]

- the development of vascularisation in muscle fibers
- increased relaxation capability of blood vessels
  - Increased synthesis of nitric oxide (NO) and its availability
  - increased release of prostacyclin PGI2
  - increased release of Endothelium – Derived Hyperpolarizing Factor (EDHF)
  - Increased sensitivity of vascular smooth muscle to the vascular expansion factors (exogenous NO)
- lowering the density of p – receptors
- lowering the activity of renin angiotensin aldosterone system (RAA)
- lowering the level of other hormones
- lowering the sensitivity of baroreceptors
- increase tissue sensitivity for insulin and reduction of hiperinsulinomia
- increased excretion of sodium chloride (NaCl)
- modification of lipid profile; improvement of HDL cholesterol/LDL cholesterol indicator, reducing the level of triglycerides
- economisation of circulatory system (lowering the frequency of heart rate, increased physical capacity)
- reduction of excess body weight. It is estimated that the reduction of 10 kg excess body weight lowers blood pressure by 10 mm Hg.

Positive effects of physical activity in obese and overweight people according to Jegier [12]:

- increased energy expenditure
- reduction of the amount of adipose tissue
- reduction of the size of adipocytes
- lower loss of fat – free body weight
- increased sensitivity of adipose tissue to the activity of lipolitic factors
- • increased activity of lipoprotein lipase
- • increased insulin sensitivity
- improvement of the indicators of lipid and carbohydrate metabolism
- activation of glucose transporters type 4 (GLUT4)
- reduction of the level of glycated haemoglobin and fructosamine
- increased cardiovascular fitness
- lowering arterial blood pressure
- lowering blood viscosity
- improvement of lung ventilation
- improvement of intestinal motility
- anorectic effect – positive changes in lipid profile
- improvement of energy balance
- increased basal metabolic rate
- better mood, improvement of mental state, anxiolytic and antidepressant effect

Physical activity recommended for people with obesity according to Jegier [12]:

- endurance training with intensity of 50 – 70 % of organism action capacity (maximal oxygen consumption – VO2 max)
- marches, march/jog, unloading exercises, cycling, water sports (swimming, rowing, canoeing)
- elimination of bends and bends with body twists from the exercises
- systematic exercises; everyday or at least 5 times a week
- addition of resistance exercises to the training
- training should last 40 – 60 minutes or 20 – 30 minutes, when it is performed twice a day;
  - a training should always begin with a warm – up and end with relaxation exercises
  - a training should include play activities and provide enjoyment to a person
  - competition should be eliminated from a training

Certainly, there are absolute and relative contraindications against systematic physical activity of adults. The decision is made by a patient's general practitioner or cardiologist.

The true question is what are the desirable norms of human physical activity. There are various opinions about the subject. It is known, that weak stimuli sustain vital functions on the minimal level. Strong stimuli result in a positive state of adaptation and training. On the other hand, too strong stimuli

cause disturbances and are harmful [4]. It also concerns post – exercise hormonal secretion [17].

The table below shows the recommendations of Polish authors from Sport Medicine Department in Łódź being the result of their long – lasting observations [12].

Table 1: The recommendations of Polish authors from Sport Medicine Department in Łódź.

Frequency of training	At least 3 times a week
Training intensity	Moderate 40 – 60% Vo2max or 60 – 75 max. heart rate
Duration of training	20 – 60 minutes, circa 40 minutes
The type of training recommended	endurance training
Resistant exercises	10 – 15% of training
Energy expenditure during training	over 1000 kcal/week; ideally over 2000 kcal/week

Table 2: Training heart rate.

Age bracket	Heart Rate (HR)	
	60% HR (bpm_1)	75% HR (bpm1)
21 – 30	115	145
31 – 40	110	140
41 – 50	105	130
51 – 60	100	125
61 – 70	95	115

According to the results of long – lasting studies conducted by the centre in Łódź, the minimal energy expenditure for physical activity is assumed to constitute 1000 kcal per week, although the most beneficial health effects may be gained with energy expenditure about 2000 kcal per week. The expenditure should be divided into 3 – 4 trainings per week. Endurance exercises as the main part of a training should last 30 – 40 minutes and should be preceded by 5 – 10 minutes of warm – up and should end with 10 – 15 minutes of relaxation exercises. Endurance exercises should constitute circa 10 – 15% of the training. It is very important to make sure, that the intensity of exercises is right for the health condition and physical functioning of an organism. Assuming that, there were no contraindications for a person to exercise and physical functioning is on average level, the exercises should be performed on the level of 60 – 75% of maximal heart rate.

The types of physical activity and sport disciplines should be diversified depending on the individual preferences, place or season.

Training heart rate for people without the risk of cardiovascular diseases (according to International Task Force for Prevention Coronary Heart Disease International Atherosclerosis Society 1998) quoted after Jegier is presented below [12].

Table 3: The average energy expenditure in selected sport disciplines.

Discipline	Intensivity	Energy Expenditure
march 5 km/godz table tennis volleyball physical exercises	5 kcal/min	300 kcal/h
tennis badminton	7 kcal/min	420 kcal/h
dance		
basketball	9 kcal/min	540 kcal/h
football swimming 40 min cross – country skiing cycling 20 km/h	10 kcal/min	600 kcal/h
running 10 km/h	> 11 kcal/min	> 660 kcal/h

In conclusion, the special role of systematic physical activity for keeping and maintaining health for the whole life should be emphasized. In shaping the attitude and habits of regular physical activity, the crucial role is to be fulfilled by family, school, work places, self – governments, non – governmental organisations, government and parliament.

Given the fact that, the highest indicators of morbidity and mortality concern atherosclerotic cardiovascular diseases, it is highly justified to make simple rules of health prophylaxis widely known. Such prophylactic measures are the regular physical activity adjusted individually according to health condition, age and physical function. A proper diet constitutes the basis of health besides physical activity.

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Catastrophe Medicine

The cooperation with the units of national rescue system for countering threats in the elimination of the effects of threats

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Summary:

The paper presents the pursuit of further changes in the perception of the role of the armed forces in the modern world, new challenges for the chemical defence forces, a new types of threats that will force to seek new solutions to the problems raised. The problems presented in the paper indicate the necessity of comprehensive examination of the issues concerning non-military threats. The author highlights the role of units and sub-units of chemical defence forces as a part of a system, which has a specialized forces that acting in the National Emergency System may be involved in removing the effects of natural disasters. The army participates with assigned forces and measures in conducting the constant reconnaissance as a part of the National Environmental Monitoring.

Modern threats impose high requirements on the system of chemical defence of the Armed Forces of the Republic of Poland. Therefore, its constant reorganisation is essential to make it capable of responding to the crises. First steps have already been made, whereas the next should be made as soon as possible. They should include:

- updating legal status of the issues concerning the participation of the army in special circumstances (calamities, catastrophes, etc.) and the principles of accounting for such operations;
- implementation of the remaining STANAG concerning the issues of chemical defence units that would allow for full compatibility in operations with other armies of the NATO;
- creating an effective management system of commanding chemical defence based on the computer network and allowing for fast transmission and procession of information;
- planning the principles of chemical defence troops participation in crisis situations;
- with the administrative authorities and local governments;
- equipping the soldiers participating in rescue operations with proper protective clothes, face masks or canisters ensuring safety during operations in contaminated areas.

Key words: the role of the armed forces, National Emergency System, chemical defence, non-military threats.

The inevitability of disasters and failures of technical devices, installations and means of transport is forcing us to undertake projects aiming at reducing the likelihood of risk and the most efficient use of the forces and measures to counter the effects, if such an event occurs. However, the potential and possibilities used within the rescue operations of the forces often exceeds the capabilities of one service. Hence, the desirability of creating a uniform, effective emergency system, which as an essential element of national security system would perform the tasks in an invariable manner either during peace or war.

Such system in our country is currently under construction. It is supposed to consist of subsystems organised to conduct rescue operations during stricly detemined types of events. The subsystems should cooperate with each other in order to achieve the ultimate goal i.e. effective saving of human life and health, property and environment during every possible event caused by the forces

of nature, imperect civilisation progress or militay operations.

Figure 1 presents the essential parts of the National Emergency System i.e.:
- National Rescue and Firefighting System,
- Departamental Rescue Systems
- Rescue Systems of the central and local governments;
- Military Rescue Systems;
- Social Rescue Systems.

Other important links of the common national security system closely operating with the rescue system include:
- systems for maincenance of law and public order,
- border security and protection system.

perform everyday military tasks and the tasks for the army, in case of emergencies can participate and often have already participated in the rescue of people and elimination of the event consequences.

In western countries it is assumed that the state of national security depends on the efficiency of the system capable of confronting crises and threats. Therefore, the possibility of improving the state can be created by using in justified circumstances the 'emergency potential' of the armed forces.

The same possibility is noted in our country. Therefore, the Military Rescue System was created and included in the structures of the National Rescue System. For the time being, however, short-term formation of organisational and functional struc-

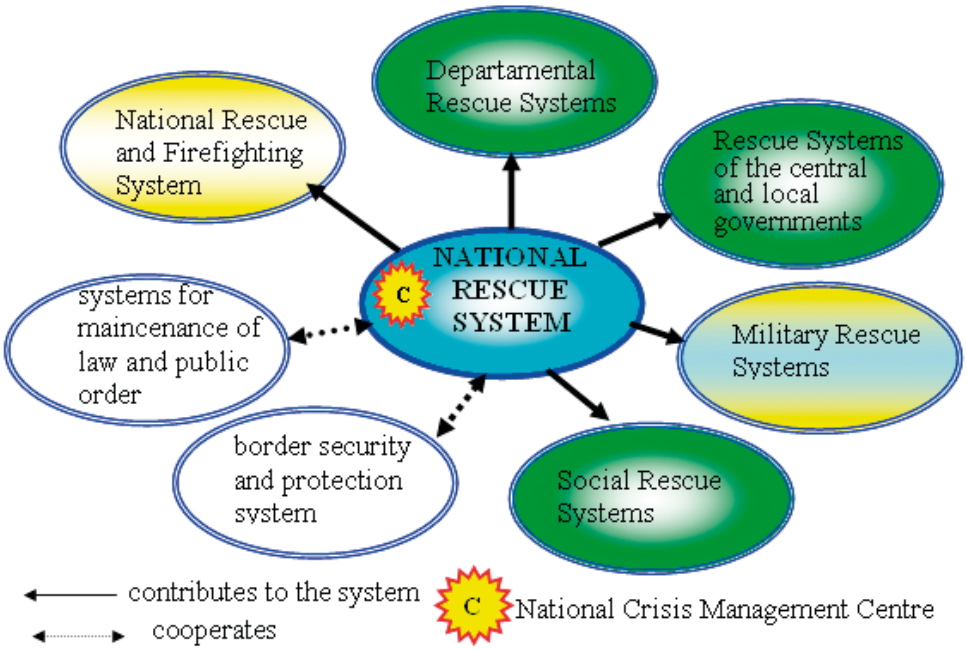

Figure 1: The links of National Emergency System
Source: R. Kalinowski, Ratownictwo.

The leading and most dynamic services in the national emergency system are the units of National Rescue – Firefighting System. However, if its forces and the possibilities of the remaining non-military systems are insufficient, the units of Military Rescue System can be called.

The structure of the Military Rescue System

Military rescue within the meaning of 'general defence' is a rescue performed by dedicated military forces (the proposed structure of the Military Rescue System is shown in Figure 1). The forces which

tures, which would cooperate with the non-military link within the framework of rescue operations, should be taking into account. Army sub-units may perform the tasks including:
- controlling and elimination of the effects of natural disasters,
- cleaning the area from explosive materials,
- providing assistance during flood operations,
- elimination of the effects of chemical failures and radiation accidents,
- assistance in case of catastrophes (e.g. marine, aviation, etc.).

Appropriate superiors (usually the commanding officers of army circles) decide about the use of

various forces (units) for civil operations. Obviously, the entrance of military forces to rescue civilians in accordance with the law generally occurs after the exhaustion of the civilian forces or their total absence.

The most crucial role in Military Rescue System is attributed to the forces assigned for flood operations, following by Chemical and Radiation Rescue Teams of the Polish Amy and specialist engineering patrols. The army can also assign other rescue groups, but only those used the most often have been mentioned.

transport of toxic industrial materials from flooded areas. At the same time, the forces and measures were assigned to eliminate the effects of the flood. After July 15th Chemical Defence Subunits concentrated on the performance of professional operations related to security of the civilians exposed to contamination, mainly biological, by assigning Decontamination and Disinfection Teams to achieve this goal.

The fundamental tasks of the Decontamination and Disinfection Teams during flood operation included:

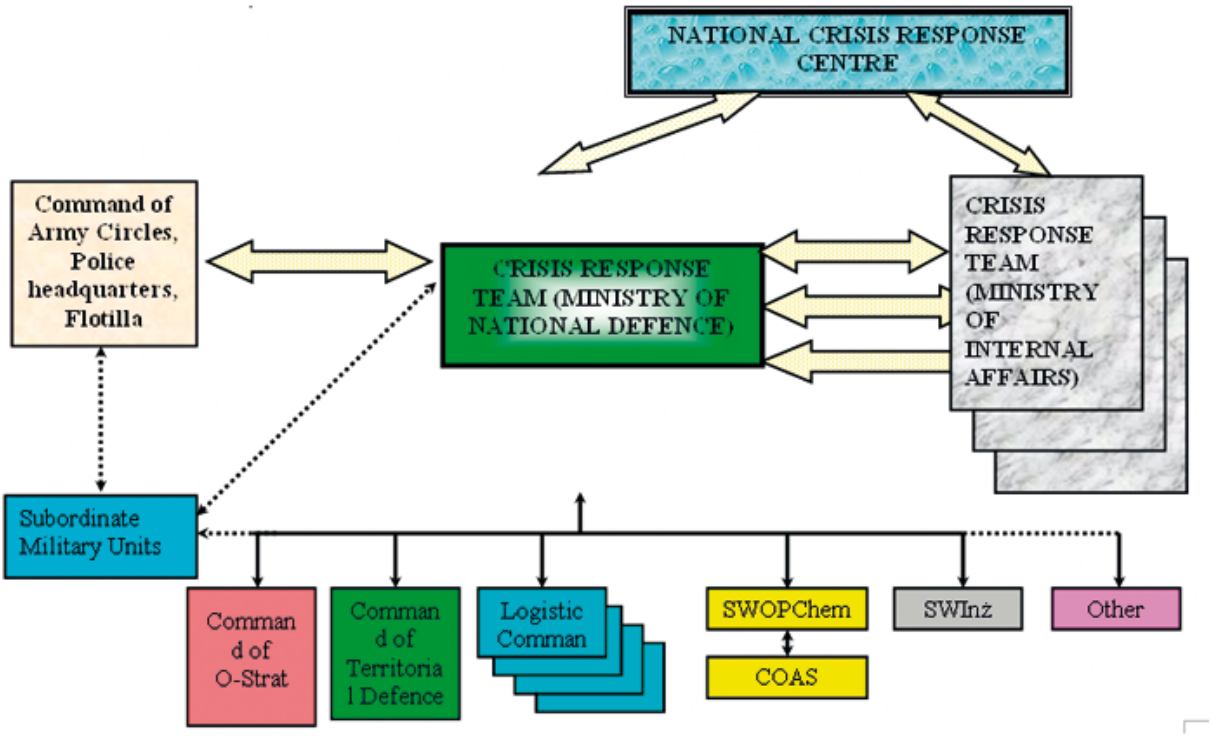

Figure 2: The structure of Military Rescue System (proposal)

The operation of chemical defence sub-units assigned to cooperate with National Rescue System in flood operation.

Among the forces assigned to flood operation, the significant role is played by chemical defence troops, even though they operate during the removal of the flood effects. Taking into account specialist tasks being performed for the injured, it has to be admitted that the fate of thousands of people, who want to return to normality – to their homes, depends of the execution of these tasks.

Chemical defence troops participated in the operation of removing flood risks in south and south-western provinces of Poland since July 14th, 1997. In the first days, they took part in the performance of auxiliary tasks of chemical rescue i.a. securing the

- decontamination and disinfection of the site,
- decontamination (disinfection) in living quarters, utility rooms and public buildings,
- decontamination and disinfection of the vehicles and equipment used for evacuation of contaminated waste and dead animals,
- disinfection of clothes, toxic waste and garbage dumps,
- sanitation treatments (bath) of soldiers and civilians involved in the flood operation,
- disinfection (decontamination) of protective clothing and personal items,
- supplying the population of flooded areas with drinking water and industrial water.

The decontamination subunits are the best prepared for implementation of such tasks. They performed

them in July and August 1997. All of the above-mentioned tasks were implemented.

At first, the Fifth Chemical Defence Battalion from Tarnowskie Góry and First Chemical Defence Battalion from Zgorzelec were used by decision of the commanders of circles, and then (from 17 July), in connection with the growing biological threat, the Fourth Chemical Defence Platoon from Brodnica and the Third Chemical Defence Battalion from Biskupiec were assigned on the orders of the Head of the Polish General Staff. Only Second Chemical Defence Battalion remained in the circle due to the high risk of flooding i.a. in Szczecin. Therefore, the battalion was ordered to maintain forces and measures in readiness to be used in Pomeranian Army Circle.

With no doubt, the largest forces used came from the Fifth Chemical Defence Battalion – in total 185 soldiers, organized into seven decontamination teams (including two backup battalions) and one clothing decontamination team. The result of their work was decontamination 54 hectares of land, removing 1,600 pieces of animal carcasses, assistance in repairing and strengthening the levees, evacuation of the reagents from Field Sanitary-Epidemiological Station in Racibórz and mainly decontamination of hundreds of buildings and farms (the qualitative list of the tasks performed by the Fifth Chemical Defence Battalion is shown in table 1).

Table 1: The qualitative list of the tasks performed by the Fifth Chemical Defence Battalion

818	Buildings (ct)
23	Schools (ct)
1 358	Farms (ct)
4	Churches (ct)
9	Workplaces (ct)
2	Sewage treatment plants (ct)
3	Urban garbage dumps (ct)
3	Cemetery (ct)
1	Water treatment stations (ct)
1	Vehicles (ct)

Source: [2].

Table 2: The qualitative list of the tasks performed by the Fifth Chemical Defence Battalion

1095	Buildings (ct)
35	Schools (ct)
771	Farms (ct)
4	Churches (ct)
73	Workplaces (ct)
1 102	Other (ct)
7421	Sanitary Treatment (person)
3	Urban garbage dumps (ct)
52	Decontamination of the means of transport (ct)
612 480	Special Treatment of roads and buildings(m2)
107 000	Water supply (litres)

Source: [2].

The Third Chemical Defence Battalion assigned 57 soldiers organised in decontamination teams for flood operations. However, it should be admitted that despite the involvement of smaller rescue teams in the activities, the effectiveness of these groups was as high as of the Fifth Chemical Defence Battalion. The effects of their actions are shown in table 2.

Table 3: The qualitative list of the tasks performed by the Fourth Chemical Defence Platoon

225	Military buildings	Public buildings (ct)
	Schools	
	Hospitals	
	Archives	
190 000	Total surface area of decontaminated buildings (m2)	
90 000	Total surface area of decontaminated land	
5 000	Decontaminated clothing (pc)	
1 200	Sanitary treatment (person)	

Source: [2].

The smallest forces to eliminate the effects of flood were assigned by the Fourth Chemical Defence Platoon and the First Chemical Defence Battalion in the number of 27 soldiers. These units also formed decontamination teams. In case of the Fourth Chemical Defence Platoon one of three teams was extended with uniform decontamination team. Moreover, they proved that well-organised action,

perfect training and reliability of equipment affect the quality and quantity of work. Despite fewer soldiers assigned to the operation, they could vaunt the great success. The effects of their actions are shown in table 3 and 4.

Table 4: The qualitative list of the tasks performed by the First Chemical Defence Battalion

23	Schools and nurseries (pc)
10	Public buildings (pc)
20	Military buildings (pc)
15	Plants (pc)
104	Apartments (pc)
1	Cemetery (pc)
4165	Sanitary treatment (person)
88	Vehicle disinfection (pc)
270 500	Water supply (litres)
601 102	Land and road disinfection (m^2)

Source: [2].

Despite many successes during the flood operation rescue services did not avoid mistakes both in the regulatory field (independently of the forces engaged in the operation) and the organizational and technical field. The main disadvantages include:

1) lack of a precise act on natural disasters that led to different interpretations of laws and hampered rescue operations;
2) lack of legal regulations concerning the sources of funding of the emergency services involved in the operation;
3) poor preparation of emergency services in case of a crisis situation (lack of emergency equipment and logistics support);
4) lack of an efficient communications system during a rescue operation;
5) insufficient ZP – 800 pump performance;
6) onerousness of task performance in protective clothing

Proposals, which have been submitted during the flood, became the basis to start work on the matching existing laws and to create new standards for proper and efficient operation after the risk. In addition, work on the construction of communications network have begun, which would ensure the proper functioning of the emergency forces in the affected area. A possibility to equip decontamination subunits with devices with better performance (a new type of motor pumps with increased discharge power). The question remains, whether we can fully take advantage of the experiences from the flood. There is no doubt that during the flood operation the subunits of Chemical Defence Troops have once again proved that they are able to response not only to war threats. but they can very well cope with the effects of threats during the crisis or peacetime. Their role in the rescue system of our country influencing the national security was highlighted. The more efficient the operation of rescue system is, the greater stability of the country, the higher the level of security. This demonstrates clearly the need to maintain and even expand and improve existing National Rescue System, and thus increase the potential of Chemical Defence Forces that can respond effectively to the consequences of the risks of today's world.

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Biology

Attempts to the construction and application of hybrid artificial organs

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Summary:

The construction and application of hybrid artificial organs is an alternative method for therapy with the use of immunosuppressants that must be used for the donor cells to survive in the recipient organism. The method of preparation of hybrid organs is based on the isolation of cells and coating them with polymer layers thus forming micro- or macrocapsules. It is essential that the polymer layers are permeable for nutrition and simultaneously posses abilities to block the foreign body reaction. Despite the range of solutions to the problem of the preparation of hybrid organs, there is still a room for a novelty in this area. These comprise the chemical structure of the polymer layers and interactions of the structures with a recipient immunological system, which influence on the clinical applications of hybrid organs.

Key words: hybrid artificial organ; immunosuppression

Introduction

The most difficult issue associated with the transplantation of cells or structures of allogenic or xenogenic origin obtained from an endocrine organ is a problem of immunological tolerance on the part of recipient organism.

The use of hybrid artificial organs is a method which would eliminate this unfavourable phenomenon without the need of administering immunosuppressive agents. The organ consists of isolated cells with a polymer layer which protects transplanted structures from recipients immunological factors. Despite numerous structural studies and patent specifications concerning the structure of such organ, it is still an imperfect creation.

Extensive research conducted in leading laboratories in the world in order to develop the best solutions in this field indicate the rank of the problem. Each new solution in this field brings forward the moment of wider application of such organ as an alternative solution for the transplantation of the entire organ.

Artificial hybrid organ

The design of hybrid organ involves coating of isolated cell of allogenic or xenogenic origin with half-permeable polymer membrane. The task of the membrane is to isolate donor cells from recipient immunological factors. Simultaneously, this membrane should be permeable for gases such as oxygen, carbon dioxide, nutrient substances and substances secreted by coated cells due to the outer stimulation [1-2]. The cover should serve as a molecular sieve which passes proteins of low and medium molecular weight and stops proteins of high molecular weight such as immunoglobulins G and M and cells involved in grant rejection [3] (Fig. 1).

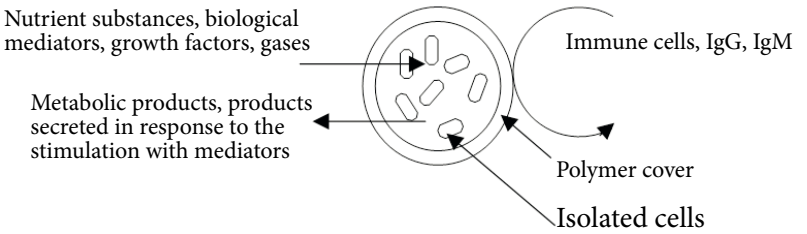

Figure 1: A diagam of the functioning of hybid organ.

Studies on obtaining polymer cover with perfect kinetics seek to find a material which is biocompatible with donor cells and recipient tissue. Simultaneously, such conditions and methods of polymerization process during production of a cover are being developed that would not lead to the destruction of closed cells.

Polymer cover should ensure the long-term survival of cell closed inside and should not biodegrade after implantation.

Basic techniques of cell encapsulation with the use of polymers

Numerous studies and patent specifications are dedicated to the solutions concerning hybrid pancreas [1,4-6], whereas only few studies relate to the structure of hybrid liver [7-10], parathyroid gland [10] and artificial muscules [11]. Solutions of a cover applied so far for transplantable structures and cells related to the construction of artificial pancreas are hollow – fiber type constructions [12-16] implanted to the organism outside the bloodstream or connected to the bloodstream. Other solutions used in this field include the construction of polymer macrocapsules [17-19] and the largest group of solutions concerning the fabrication of microcapsules [19-24].

Numerous techniques for producing polymer covers in the process of microencapsulation have been developed so far. The best known method was developed by Dupuy and is called **interfacial polymerisation** [25-26]. It involves the formation of capsules of water-insoluble polymer which forms from water-soluble monomers. The reaction leading to the formation of a cover around alginate beads containing cells is catalysed with light. The cover was formed of acryloamide (AAm) and bisacryloamide in the process of free radical polymerisation.

Another method of **interfacial precipitation** was developed by Sefton [23]. He used copolymer of 2-Hydroxyethyl methacrylate – methyl methacrylate (HEMA – MMA) dissolved in polyethylene glycol (PEG) with polyvinylpyrrolidone (PVP) to form a membrane. The size of the pores in the wall of the capsule was dependant on PVP, which higher concentration caused an increase of pores in the wall of the cover. A membrane precipitated by this method has very good physical parameters. Capsules are spherical, whereas the wall of the membrane are of the same thickness. The process of membrane formation is not bland for the cells, because it is performed in anhydrous conditions and hexadecane is used for extraction.

Interfacial adsorption and polyelectrolyte complexation proposed by Lim and Sun [27] involve the formation of alginate beads cross-linked with calcium ions that contain cells. Such structures are subjected to complexation with aqueous solution of poly-L-lysine (PLL). The result of this process is a complexation between anionic alginate surface and positively charged poly-L-lysine. Thin PLL cover is formed as a result of interfacial adsorption.

The use of alginate cross-linked with calcium ions to cell encapsulation seems to be the most common method. The majority of modification techniques concerns additional enhancement of the wall of the capsule through combining alginate with other nontoxic polymers with the opposite charge in relation to its surface charge. Alginate may be also coated with chemically cross-linked synthetic polymers [28] or with the use of light as an initiator of polymerisation process [29].

Major directions of studies in the process of construction of artificial hybrid organs

Hybrid organs are subjects to numerous intense research. A successful solution to the issues of physic-chemical and biological nature in the process of their construction would enable allogenic or xenogenic cell transplants on a large scale without the need to administer immunosuppressive agents.

The following issues dominate in the numerous studies related to the constructional problems of hybrid organ:

1) the selection of a polymer to construct the cover,
2) the selection of 'soft' conditions of polymerisation for biological structures being closed,
3) the development *in vitro* and *in vivo* tests for:
   a) determination of polymer biocompatibility,
   b) duration of its biodegradation,
   c) assessment of the number of cells closed in the capsules, and thus the number of capsules implanted in a recipient in order to restore endocrine function of the organ or support its function
   d) determination of the life span of the coated cells

4) finding the most favourable area in the organism to implant such an organ and the possibility to replace it in as non-invasive way as possible.
5) obtaining reproducible techniques of encapsulation for development of technological method of its fabrication.

The results of experimental and clinical applications of artificial hybrid organs

Implantation of biomaterial as a foreign body always starts numerous reactions of immunological system. Macrophages and cells that cooperate with them secrete substances e.g. interleukin or fibronectin, which cause the accumulation and proliferation of fibroblasts [30 -31].

On such cellular stroma a fibrous connective tissue around the implant is formed consisting mainly of collagen. Freemen *et al.* have revealed that the connective tissue, which surrounded silicone implants, caused twenty to hundredfold reduction of diffusion speed of glucose through the walls of the capsules [32]. First attempts to form encapsulated cells with the use of alginate for the purpose of transplantology were made in 1970s. However, it were Lima's studies [27] on the construction of hybrid pancreas that have contributed to significant popularisation of the method.

Lima has polymerised sodium alginate mixture with isolated islets of Langerhans in $CaCl^2$ solution and afterwards using negatively charged surface of cross-linked alginate he combined it with poly-L-lysine with positive charge and thus formed the external cover. The main disadvantage of this method is toxicity of PLL for encapsulated cells, which in time became replaced with dextran, chitosan and other polymers [33]. The external cover with PLL favoured also the formation of thick layer of connective tissue around the capsule after the implantation.

Methods of encapsulation with the use of agarose in the process of microcapsules fabrication, in which single islets were present, as well as alginate capsules with closed islets are described in the review paper written by Hiro Iwata [20].

Shorter or longer periods of euglycaemia obtained in experimental conditions after implantation of coat islets to the organism of animals indicated that the islets are alive and function without being destructed by recipient immunological system.

However a capsule fabricated with the use of interfacial precipitation by Stefton [23] (Fig. 2) had excellent physic-chemical parameters of the wall, it prevents in the direct way watching what is happening with closed cells. According to the author, such membrane protects encapsulated cells from the interference of the immune system, but there have been no information so far about wider application *in vivo* of such system.

In case of transplanting β cells isolated from the islets of Langerhans of the pancreas or the entire islets the

Figure 2: SEM image of a part of the wall of the capsule fabricated by Sefton. The wall was fabricated of copolymer HEMA – MMA dissolved in PEG with or the without addition of PVP.

attention was focused on the fact that one of the condition of maintaining euglycaemia for a longer period after a graft kept functioning is suitable large number of isolated, active cells or islets used for the graft [35-36]. Transplantation of too small number of these structures leads to brief improvement of glycaemia and then cells die of 'overwork' as they cannot cope with extensive secretion of insulin in response to excessive stimulation by glucose.

Developed methods of isolation the islets from the pancreas cause many losses of active structures. As a consequence, only a small part of obtained islets may be used for a transplant. The attempts have been made to breed isolated islets in *in vitro* conditions and after their multiplication they were implanted to the recipient's organism [36].

In case of the encapsulation of isolated islets with a polymer, a specified number of islets is necessary to obtain the state of euglycaemia as well. The goal may be achieved by coating multiplied islets from the culture *in vitro*, coating the islets coming from several pancreas and gathering frozen microencapsulated islets in a bank [37].

Despite a significant progress in the field of construction of artificial hybrid organ have been made in numerous major laboratories in the world, its clinical application have been reported only in few cases. In 1980 Valente [38] described implantation

of closed 15000 to 90000 isolated islets of Langerhans in the covers of Milipore membrane with pores sized 0.46 μm. The state of euglycaemia was obtained in two among 13 patients for three months, whereas in the rest the administration of insulin was reduced for 12.5 to 77.7% of a starting dose.

In 1994 the implantation of microcapsules with the islets of Langerhans closed in cross-linked with calcium ions sodium alginate complexated with poly-L-lyzine was described by Soon – Shiong *et al.* [39]. 678000 isolated human islets obtained from three pancreatic glands were implanted. Six months after transplant 340000 encapsulated islets were additionally implanted. The state of euglycaemia was obtained for the period of 3 months.

Selected results of the studies conducted in research units in Lodz

In 1997-2010 the construction of artificial hybrid organ [41-49] was being developed and patented [40] based on the system of multilayered macrocapsule made of sodium alginate with multi-chambered core (Fig. 3) covered with a layer of synthetic polymer PMMA (Fig. 4 and 5) at the Institute of Applied Radiation Chemistry, Technical University in Lodz, the Laboratory of Experimental Surgery attached to the Endocrine and General Surgery

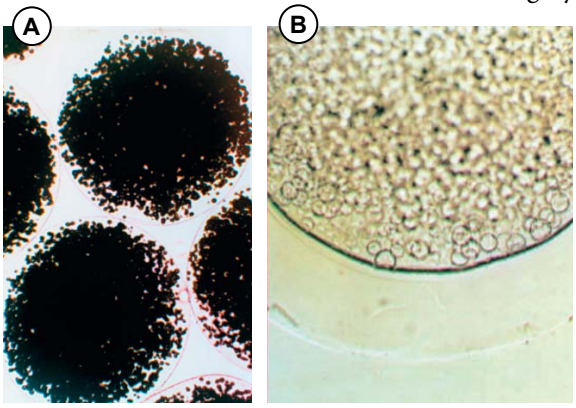

Figure 3: Chambered coremade of 1,5% sodiumalginatecross-linked with calcium ions (A) andcovered with a layer of 3% sodiumalginate (B).

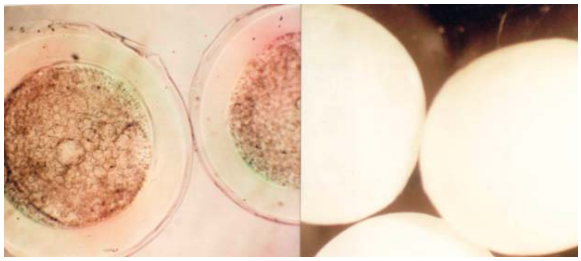

Figure 4: Multilayeredcapsulesodium alginate cross-linked with calcium ions and covered with external layer of PMMA.

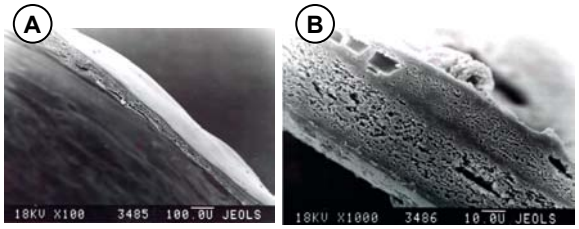

Figure 5: SEM images of the structure of the external cover made of PMMA: A: zoom x 100; B: zoom x 1000.

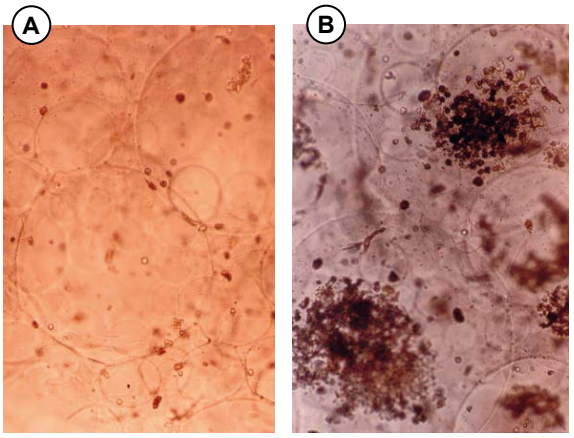

Figure 6: The development of encapsulated fibroblasts in multi-chambered core cultured *in vivo*. A: immediately after encapsulation; B: after 28 days

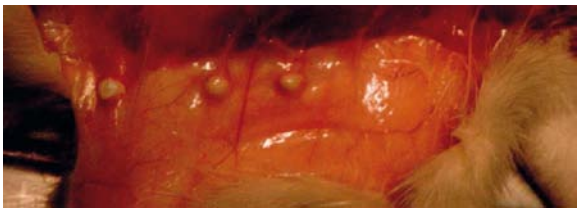

Figure 7: *In vivo* testing of capsuleswith a cover made of PMMA (viewed after 28 days after implantation to the skin of Wistar dog).

Clinic of Medical University in Lodz and Medical University in L'Aquila in Italy.

In *in vitro* studies such system proved to be friendly for multiplication of fibroblasts closed in it (Fig. 6) and polymer cover demonstrated full biocompatibility with the surrounding tissue in *in vivo* tests conditions (Fig. 7).

The cooperation of the Institute of Technical Biochemistry with Laboratory of Experimental Surgery attached to the Endocrine and General Surgery Clinic of Medical University in Lodz gave the possibility of testing *in vivo* other natural polymer in an animal model i.e. bacterial bionanocellulose produced in form of tubes by bacteria Gluconacetobacter xylinus E25 in stationary cultures. Thus obtained tubes as composites with 0.5% alginates were used to coat

implanted follicular epithelial cell of the thyroid (Fig. 8) placed in peritoneal cavity of Wistar rats that had previously had total thyroidectomy.

Within 3 weeks after the implementation of such graft, the level of T3,T4,fT3 and fT4 hormones

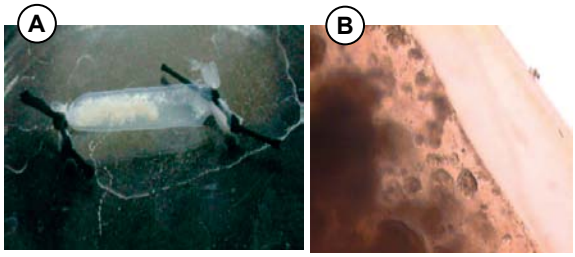

Figure 8: Bionanocelluloid cover for implanted allogenic thyroid follicular cells.A: the view ofhybridstructure; B: a part of hybrid structure with thyroid follicular cells; zoom x100

in peripheral blood was measured in the group of rats after thyroidectomy. After 3 weeks it was the same as before thyroidectomy. Histological and pathological tests of the area of thyroidectomy have not demonstrated that the same level of hormones was the effect of leaving some parts of pancreatic tissue in the resection area.

In the view of the lack of progress in the field of immunological tolerance in transplantology the concept of the application of hybrid artificial organ soon will become one of the most developmental branches of medicine in leading laboratories in the world. The development and application of such

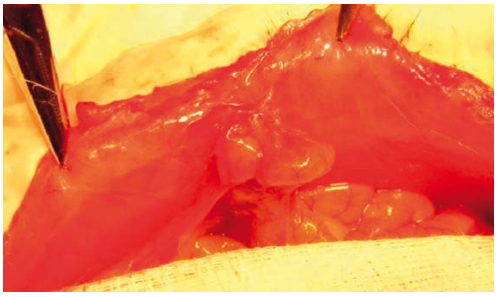

Figure 9: Bionanocelluloid tube implanted to peritoneal cavity of Wistar rat, 3 weeks after implantation.

constructed organ in clinical conditions will require interdisciplinary cooperation of scientists – chemists, biologists and physicians.

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Military Medicine

Equipment and measures of individual and collective protection used in chemical rescue in 1945 – 2000. Part III

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Summary:

The paper describes a modern, lightweight, insulating, disposable protective clothing. Modern gas-tight overalls are characterised, being the part of the Individual Protective Set and Barrier Protective Clothing. The author depicts a filtering ventilation device co-operating with a gas-tight garment and also makes a comparison of protective properties of gas-tight garment with Barrier Protective Clothing and Polish Filtrating Protective Clothing. The division of collective protection measures was presented as well.

Key words: chemical contamination, comparison and types of protective clothing, the division of collective protection measures.

Light protective clothing is a modern solution adopted by numerous countries. It is a disposable, cheap clothing put on clothes and footwear that can be characterised with low mass and relatively long protection time (about 12 hours). The clothing may also form part of the individual protective equipment.

In Poland, there is work in progress on implementation of Light Insulation Protective Clothing (LIPC) presented in Fig. 1, developed by the Military Institute of Chemistry and Radiometry (WICHiR). It is intended for the Army, the crews of the Navy, aircraft and helicopter crews, aviation technical personnel. It may also constitute military equipment of chemical rescue sub-units, sampling units, shelters and hiding places for collective protection of the army and civilians. This is a two-piece clothing consisting of sweatshirts with integrated hood and pants with integrated rubber shoes. The duration of protection time against the drops of chemical agents amounts to 12 hours and its total weight does not exceed 1.5 kg. It is produced in three sizes. Storage period amounts to 15 years.

Gas-tight garment is also an insulating clothing used by specialist chemical rescue teams as an additional equipment of chemical subunits and specialist teams for contamination detection. It ensures the highest level of protection and is intended for operation in particularly hazardous conditions (contact with liquid chemical agents, toxic industrial materials, lack of oxygen). The main focus is put on its protective properties (also against toxic industrial materials) and therefore it is not intended for combat. It consists of one-piece overalls adjusted to cooperate with breathing apparatus or filtering and ventilating devices (with a blow) and cooling systems. These devices can be worn under the overalls or on the outside. In order to obtain a better seal (to avoid problems connected with appropriate seal of the mask and hood connection), solutions with a panoramic widescreen.

Figure 1: Light Insulation Protective Clothing.
Source: WICHiR materials..

The clothing may be subjected to decontamination procedures. It is also used by civil rescue units.

Being a part of Individual Protective Set (IZO-1) (Fig. 2), the gas-tight garment is used by the Armed Forces of the Republic of Poland and in chemical rescue as a permanent equipment of military teams of specialists of chemical rescue and additional equipment of chemical and specialist teams of the Air Forces and the Navy.

It provides protection for the respiratory system and the entire body surface during:

Figure 2: Gas-tight garment of Individual Protective Set IZO-1.

Source: The materials of Milagro Powlekarnia Ltd. company.

- conducting contamination detection in the areas of high concentration of chemical agents or in areas poor in oxygen threatening with rapid loss of the protective properties of the absorbent filters in the gas mask,
- operations in the failure sire with contamination zones with toxic industrial materials, radioactive substances, chemical and biological agents occurring in all possible forms,
- evacuation of the casualties from the risk zone (area of contamination).

It is a one-piece overalls designed for cooperation with pressure breathing apparatus worn outside. It has an integrated hood and footwear. The sleeves of the garment are ended with stiff cuffs on which soft rubber cuffs and rubber gloves are worn. In front of the overalls there are two valves allowing for appropriate inside ventilation i.e. the inlet valve, which can be combined with breathing apparatus and outlet valve through which the used air is removed outside the overalls. Inlet valve is combined with a system of hoses distributing the air inside the garment. The overalls is fastened at the front from the top with gas-tight zip.

Barrier Protective Clothing (Fig. 3) is intended for decontamination subunits and specialists of chemical rescue. It was developed by WIChiR with cooperation with Milagro Powlekarnia Ltd.

Together with MP-5 gas mask, it provides protection against the action of chemical and biological agents and after the application of appropriate combined filters it protects also against toxic chemical materials. The clothing includes: protective overalls, protective gloves (the same as in filter protective clothing) and filtering ventilation device. Barrier Protective Clothing has the one-piece structure with permanently integrated rubber boots and hood. A panoramic widescreen ensuring good visibility and protecting the gas mask is pasted into the hood. The sleeves are ended with stiff cuffs with internal rubber seal. Protective gloves are put on the cuffs. In the back of the hood there are exhaust valves enabling the air excess to flow from the space under the clothes. On both sides of the torso at the waist the overalls have a connection to the filtering and ventilation device. In order to provide greater security and comfort, the air supplied from the filtering and ventilation device is supplied to absorbent filter of the mask by a pipe. The overalls are fastened with gas-tight zip.

Figure 3: Barrier Protective Clothing.

Source: materials of WIChiR).

A filtering ventilation device (Fig. 4) consists of two self-powered filtering blow devices placed on a light frame. The Frame is equipped with switches and carrying belts. It is carried on the back. The device is adapted to cooperate with six typical absorbent filters for gas masks (e.g. FP-5). Its operation time is at least 7 hours.

Figure 4: Filtering ventilation device of Barrier Protective Clothing

Source: Materials of WIChiR).

The efficient operation of insulating clothing is possible only during a relatively short period of time, especially during intense physical exertion and high temperature. This fact is a reason of annoying restrictions in the conduct of activities and is the main reason for the abandonment of this type of clothing in combat solutions. The application of sorptive filtering materials enabled assimilation of protective clothing to combat clothing. The sorptive filtering layer provides very good protective properties against vapours of chemical agents, but its resistance to these agents in a liquid or aerosol form is significantly lower. Improvement of the resistance is gained by application in the clothing of external layer protecting the sorptive filtering layer against agent in a liquid or aerosol form. Most of the solutions applied in filtering protective clothing are also applied in combat clothing. There are also solutions

intended for use by aircraft and helicopters crews and crews of combat vehicles. They may be in form of overalls or protective underwear.

The combat clothing aims to maximize the approximation of the functional characteristics to the normal uniforms. It is usually two-piece clothing consisting of a jacket with integrated hood and trousers. Other elements include: protective footwear and gloves made of insulating materials.

Figure 5: Polish filtrating protective clothing.
Source: materials of WIChiR,

Filtering protective clothing (Fig. 5) is the equipment of the Armed Forces of the Republic of Poland and it can be characterized with comparable world solutions. The protection time against the vapours of chemical agents equals at least 24 hours, whereas against drops and aerosols at least 8 hours. It maintains its protective properties after 30 days of wearing in normal conditions (no chemical contamination) and after 6 washing cycles. Storage time in factory packaging amounts to 15 years. Footwear and gloves provide 24-hour protection time against chemical agents in liquid form.

Polish filtering protective clothing consists of two pieces (jacket and trousers). It is double-layered. The external layer is made of knitted fabric with hydrophobic, oleophobic and additionally non-flammable layer with disruptive pattern in green, brown and black. The internal layer is made of filtering sorptive fabric SARATOGA with active carbon in the form of beads deposited on the fabric.

The jacket is fastened with a zip secured from the outside with flap of material with Velcro-type fastening placed along the entire length. A rubber welt placed in the tunnel at the edge of the hood is used to seal the connection with the gas mask. The connection of the sleeve and the glove is sealed with a leak stopper sewed on the outside of the sleeves. The perimeter sealant is adjusted by the tape with Velcro-type fastening. The loops to be put on the thumbs are sewed on the sleeves. At the level of the waist, the jacket has a tunnel with a string, regulated from the inside. The lower edge of the jacket is finished with a rib placed in the tunnel. The trousers with textile-rubber braces have wide legs so that they can be put on without taking off the footwear. The zip is secured on its entire length with a flap with Velcro-type fastening. The connection of the footwear with the leg is sealed with a seal sewed on the outside of the legs.

An important parameter of filtrating protective clothing is its functionality (time of wearing) in normal conditions i.e. without the occurrence of contamination. It is the time of its use after which it still maintains its protective properties (protection time against various agents). The reason for this limitation is absorption the pollution from the surroundings (sweat, smoke, etc.) by active carbon and the loss of its sorptive parameters. Therefore, after removing the clothes from the hermetic packaging, its wearing rime should be strictly controlled i.e. it should last for 30 - 45 days and also it depends on whether the garment is washed during that time. A significant reduction of protective properties of filtrating garment occurs as a result of wetting the sorptive filtering layer with petroleum products, urine or faeces. In such event it is recommended to replace it as soon as possible.

Filtrating clothing is not susceptible to decontamination, because toxic agents absorbed by active carbon cannot be removed. This fact is assiduously ignored by the manufacturers. The agents can be released to the environment after some time (especially in increased temperature).

Protective gloves and footwear are the additional parts of filtrating clothing. They are made usually of insulating materials. A major problem when operating the equipment is to have a protective gloves allowing for the operation (hindering to the acceptable degree). Gloves with a thickness of 0.2 mm are used by staff performing tasks requiring special precision and intuition, under conditions non-threatening with strong pollution. Those of 0.4 mm thickness are used by flying crews, crews of combat vehicles and military equipment service. Gloves with a thickness of 0.6 mm are intended for the remaining personnel. Gloves with thicknesses of 0.4 mm and 0.6 mm

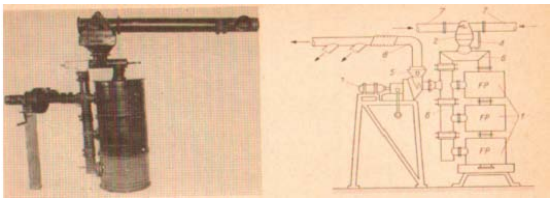

Figure 6: Filtering device designed for installation in a stationary object.

provide protection for 24 hours, while the thinnest ones provide protection for 6 hours. Gloves used with the Polish filtering protective clothing provide protection for 24 hours.

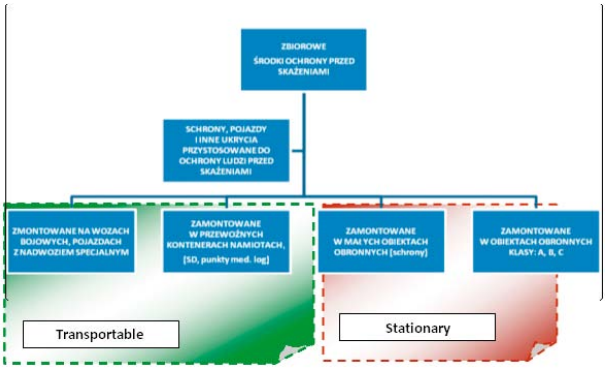

Figure 7: The division of collective means for protection against contamination.

protection. They are also responsible for formation of overpressure in the inside to prevents the ingress of contamination into the interior design through any leaks.

The air supplied to the inside of the shelter is cleaned in a similar way as in gas mask with the use of filtering absorbents based on the active carbon. The walls of the building, armour, hull, or layer of material may create a protective barrier against contamination depending on the type of the object.

The development of insulating materials (similar as used in protective clothing) has enabled the devel-

Figure 8: Light collective protection system: a) view on the set of tents, b) interior view, c) entrance lock with containers for water and sewage, d) high-pressure washing device to supply the shower with power and containers for surfaceactive agents, e) entrance lock - view from inside the tent, f) sanitation lock

Source: materials of WIChiR.

Filtrating protective clothing is currently commonly used due to the low physiological load of the organism and comfort. However, this solution has some limitations (not to say defects) that should be kept in mind when developing standard operating procedures.

Collective means of protection against contamination occur as independent objects (e.g. permanent and transportable shelters) or as elements structurally integrated with military objects (e.g. tanks, armoured personnel carriers, ships). They are used in fixed and mobile command posts, medical facilities, rest facilities for personnel, vehicles, aircraft and ships.

Filtering ventilation, which clean the air and supply it to the protected inside (uncontaminated zone) devices are inherent in collective means of

opment and the implementation of the light systems of collective protection (tent-type) to the army. These are protective systems that can be transported and unfolded depending on the needs. Usually they look like tents, which external covering or internal element are made of insulating material protecting against chemical, biological agents as well as against radioactive dust.

The Armed Forces of the Republic of Poland have collective protection system of light type (Fig. 7 a, b). It is intended to provide collective protection of people against the action of chemical agents, toxic industrial materials, biological and radioactive agents. The protection is achieved by the system tent made of barrier materials with protection time against chemical agents and toxic industrial materials of at least 24 hours and filtering ventilation device. The set includes three tents, entrance

lock, sanitation lock and redoubled filtering ventilation device (UFW-900-2C) installed on the biaxial trailer. Tents and locks have air-operated frame construction made of polyamide gummed fabric. The surface of a single tent amounts to 27 m^2, entrance lock – 11 m^2 and sanitation lock – 7 m^2. Connecting of the components (tents, locks) is made by zippers.

Decontamination point is located in the entrance lock (Fig. 7 c, d, e). It comprises:

- transitional vestibule, in which there are bags of gummed fabric for the contaminated protective clothing and individual equipment items;
- decontamination vestibule with:
  - shower and rubber bathtub,
  - shower device supplied with warm water from high-pressure washing device and the container for surfaceactive agents,
  - ca. 1000 dm^3 containers for clean water and sewage,
  - control vestibule with a supply of individual protective equipment (protective clothing and gas mask).

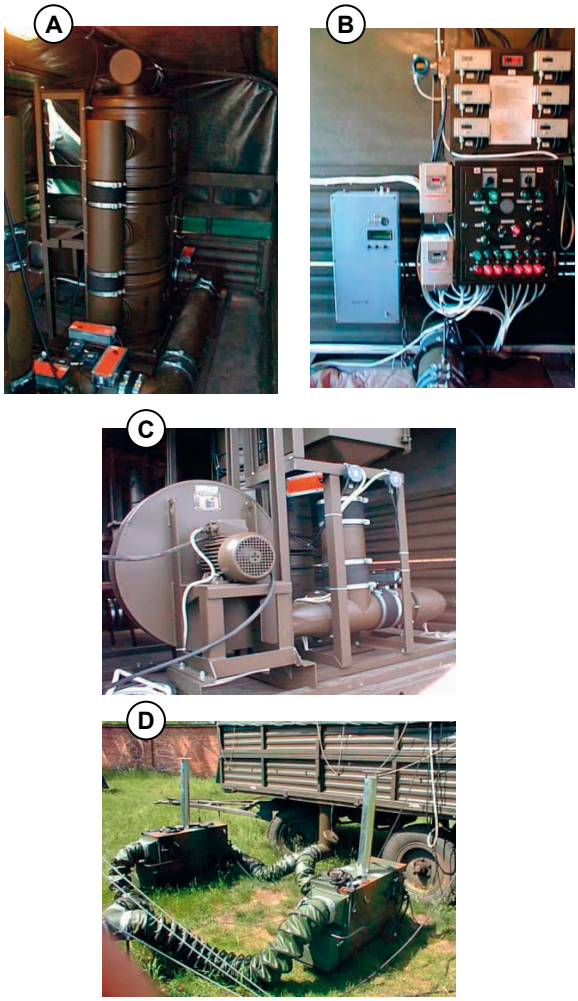

Figure 9: Redoubled filtering ventilation device UFW-900-2C: a) column of combined filters FP-300P, b) gas invigilator ALERT-1M, control panel and an array of control and measuring instruments, c) view on WPO-12,5 ventilator with mounting and connective elements, d) air heaters (source: materials of WIChiR).

Sanitation lock (Fig. 7f) is equipped with toilets and sinks. An emergency exit is located there. The construction frame is filled by ventilators adopted to supply them with power of 230 V or with a foot pump. Transport packaging for the set of tents is constituted by covers for tents, locks and fittings, and boxes of equipment. The entire system is unfolded by 8 people during 30 minutes. The system is transported with a truck.

Redoubled filtering ventilation device UFW-900-2C included in the set (Fig. 8 a, c) is intended for:

- cleaning the air from radioactive and neutral dust;
- cleaning the air from aerosols and vapours of chemical and biological agents and toxic industrial materials;
- generating overpressure inside the object.

It consists of two UWF-900 filtering ventilation devices that can work simultaneously or each with a capacity of 900 m3 / h. The set can be used in pure ventilation regime (without combined filters) or filtering ventilation.

Warning and alerting facility staff prior to chemical contamination, and before puncture of combined filters is performed using gas invigilator ALERT-1M, located next to control panel and an array of control and measuring instruments (Fig. 8 b). Heaters can be connected next to the device (Fig. 8 d).

Figure 10: Filtering device (UFW) for Leopard 2 A4 tank.

In the event of contamination, it is necessary to seal the vehicle (close hatches, etc.). As a result of low natural exchange of the air, in a limited space after some time oxygen content descreases, simultaneously the content of carbon dioxide is increasing. In order to eliminate these phenomena, it is essential to supply the appropriate amount of cleaned air to the vehicle. Therefore, the vehicles are equipped with collective protection system, which operate in one of the following ways:

a) overpressure – cleaned air is supplied directly to the vehicle. The overpressure is generated to prevent the contaminated air from entering the vehicle, what is essential when a vehicle is moving. In addition to protecting the crew inside the vehicle it provides protection from contamination.

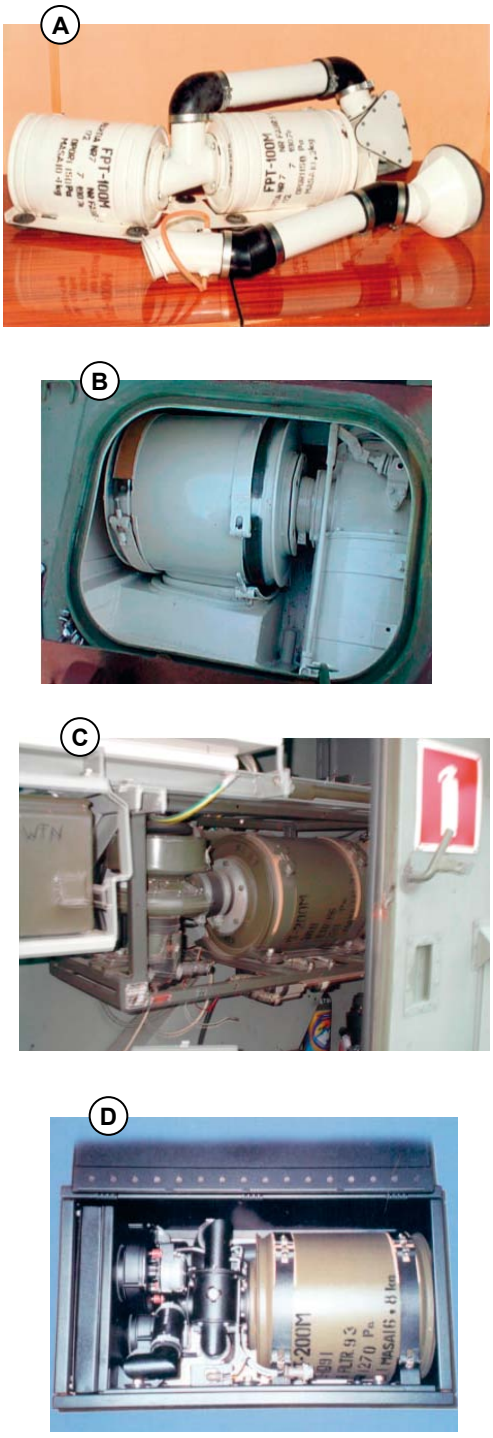

Figure 11: Examples of Polish filtrating devices used in vehicles: a) UFWCz-200 tank T-72, b) UFW combat section of 2S2 GOŹDZIK, c) UFW of radio station NUR-30, d) filtering device UFS.B2.01-100FW,

Source: Fig. a, b, c – materials of WIChiR, Fig. d – materials of ARMPOL company.

b) breathing assisting (collector) - breathing air for the crew members is supplied via cables. It requires the crew to use protective equipment of respiratory path (special masks or general masks), provide increased filtration and greater airflow than masks.

More comfortable conditions are created by overpressure systems, but if it is not possible (or advisable) to provide overpressure and filtration in the entire space of the vehicle, breathing assisting systems are required. Filtering ventilation devices, which should supply the appropriate amount of cleaned air depending on the number of crew members and kept the pressure, are the main element of collective protection system. For example a device produced by Dräger Company, used in Leopard 2 A4 by 10th BKPanc in Świętoszów on (Fig. 47), provides air flow 180 m^3/h and its mass is ca. 90 kg.

The recommendations of the company stipulate that to ensure adequate security, the interior of the vehicle must be sealed so that at a speed of 70 km/h blood pressure 400 Pa is achieved, and at a speed of 100 km - h 600 Pa, at flow rate 120 m^3 - h.

Many vehicles used in the Polish Armed Forces are equipped with a collective protection systems. The examples of such devices are shown in figure 48. T-72 tanks depending on the date of production are equipped in UFWCz-100 devices (with FP-100M combined filter) or in UWFCz-200 devices (with two FP-100M combined filters) – fig 48 a. The device may be switched manually or automatically. A self-propelled howitzer 122 mm 2S1 GOŹDZIK is equipped with two filtering devices. In the combat section (3 people) it is with FP-200 M combined filter (Fig. 10 b), whereas the mechanics of the driver section (1 person) with FP-100M combined filter. Radar stations NUR-30 (container type) are equipped with filtering devices UFWS-100 FASER production with FP-200 M combined filters (Fig. 10 c).

As a part of missile system modernisation NEWA commanding and homing cabins were equipped with modern filtrating devices (UFS.B2.01-100FW/24V (Fig. 10 d) produced by ARMPOL). This device has an expense of 100 m3 / h and produces a pressure of 250 Pa. It records total operating time also when during filtration process. However, the fact that a vehicle is equipped with this device does not ensure its effectiveness. There are a number of cases with lack of operation, improper placing or even maladjustment of collective protective system.

Using filtrating devices with exceeded usability time is common. The missile squadron of Air Force and Air Defence radio station R-140 on the undercarriage of a STAR car equipped with UFWS-100 filtering device produced by FASER had a combined filter FP-100 produced in 1981, so long after the period of suitability for use. The squadron is equipped with the Soviet trailer (mobile command post element) equipped with Soviet equipment with filtering capacity of 100

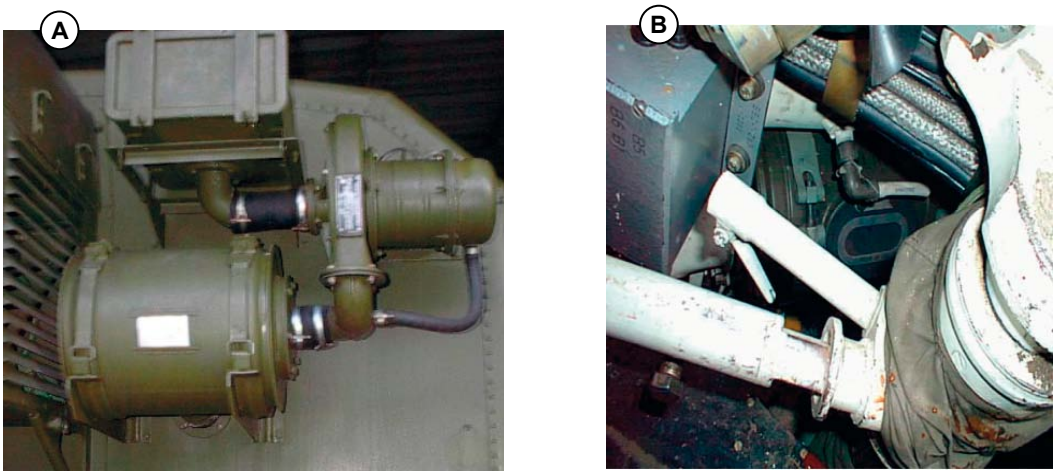

Table 12: The examples of improper use of collective protection devices a) Soviet filtrating device produced in 1975 with original combined filter, b) view on the FP-100M filtrating device in PT-91 tank after removing the commander's seat (Source: WIChiR materials).

m^3/Hz produced in 1975 with the original combined filters (Fig. 11 a).

Czech FV MZ 15/24 filtrating device was used in the driver cabin of radio station NUR-15 (TATRA vehicle). It is a collector device supplying the clean air under the cowling for no more than 4 people, which is not adjusted for gas masks used by the Armed Forces of the Republic of Poland. Applied corrugated hoses do not fit the dimensions and shape to the terminals of masks used in the Polish Army (both old MP 4 and newly introduced MP 5).

Filtering devices of self-propelled howitzer 2S1 GOŹDZK do not have a control panel (control operation, indications of flow, pressure), and switching the type of work (ventilation / filtering ventilation) is done manually with a lever.

PT-91 tank is equipped with UFWCz-100 filtering device with FP – 100M combined filter. The access to the filter is very difficult (Fig. 11 b) and in case of replacement equipment a part of the tower should be dismantled There are no overpressure measurement instruments and capacity measurement instruments.

The protection against contamination was always a very significant and continuously developed issue. It acquired a special significance when there was need for operations on the contaminated field or when early warning of the use of chemical agents or failure with toxic industrial materials is not possible. To ensure a proper protection of population and maintaining the continuity of operational capacities of chemical rescue units and the army, they should have a proper equipment. The equipment and its technical and operational parameters affect the increase of protection possibilities and ways of conducting rescue operations. It is desirable that the protection means would ensure non-limited protection and that they do not burden the body of the people using them. In the case of protective clothing it would be ideal to use it as a field uniforms. Unfortunately, at the time the level of technological development and the existing material solutions did not provide these opportunities. Therefore, the means of protection (and hence their technical and operational parameters) were a compromise between user requirements and technical capabilities and financial resources.

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Pharmacy

Counterfeit medicinal products, medical devices and dietary supplements – growing safety risks for public health

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Summary:

Counterfeit medications, medical devises and dietary supplements pose a inherently dangerous and growing problem. The majority of worldwide markets for pharmaceuticals are well regulated and efficient, but trade of counterfeit pharmaceuticals is a lucrative business. Not surprisingly, criminals and criminal organizations are recognizing the profit that can be made from trading in diverted, counterfeit or stolen pharmaceuticals. In very general terms, counterfeit medicines include products that have no active ingredient, the incorrect active ingredient, that are super-potent or subpotent, contain dangerous impurities, or are adulterated with undeclared active ingredients, and also those with counterfeit primary or external packaging. Counterfeit pharmaceuticals represent a serious threat to world public health. On a daily basis, many individuals around the world risk death or serious injury when they unknowingly use and consume counterfeit drugs and products manufactured and supplied outside effective regulatory regimes. The appearance of some counterfeits is so good that even major retailers and pharmacies have unknowingly purchased counterfeits. But while there are new forms of counterfeit goods, there are also new strategies for combating counterfeiting. We described the usefulness of the time-of-flight mass spectrometry with the electrospray ionisation (LC-ESI-MS-TOF) and the X-ray powder diffraction method (XRPD) for counterfeit screening from the Polish illegal market.

Key words: counterfeit medication, medical devices, dietary supplements, public health, anti-counterfeiting action

Introduction

In recent years, drugs protected by patents, generic drugs (generics) and medical devices are becoming an objective of counterfeiters. Simultaneously, illegal production and illegal supply for counterfeit medicinal products and dietary supplements (including products containing false information about the composition, origin, effects and usage), particularly in online offers and turnovers outside pharmaceutical market (markets, oriental medicine clinics, sex shops, gyms) are growing in many countries. There are also more and more data about hospitalisations and deaths of people who used preparations of unknown origin, purchased from illegal sources, where no one asks for prescription and informs about the adverse effects or interactions with other drugs.

The definition of World Health Organisation (WHO) is the most commonly used to define counterfeit medicines and states that '*A counterfeit*

medicine is one which is deliberately and fraudulently mislabelled with respect to identity and/or source. Counterfeiting can apply to both branded and generic products and counterfeit products may include products with the correct ingredients or with the wrong ingredients, without active ingredients, with insufficient active ingredients or with fake packaging. A counterfeit medicine may be of good quality and meet all requirements of the specification'. Counterfeit does not apply to: medicines unadmitted to trade, if they

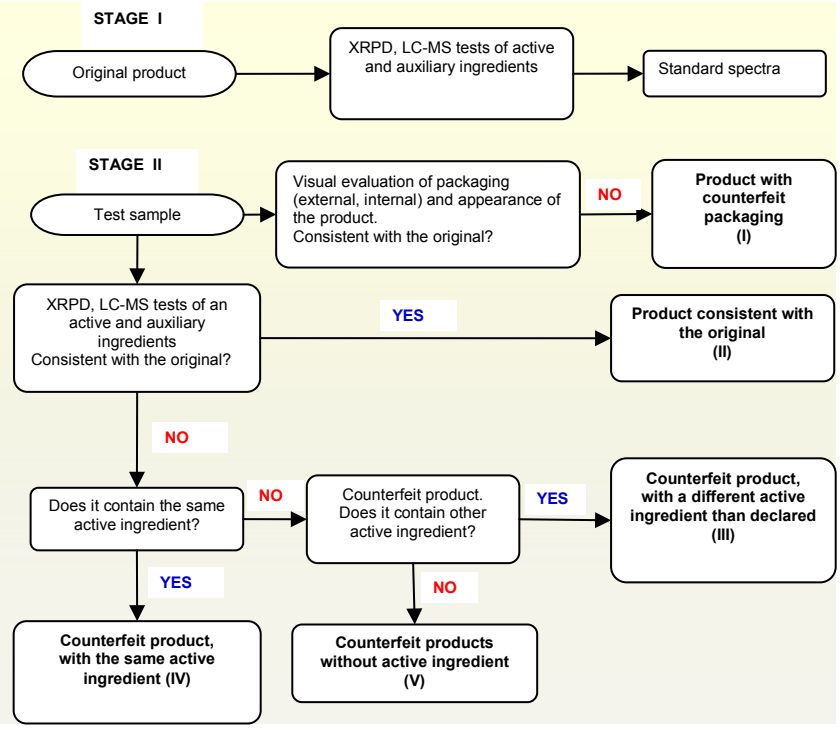

Figure 1: The strategy of classification of counterfeit products according to WHO.

are used legally in other countries, quality defects associated with failure to comply with the principles of GMP/GDP standards and aspects related to patent protection [1, 2].

Counterfeit medicines should not be confused with substandard medicines. WHO proposed a new definition of substandard medicines in March 2010 i.e. '*Substandard medicines (also called out of specification (OOS) products) are genuine medicines produced by manufacturers authorized by the National Medicines Regulatory Authority (NMRA) which do not meet quality specifications set for them by national standards*' [3].

In well-developed countries with effective market control and protection system, the amount of counterfeit products in legal chain of distribution is estimated at ca. 1% in comparison to 10-30% in developing countries. It applies mostly to certain areas of Asia, Africa, South America, where the following medicines are being counterfeited: antibiotics (28%), hormones (including steroid hormones, 18%), antiasthmatic and antiallergic medicines (8%), antimalarial medicines (7%), analgesics and antipyretic (6%). The amount of such products in Russia and numerous former Soviet republics is estimated at even 10 to 20%, what constitutes serious direct threat to public health. In the EU approximately 7.4 million packages of medicines were confiscated in 2009.

However, only in the two last months of 2008, due to a coordinated action of customs officers, additionally 34 million counterfeit medicines were confiscated in 27 member countries of the EU (mainly antibiotics, antimalarial, antineoplastic medicines and cholesterol lowering medicines), including 2.2 million only at Brussels Airport (mostly antimalarial and analgesics medicines) [4-6]. The most common counterfeit medicines in the European Union are medicines for erectile dysfunctions, weight loss and hormonal drugs. The most important points on the counterfeits smuggling channel in the EU include the Switzerland, India, China and the United Arab Emirates and online shops are engaged in their distribution. According to the data of the European Federation of Pharmaceutical Industries and Associations (EFPIA) there was no country in 2009 where no cases of counterfeit medicinal products have emerged.

The total number of illegal medicines retained by Polish customs services in 2009 amounted to 57 200 units, 95% of which were constituted by postal items containing drugs, in amounts far exceeding the number that indicates the so-called 'personal use' (usually 60-1400 packages per consignment). It is likely that such not too large packages constitute the main source of counterfeit products in our country.

The Council of Europe has long been involved in detecting and solving increasingly serious public health threats generated by counterfeit drugs, medical devices and food supplements, in particular by the actions of the European Directoriate for the Quality of Medicines & HealthCare (EDQM). In April 2010 the European Committee on Crime Problems (CDPC), which represents the network

of national laboratories *OMCL-Network*, along with several Member Countries and the European Commission in the role of observers issued a draft of the *Convention of the Council of Europe on the counterfeiting of medical products and similar crimes posing a threat to public health* [7]. The term 'medicial products' was invented for the purposes of the Convention meaning medical products and medical devices.

The purpose of this Convention is to prevent risks to public health and to combat those threats through: ensuring criminalisation of certain acts, protection of crime victims' rights established under the Convention and to support national and international cooperation. In order to ensure effective implementation of the Convention by the Parties shall establish a special system for monitoring existing threats. According to the main assumptions of the draft Convention: counterfeit drugs undermine the relationship of trust between the patient, physician and pharmacist; patients deprived of the protection against this phenomenon trust that the ordained drugs will always help them, so that counterfeiting medical products disrupt the functioning of the entire health care system. Criminalisation and appropriate penalisation of this practice will increase the efficiency of justice and contribute to raising the level of public health. In October 2010, the process of ratification by individual member states is expected to begin.

Illegal and counterfeit products examined at the National Medicines Institute (NIL)

Since 2006 medicinal products and products declared to be dietary supplements are directed to the NIL in order to prepare an opinion explaining whether the products are medicinal products, whether they are genuine, whether they are legal products (and hence registered by the authorized body), whether they are dietary supplements and whether they are introduced to the turnover on the basis of appropriate procedure. It became, therefore, necessary to implement appropriate principles for procedures in the Institute and develop analytical methods enabling to answer the above-mentioned questioned. Consequently, the following scheme of proceeding with a sample was introduced. It is shown on figure 2.

While analysing the instructions transmitted to NIL by police, prosecutors and customs offices, illegal and counterfeit products reaching Poland can be divided into seven groups:

1) **Illegal and counterfeit medicinal products and dietary supplements recommended for erectile dysfunctions** that contain sildenafil citrate, tadalafil, vardenafil or their structural analogues. By the half of 2010 thirty of them

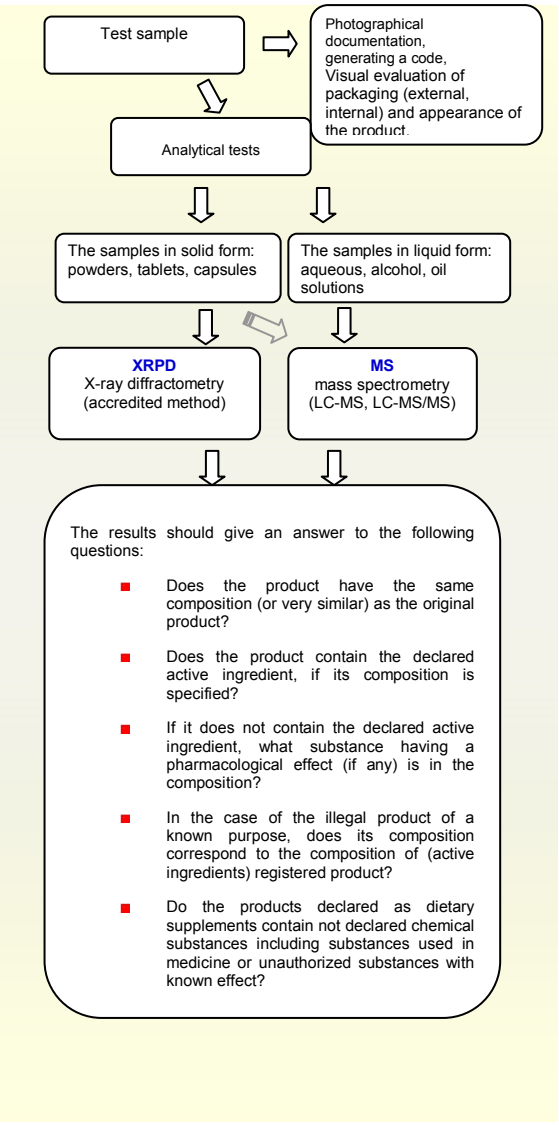

Figure 2: A scheme of proceeding with a sample of illegal or counterfeit products at the National Medicines Institute

were indentified. Very disturbing is the fact that the pharmacological potency of some analogues is often several times higher than of the parent compounds, and the side effects are unknown. Pseudo-herbal supplements containing such active ingredients are available in Poland in the online offerings, and even end up in legal distribution and pharmacies. In total, 35 products containing (or supposed to contain) the substances used for erectile dysfunctions were examined in the NIL in 2009. Among them 32 have been classified as counterfeit (91%) and the remaining as illegal (fig. 3). Due to the popularity of this type of products they will be more comprehensively described in

a separate section of this article.

2) **Counterfeit herbal dietary supplements, containing undeclared sibutramine or its structural analogues** i.e. monodesmethyl sibutramine or didesmethyl sibutramine. Unit doses of the substances contained in one capsule sometimes exceed even twice the recommended maximum daily dose. It is worth emphasizing that at the beginning of 2010, the European Medicines Agency recommended complete withdrawal of sibutramine treatment, due to the increased risk of serious cardiovascular events such as stroke or heart attack. All drugs containing sibutramine were withdrawn from pharmacy sales in Poland, what, unfortunately, according to the principle '*if there is a demand, there is a supply*' caused the substantial increase in the number of offers in the Internet sales of counterfeit supplements.

3) **Illegal and counterfeit anabolic steroid hormones.** Products of this type are available in a broad offer in the internet and in shops selling supplements for athletes, and in gyms. Some of them contain much higher doses than those used in medicine or steroids withdrawn from use. Side effects caused by the use of steroids are considered in two categories. The first category includes potential liver diseases such as biliary obstruction, hepatitis and even cancer, and if administered orally liver lesions. Second category of potential side effects includes aggregation of direct action of steroids and hormones stimulated by them. Side effects are various in women, men, adults and children.

4) **Illegal herbal materials and products of traditional Chinese medicine**, mainly in form of pills or extracts.

Table 1: Selected dietary supplements containing sibutramine hydrochloride (CHS) or desmethyl sibutramine hydrochloride (ChDMS) declared as herbal products and examined in the NIL in 2006-2010.

Name of the preparation	Year	Declared manufacturer	Test method	Recognized active ingredient
LIDA DAI DAI HUA JIAO NANG	2006	Kunming Dali	LC-UV XRPD	ChS 27.2 mg Caps
				ChS 27.4 mg Caps
	2007			ChS 23.8 mg Caps
				ChS 19.4 mg Caps
				ChS 23.9 mg Caps
				ChS 14.3 mg Caps
				ChDMS 25.1 mg Caps
				ChDMS 28.8 mg Caps
				ChDMS 24.3 mg Caps
				ChDMS 29.3 mg Caps
				ChDMS 28.4 mg Caps
Meizitanc	2007	Plant Research and Science Inst.	XRPD, LC-UV	ChS 22.6 mg Caps
Meizitang	2006	-	XRPD, LC-UV	ChS 27.5 mg Caps
				ChS 27.0 mg Caps
	2007			ChS 21.8 mg Caps
				ChS 24.9 mg Caps
Super Slim		-	XRPD, LC-UV	ChS 25.5 mg Caps
Miaozi		Bainian Pharmacy, Hongkong	LC-UV LC-MS XRPD	ChS 8.0 mg Caps
				ChS 8.5 mg Caps
				ChS 9.8 mg Caps
	2010			ChS 8.7 mg Caps
3X Slimming Power	2010	Made in Japan	LC-UV, XRPD LC-MS,	ChS 11.5 mg Caps
White Lion-White Tea		Sichuan ZhenHuang Medicine	LC-UV, XRPD LC-MS	ChS 9.6 mg Caps

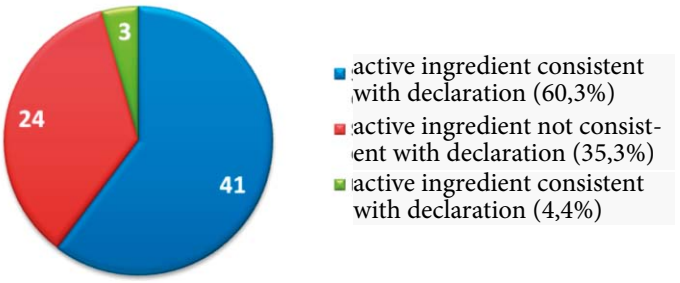

Figure 3: Active ingredients identified in illegal and counterfeit steroid preparations containing anabolic hormones examined in the NIL in 2009-2010 (n = 68).

5) **Illegal and counterfeit dietary supplements and cosmetics** offered in sex shops, containing cantharides, yohimbine, benzocaine or lidocaine. Some have markings typical for homeopathic medicines e.g. Cantharis D6 and D4 Yohimbinum.

6) **'Miraculously' acting products treating all diseases** e.g. 'Miracle Mineral', an aqueous solution of chlorine dioxide, which supposedly treats malaria and HIV in a few hours.a)

7) **a) 'designer drugs'** - that is, compounds stimulating living organisms, which as foreign substances become a factor increasing its

Table 2: Selected counterfeit preparations containing steroid anabolic hormones examined in NIL in 2009-2010.

Name of the preparation	Declared manufacturer	Declared active ingredient	Test method	Recognized active ingredient
Methandienone 0,005 g	none (Made in Russia)	methandienone	XRPD LC-MS	no active ingredient
Sustanon 250 mg	NILE Co	testosterone esters: propionate, phenylpropionate, isocapronate, decanoate	LC-MS	testosterone heptanoate
Deca-Durabolin	none	nandrolone decanoate	LC-MS	testosterone derivative
Oxymeth tablets	none	oxymetholone	LC-MS	methenolone
Decabol 250	British Dragon Pharmaceuticals	nandrolone decanoate	LC-MS	testosterone propionate
Trenbolone acetate	none	trenbolone acetate	LC-MS	testosterone heptanoate
Methadienone 0,005 g	none (Made in Russia)	methandienone	XRPD LC-MS	creatine
Deca Durabolin 50 mg/ml	Nile Co. Organon	nandrolone decanoate	LC-MS	no active ingredient
Sustanon 250 mg	Nile Co. Organon	testosterone esters: propionate, phenylpropionate, isocapronate, decanoate	LC-MS	no active ingredient
Testosterone 450 mg/ml	International Pharmaceuticals	testosterone esters: propionate, heptanoate, cypionate	LC-MS	testosterone cypionate
Trenbolac Drostanpro 200 mg/ml	International Pharmaceuticals	trenbolone acetate, drostanolone propionate	LC-MS	testosterone heptanoate
Mastabol 100 mg/ml	British Dragon	dromastanolone dipropionate	LC-MS	boldenone undecylenate, testosterone propionate
Boldabol 200 mg/ml	British Dragon	boldenone undecylenate	LC-MS	boldenone undecylenate, testosterone heptanoate
Trenabol	British Dragon	trenbolone acetate	LC-MS	testosterone heptanoate
Trenabol 200	British Dragon	trenbolone heptanoate	LC-MS	trenbolone heptanoate, testosterone heptanoate

efficiency in non-physiologic way. They are available commercially in the form of easy-to-eat pills, powders or herbal mixtures with addition of psychoactive compounds. The names of the majority of designer drugs, their packaging and incentive methods used by distributors to purchase them relate to their physiological action. The monitoring of global market indicates that the number of preparations belonging to the group of designer drugs is constantly increasing, because new psychoactive compounds with stimulating effect are being synthesized or the descriptions of syntheses available in scientific and patent literature are used.

8) **b) 'Spice' is a brand name of designer drugs** being a mixtures of aromatic, psychoactive herbs sold in so-called 'collector's shops' and via the internet as 'herbal smoking' mixture. Although, the manufacturers officially warn of Spice consumption by humans, they are usually being smoked due to their effects similar to cannabis (Canabis sativa L.) caused mainly by the addition of synthetic cannabinoid alkaloids (non-narcotic hallucinogenic and psychotropic compounds).

Counterfeit products used in erectile dysfunction

In Europe and the United States a rapid increase in the amount of counterfeit drugs in the last decade is primarily related to the registration of phosphodiesterase type 5 inhibitors (PDE-5) - effective vasoactive drugs used for erectile dysfunction (ED). This group includes sildenafil citrate (*Viagra*, Pfizer), vardenafil hydrochloride (*Levitra*, Bayer) and tadalafil (*Cialis*, Eli Lilly) [8-10]. Viagra was patented as the first one in 1996 and was introduced in 1998 for the treatment of erectile dysfunction and primary pulmonary hypertension (in this indication under the name *Revatio*). Trade name Viagra, is derived from the Sanskrit word 'wjaghra', which means tiger. After finding a way to circumvent the Pfizer patent on this compound, numerous companies started to produce it around the world. The examples of these generics include *Kamagra* (Ajanta Pharma, India) and Polish *Maxigra* (Polpharma). Another generic of *Viagra* under a trade name *Vizarsin* produced by Krka company was approved in the EU since September 2009.

Erectile dysfunction usually occurs in patients with hypertension, diabetes and ischemic heart disease. Unfortunately, PDE-5 inhibitors have negative interactions with medicines used to treat these diseases, what resulted in the development of herbal medicines alternative to chemical PDE-5 inhibitors. These herbal therapies quickly captured the market and led to the impression that they are safe and free from any side effects. Unfortunately, many products offered primarily as dietary supplements, especially those therapeutically effective, turned out to be enriched with PDE-5 inhibitors, undeclared in the composition, mainly sildenafil or its structurally modified analogues such as acetildenafil, hydroxyhomosildenafil, homosildenafil, tiosildenafil or tiohomosildenafil [11, 12]. According to information published by the European Commission (European Commission - Taxation and Customs Union), it appear that among the products constituting a real threat to public health and covered by intellectual property rights counterfeit and illegal products containing PDE-5 inhibitors are in the first place. It is estimated that ca. 2.5 million men in Europe are exposed to the counterfeit products containing sildenafil, the same as buying it in the legitimate distribution chain. In 2004-2009 about 38 million tablets containing sildenafil citrate were confiscated in Europe, accounting for 96% of all counterfeited Pfizer medicines. For a 2383 confiscations of *Viagra* performed in the world in 2005-2009, 82% was constituted by counterfeit products including 483 products offered in the internet (76%, Fig. 1) [13].

In EU countries, selling counterfeit erectile dysfunction drugs is mainly connected to the internet. A group of experts from the *Operation of European Conventions in the Penal Field* estimate that more than half of sildenafil sold by about 15 000 websites are counterfeit. The websites have ca. 13 million visitors and monthly sell ca. 2.3 pills without a prescription. In Poland the research on counterfeit and illegal medicinal products and dietary supplements is conducted since 2006 by the National Medicines

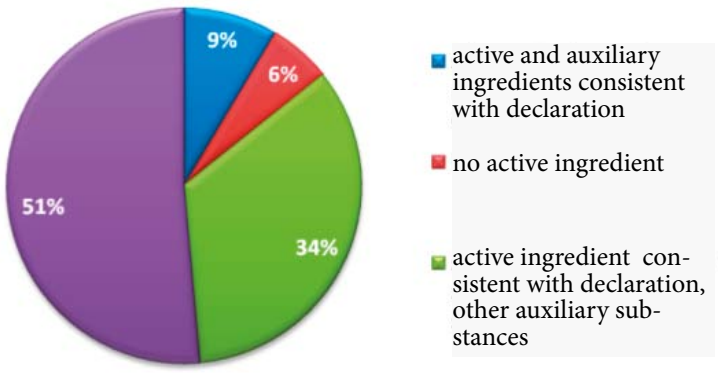

Figure 4: Active ingredients identified in illegal and counterfeit products recommended in erectile dysfunction tested in NIL in 2009.

Institute. In total, 35 products containing (or supposedly containing) substances used in erectile dysfunctions were tested. 32 were classified as counterfeit (91%) and the remaining ones as illegal (Fig. 3).

Powder X-ray diffractometry (*X-ray powder diffraction,* XRPD) was introduced to screening tests of tablets and capsules. The first step of X-ray analysis is performing the examination of the entire tablets, which in most cases allows for a clear statement whether the test product differs from the original and the assessment of the composition of the coating. Then, after removing the coating, tablets are crushed and the composition of tablet mass is examined with the use of XRPD method [16]. Differences in diffraction spectra of the original and counterfeit products are visible at first glance and do not require complicated chemometric analysis, as is the case with much more frequently performed studies using near-infrared spectroscopy (NIR).

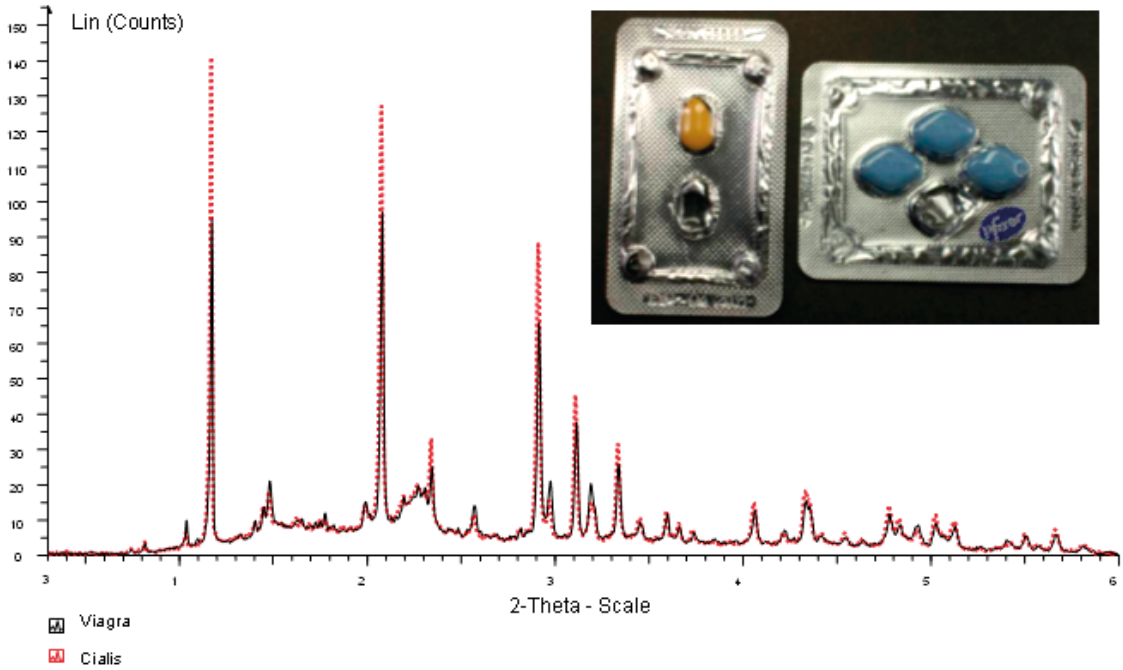

Figure 5: XRPD diffractogram for Cialis (declared tadalafil) and Viagra (declared sildenafil) in which sildenafil was found (identical composition of the tablet mass, both preparations are counterfeited).

Composition of the investigated preparations also was confirmed by high performance liquid chromatography electrospray ionisation tandem time-of-flight mass spectrometry using (LC-ESI-MS-TOF). The interpretation was performed using a previously tested model substances and comparing them with the mass spectra obtained in the analysis. The application of LC-MS/MS technique was particularly important in case of analysis of unknown substances, e.g. unregistered structural analogues of the active substance (API). For this purpose the software was used which enabled determination of elemental composition (by measuring the exact mass and the compliance of isotopic profile of obtained spectrum with the theoretical) and assigning them the most likely chemical formula of a summary.

Counterfeit medical and diagnostic devices

Medical devices sector is very diverse and nowadays constitutes ca. 8000 of various products, from simple bandages and glasses, through implants, sophisticated devices for diagnostics and imaging, up to complex devices for minimally invasive surgical procedures. In the United States, the biggest manufacturer of medical devices in the world, there are ca. 80 000 various products registered for use directly by patients, in doctor's and dental offices and in hospitals. In the EU medical devices labelled by the manufacturer of a CЄ may be introduced to the turnover and use, after conducting appropriate procedures of the compliance assessment with the requirements. Custom-made medical devices, intended for clinical or diagnostic in vitro tests, are not labelled with a CЄ sign. All medical devices should be manufactured in accordance with the Standard ISO 13485:2003 (PN-EN ISO13485:2004) 'Medical devices -- Quality management systems -- Requirements for regulatory purposes'. It specifies the requirements for quality management system, which should be or

Figure 6: Established presence of counterfeit medical and diagnostics devices in the world by 2010.

the design, development, production, installation and servicing of medical devices and the design, development and provision of related services. This standard is harmonized with the Medical Devices Directive MDD 93/42/EEC which was implemented into Polish law as the Medical Devices Act of May 20th, 2010 (Dziennik Ustaw [Journal of Laws] No. 107, item 679).

The three major problems in case of medical devices are counterfeiting, altering and cloning. Altering/renewing applies mainly to single-use equipment, where the counterfeiters find a way to convert or renew equipment for single use and re-enter it on the market or sell directly to hospitals. In developing countries, a buyer usually knows about this and takes advantage of a lower price, but often does not realize that the purchased equipment was previously used by another patient. Another category of problems with counterfeiting medical products is the reworking them to accept other common consumable parts and

Table 3: Counterfeit medical products detected in 2001-2010

Year	Reporting country	Medical device
2001	United Kingdom (MDA)	Intraocular lens. Counterfeit CЄ marking.
2004	United Kingdom (MDA)	Hi-Tec BARG TF vaginal tape tension free used in surgical treatment of urinary incontinence. Counterfeit CЄ marking.
2004	USA (FDA)	Contact lenses of Cooper Vision Proclear Lenses. Telesales (telephone orders).
2004	USA (FDA) and France	Contact lenses of J&J SureVue. Internet.
2004	USA (FDA)	Contraceptive transdermal patches 'Ortho Evra transdermal contraceptive'. Internet.
2005	United Kingdom (MHRA)	Dental filling material 'Spectrum® TPH' by Dentsply.
2005	Ireland (IMB)	Durex condoms. Retail sales in vending machines and pharmacies.
2005	USA (FDA)	Polypropene mesh Prolene® used in surgical repair of hernias and other fascial deficiencies
2006	USA (2006), Greece (2006), China (2007), India (2007), Pakistan (2007), Philippines (2007), Saudi Arabia (2007), Turkey (2007), the United Arab Emirates (2007)	Test Strips «One Touch ® Glucose strip» to determine the level of glucose (for glucose meters) from LifeScan. Wholesalers, distributors and pharmacies.
2006	Ireland (IMB)	Self-diagnostic kits for HIV and chlamydia Pharmacies and the internet.
2008	Australia (TGA), China, Taiwan	Cooling compresses (Thermoskin Ice-Pack). Wholesalers.
2009	USA	Lithmann® Stethoscopes (3MHealthcare) Websites and other unauthorised retailers
2009	United Kingdom (MHRA), the Netherlands, Poland	Needles for insulin pens (NovoFine pen needles) Wholesalers and pharmacies
2010	USA (FDA)	Polypropene surgical mesh 'Bard Flat Mesh' of various sizes (15 series).
2010	USA (FDA)	Tourniquets (C-A-T®) for first aid.

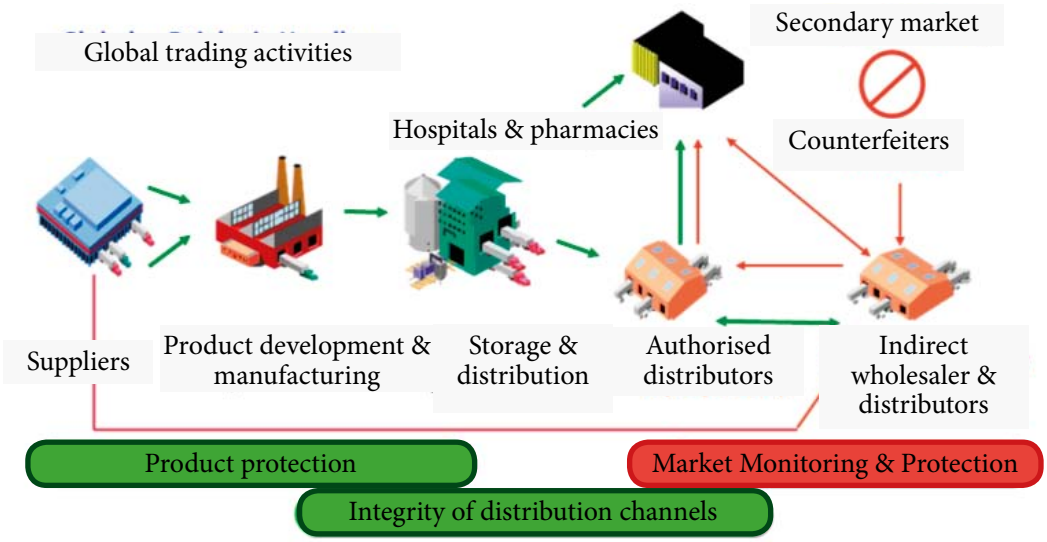

Figure 7: Distribution of medical devices and pathways of counterfeit products into the legal chain and patients.

reagents, obviously, usually much cheaper than the original - which does not guarantee the correct diagnostic results.

Summary

Counterfeit dietary supplements (mainly recommended for erectile dysfunctions and weight loss) belong to the group of illegal products used in health care and most often placed on the market in the EU countries. The lack of definition of counterfeit dietary supplements in the EU and Polish law poses the great difficulty in the correct classification of such products. Therefore, it is not clear how a dietary supplement containing undeclared pharmaceutical active ingredient should be treated; either as a counterfeit or a food product not corresponding to the declared composition on the packaging. Obviously health and criminal consequences in both cases are completely different. In NIL products are treated as counterfeit drugs, because the threat they pose to the patients is even larger, as they believe to take natural products (usually declared as a completely vegetable), safe and without side effects or interactions with medication. Therefore, they do not associate health problems with these products and this fact further increases the risk of seriously endangering the health and life.

The presence of unlabeled active ingredients and their impurities, incorrect dosage, due to other than the declared content can lead to serious side effects and even death of people taking them. In addition, incorrect or incomplete description of the composition of the product creates a specific risk due to drug-drug interactions, and the lack of information on contraindications can lead to serious medical incidents. Moreover, due to the absence of appropriate therapeutic substances, patients remain untreated, what may encourage them to seek additional medical assistance thinking that taken product does not show in their case the proper pharmacological action.

In conclusion, statistically small amount of information about medical incidents and adverse reactions to such products in relation to the size of their supply in the EU is puzzling. It is still obvious that the sale carried out outside legitimate chain is difficult to supervise, as well as the fact that illegal distributors do not monitor the problems posed by their products, and people with additional health problems rarely admit that they have taken illegally purchased medicinal product.

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Military Medicine

For the 10th anniversary of anthrax attacks

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Summary:

The paper discusses the current state of knowledge on anthrax acquired basing on historical experiences and simulation research. Despite the considerable progress, there are still serious difficulties in the diagnosis, treatment and prevention of anthrax. The preventive and eliminating actions that are being elaborated for anthrax attacks effects are also insufficient. We should also critically assess the possibility of decontamination of the environment and of protecting raw materials and food products. In the concluding remarks the moral aspects of achievements in biological research on anthrax are emphasised, which results may also be used to manufacture biological weapon.

Key words: anthrax, biological weapon, bioterrorism, treatment and prevention of anthrax

Introduction

Since the attacks on the World Trade Center (WTC) in New York in 2001 the global community has realized that every country may be vulnerable to terrorism. Although the terrorist attacks cause immediate havoc, casualties and the atmosphere of fear, historical facts and simulation studies indicate that social disturbances caused by bioterrorist attacks are equally or even more dangerous. The American Centre for Disease Control and Prevention (CDC) has classified over 30 biological agents to three categories of biological weapon: A, B and C [1].

Category A includes easy-to-spread agents inducing respiratory infection, easy transmittable from human to human with a high mortality rate and as a consequence causing malfunctions of health services and provoking panic, and social unrest. The category A comprises microbes of anthrax, smallpox, haemorrhagic fevers, plague and tularaemia. Undoubtedly, the first place in the category A is occupied by the microbe of anthrax, an aerobe *Bacillus anthracis* due to the historical facts and unique properties of this microbe such as easy proliferation, resistance of spores, easiness of spreading powdered spores in the form of aerosol and infecting people and animals via inhalation [2].

The history of anthrax as a biological weapon (bioweapon)

In the modern times, anthrax microbes were used as a bioweapon for the first time during the First World War. Among others, German agents infected sheep, cattle and mules of the Allies supply transports. In the thirties of the last century special units of Japanese army investigated the number of germs including anthrax as a bioweapon and conducted experiments on war prisoners [3]. During the Second World War, the experiments conducted by British army on the Gruinard Island showed the possibility of effective spraying of aerosol containing anthrax microbes. As a result of the experiment, contaminated island was closed until 1990, i.e. for

over 40 years [4]. Basic data concerning the effects of spraying anthrax microbes were gained in 1979 after the failure in the military facility in Sverdlovsk, when the spores of *B. anthracis* were accidentally released and proliferated along the direction of the wind resulting in multiple deaths and illnesses.

Although only 4 mg to 1 g of dry spores were released, there were up to 150 cases and 100 deaths due to the pulmonary anthrax [5]. The incident in Sverdlovsk most explicitly illustrates what may occur after using anthrax as a bioweapon. Settling spores mixed with the air causing distant cases of infection. The epidemic lasted for 6 weeks from first to the last case. It was perhaps the reason why anthrax as a bioweapon gained the attention of terrorists. In the nineties of the last century Japanese religious movement Supreme Truth (Aum Shinrikyo) attempted to use anthrax as a bioweapon in addition to sarin [6]. Fortunately, the sect did not have pathogenic strain and an effective technique to spray the microbes, so they did not achieve the intended target. In 1991 before the Gulf War, the USA and United Kingdom drew the attention to the possibility of producing and storing anthrax microbes as bioweapon by Iraq and vaccinated intervention military units against anthrax.

Later it has been established by the UN special commission (UNSCOM) that Iraq had 8500 kg of concentrated anthrax cultures intended for the production of vaccines [7]. The most spectacular bioterrorist attack with the use of anthrax took place directly after the before-mentioned terrorist attacks on WTC in September 13th, 2001. At that time, an anonymous sender sent several letters containing gram quantities of dried spores of fully malicious strain of anthrax bacillus. As a result 11 people were infected with pulmonary anthrax, five of which died [8]. Until today, the perpetrators were not disclosed. One hypothesis suggests that it was not a terrorist attack, but a warning action performed by a scientist involved in anthrax research [9].

Respiratory infection with anthrax bacillus spores

Pathogens of various diseases subjected to atomisation may be more sensitive to environmental degradation than those entering an organism by ingestion or intradermal inoculation. Even though, the experts are generally in agreement that respiratory infection requires substantially less pathogens than gastrointestinal or cutaneous infection [10]. Pathogens intended for inhalation are subjected to aerolisation in liquid or dry form. The aerolisation of dry forms is more effective, because the mechanical stresses occurring in the process of liquid aerolisation are greater and may destroy more pathogens. There are substantial differences regarding the data concerning the effectiveness of biological attack according to the apparatus used to produce aerosol. The product range is diverse from hand-spray canisters to large containers with mechanical atomisation. The latter ones can be installed in the aircraft (crop nebulisation), in the means of land transport or in vessels. The progress in aerolisation methods is very rapid, because pharmaceutical and cosmetic industry is constantly improving the methods of spraying specified drugs and cosmetics. The improvements of these methods may be potentially used to spray pathogens.

There are three methods of dissemination: spot, multi-spot and linear. Spot dissemination is a release the pathogen or a toxin from one source (e.g. a bomb, artillery shell, case-type box, etc.). The source of point dissemination may be launched inside the attacked object (e.g. it may be located in a closed ventilation system of a building) or in the open space. The spot dissemination of *B. anthracis* was used, fortunately unsuccessfully, by the aforementioned Aum Shrinrikyo sect.

Multi-spot source of dissemination is based on the same technique as the spot one, but it has a multiple dissemination sources. Aum Shrinrikyo has also attempted to use this technique in a form of fake briefcases (document cases) fitted with small ventilators and containers with pathogens. Linear dissemination is spreading pathogens from a moving source (a vehicle, aircraft, vessel).

To obtain the aerolisation effectiveness, sprayed particles must be small enough to fit through the nozzle of the spraying device and to penetrate the infected organism through the smallest alveoli and bronchioles. The inside diameter of the smallest bronchioles amounts to 5 microns. The spores of anthrax bacillus meet the conditions, because their diameter is circa one micron and their cell walls protect them against extreme conditions of spraying. As for the issue of environmental degradation of sprayed spores of *B. anthracis*, mentioned English experiment with the contaminated Gruinard Island confirm their usefulness as a bioweapon [11]. Settled in the external environment even for decades, the anthrax microbes have maintained full viability and virulence characteristics, and in favourable conditions they may be re-lifted by the wind. The good example of such phenomenon is the abovementioned incident in Sverdlovsk in 1979.

Pathogenesis and clinical symptoms

Spores, especially those mixed with suitable compound to prevent them herding themselves in conglomerates, are easly atomised in aerosol with a particle size corresponding to the size of a single spore

[12]. Due to such fragmentation of aerosol particles, after entering the alveoli the spores can easily penetrate through their walls to the organism [13]. Spores develop into vegetative forms in a nutrient-rich environment of a connective tissue surrounding the alveoli. Macrophages located around the alveoli assume their phagocytosis and reach the nearest lymph nodes. Toxins produced by phagocytosing anthrax bacilli are capable of destroying the membrane of endosomal vesicles in the cytoplasm of macrophages and multiplying, simultaneously leading to their death. The released anthrax toxins cause oedema, bleedings and necrosis of the lymph nodes. The entire incubation process lasts from 1 to 3 days. Afterwards, clinical symptoms develop including fever, diarrhoea, cough, shivers, asthenia, headaches, abdominal and chest pains. The second stage develops abruptly with an increasing fever, dyspnoea and shock. These were the symptoms experienced by the victims of epidemic in Sverdlovsk and after the anthrax postal attack in the USA.

Diagnosis

Clinical tests in the diagnosis of anthrax are generally nonspecific [2]. An increased activity of transaminases and hypoxia are observed. Microscopy of blood smears indicated Gram-positive bacilli, which easily multiply in an ordinary nutrient medium under aerobic conditions. After the anthrax infections in U.S. mail in 2001, blood cultures of patients with advanced pulmonary form of anthrax taken before administration of antibiotics were 100% positive. Bacteriological tests on expectorated sputum has limited importance in anthrax diagnosis. Likewise, radiographic examination has only auxiliary importance, when lesions manifest with the infiltration of exudative fluid in pleura and ectasis in the mediastinum. A good confirmatory test in people, who may be infected via inhalation, is culture of nasal swabs, however the negative results do not allow for the exclusion of the infection.

A great problem in clinical diagnosis of pulmonary anthrax is poor diagnostic knowledge of primary care physicians. A survey regarding diagnosis of pulmonary anthrax was conducted in the USA based on the history of disease of selected patients from anthrax attack in 2001 [14]. Only 55% from 164 of the physicians surveyed answered the questions. The most common diagnosis were pneumonia and influenza, whereas only 6% took anthrax into account.

The results of the accuracy of recognition of anthrax and other microbes are more comforting [15]. Between 2007 and 2008 the samples of bioterrorist agents and harmless microbes were delivered to the laboratories of public health. The results of correct identification of anthrax amounted to 90% in 2007, whereas in 2008 they amounted to 99.9%. The waiting time for test results in some tests was reduced from more than 10 days in 2007 to 3-4 days in 2008.

Rapid progress in improving the detection of most dangerous disease microbes can be observed in recent years. It includes aiming at miniaturisation of diagnostic devices that will improve the capacity of the tests and shorten the time required for achievement of capacity to make a targeted response to the identified agent [17]. A technique of testing with the use of so-called microarrays can posses wide range of diagnostic applications [18]. Microarrays were used as a testing tool to determine the aetiology and pathogenicity of dangerous pathogens. So far, the main focus has been given to DNA microarrays, but the current range of applications comprises protein, antibody and carbohydrate microarrays [19].

Anthrax treatment

In hospital treatment of anthrax there is no risk of transmitting the microbes from one person to another, so that the usual precautions such as hands washing are also adequate for treatment and care of patients with pulmonary anthrax. Similarly, no separate rooms for patients are applied. According to the recommendations of CDC and WHO, as long as drug sensitivity of bacteria isolated from patients is not determined, the first drug administered should be ciprofloxacin or doxycycline. It is also recommended to administer one or two of the following antibiotics: rifampicin, chloramphenicol, clindamycin, erythromycin, gentamycin, streptomycin or vancomycin. When clinically there are no contraindications, the administration of antibiotics should last up to 60 days with the change to oral administration [8]. Total 60-day administration of ciprofloxacin should be determined in patients with a certainty that they were exposed to aerosol anthrax. Simulation studies have established that prophylactic antibiotic treatment started in the second day after the exposure to anthrax aerosol could protect 86% to 87% exposed people from the infection. Any delay in prevention lasting two days resulted in increased risk of infection from 5.2 % to 6.5%. Anthrax vaccines are recommended as a complement to antibiotic prophylaxis for people after exposure to high concentration of aerosol.

In the environment of decision makers and drug distributors there is a concern that the needs of so long prophylaxis may quickly deplete the stocks of antibiotics. After post attacks in the USA conducted only with the use of few letters with anthrax microbes, over 30 000 people were provided with post-exposure prophylaxis and 5 000 were recommended with full 60-day administration of antibiotics [20].

Vaccination

Vaccines against anthrax have been manufactured for years and seem to be safe, however they are not one hundred percent sure [21]. The durability of resistance remains uncertain as well [22]. Vaccines are onerous to use, as they require repeated administration: after 2 and 4 weeks, 6, 12 and 18 months and annual re-vaccination. Major immunogen of vaccines currently used to immunise people is non-toxic protective antigen (rPA), a binding component of lethal anthrax toxin [3]. In the last decade much attention was focused on the development of new immunoprophylaxis, aiming at i.a. development of second-generation vaccines, which most likely would cause less side effects, but still they will have to be repeatedly administered with the inclusion of Aluminium adjuvant [8]. To solve these problems, it is being searched to develop vaccines formulations capable to stimulate rapid immunity after needless injection, stable in room temperature what in turn would facilitate storage during mass vaccination. The use of achievements of molecular biology to produce genetically altered strain and causing good immunity has raised large interest. Genetic studies have identified several epitopes associated with humoral neutralisation and showed that selective antipeptide reactions mediate in the *in vitro* protection, whereas passively transferred antibodies for selective epitopes constituted a protection for a mouse from lethal dose of a toxin [21]. It is emphasized that if the reaction from the threat of anthrax attacks is to be effective, modern vaccines, which generate immunity within reasonable timeframes and are less troublesome during the organisation of mass prophylaxis, are necessary.

As of today, in the USA the recommendations of the Advisory Committee on Immunisation Practices (ACIP) issued in 2009 are applied [23]. They reflect the state of supply in anthrax vaccine in the USA and include: 1. updated information about anthrax epidemiology; 2. summary of the efficacy, effectiveness, immunogenicity and safety of the vaccine; 3. instructions on how to use it before the exposure and 4. recommendations for post-exposure administration. Significant changes in the recommendations of ACIP relate to: 1. the reduction from 6 to 5 doses required after and during post-exposure immunisation; 2. during pre-exposure immunisation it is required to administer vaccine intramuscularly rather than subcutaneously; 3. used as a part of post-exposure prophylaxis in pregnant women exposed to aerosolised spores of *B. anthracis*; 4. instructions about the procedures in post-exposure immunisation organised by public health system during operations liquidating the effects of anthrax attack; 5. indications for people previously unvaccined to be subjected to 60-day post-exposure antibiotic prophylaxis for aerosolised spores of *B. anthracis* in combination of 3 doses of vaccines. The Americans have learned about the fact that currently licensed vaccine is a major problem towards bioterrorist threats, when they examined the level of antibodies for protective antigen in a large group of soldiers vaccines against anthrax [2]. They noted that over a half of vaccines have shown low ability of serum to *in vitro* neutralise the toxin.

Response from the state

Today it is taken as a fact that anthrax attacks in September 2001 heralded a new era of bioterrorist threats. At that time there was little data about the effects of such events. In the study developed within 7 months after anthrax attacks interviews with the officials from the Capitol were conducted. Psychosis created after the attacks resulted from the likelihood of exposure to sprayed spores [25]. Some patients with positive nasal swab tests manifested psychological disorders. Nearly 30% of examined people who did not have contact with sprayed microbes thought that they were exposed; 18% of all examined people demanded medical care. Extrapolation of these numbers to great potential threat indicates the importance of the consequences which may affect the functioning of public health when people change their behaviour basing on imaginary belief that they were subjected to anthrax attack. Stress, loss of faith in the actions of the authorities and effectiveness of antibiotics administration accompanied by growing hostility and distrust will be the consequence of such belief. For these reasons, worldwide tendency to strengthen the confidence in biosafety is not weakening since 2001. E.g. the government of Australia introduced regulations comprising i.a. supervision over certain pathogenic microorganisms including *B. anthracis* in 2009 (Security-Sensitive Biological Agents – SSBA) [11]. The list of the microorganisms is similar to the list of selected agents and toxins (Biological Select Agents and Toxins – BSATs) that exists in the USA since the half of the nineties of the previous century. There were two reasons that lead Australian government to this way of the regulation of biosecurity:

The security threats may result not only from the operations of terrorist groups but even from the actions of frustrated laboratory personnel, especially those removed from work in laboratories of high security level, who had access to the most pathogenic disease agents;

The government considered it necessary to organize actions against threats on the basis of carefully prepared regulations adopted to the needs forced by modern bioterrorism.

The decrease of expenditures on the research in the field of health protection due to the economy forces

the scientists to issue warnings about the insufficient state capacity to combat infectious diseases and bioterrorist attacks. And the needs in this fields have not been decreasing for years. The U.S. government spent billions to prepare the society for bioterrorist attack since 2001. Likewise, in 2011 federal budget for civil biodefence amounted to 6.48 billion dollars [26].

Prevention planning

Preparation of the society against the threats requires coordination of actions and its permanent verification. To improve the preparations, a series of interviews were conducted in the USA with civilian and military decision-makers responsible for organization of prevention in threat conditions [27]. A software, which stimulated a hypothetical anthrax attack, was used to prove various behaviours and their assessment. The attention was focused mainly on the assessment of the answers concerning two key steps in decision-forming process i.e. pre-accident planning and investments.

The results of the survey enabled the authority to assess the current opportunities of prevention, identification of a gaps in politics, determination of the technology level used in prevention, assessment of the flow of information and connection between the responding organisations and disclosure of the deficiencies that require elimination. Another thematically similar survey was conducted in order to determine the knowledge of physicians about the recognition of category A of bioterrorist threats [14]. Altogether 820 physicians were interviewed. 71% admitted to be unsure whether they could identify agents of 5 dangerous infectious diseases. They were more confident in an identification of smallpox (48.6%). The majority of the responders to the survey were physicians of emergency conditions and infectious diseases. 71% indicated the need to organise various trainings and the lack of availability of specialist literature. Nearly 72% of respondents admitted to poor knowledge of official regulations concerning combating diseases. Overall, survey results showed large uncertainty of physicians in identifying diseases presented in the survey. The clinician doctors emphasized in particular their lack of diagnostic skills and expressed the need for more training.

Decontamination

Decontamination of the environment is a key step in elimination of the effects of bioterrorist attack. The costs of decontamination after anthrax attack in the USA in 2001 were estimated at hundreds millions dollars and even though after 2 years after the attacks some objects could not be put to use again [26]. Large scale attacks will result in even larger contamination and correspondingly larger areas will require decontamination, which would entail even greater costs. American have developed a procedure of decontamination of the buildings contaminated with *B. anthracis* [28] after the anthrax attacks in 2001. It was divided into several stages comprising identification of the range and contamination level by field sampling and vacuum removing of the spores with the use of HEPA filters. There are several challenges with this method of decontamination. They include the detection sensitivity of settled spores and detection of alive spores without ability to multiply on artificial substrates. There are many other issues starting from development to the construction of various device sets to perform different decontamination procedures. Decontamination conducted on the model strain has shown that the largest fraction (ca. 81%) of spores were not removed during the first decontamination procedure. Fewer spores were detected after following procedure, whereas 93% of their initial number were removed after third procedure.

Food terrorism

Food is regarded as a potential target of bioterrorist attacks with the use of anthrax microbes [29]. Attacks may take various forms. Apart from aerosol spraying of *B. anthracis* spores and contamination the entire environment, there is also a possibility to contaminate specific materials and food products. Mass produced food can be contaminated and it would lead to the infections of hundreds or thousands people. To verify these possibilities i.a. the behaviour of *B. anthracis* spores in beverages like wine and juices was tested [30]. Beverage samples were contaminated with the spores in a dose of ca. 106 CFU per ml and the number of viable spores were periodically calculated during the storage of contaminated beverages for 30 days in 400C. The research revealed that in the most contaminated liquids the number of viable spores did not decline below 1 log CFU/ml after this time. In the bacteriological analysis of food suspected to be contaminated, the emphasis is placed on developing fast methods of detection of toxoinfection and food poisoning [31].

Moral aspects of research on the biological weapon

In all the years the subject of double use of biology achievements both for peace and hostile purposes has been running through publications about bioweapons. In particular, many modern biological researches can be either about assistance in treatment and improvement of welfare or the killing and destruction. Until now, scientists, whose research could serve for developing dangerous technologies

for human, have believed in the maxim that technologists and politicians are responsible for using science for inhumane purposes [32]. However, nowadays when biological research could have global catastrophic effects, such an attitude requires a thorough revision. There are many examples of studies about anthrax microbes e.g. coating the spores with a polymer causing better dispersion of aerosol and multiple reduction of an inhalation infective dose [12] or genetically modified properties of *B. anthracis* hindering their detection and treatment [33]. Posing questions about the purpose of such research remains a scientific rhetoric.

Recently, Israeli authors have tackled this issue as regards the situation of Israel [34] highlighting that new achievements in biotechnology will encourage Arabic terrorists to provoke unrest on the background of possessing by them even more destructive kinds of weapons. The importance of social sensitivity to these challenges is the subject of a study of special state committee. The situation may exacerbate even more after killing Osama bin Laden by Americans.

Due to the poor performance of intelligence and fast detection systems, unpredictable nature of bioterrorism events requires developing measures of medical prevention, which will be able to treat the exposed. After anthrax attack, the most effective and economic form of protection seems to be vaccination accompanied by administration of antibiotics. However, such prevention is ineffective, as it may seem due to the fact that the time between primary exposure and starting a treatment may be long. Because of that, it is worth to designate therapeutic strategies focusing on the inactivation of anthrax toxins. Currently, physicians can eliminate the infection with anthrax, but they have no therapeutic options to combat anthrax toxins causing toxaemia and tissue destruction, and their lasting activity even after antibiotic elimination of anthrax microbes from an organism. Therefore, further broadening of the knowledge about pathogenesis of the anthrax, reaction of a host and search for effective medicines has become an urgent need.

Summary

The paper discusses the issues concerning an anthrax microbe considered to be the most likely bioterrorist threat agent. In the event of anthrax attack early diagnosis is essential to control the proliferation of the disease. Historical examples enriched with the stimulation of biological attacks prove how effective is bioweapon in causing danger and panic, and indicate that there is the risk of complete collapse of normal functioning of the attacked society if the attack is not brought under control. A crucial role in clinical diagnosis of bioterrorist cases may be played by pulmonologists, because inhalatory infection with anthrax cause primary symptoms in the lungs. Wherever there is a group of cases with pulmonary symptoms of unknown aetiology, bioterrorist source of epidemic should be always taken into consideration. After determination that a bioterrorist attack could have occurred, the next essential step is to determine an agent, because it involves serious implications related to isolation and treatment of potentially exposed people. And finally, as it was previously emphasized, in relation to a terrorist attack an expertise beyond medical knowledge will be required. Conventional terrorist attacks are definitely more likely than bioterrorist ones, which require complex knowledge about microbes of dangerous diseases, processing them into weapons and spraying technique. The most important for emergency services and public health services will be the first hours after the attack and the knowledge of previously developed plans of prevention, availability of emergency measures and procedures for their disposal.

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Emergency Medicine

First aid, antidotes, treatment and the description of physico-chemical properties of toxic industrial substances on the example of ammonia, chlorine and hydrogen chloridey

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Summary:

Poland is in an exceptionally high degree vulnerable to the industrial contamination. There are over 500 plants using toxic industrial materials in the process of production or storing them.
The paper presents main threats caused by a failure or industrial disaster and depicts the first aid in such events. The particular attention was paid to the threats caused by uncontrolled contact with such substances as ammonia, chlorine and hydrogen chloride. Detailed toxicological information related to these substances was presented as well

Key words: toxic industrial materials, hazardous substance, chemical contamination

Toxic industrial materials is a term without unambiguous, generally accepted definition. Numerous definitions, sometimes widely varying, can be encountered in literature. This is the cause of misunderstandings in counting certain substances to toxic industrial materials.

Two of them can be cited to make an example:

'Toxic industrial materials are chemical substances of various kinds, usually materials used in the industry that in certain conditions may cause injuries (poisonings) to humans and animals and result in degradation of the environment'.

'Toxic industrial materials are chemical compounds with toxic properties, used in large amounts in the industry or transported and having capability of easy transition to the atmosphere in case of the damage (failure) of the devices and causing injuries to the population'.

The term 'hazardous substance' means a substance or mixture which due to one or more chemical, physical or toxic properties is considered to be a threat. Because of possible threat they pose to people and environment, such substances are the subject of interest of many institutions. Seventy five hazardous substances are produced, processed and used in Poland. Among hazardous substances the group of extremely hazardous substances is to be distinguished.

Chemical contamination is a term used in environmental protection to define contamination emitted by the industry, public utility and living sector, and transport i.e. gas contamination of the atmosphere, contamination of water and soil by sewage and solid waste contamination of water environment and lithosphere.

Industrial contamination includes thus a very large group of chemical compounds of various state of matter, different capability of transition into the

atmosphere and various toxicity, causing possible changes in the environment.

Toxic industrial pollution

Poland is exceptionally exposed to this type of contamination. It results from the scope of national chemical industry and consolidating position of Poland as a country of primary processing of raw materials.

National industry processes fossil raw materials with energy-intensive methods using outdated technologies and equipment until raw products are produced. The products are exported abroad, whereas industrial waste, hard to recycle is left in the country. Their amount is often higher than the amount of manufactured goods and usually they are toxic and harmful to humans.

In the territory of the Republic of Poland there are over 500 plants using in production process or storing toxic industrial materials. They are characterized by high sensitivity to accidents, damages or failures due to the considerable number of pipelines, high pressure in the systems and the presence of flammable materials.

The accidents in the plants or their destruction can lead to the formation of vast zones of chemical contamination. Plants are located in the territory of the country in an nonuniform manner. The majority of them is concentrated on the Vistula along its entire course (Kwidzyń, Bydgoszcz, Toruń, Włocławek, Płock, Puławy, Tarnów).

Another grouping of chemical plants using toxic industrial materials concentrates along the upper reaches of the Oder River from Brzeg Dolny and in the area of Upper Silesia. The largest are located in Brzeg Dolny, Kędzierzyn, Chorzów, Jaworzno. Other large plants are located in Police, Kostrzyń and Gorzów Wielkopolski.

In addition to the plants using toxic industrial materials located in the territory of the country, chemical contamination may result from the accidents in chemical plants situated near our borders. These include i.a. chemical plants in Schwedt, Wittenberg and Ostrava.

Another potential source of risk is a transport of toxic substances associated with supply of raw materials to chemical plants, their transit and export .

Accidents in production plants

Depending on the type of accident, toxic chemical substances escape to the atmosphere either in a single act (a burst) or during a certain period of time.

The amount of toxic substances, which can be found in the atmosphere in a given time depends on i.a. constructional design and tank capacity, type of chemical compound, scale and type of the damage, physical parameters and storage conditions of chemicals as well as the scale, type and duration of the actions undertaken to localise the failure. Weather conditions in the area of failure have also significant impact on the size of leak of toxic substances from damaged systems.

Owing to the very complex nature of quantity relations conditioning the size of leak of various substances from specific systems (tanks), in practice when assessing the scale and consequences of failures this type, the amount of substance released in a given time depending on the type of damage is not specified. Data assuming one-time leak of all substances or data from the identification of failure are interpreted as a rule. In particular instances, very different quantities of substances (from several kilograms to the hundreds of tons) can seep into the environment during the leak The level of threat caused by each accident is, however, determined not only by the amount of released substances but also by their toxicity.

In case of massive industrial disasters accompanied by the leak of toxic substances to the environment, the threat to the population is caused by various amount of toxic compounds. For example, during the accident of Union Carbide chemical plants in India in 1984 the leak of toxic compound (methyl isocyanide) lasted for 30 minutes and at least 5 tons of chemicals escaped to the atmosphere. After the disaster in Soveso chemical plant in Italy 3 kilograms of highly toxic dioxin were released to the environment.

Contamination zone of toxic industrial materials covers the site of the accident (the leak) and the zone, where contaminated air spreads with concentration causing given injuries (fatal, moderate, slight, threshold). The surface of the leak formed due to the spillage of toxic industrial materials covers usually relatively small area and it is often limited by ground embankment, which are built in many cases around tanks (systems) containing toxic substances. In the worst cases it covers several hectares.

Toxic substances in a solid form of high fragmentation (triturate), while escaping o the environment especially under certain pressure, may be carried by the wind and as a result they may contaminate larger area. Contaminated area my take on the shape of circle, ellipse or irregular figure. The size of the areas may amount to several hectares, whereas in very unfavourable weather conditions they may reach the size of few km^2.

Toxic substances in the liquid state spread gravitationally in the area of accident. They may flow into ditches, valleys, sewers, rivers, etc. If toxic industrial materials gets into the river, water becomes contaminated on a large distances reaching dozens and hundreds of kilometres and sometimes even the entire length of the river.

The destruction area (accident area) is characterized by the strongest toxic effects of toxic industrial materials. Its radius depends on the storage conditions and the scale of destruction (accident). For most materials it does not exceed 1 km. The radius of the destruction area increases 1.5 – 2 times, when fires occur, what is substantiated with the increased likelihood of the leak of more toxic industrial materials under such conditions as well as the splattering due to the bursts.

The zone of spreading cloud of contaminated air (primary and secondary) results from the evaporation of the toxic substances from the accident site. It has a shape of a sector with centre located in the site of accident.

The depth and dilation angle of the side boundaries of contamination zones depends on numerous factors:
- type and amount of released toxic industrial substances,
- topographical conditions
- season and weather conditions in the ground layers of the atmosphere (wind speed and direction, layer, precipitation).

Large amount of the factors affects great variation of the cloud range of contaminated air in various conditions. For example, the depth of the contamination zone may reach several dozen of kilometres for chlorine – a compound used in large amounts in chemical industry.

1. Ammonia

Identification of chemical substance chemical formula: NH_3

Identification of hazards: Flammable, toxic substance. Toxic in case of exposure of respiratory tract.

First aid
Essential drugs: oxygen, Atrovent in capsules, dexamethasone for inhalation, cortisol, furosemide (ampules), analgesics (e.g. dipyrone).
Antidote: unknown.

Inhalation exposure
First aid: Remove the poisoned from exposure area, lay in a comfortable reclining or sitting position, keep calm and in total immobility (the risk of pulmonary oedema during effort), protect against heat loss. Administer oxygen to breathe. In case of 'suffocation feeling', inability to speak, wheezing, administer Atrovent from capsules for inhalation. Call a physician immediately.

Medical aid: If the symptoms of swelling of the larynx (aphonia, stridor) persist, despite administering Atrovent, establish permanent intravenous route and administer cortisol intravenously. Lack of improvement justifies intubation and immediate transport to the hospital with reanimation ambulance. Depending on the symptoms in the respiratory system – cortisol, furosemide. Transportation to hospital by ambulance or reanimation ambulance under the supervision of a physician (risk of oedema and pulmonary complications).

Skin exposure
First aid: Liberally rinse with running, cool water, simultaneously taking carefully clothes off due to the possibility of severe damage to poured skin. Do not use neutralizing (acidifying). agents. Put a sterile dressing on the burns. Pour cold (!) water (tap water) on a frostbitten skin ('pale') or soak in cold water (e.g. hands). When it turns pink, put a sterile dressing.

Medical aid: Administer dipyrone. Any case of skin burns or congelation requires surgical assistance. Transport to the hospital with an ambulance or reanimation ambulance – according to the extent of the burns.

Eye exposure
First aid: Liberally rinse the eyes with cool water for at least 15 minutes.
Note: Any person vulnerable to eye contamination should be informed about the need and way of their immediate rinsing.

Medical aid: In any case of eye contamination, urgent ophthalmological assistance is required.

Ingestion
First aid: Do not induce vomiting. Give egg white or milk to drink. Do not administer anything by mouth. Call a physician immediately.

Medical aid: An analgesic may be administered intravenously (e.g. dipyrone). Immediate transport to the hospital with reanimation ambulance, ensuring surgical assistance due to the risk of oesophagus and stomach perforation.

Specific danger:
- The gas is lighter than air, accumulates in the upper parts of rooms.
- Toxic, inflammable gas.
- It burns poorly in the air, but well in the oxygen

with a greenish flame.
- Containers with ammonia exposed to fire or high temperature may explode.

General recommendations:
- Notify the neighbourhood about the failure
- Remove all people who do not participate in elimination of the failure from the endangered area; order evacuation if necessary.
- Call the State Fire Service and Police.

Special protective equipment: Gas-tight chemical protection suit including self-contained breathing apparatus.

Proceeding in case of release
Leak: Remove all sources of ignition. Avoid direct contact with releasing substance. Remove gas with fine water spray. Secure drains. If possible stop a leak (close the gas supply, seal, place damaged container in an emergency airtight chamber).
Note: Never direct water jet on the leak.

Storage and handling: Handling: do not eat, drink during usage. Avoid inhalation. Obey the rules of personal hygiene. Use individual protective measures. Work in well ventilated rooms. Keep the substance away from open fire and high temperature.

Requirements forventilation: Local exhaust ventilation is necessary with a casing of the area of gas emission to the air environment and general ventilation of the room. Spot ventilation holes at the top of the casing. The exhaust of the general ventilation in the top part of the room. Ventilation systems must comply with the conditions determined due to the danger of fire or explosion.

Occupational exposure limits:
- MAC 20 mg/m^3
- STEL 27 mg/m^3

Requirements for personal protective equipment: If the concentration is determined and known, the selection of personal protective equipment should be made taking into account the concentration of a substance occurring in the workplace, exposure time and the activities performed by the employee, based on the directory 'Personal Protective Equipment', issued by the Central Institute for Labour Protection.

In an emergency situation, if the concentration of the substance in the workplace is not known, use personal protective equipment recommended for the highest class of protection.

Protective clothing made of materials coated with viton, butyl rubber, polyvinyl chloride, neoprene or hypalon; gloves made of natural rubber, neoprene, polyvinyl chloride or perbunan; footwear made of neoprene; goggles protecting against drops of a liquid (in case of using half-mask), type-B canister after completion with a mask or half-mask; if the concentration of a substance is higher than 1% volume or there is an oxygen deficiency in the air, use gas-tight clothing coated with viton, butyl rubber, polyvinyl chloride, neoprene or hypalon, anti-electrostatic with isolating apparatus to protect respiratory tract.

Physicochemical properties
Basic properties:
- State of matter at 20°C: gas
- Colour: colourless
- Odour: pungent, characteristic
- Explosive limits in the mixture with air:
  – lower: 15% of the volume.
  – upper: 28% of the volume.
- Gas density (0°C, 1013 hPa): 0.771 g/dm3
- Liquid density (-33.43°C, 1013 hPa): 0.682 g/cm^3
- Vapour pressure in relation to air (0°C, 1013 hPa): 0.597
- Solubility in water (20°C, 1013 hPa): 42.8% of weight.

Stability and reactivity
Combustion products: water, nitrogen, nitrogen oxides.
Chemically stable. It dissociates to small extent in 840-930°C. Highly soluble in water the substance forms alkaline solutions. Chemically active. It creates a risk of fire and/or explosion in the reactions with: acetaldehyde, acrolein, boron trifluoride, bomine, chloine, perchloric acid, chlorine trifluoride, chlorosinale, ethylene oxide, fluorine, hydrogen bromide, hypochlorous acid, iodine, nitric acid, nitrogen dioxide, nitrogen trichloride, nitrosyl chloride, phosphorus pentoxide, picric acid, phosphorus and phosphine, arsine, antimony hydride, sodium, sulfur dichloride. Ammonia, especially in humid environment attacks copper, tin, zinc and their alloys.

Toxicological data
Toxicity class: List B of the Ministry of Health and Social Welfare (MziOS) lists ammonia concentration of over 9%. Toxic substance according to Annex 2 to the Regulation of MZiOS of 21 August 1997. The substance is not included in the lists of carcinogens and probably carcinogenic to humans (by regulation MZiOS of 11 September 1996). The substance is not assessed in terms of carcinogenicity by the IARC.

Concentrations; lethal and toxic doses:
- odour detection threshold – 0.4-40 mg/m^3,
- LD_{50} (rat, oral administration) – 350 mg / kg,
- LC_{50} (rat, inhaled administration) – 7600 mg/m^3 (2 h),

- LD_{50} (rabbit, rat, external administration) – no data,
- LCL_0 (rat, inhaled administration) – 1420 mg/m^3 (4 h).

Toxic and other harmful biological effects to the human system: irritant and corrosive. Routes of exposure: by inhalation, by ingestion.

Symptoms of acute poisoning: in form of gas and vapours it causes pain and tearing, redness of conjunctions, swelling and spasm of the eyelids, cough, sore throat, hoarseness, ptyalism, nausea, vomiting, retrosternal pain, shortness of breath. Other possible symptoms include laryngeal oedema with a sense of choking, bronchiospasm, respiratory arrest, pulmonary oedema. Direct consequence of poisoning includes acute bronchitis, pneumonia and lung fibrosis with severe respiratory failure. Sin contact with gas, vapour or solution may result in chemical burns with severe ulceration. Liquid ammonia causes frostbite. Eye contamination with gas, vapours or solution results in pain and acute inflammation, corneal ulceration; necrosis or blindness may occur. Exposure by ingestion causes oral mucosa, throat, oesophagus burns, abdominal pain with a risk of complications and threat to life.

Symptoms of chronic poisoning: irritation of mucous membrane, upper respiratory tract, eyes, skin inflammation and chronic bronchitis.

Ecological data
Permissive air pollution:
- 400 μg/m^3 –30-minute concentration
- 200 μg/m^3 –24-hour concentration (average),
- 50 μg/m^3 – average annual concentration.

Ammonia is highly soluble in water forming alkaline solutions harmful to aquatic organisms.

Disposal
Destroying and neutralisation:
Ammonia should be neutralized by absorbing it in the appropriate amount of sulphuric acid solution with a concentration of 10-20%.

Transportation
Labelling of the means of transport:
- motor vehicle – orange reflective warning plates
- carriage – warning labels No 6.1 and No 8
- tank – orange warning plates with identification numbers 268/1005
- warning labels No 6.1 and No 8
- tank carriage – orange warning plates with identification numbers
- 268/1005, warning labels No 6.1, No 8 and No13
- labelling of transport packages with the words: *AMMONIA, ANHYDROUS (UN 1005)*, warning labels No 6.1 and No 8
- the type of the container: cylinder, tubular containers, pressure barrel, bundles of cylinders made of carbon steel, alloy steel, aluminium alloys, composite material
- containers must have valid admission of the Office of Technical Inspection in accordance with applicable regulations.

2. Chlorine

Identification of chemical substance and enterprise
Chemical formula: CI_2

Hazard identification:
Toxic and irritant substance. It acts toxically in case of inhalative exposure. Irritating to eyes, respiratory system and skin.

First aid:Necessary medicines: oxygen, Atrovent in capsules for inhalation, dexamethasone for inhalation, cortisol, furosemide.
Antidote: unknown.
Treatment: symptomatic treatment.

Inhalation exposure
First aid: Remove the poisoned from exposure area, lay in a comfortable reclining or sitting position, keep calm and total immobility (the risk of pulmonary oedema during effort), protect against heat loss. Administer oxygen preferably by mask. In case of breathing difficulties, inability to speak and/or hoarseness, wheezing, administer Atrovent from capsules for inhalation. Call a physician immediately.

Medical aid: If the symptoms of swelling of the larynx (aphonia, stridor) persist, despite administering Atrovent, administer dexamethasone by inhalation, establish permanent intravenous route and administer cortisol intravenously. Lack of improvement justifies endotracheal intubation and immediate transport to the hospital with reanimation ambulance. Symptoms of pulmonary oedema justify administration of oxygen (through a mask) and invtravenous administration of cortisol, furosemide. Transportation to hospital by ambulance or reanimation ambulance under the supervision of a physician without interrupting of treatment.

Specific danger: toxic, irritating, suffocating, nonflammable gas. It is heavier than air and accumulates near the ground and in the lower parts of rooms. It creates fire risk in contact with flammable substances and materials and forms explosive mixtures with hydrogen.

General recommendations: Notify the neighbourhood about the failure;
- Remove all people who do not participate in elimination of the failure from the endangered area; order evacuation if necessary;

- Call the State Fire Service and Police;
- Fire: non-flammable gas.
  Containers exposed to fire or high temperature water from a safe distance (risk of explosion) until extinction; if possible, remove them from the hazardous area.

Special protective equipment: Gas-tight chemical protection suit including self-contained breathing apparatus.

Proceeding in case of release
Leak: Avoid direct contact with releasing substance. Do not allow for contact with flammable materials. Remove gas with fine water spray. Secure drains. If possible stop a leak (shut the gas supply, seal, place damaged container in an emergency airtight chamber), isolate contaminated area.

Storage and handling: Handling: do not eat, drink during usage. Avoid inhalation. Obey the rules of personal hygiene. Use individual protective measures (as listed in point 8). Work in well ventilated rooms fitted with general and local ventilation.

Type of storage: gas storage with a separate room for toxic and corrosive gases, fire-resistant. Keep in cool, well-ventilated room.

Requirements for ventilation:
Local exhaust ventilation is necessary with a casing of the area of gas emission to the air environment and general ventilation of the room. Spot ventilation holes at the working level or below. The exhaust of the general ventilation in the top part of the room and near the floor.

Occupational exposure limits:
- MAC 1.5 mg/m^3
- STEL 9 mg/m^3
- CEIL not specified

Requirements for personal protective equipment:
If the concentration is determined and known, the selection of personal protective equipment should be made taking into account the concentration of a substance occurring in the workplace, exposure time and the activities performed by the employee, based on the directory 'Personal Protective Equipment', issued by the Central Institute for Labour Protection.

In an emergency situation, if the concentration of the substance in the workplace is not known, use personal protective equipment recommended for the highest class of protection.

Protective clothing made of materials coated with viton, neoprene or hypalon; gloves made of natural rubber; footwear made of neoprene; goggles protecting against drops of a liquid (in case of using half-mask), type-B canister after completion with a mask or half-mask; if the concentration of a substance is higher than 1% volume or there is an oxygen deficiency in the air, use gas-tight clothing coated with viton, neoprene or hypalon, anti-electrostatic with isolating apparatus to protect respiratory tract.

Physicochemical properties
Basic properties:
- State of matter at 20°C: gas;
- Colour: yellow-green;
- Odour: pungent, penetrating;
- Gas density in relation to air (0°C, 1013 hPa): 2.49 g/dm$^{3;}$
- Gas pressure:
  – in 20°C 0.68 MPa,
  – in 30°C 0.9 MPa;
- Solubility in water (20°C, 1013 hPa): 7.30 g/dm$^{3;}$
- Solubility in other solvents: soluble in most organic solvents.

Stability and reactivity
Combustion products: non-flammable gas. The substance is chemically active; reacts directly with all chemical elements except inert gases, carbon, fluorine, oxygen and nitrogen. The substance reacts violently explosively with organic and inorganic compounds or forms explosive compounds. Containers exposed to fire and high temperature may explode. It is corrosive to most metals, especially under the influence of moisture. It is thermally stable. It dissociates at temperatures above 1000° C and is a strong oxidant.

Toxicological data
Toxic class:
- Substance not listed in list A and B of MZiOS
- Toxic and irritant substance according to Annex 2 to the Regulation of MZiOS of 21 August 1997.
- The substance is not included in the lists of carcinogens and probably carcinogenic to humans (by regulation MZiOS of 11 September 1996).
- The substance is not assessed in terms of carcinogenicity by the IARC.

Concentrations; lethal and toxic doses
- odour detection threshold:
  – detection: 0.2 mg/m3,
  – identification: – 0.6 ÷ 1.2 mg/m^3
- LD_{50} (rat, oral application) – not applicable,
- LC_{50} (rat, inhaled application) – 864.1 mg/m^3 (1 h),
- LD_{50} (rabbit, rat, external application) – no data,
- LCL_o (rat, inhaled application): 407 mg/m^3 (1 h),
- LCL_o (human, inhaled application): 2530 mg/m^3 (30 min).

Toxic and other harmful biological effects to the human system: irritant and suffocating in contact

with moist surface of mucous membranes it is forms hypochlorous acid, hydrogen chloride, oxygen free radicals and other compounds of chlorine with a strong biological effect.

Routes of exposure: by inhalation
Symptoms of acute poisoning: in concentration ca 4 mg/m^3 it causes tearing, conjunctival hyperaemia, in larger concentration it results in damage to the cornea, sore throat, at concentrations of ca. 80 mg/m^3 it causes coughing fits, sometimes accompanied by vomiting and blood discharge with a feeling of suffocation, chest tightness, retrosternal pain; in concentration of 120 ÷ 150 mg/m^3 – pulmonary oedema, hypotension, cardiac arrest. Gas at a concentration of about 3000 mg/m^3 may cause death after a few deep breaths. There may be swelling of the larynx with a feeling of suffocation (lack of data on concentrations).

Consequences of acute poisoning: patients who survived acute intoxication with sublethal concentrations of chlorine developed a mixed respiratory failure.
Symptoms of chronic poisoning: Repeated exposure may lead to a reduction in respiratory efficiency. There are lesions in the cornea of the eyes, perceptible in the ophthalmological examination of the eye. Impairment or loss of smell, skin lesions.

Ecological data
Permissive air pollution:
- 100 μg/m^3 –30-minute concentration
- 30 μg/m3 –24-hour concentration (average),
- 7 μg/m^3 – average annual concentration.
- Permissible pollution of inland surface waters:
- I, II and III class of cleanliness – not detectable.
- Chlorine dissolved in water destroys organic life and has bactericidal activity.
- Spreading cloud of chlorine gas causes the destruction of biological life in the contaminated area.

Disposal
Destruction and neutralization:
Chlorine must be neutralized by entering it at a moderate speed to an appropriate amount of 15-percent solution of sodium hydroxide.

Labelling of the means of transport:
- motor vehicle – orange reflective warning plates
- carriage – warning labels No 6.1 and No 8
- tank – orange warning plates with identification numbers 268/1017
- warning labels No 6.1 and No 8
- tank carriage – orange warning plates with identification numbers 268/1005, warning labels No 6.1, No 8 and No13
- labelling of transport packages with the words: C*HLORINE (UN 1017)*, warning labels No 6.1 and No 8

The type of the container: cylinder, tubular containers, pressure barrel, bundles of cylinders made of carbon steel, alloy steel, nickel alloys, composite material.
Containers must have valid admission of the Office of Technical Inspection in accordance with applicable regulations.

3. Hydrogen Chloride

Identification of chemical substance and enterprise
Chemical formula: HCl

Hazard identification
Toxic and irritant substance. It causes severe burns. Irritating to the respiratory system.

First aid
Necessary medicines: Atrovent in capsules, dexamethasone for inhalation, cortisol, furosemide (ampoules).
Antidote: unknown.
Treatment: symptomatic treatment.

Inhalation exposure
First aid: Remove the poisoned from exposure area, lay in a comfortable reclining or sitting position, keep calm and total immobility (the risk of pulmonary oedema during effort), protect against heat loss. In case of glottic spasm (suffocation, aphonia, hoarseness), administer Atrovent from capsules. Administer oxygen for breathing. Call a physician immediately.

Medical aid: If the symptoms of swelling of the larynx (aphonia, stridor) persist, despite administering Atrovent, administer dexamethasone by inhalation, establish permanent intravenous route and administer cortisol intravenously. Lack of improvement justifies immediate transport to the hospital with reanimation ambulance. Symptoms and changes in lung sounds clearly justify inhalation administration of dexamethasone, intravenous of hydrocortisone, furosemide. Continue the administration of oxygen. In any case – transport to the hospital by reanimation ambulance.

Skin exposure
First aid: Take contaminated clothes off, rinse the skin with running, lukewarm water. Do not use neutralizing agents (acidifying). Put a sterile dressing on the burns. Call a doctor.

Medical aid: Transport to the hospital by an ambulance providing surgical assistance and treatment.

Eye exposure
First aid: Liberally rinse the eyes with cool water for at least 15 minutes.
Medical aid: In any case of eye contamination, urgent ophthalmological assistance is required.

Ingestion exposure
First aid: Do not induce vomiting. Give egg white or milk to drink. Do not administer anything by mouth.

Medical aid: An analgesic may be administered intravenously (e.g. dipyrone). Immediate transport to the hospital with reanimation ambulance, ensuring surgical assistance due to the risk of haemorrhage and collapse.

Proceeding in case of fire
Specific hazards: toxic, irritating, suffocating, non-flammable gas. It is heavier than air and accumulates near the ground and in the lower parts of rooms. Containers exposed to fire or high temperatures may explode.

General recommendations:
- Notify the neighbourhood about the failure.
- Remove all people who do not participate in elimination of the failure from the endangered area; order evacuation if necessary.
- Call the State Fire Service and Police.
- Containers exposed to fire or high temperature water from a safe distance (risk of explosion) until extinction; if possible, remove them from the hazardous area.

Special protective equipment: Gas-tight chemical protection suit including self-contained breathing apparatus.

Proceeding in case of release
Leak: Avoid direct contact with releasing substance. Secure drains. Remove the sources of ignition. If possible stop a leak (shut the gas supply, seal, place damaged container in an emergency airtight chamber), releasing gas should be diluted with dispersed water streams.

Storage and handling: Handling: do not eat, drink during usage. Avoid inhalation. Obey the rules of personal hygiene. Use individual protective measures (as listed in point 8). Work in well-ventilated rooms.
Type of storage: gas storage with a separate room for toxic, fire-resistant. Keep in cool, well-ventilated room.

Requirements for ventilation: Local exhaust ventilation is necessary with a casing of the area of gas emission to the air environment and general ventilation of the room. Spot ventilation holes at the working level or below. The exhaust of the general ventilation in the top part of the room and near the floor.

Occupational exposure limits:
- MAC 5 mg/m^3,
- CEIL 7 mg/m^3.

Requirements for personal protective equipment: If the concentration is determined and known, the selection of personal protective equipment should be made taking into account the concentration of a substance occurring in the workplace, exposure time and the activities performed by the employee, based on the directory 'Personal Protective Equipment', issued by the Central Institute for Labour Protection.

In an emergency situation, if the concentration of the substance in the workplace is not known, use personal protective equipment recommended for the highest class of protection.

Protective clothing made of materials coated with viton, butyl rubber or polyvinyl chloride; gloves and footwear made of natural rubber; goggles protecting against drops of a liquid (in case of using half-mask), type-B canister after completion with a mask or half-mask; if the concentration of a substance is higher than 1% volume or there is an oxygen deficiency in the air, use gas-tight clothing coated with viton, butyl rubber, polyvinyl chloride, with isolating apparatus to protect respiratory tract.

Physicochemical properties:
Basic properties:
- State of matter at 20°C: gas
- Colour: colourless
- Odour: pungent, choking
- Vapour pressure in relation to air (0°C, 1013 hPa): 1.268
- Gas pressure:
  – at 5.9°C: 3.04 MPa
  – at 20°C: 4.3 MPa
- Solubility in water (20°C, 1013 hPa): 45.14% of weight.

Stability and reactivity

The substance fumes in contact with humidity of the air. In the presence of even trace amounts of water it acts corrosively on metals, causing the separation of flammable hydrogen. It reacts dangerously with carbides, acetylides, sodium, lithium silicides, fluorine.

Toxicological data
Toxicity class:
- List B of the Ministry of Health and Social Welfare (MZiOS) lists hydrochloric acid at concentration of over 10 %.
- Toxic and irritant substance according to Annex 2 to the Regulation of MZiOS of 21 August 1997.
- The substance is not included in the lists of carcinogens and probably carcinogenic to humans (by regulation MZiOS of 11 September 1996).
- The substance is not assessed in terms of

carcinogenicity by the IARC (group 3)

Concentrations; lethal and toxic doses:
- odour detection threshold – 1.5-53 mg/m3,
- LD50 (rat, oral application) – no data,
- LC50 (rat, inhaled application) – 7146 mg/m3 (30 min); gaseous HCI
- LD50 (rabbit, rat, external application) – no data,
- LCL0 (rabbit, oral application) – 900 mg/kg; aqueous solution of HCI
- Toxic and other harmful biological effects to the human system: irritant and corrosive. Employees accustomed to HCI tolerate concentrations of 15 mg/m^3.
- Routes of exposure: inhalation, aqueous solution (hydrochloric acid) – ingestion.

Symptoms of acute poisoning: a gas or aerosol form of hydrochloric acid causes eye pain, tearing, conjunctival redness, burning pain of mucous membranes in the nose and throat, cough. At concentrations exceeding the ceiling values it may cause spasm of the glottis, laryngeal oedema, pulmonary oedema. Contamination of the skin causes painful chemical burns. Eye contact results in burns of the eyelids, conjunctiva and cornea leading to blindness. Ingestion causes burns of the oral mucosa, pharynx, oesophagus, abdominal pain, gastrointestinal haemorrhages and it can lead to circulatory collapse. The consequence of the burns are cicatricial lesions.

Symptoms of chronic poisoning: damage to tooth enamel, conjunctivitis, chronic bronchitis. Frequent contact with an aqueous solution may cause dermatitis.

Ecological data:
Permissive air pollution:
- 200 μg/m^3 –30-minute concentration
- 100 μg/m^3 –24-hour concentration (average),
- 25 μg/m^3 – average annual concentration.

Disposal
Destruction and neutralization: Hydrogen chloride should be absorbed in water and formed solution should be neutralised with alkalis (sodium carbonate, whitewash, sodium hydroxide).

Transportation data:
Labelling of the means of transport:
- motor vehicle – orange reflective warning plates
- carriage – warning labels No 6.1 and No 8
- tank – orange warning plates with identification numbers 268/1050
- warning labels No 6.1 and No 8
- tank carriage – orange warning plates with identification numbers 268/1050, warning labels No 6.1, No 8 and No13
- labelling of transport packages with the words: *HYDROGEN CHLORIDE (UN 1050)*, warning labels No 6.1 and No 8.

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Catastrophe Medicine

The types of terrorist attacks and possible ways to prevent them

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Summary:

The following paper presents threats which the world is facing on the threshold of the 21st century as well as a basic division of terrorist attacks regarding the place of their organization and applied agent. Basic agents applied in attacks with the use of biological weapons and toxic industrial agents were characterized. The final part of the paper indicates actions which should be undertaken in our country in order to prevent the threat of terrorist attacks.

Key words: threats, terrorism, terrorist attack, preventing attacks.

At the end of the 20th century and especially the beginning of the 21st century major changes have occurred and new threats for the security of various countries including Poland have emerged. The threats have drastically changed the approach to security issues, its understanding as well as countering them.

The interest of security issues of the counties and societies have been enormous so far, but they have benn usually associated with international conflicts and armed forces. Nowadays, as regards generally understood security, the armed forces play the crucial role, but not the most crucial one. Therefore, contemporary approach to security issues must be multi-faceted.

As it was previously mentioned the discussions concerning the security focused almost solely on the assessment of military threats. However, it turned soon out that a war threat is highly unlikely especially in Europe. It may be concluded that such situation will continue and the likelihood of the armed conflict will become lower. It will obviously not cause sudden reduction of the quantity of the armed forces and even if only at the expense of enhancing their quality and capabilities. It should be taken into consideration that the armed forces are prepared to counter not only military threats, therefore there will be still a need to maintain them.

In addition to military threats, there are also non-military threats, which will definitely dominate nowadays. These include four groups of threats which could lead to crisis situations and having impact on the security and functioning of the entire country or its regions [1]:

1) natural threats (all dangerous phenomena related to the nature)
2) technical risks (connected to the development of civilization and industry)
3) terrorism
4) other threats including:
   - substantial reserves of chemical and biological weapon in countries with unstable political situation;
   - uncontrolled flow of mass destruction weapon and intermediate products used in its production including radioactive substances;
   - international organized crime;
   - large amount of local conflict caused by various reasons (fundamentalism, nationalism,

[1] Łepkowski W. Wykład dla PAN. Warsaw; 2004

religious wars);
- uncontrolled and illegal immigration

The events in the United States [2] in 2001 revealed that the most serious threat to the security of the countries is terrorism, namely contemporary terrorism which is qualitatively different from the one from the period of the French Revolution i.e. its beginnings or the half of the 20th century.

Contemporary terrorism is inextricably linked to the civilisation of 20th century. Attacks changing the face of the modern world, casualties counted in thousands have caused trepidation among politicians, in business circles and society in the globe. Terrorism is a synonym for the crime, which affects people connected with authorities and those having nothing in common with politics [3].

It turn out that there are almost 150 definitions of terrorism, each different from another though having a lot in common.

Ultimately, for our considerations it seems advisable to adopt a definition found in the dictionary of terms related to security issues according to which, a terrorism is a theory and practice of specifying differently ideologically motivated, planned and organized actions of groups or individuals resulting in violation of existing law, undertaken in order to extort certain behaviours and benefits from the authorities, countries and societies, often affecting the goods of the outsiders [4].

Taking into account fundamental division of terrorism in respect of the place of attack, three basic types can be distinguished i.e. air attack, sea attack and attacks on the ground.

Huge losses and extensive damage can be caused using different aircrafts with primary role of attacking targets on the ground or water. A typical example of such attack is the attack of September 11, 2001 on the World Trade Centre and the Pentagon.

Act of terror can be defined as[5]:
- hijacking a passenger aircraft or any other aircraft filled with fuel or explosives in order to destroy a specific object or attack civilians by striking hijacked aircraft in the target of the attack;
- using any aircraft (manned or unmanned) as a unit to drop (spray) contaminants (chemical or biological);
- using any aircraft with nuclear load or so-called dirty bomb in order to destroy important object (e.g. nuclear power plant, dam) or to cause contamination.
- The only way to reduce the risk of such attack is to rigorously inspect passengers and properly protect the airports.

The next way to implement an attack is a sea attack. Marine areas conduce to perform such operation i.a. due to:
- convenient depth of water on the routes of maritime communication facilitating planting bottom contact mines
- short period of occurrence of icing phenomenon (mostly in the inshore zones) which prevents operations of terrorist groups with the use of high-speed motor vessels.

The prevention of such actions will consist mostly of intensified patrolling of marine areas by the naval units and special anti-terrorist groups consisting of special operations forces.

The last basic way of terrorists' operations are terrorists attacks conducted on the ground. They should be reckoned mainly in relation to such objects as:
- infrastructure objects being the seat of the government and the local authorities;
- objects of diplomatic missions;
- objects of critical infrastructure (power plants, dams, important industrial plants, etc.);
- so-called 'soft objects'(railway stations, underground, cinemas and theatres, means of mass communication);
- military objects.

The division of terrorist attacks can be also made due to the type of weapon used. The main types include:
- the attack of concentrations of people, certain people or object with the use of firearms or rocket arms;
- kidnapping or detaining means of public communication together with passenger as hostages,
- terrorist attacks in public places with the use of explosives.

The latter ones mainly consist of:
- detonating charges in public places such as communication objects, commercial objects, schools, administration departments;
- a credible threat to detonate the explosive;
- delivering a false information about planting an explosive in public buildings i.e. school,

[2] Terrorist attacks of September 11, 2001 organized by Al-Qaeda.

[3] Jałoszyński K. Współczesny wymiar antyterroryzmu. Warsaw; 2008: 31.

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[5] Olszewski R. Reagowanie na zagrożenia z powietrza w czasie pokoju [in:] Bezpieczne niebo. Materials from the conference held at the National Defence University on September 10,2002. AON: Warsaw; 2002: 51.

administration department, commercial objects resulting in the need of preventive evacuation of people working there, patients, and substantially disorganizing the wok of the institution.

Another type of attack is cyberterrorism, which is the use of the internet in terrorist activities including hacking, paralysing the flow of information and data falsification; blocking the information, data manipulation or destruction and damage to the entire electronic information system.

The attacks on information systems may be connected with other types of terrorist attacks and as a matter of fact they are preliminary attacks. In the contemporary world there are multiple information systems which disruption could harm the functioning of the state and the security of citizens. The threats to the systems operating in energy sector, water supply system, gas pipeline sector or emergency and uniformed services are particularly dangerous, because their paralysis may result in the paralysis of the entire country.

So far, these attacks have not resulted in casualties or serious threat to their lives.

An attack in Queensland, Australia in 2000 is considered to be the first deliberate act of cyberterrorism targeting at the control system of pumping stations located in Sunshine Coast. What happened there was hacking the control system of pumping station and releasing millions of litres of pollutants to surface water. The perpetrator was motivated by revenge for not getting a job by local employment office. The consequence of the attack was long-lasting action of purification with the cost amounting to 50 000 dollars.

The act of bioterrorism is one of the most dangerous attacks. Characteristic features of such actions include:

- fast proliferation of microorganisms (bacteria, viruses),
- lack of effective medicine,
- difficulties in immediate diagnosis of the cause of morbidity and mortality,
- confusing symptoms during the development of the disease,
- the fact that it is very economical weapon, because the small amount of the substance proliferates and moves with the carriers (people, animals, etc.)
- the effect of use is not immediately noticeable,
- the fact that it may result in secondary transmission of the disease on other individuals and the likelihood of epidemic to emerge,
- a component of the contamination could be any element of ecosystem (water, air, soil, etc.)
- lack of the possibility of protection in case of mass use.

Given the threat of using biological weapons for attack, the factors determining this fact should be mentioned. Certainly, these include:

- easiness of acquisition (as they are used in pharmaceutical industry, small laboratories),
- low costs of use (the costs of causing comparable loss among population on 1km^2 by conventional weapon amount to 2000 USD, by nuclear weapon – 800 USD, biological weapon – 1 USD),
- very effective scale of use regarding mortalities and triggering infectious diseases,
- invisibility during the attack,
- easy to hide and move,
- it is extremely difficult to quickly recognize the cause of morbidities and mortalities,
- during the incubation of the disease the symptoms

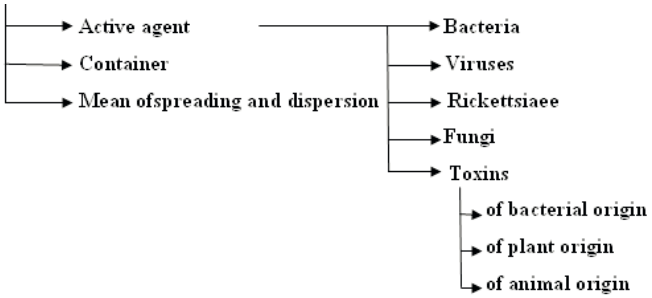

Figure 1: Components of biological weapon

are often unusual and misleading.

The following chart presents the components of the biological weapon[6]:

Let us define various active agents:
Bacteria [7] are microscopic protozoans or organisms forming groups of undifferentiated cells. They are present in most habitats on Earth and can exist where no other live forms can. Among bacteria there are some pathogenic for human, animals and plants producing harmful bacterial toxins. Currently, Gram-positive and Gram-negative bacteria are distinguished. Endotoxin LPS found in the membrane of some Gram-negative bacteria is one of the most lethal substances inducing shock, which manifests itself with rapid decrease of pressure often leading to death. Although some Gram-positive bacteria also contain endotoxins, which having particular properties of inducing fever may lead to death, they are generally considered to be less dangerous. Diseases triggered

[6] Terroryzm biologiczny „Bioterroryzm". AON; Warsaw: 2008.

[7] Pięta J. Broń masowego rażenia. Warsaw: 2007.

by bacteria include anthrax, plague, tularaemia, glanders, cholera.

Viruses [8] parasitize plant, animal and human bacterial cells. Diseases triggered by viruses include smallpox, viral haemorrhagic fevers, Venezuelan equine encephalitis, rabies, foot-and-mouth disease (swine and cattle disease) and many more.

Rickettsiae [9]are specific varieties of bacteria i.e. Gram-negative bacteria which are parasites on some stage of developmental cycle and cause diseases like Rocky Mountain spotted fever carried by arthropods (insects, spiders, ticks, etc.). Best known disease caused by Rickettsiae and usually carried by lice is typhus (spotted fever) which is lethal more often than other bacterial diseases. Rickettsiae also induce Q fever, Balkan influenza, trench fever and other diseases usually carried by arthropods.

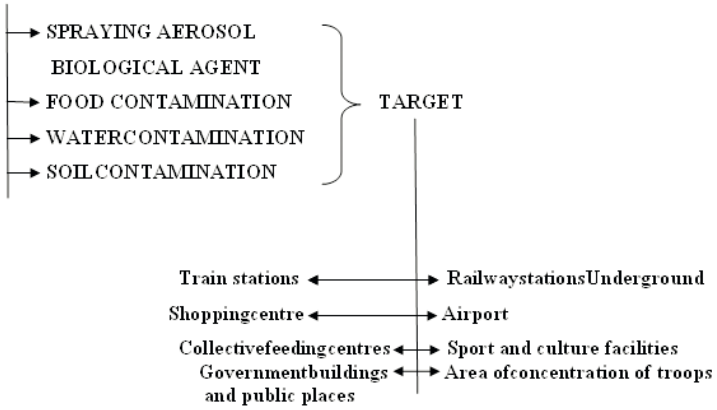

Figure 2: Ways of using biological weapons

Toxins [10]and among them biological toxins, botulinum toxin, mycotoxins, staphylococcal enterotoxin B, ricin, saxitoxins.

There are various forms and ways of using biological weapons presented by the following diagram [11].

The probability of biological agents being used in terrorist attacks is constantly increasing and acquires more and more significance. Multiple reports have revealed that terrorist groups and organisations show interest in them. Even the World Health Organisation (WHO) alerts to the possibility of theorist attack with the use of biological weapon such as Ebola viral haemorrhagic fever, smallpox, plague bacteria, botulinum toxin and anthrax bacilli.

Few examples of tragedies resulting from the use of biological agents are listed below[12].

Sverdlovsk (currently Yekaterinbug), formed USSR. In 1979 a failure in Military Institute of Microbiology occurred resulting in anthrax germs escaping into the atmosphere, epidemic and 68 deaths. The Soviets argued that it was the meat from animals infected with anthrax which was the source of the disease.

In September 1984 members of the Rajneesh movement subjected citizens of The Dalles, Oregon to the contamination of bacteria Salmonella typhimurium using salad boxes in four restaurants. This act of bioterrorism resulted in 751 people sick, 45 of them required hospitalisation. In 1986 Ma AnandSheela testified during the proceeding in federal court that bacteria culture was grown on a ranch owned by the sect.

Six weeks after the accident in Tokyo's underground Larry Harris, laboratory technician from Ohio, ordered a strain of bacteria causing bubonic plague on May 5,1995 in American Type Culture Collection company from Rockville (Maryland). Harris had risen suspicions four days after the order. Officials were surprised by the impatience of the customer and his ignorance of laboratory techniques. Therefore, they contacted federal authorities and it turned out that Harris is a member of the organisation proclaiming superiority of the white race.To buy bacteria causing plague he needed only a credit card and forged letterhead. In November 1995 federal court found Harris guilty of postal law violation.

Krzysztof Chomiczewski from Military Institute of Hygiene and Epidemiology believes that currently there are no completely effective defence possibilities of larger communities against the effects of biological weapons. Vaccines may prevent some diseases, but this way of protection is worthless due to the fact that pathogenic factor is not known in advance. Moreover, there are no vaccines against most potential pathogens, which may be striking agents of biological weapon. Antibiotics may not be effective as well before a microorganism is identified and will never be if we encounter naturally antibiotic-resistant

[8] Ibidem.

[9] Ibidem.

[10] Ibidem.

[11] Terroryzm biologiczny „Bioterroryzm".AON; Warszawa: 2008.

[12] Ibidem.

strains or strains produced via genetic engineering methods[13].

Presented facts indicate the necessity of a broad look on the real threat of biological weapons, the need of developing a system preventing the use of such weapon and procedures for the most effective elimination of its effects. The most effective means of defence against biological striking agents is effective prevention both during wartime and terrorist attacks. What emerges clearly is the need to identify the intention of use such weapons, therefore all experts emphasize the substantial role of secret services and police. Another extremely important part of effective prevention is having efficient, fast and integrated epidemiological surveillance system and specialized accredited microbiological laboratories, which are adequately equipped and capable of quick and accurate diagnostics.

In the event of real threat it is necessary to have trained and adequately equipped staff of emergency and health services capable of reacting effectively in accordance with developed procedures. It is essential to have appropriate sanitary transport, properly prepared hospital base, reserves of antibiotics, vaccines and disinfectants.

The next type of attack is radiological terrorist attack aiming at damaging nuclear reactor located in power plants, research institutes or war vessels. The release of radioactive substances, being usually local and limited, occurs due to the damage. In order to prevent such events to happen the protection of objects with reactors as well as the control of radiological contamination on the national level via the activity of appropriate service should be properly organized.

Radioactive contamination in our country may result from failures of nuclear power stations located in the neighbouring countries. Ten nuclear power plants are operating at the distance of 300 km from Polish borders. Only Belarus is not using nuclear power plants. Nuclear power plants in the closest vicinity of our borders are located inDukovany (Czech Republic; 122 km),Mochovce (Slovakia; 125 km), Temelin (Slovakia; 128 km) and in Ukraine (140 km).

Twenty six nuclear power stations are operating at the distance of 650 km from our borders. Another serious problem is radioactive waste dumping. Average sized nuclear power plant produces annually circa 20 tons of radioactive waste. Stored waste are losing their properties for hundreds of thousands years. In case of nuclear accident in any neighbouring country there is a high probability of contamination of our territory.

The essence of chemical terrorist attack is employing the use of blood agents and hazardous chemical substances (toxic industrial materials). The main purpose of such attack is causing maximum damage and civilian casualties (attack on 'soft targets', critical infrastructure, etc.). Currently, the majority of counties in the world uses plants using hazardous materials which may cause significant threat for people and the environment. Therefore they are potential targets of terrorist attacks.

Toxic industrial materials contamination is one of the greatest threats in the peace time and during the war.

Some toxic industrial chemicals are listed below[14]:

Acrylonitrite – poisoning occurs via inhalation, digestive track and skin. The functioning of central nervous system is disrupted. It also causes severe burns after contact with skin.

Nitrogen oxides – poisoning symptoms include irritability or nitrite symptoms i.e. considerable gastrointestinal upset, nausea, severe pain in the diaphragm, vomiting, diarrhoea, thirst.

Ammonia –muscle weakening with increased reflex activity, seizures, hearing impairment occur after few minutes of intense exposure. Pulmonary oedema is also possible. Ammonia poisoning may result in psychological disturbance and neurological disorders, clouding of cornea and lens, and sometimes even in blindness.

Nitric acid – during inhalation it is possible for spasms of larynx and lungs and laryngeal or pulmonary oedema to occur. It causes severe skin burns. Swallowing may result in burns of the lips, mucous membranes, oral cavity, oesophagus and stomach.

Dimethylhydrazine – poisoning results in pulmonary oedema, which in case of acute condition leads to severe paralysis of central nervous system, occasionally ending with death. Liquid dimethylhydrazine causes skin burns.

Hydrazine – poisoning symptoms are similar to dimethylhydrazine.

Dioxin – poisoning results from inhalation, skin contact or through digestive track. It causes metabolic disorders, liver and nervous system functioning disorders.

[13] Chomiczewski K.:Zabezpieczenie Polski przed atakiem bioterrorystycznym.Przegląd Epidemiologiczny. 2003; 57: 363-368.

[14] Urząd Gminy Michałów. Obrona cywilna i sprawy obronne. http://www.michalow.pl/page.php?id=41

Ethylene dichloride is a drug causing dystrophic lesions in liver, kidneys and other organs. Due to resorptive activity it causes clouding of cornea. Dangerous when inhaled, ethylene dichloride operates also through intact skin. Particularly toxic after drinking.

Carbon monoxide displaces oxygen from blood creating carboxyhemoglobin. Blood oxygen content may lower from 18-20% to 8% (anoxemia). Carbon monoxide can directly and toxically affect cells, hinders internal respiration, affects carbohydrate metabolism simultaneously increasing blood-sugar level, disrupts phosphorus and nitrogenmetabolism. Death occurs as a result of respiratory arrest.

Ethylene oxide is a drug with strong, special toxic properties and having inhalation and irritating effects. It abruptly irritates skin. Skin paralysis occurs after exposure to ethylene oxide in liquid, gaseous state of matter and in the form of solutions.

Sulphur dioxide affects mucous membranes (moist) due to the formation of sulphurous or sulphuric acid causing severe local irritation. The symptoms of poisoning include bronchial spasm, difficulties in breathing, upsetting metabolism of carbohydrates and proteins, oxidation processes in spinal cord, liver, spleen and muscles.

Carbon disulphide generally poisons the entire body. Local symptoms are unclear. Basically, it penetrates the organism via inhalation, but penetration though intact skin is also possible. High concentrations exhibit narcotic effect. Chronic exposure to low concentration of carbon disulphide causes diseases of central autonomic and peripheral nervous system, endocrine and internal orgasm of cardiovascular system. It affects development of cardiovascular diseases, peptic ulcer disease, diabetes and many others.

Tetraethyl lead is a powerful poison affecting mostly nervous system. It has cumulative properties. Poisoning is possible via inhalation, gastrointestinal tract and skin.

Phosgene has irritating effect on lungs. Poisoning reduces permeability of alveoli walls and blood vessels leading to the situation when liquid part of blood (plasma) enters into alveoli and causes pulmonary oedema. As a result air hunger occurs, which can increase due to poorer circulation.

Hydrogen fluoride intensely irritates the upper respiratory tract. After exposure to high concentrations eyes and nose become irritated and lacrimation and excessive salivation occurs. Other symptoms include badly healing conjunctivae, mucosa, nose, oral cavity, larynx and bronchial ulcers, purulent inflammation and nose bleeds. Occurrence of toxic hepatitis is also possible.

Chlorine irritates respiratory tract and may cause pulmonary oedema.

Chloropicrin has suffocating and generally toxic properties. Vapours strongly irritate mucous membranes of eyes and lungs. It may cause pulmonary oedema and central nervous system disorders and is highly irritant to skin.

Hydrogen cyanide (Prussic acid)strikes the organism by rapid blockade of intracellular iron-containing respiratory enzymes what hinders oxygen transport in the tissues and causes internal hypoxia. Functioning of central nervous system is disrupted.

Actions preventing failures, which could lead to contamination toxic industrial materials, include:

- contamination forecasting,
- organisational and preventive undertakings,
- proper distribution of toxic industrial materials,
- organising of adequate warning and alerting system about the risk of contamination with toxic industrial materials,
- training and maintaining specialist rescue teams in constant readiness to eliminate the effects of contamination with toxic industrial materials,
- equipping specialist groups in appropriate measures and devices to eliminate the effects of contamination with toxic industrial materials,
- making workers and citizens familiar with procedures after anticipatory signals alerting about contamination with toxic industrial materials and in contaminated area.

The increase risk of terrorist attacks in our country creates undeniable need to consolidate efforts of all institutions responsible for national security. Only through joint, coordinated actions it is possible to prevent such big tragedy as potential terrorist attack.

Except on the efforts, the attention should be focused on crisis management system, which is continuously being expanded and improved. The experts on terrorist attacks claim that the fact of conducting such attack is one thing and skilful performance of services after the attack is completely different thing. It is high effectiveness of the entire crisis management system that influences the number of casualties, which may grow bigger after wrongly conducted rescue action.

Another important factor and in my opinion the most important one is the awareness of the society. It is still thought that we live in the county which is not threatened by terrorist attacks.

Nothing could be more misleading. Obviously, it is not about scaring the society and introduce the sense of constant threat, but about preparing society for common opposition to such attacks, ability to specify threats and proper reaction in the event of attack.

In my opinion it is a joint action of the state institutions and the entire society and sensitivity to all signals that can prevent acts of terror from happening and improve the level of national security.

Therefore, in order to adequately prepare the country for terrorist attacks it should be assumed that Poland is under constant threat of terrorist attack and that it is not properly prepared not only for detecting plans of an attack, but also for dealing with its effects. Moreover, the mentality of decision makers and responsible services should be altered, as they have been repeatedly convincing the public, that the situation is different even though the facts show something else. Consequently, several important actions should be undertaken, such as[15]:

- the procedures of action in case of threat from suicide bombers should be developed, including legal grounds to use them (empowering marksmen to kill them, the use of firearms with intended lethal effect) as well as appropriate tactical procedures;
- uniform structures responsible for the entire training, equipment and preparation for action of all tactical and counter-terrorist units in Poland (police, military and other services such as Internal Security Agency, Border Guard, customs services and the tax office) should be developed. It would result in major benefits concerning purchasing the equipment;
- development of information exchange system and coordination system with neighbouring countries (in case of cross-border incidents) and countries leading in combating terrorism and having the greatest combat experience including joint trainings;
- development of support and security structures including transit forces (aircraft, helicopters, vessels, land vehicles), commanding structures and planning special operations, reconnaissance protection and counter-intelligence cover;
- it is necessary to prepare antiterrorist forces to operate in contamination conditions or under threat of contamination (apprehension of people in possession of hazardous substances) as well as rescue and hospital base (the network of hospitals preparedfor hospitalisation of victims of mass destruction weapons, appropriately prepared emergency services including sub-units eliminating the effects of contamination);
- effectively operating crisis management structures must be created, with clear division of powers and responsibilities, primarily responsible for coordination and cooperation of various services (police, the Polish Army, emergency services, government and local authorities),
- an effective and standardized communication system for the needs of rescue services, independent from civilian systems, providing the possibility to transmit classified information including radiotelephone and telecommunication system (between crisis management centres, management positions and central authorities);
- it is essential to establish a unified structure which would coordinate data collection concerning terrorists by all services. It could be a completely new institution or a part of the existing one,
- it is necessary to undertake a series of training projects conducted in the most realistic way and coordinating each structures,
- a national educational and information campaign should be conducted, which would make the society familiar with the threat and possible ways to behave in crisis situation.

The overall conclusion is that Poland is not safe due to current geopolitical conditions. On the contrary, it is vulnerable to terrorist attacks. Improved security in this area will depend on the way the abovementioned demands will be implemented, on the staff we have at different levels of crisis management system and the awareness of the society. After the fulfilment of all these conditions, we will be able to risk a statement that as a country we are properly prepared to deal with a potential terrorist attack.

[15] Piekarski M. Polska – czy jesteśmy bezpieczni?, http://www.specops.pl/vortal/taktyka_czarna/walka_z_terrorem/Michal_Piekarski/Polska_czy_jestesmy_bezpieczni/polska_czy_jestesmy_bezpieczni.htm

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Emergency Medicine

Decontamination of victims in emergency departments

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Summary:

Nowadays the possibility of use of biological, chemical, radiological or nuclear weapons by terrorists has become a real threat. As a result Emergency Departments being the first link of medical assistance are forced to develop appropriate standards and a pattern of action in case of the act of using the above-mentioned weapons. The risk of influx of a large number of victims to the ED may result not only from the possibility of using the weapons of mass destruction by terrorists, but also from the possibility of patients exposure due to technical failures in the work places storing hazardous materials. In case of exposure to the hazardous materials, both emergency medical services and emergency departments must be prepared to deal with such threats.

Key words: decontamination, weapons of mass destruction, mass events, emergency department.

Because of the existence of many potential scenarios of the mass destruction weapons (WMD) usage, it is crucial to create a plan, which would be implemented in the event of an accident with WMD and therefore it would not lead to re-exposure of patients and hospital personnel. The plan should be so universal to manage various types of WMD. It is extremely important to define essential health care professionals responsible for decontamination.

The term decontamination originates from Latin contaminatio meaning defilement, pollution and with the prefix de – meaning stain removal, decontamination. Thus, mass decontamination is a physical process associated with the rapid reduction or removal of hazardous materials from the surface of the human body in the situations of potential life or health threat to a substantial number of victims. In order improve the effectiveness of mass decontamination, General Sanitary Inspectorate has compiled the list of sporicidal substances shown in the table below.

While compiling the security plan for a hospital for the mass accidents and process of decontamination in an emergency department, it is crucial to discern that people, who will have contact with the victims are the first to be exposed for a very high concentration of hazardous substances. Therefore, first decontamination rooms in the hospital should be in as distant location from emergency department as possible. This should be a place for preliminary decontamination of patients performed through clothing removal.

The ideal solution would be, if the full decontamination process took place in the place of the event, far away from the hospital, but previous experiences revealed that during events having all hallmarks of mass accidents the majority of the patients arrive to the hospital on their own without a possibility of undergoing the decontamination process on the spot. Hence, the development of procedures to eradicate the contamination resulting in the huge number of victims requires in the first place compiling the set of procedures that would eliminate the contamination with simultaneous prevention of its proliferation and

acquainting the whole medical staff with the complexity of conducted actions and possible threats. It is essential to define the responsibilities of particular teams during whole decontamination process and afterwards, taking into consideration not only the achievement of the intended goal – i.e. decontamination of the patients – but also procedures guaranteeing safety to all people participating in the action.

Table 1: Sporidical preparations

The name of preparation	Concentration [%]	Time	Active compound	The scope of action
Aldesan E + activator	conc	10 h	Glutaraldehyde	B, M, F, V, S
Cidex Long Life + activator	conc.	10 h	Glutaraldehyde	
Cidex Solution + activator	conc	10 h	Glutaraldehyde	
NU-Cidex	conc	10 min	container A – hydrogen peroxide, container B – peracetic acid	
PeraSafe	1,62	20 min	sodium perborate, TAED	
Gigasept FF	12,0	18 h	succinic aldehyde	
Perform	2,0	1 h	potassium peroxymonosulfate sulfate, sodium benzoate	
Renalina	3,5	11 h	paracetic acid	
Sekusept Pulver + 0,5% activator	2,0	6 h	sodium perborate, TAED	

Preparatory proceedings

While considering the decontamination algorithm, it is essential to take into account the needs of a hospital as a unit, where the decontamination process will take place, simultaneously including all possible scenarios. In this respect the emergency department should be divided into specific zones. A 'hot zone' is a zone of work of professionally trained rescuers, who are adequately protected with a personal protective equipment. The level of medical personnel protection is dependent on the type of a threat. People responsible for patient decontamination usually wear clothes, which insulate both respiratory tract and skin. The second zone called the 'cold zone' is a place, where rescue services, wearing commonly used protective clothing, work. Patients, who stay in this zone, have already undergone the decontamination process. Such division is required, taking into consideration the necessity of providing medical personnel with an appropriate personal protective equipment, and the process of preparation and training for such eventuality.

However, safe decontamination is not only the specified room and equipped personnel, but also a number of undertakings starting with rooms, that ensure the safety of the patients and their privacy through adapting the hospital space to the crowd control and ending up with adequate decontamination rooms with independent water, plumbing or ventilation systems. The decontamination plan in the emergency department should therefore contain the instructions for proceeding with the victims before and after decontamination, the choice of appropriate water temperature for decontamination, procedures concerning mass decontamination performed with standardized methods (decontamination cabins and containers) and mass decontamination performed with alternative methods using available resources.

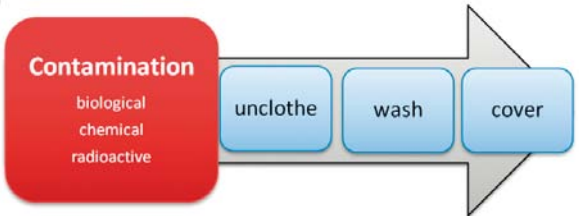

Figure 1: The schema of initial decontamination

Decontamination stations

When a large number of people was contaminated with toxic materials, using the decontamination stations is the only efficient way to reduce or totally eliminate the contamination that occurs on the people exposed to the above-mentioned materials. Contaminated persons are those, who have stayed in the area of contamination or have had any contact with a person or equipment from such area. Two types of decontamination stations may be differentiated, namely mobile and stationary. Huge complexes of showers in Israel may be listed as an example of stationary stations, whereas mobile stations are various transportable systems adapted to be easily broken down either on the site or outside the hospital.

Most of the decontamination stations have the same system, consisting of three zones. The first one constitutes the entrance to the station; this is a place,

where the victims are registered, submitted to control, whereas their condition and level of contamination is described. At this stage, the decontamination process involves unclothing of the victims, because clothes often are permeated with hazardous substances.

It should be remembered to take the clothes in the vicinity of the face off in the first place, then clothes from the upper and lower limbs. Such clothes should be preserved and packed into plastic bags. The bags should be tied and put into another bag, and then an identification number should be attached to the bag. The same number should be attached to the patient's wrist for the identification purposes. Substitute pre-decontamination clothing may be given out for people awaiting for decontamination. After such preparations, a patient may be transferred to the second decontamination zone, where the exact decontamination takes place with precise washing of the whole body with the use of water and soap (2-4 minutes). Afterwards in the third zone, the process of drying of the victims takes place. Drying should be gentle in order to avoid skin abrasions or congestions. A patient is prepared to be moved to a typical hospital bed.

Personal protective measures against contamination

Analysing the needs of hospital coming from admitting patients after exposure and the necessity of submitting them to decontamination, it is crucial to take into consideration the types of protective clothing, which has to ensure appropriate protection and usefulness during decontamination. Usually, the higher level of protective clothing is, the longer training medical personnel, being main receiver, needs. To the personal protective equipment universally used several items may be counted i.e. gloves, goggles (usually made of PVC), protective clothing, rubber footwear, respiratory protective equipment. Training in using protective clothing and respiratory protective equipment is a fundamental condition of safe work in contaminated zone.

Decontamination with use of specialist decontamination tents

Sometimes the rooms for decontamination of patients in an emergency department are too small to cope with mass influx of the patients, or even there are no such rooms. In such situation it is necessary to arrange a decontamination point outside a hospital. Nowadays, there are many companies that produce easy to unfold, inflatable decontamination tents. They are made of waterproof fabric

Figure 2: Decontamination tent

and their construction consists of inflatable sleeves filled with air from oxygen cylinders. Depending on the size of the tent, there is various number of decontamination cabins separated with screens from each other. There are also two hose lines supporting the tent with water, which after usage is carried with pumps to the special tanks. The equipment of a tent consists also of hydrophore, water heater, air heater and aforementioned tank for post-decontamination water.

Decontamination technique

Decontaminative actions should be undertaken immediately, when the possibility of contamination with hazardous materials is stated basing on the diagnosis and contamination measurements or clinical symptoms (skin, respiratory, ophthalmological, neurologic symptoms with vomiting), occurring in a high number of people,. The only exception from proceeding with immediate decontamination is the implementation of directly life-saving medical treatment, which cannot be postponed, due to the possible death of the victim. In this case hospital should be isolated from the contaminated person.

In hospital conditions decontamination should be performed in two or more parallel strings of fit people or changeably one for fit people and the second one for patients on stretchers. The help of services equipped with handy showers should be applied towards patients on the stretchers. Victims are moved through the whole decontamination tunnel on the stretchers on the special roller transport line.

If the necessity of starting directly life-saving medical treatment occurs, the victim is placed on a stretcher so that the access to the head is ensured, whereas the resuscitation zone is placed near the exit of decontamination chamber in order not to slow down the decontamination of remaining victims.

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History of Medicine & Pharmacy

Pharmaceutical and medical help for Polish self-defence centres in Volhynia in 1943-1944

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Summary:

During the II World War Polish population was persecuted and murdered not only by German and Soviet occupying authorities. Also Ukraine nationalists, especially the Ukraine Insurgency Army (UIA) formed in the beginning of 1943 by Stephan Bandera, ferociously fought against them. Since spring 1944 its units killed circa 60 thousand Polish citizens in Volhynia. Their purpose was to annihilate Polish people in this area, so their actions may defined as genocide.

To defend against UIA attacks, Poles had converted inhabited places into self defended fortress. However most of them were destroyed, only the biggest survived where effective self defence system was organized. One of the most important parts of this system was medical and pharmaceutical aid for defenders and thousands of others looking for shelter. In such a densely populated areas many hazardous infection diseases occurred mostly typhoid.

Article describes prevention and treatment by sparse medical personnel often operating in small rough-and-ready hospitals in overcrowded villages.

Key words: Second World War, Volhynia, Ukraine nationalists, Poles, Medical aid.

Ukrainians prevailed significantly among the inhabitants of the Volhynia Voivodeship, being the one of the largest regions in the Second Republic of Poland. According to the census of 1931 they accounted for 68% of the population. Polish community there constituted only 16.6%. A third group were Jews constituting 9.9%, mainly living in cities. During the Second World War both the authorities of the Soviet Union and the Third Reich used the ethnic differences in Volhynia in their struggle against the Poles living there [22].

The biggest threat for the Polish community was, however, the Ukrainian nationalism. It should be noted that before the war, especially in the thirties, one of the major socio-political problem in Volhynia was the fact that Ukrainians were prejudiced against the Polish government, and in some districts, especially the eastern, also in relation to the Polish people. Ukrainians felt discriminated by Polish authorities, accusing them for depleting their rights acquired during the Austro-Hungarian Empire. The situation was already intensified in 1922, when most leaders of the Ukrainian political parties, mainly nationalist, were of the view of the non-recognition of Polish sovereignty. They boycotted the elections to the then parliament. In later years, Ukrainians protested against polonization these areas, conscription into the Polish army and education policy reducing the number of Ukrainian schools. Large agitation of Ukrainian country folk was caused by the actions of settling Poles from the central Poland, especially military settlers. Ukrainian-Polish conflict lasted throughout the entire Interbellum. With the outbreak of World War II it

turned into a ruthless struggle of the Ukrainians against the Poles [11].

Its development was inspired and stimulated the activists of the Organization of Ukrainian Nationalists (OUN), founded in 1929 in Vienna as a result of a fusion of radical groups of Ukrainian nationalists, operating in the Soviet Union, Romania, and especially in Eastern Galicia. The centre of the OUN was located in Lviv. Over the next several years it was of the nature of the politico-military organization, working with conspiracy methods. Its principal objective was to establish an independent state on the lands recognized by it for being Ukrainian ones[9].

From the outset, the OUN collaborated with the Germans, who, however, after signing in January 1934 the Polish-German declaration of non-violence, limited the contacts to a minimum. Their revival occurred again in spring 1939 as a part of preparations of the Third Reich for war with Poland. When the war broke out Ukrainian nationalists acted sabotage against Polish military units and attacked Polish people, killing more than three thousand people [28].

After the occupation of Volhynia and Eastern Galicia by the Soviet Union, NKVD arrested some activists of the OUN. Many fled to the Third Reich and formed their own military units, which crossed the borders with German army in June 22nd, 1941 [13].

Genocidal activity of the UPA in Volhynia

The outbreak of the German-Soviet war was received with great enthusiasm by Ukrainians in Volhynia. The entering German troops were welcomed as liberators. They posed welcome gates decorated with flowers and flags, in national colours of Germany and Ukraine. Ukrainian nationalists were revealing in the field assuming power, assuming executive positions in the government and forming Ukrainian police. Germans entirely relied on Ukrainians in its ethnic policy in the region. Thus, Ukrainians received the status of privileged population what was eagerly used to implement anti-Polish policy. They developed slowly and steadily a wide-ranging activity aiming at the elimination of Polish population. They started persecutions and terror, often larger than the German occupation authorities. Ukrainian government imposed high levies on Polish villages and communities. Polish young people was sent to the forced labour in Germany, protecting Ukrainian young people. Nationalists hit squads engaged in killings of Poles with the approval of the German occupation authorities. Since the beginning of 1942 individuals and then the entire Polish families were killed in different regions of Volhynia [22].

Rapidly developing faction of OUN led by Stepan Bandera (OUN-B, Bandera faction) was involved in the most ruthless activities against the Poles. In autumn 1942, they established their own armed formation under the name of the Ukrainian Insurgent Army (UPA). At the Third Conference of the OUN-B, which took place in February 1943, it was decided to perform the initiation of one of the main program objectives of this fraction, which was the removal of Poles from the territories recognized by its members as the Ukrainian. It was decided to 'clean out the Polish population', still in the course of the war so that afterwards they were ethnically homogeneous and did not have to hold any plebiscites [10].

Soon after the UPA started a campaign of extermination of the Polish population. Its first mass murder was the massacre in February 9th, 1943 in the Polish colony Parośla in Sarny Oblast. The crime was performed by Bandera sotnya under the command of Korziuk Fedir, pretending to be Soviet partisans. 173 Poles were murdered there by UPA unit. In April 21st and 22nd of the same year circa 600 Poles became victims in Janowa Dolina in Kostopil Raion. The most serious escalation of the murder took place in spring 1943 in the eastern districts of Volhynia i.e. Sarny, Kostopil and Kremenets. In June the mass slaughter of Polish population took place in Dubiecko and Lutskyi Raion and in July and August it extended to the western districts i.e. Horokhivskyi, Volodymyr-Volynsky, Kovelskyi and Liuboml Raions. The culmination of murders occurred in summer, when it spread over the entire Volyn Oblast. In July 11th, at dawn UPA units carried out a coordinated attack for 99 Polish towns under the motto 'death to Lachy' and killed over 12 000 people. Over 530 Polish villages and settlements felt victim of the assaults in July. Over 17 000 Poles were murdered at the time [15, 27].

Ukrainian civilians also participated in murders committed with great cruelty. Larger villages and settlements were captured at first in armed attacks and afterwards the villagers were killed with axes, scythes, forks and saws. People attending masses in the churches were murdered as well.

The course of various actions was extremely tragic. Usually, they began with a blessing gave to the OUN-B units by the Orthodox priest, who also blessed the murder tools i.e. axes, scythes, crowbars and saws. Initially, the Ukrainians, having organizational and numerical advantage over the Polish inhabitants of the villages selected for the attack, found it relatively easy to defeat them. After incapacitating the entire families or larger groups ,

before depriving them of their lives, they tormented them in a barbarous way. They raped women in front of everyone, then mutilated them, split their stomachs open, cut off their breasts, picked the eyes out. Children were pierced with forks. Men were impaled or chained to horses and torn. Sometimes mutilated but still alive men were thrown to wells, ponds and rivers [27].

Polish historians estimate that up to June 1944, when the entire province of Volhynia was invaded the Red Army, about 60 thousand Poles were murdered [15].

Organization of murders, their course, size, territorial scope and the objectives and motives which guided the action justify the conclusion that in Volhynia it came to the crime of genocide in 1943-1944. The genocide was performed by UPA, strengthened by deserters from Ukrainian Auxiliary Police Constabulary and supported by numerous Ukrainian peasantry [27].

The organization of medical assistance by the District Delegate of the Government of the Republic of Poland

The increase in risk for Poles in Volhynia was viewed with concern by the authorities of Polish Underground State, both civil and military, operating in Warsaw. They were unpleasantly surprised by the development of anti-Polish action by the OUN-UPA. They already send their emissaries in the second half of 1941 in order to create underground administrative organs and defence units there. Ukrainians however, quickly recognized them, arrested and murdered. Therefore, people living there had the biggest chances to conduct the underground activities. It was only necessary to organize them and spur into action. Initially, particularly intensive work in this area was taken by the People's Party (SL), which adopted the code name 'Roch'. By the end of 1941, the Central Leadership of the People's Party sent 2nd lieutenant Zygmunt Rumel there, who was born and raised in Volhynia. As he knew a lot of people, he easily organised underground groups of the SL and initiated a collaboration with groups of Ukrainian Peasant Party - SL sympathizers - and Volhynia Rural Youth Union. He aimed at establishing the agreement with Ukrainian. He formed the units of Peasants' Battalions among Polish villagers, which were supposed to become a core of self-defence centres. In this respect, the SL activists mirrored the efforts of the officers of Home Army (AK), who formed a conspiracy troops fighting there on the orders of the Government of the Republic and Supreme Commander of Polish Armed Forces in exile. At this level there was then sharp friction between the SL activists and the AK officers [29].

The SL Leadership decided to expand successes achieved by 2nd lieutenant Rumel. In May 1942 Kazimierz Banach, pseudonym 'Jan Linowski' was nominated for the Government Delegate in Volhynia District. He was a leading activist of SL and simultaneously he was a chief of staff of the Headquarters of the Peasant Battalions (BCh). Thus, he was familiar with political and military issues [3].

The nomination met with acceptance of the authorities of the Government Delegation as it saw in him a good candidate for the delegate in this district, because he had worked there before. In the years 1935-1939 he was president of the Rural Youth Union of Volhynia, so he knew many young people across this province, both in cities and in villages. As a delegate he arrived there at the end of November 1942 when he was the sole representative of the central authorities of the PPP. Lt Col Kazimierz Bąbiński 'Luboń', the Commander of the Home Army in Volhynia District went there in March 1943 [1,16].

As the activist of SL and co-creator of BCh, Kazimierz Banach treated the Home Army and its strategy with reserve, as it engaged in the defence of Poles against UPA in a limited way. Its main goal was to prepare and conduct major combat with the Germans in the final stages of the war. The leadership of SL believed that the most important task was to organize the widest possible support, including the military, for the Polish population in Volhynia against Ukrainian nationalists. Therefore, Banach decided that his aim would be to develop strong self-defence centres in villages. In March 1943 he demanded assistance in supplying these centres in weapons from Gen. Stefan Rowecki 'Grot', Chief Commander of the Home Army , but he never gained it [3].

Together with his colleagues he created a very extensive National Security Corps (PKB), which included ca. 250 outposts and posts with ca. 4 thousand people serving there and in case of full the case of full mobilization the number could be increased to 15 thousand people. The area of the Volhynia District was divided into three inspectorates: southern, northern and eastern [26].

He attached great importance also to provide people residing in self-defence centres with various assistance, including medical aid. The organization of district delegation was directed on the work in these two main directions - the armed struggle and social welfare. The following military and administrative structures were formed within district delegation: the department of safety and self-defence, command of the National Security Corps, the department

of social welfare, the propaganda department, the department of education and culture, communication inspectorate [1].

County delegations were organised in a similar way, but instead of departments they consisted of offices. They were formed in every pre-war counties. It was a large organisational achievement which reinforced the self-defence movement in Volhynia.

As a delegate of the district Kazimierz Banach appointed two deputies: Cpt. Julian Kozlowski, who was responsible for the safety and self-defence and a priest Anthony Dabrowski, who was entrusted guiding the work of the department of social welfare [1].

There were no physicians or pharmacists in the composition of district delegation. Many of them worked in sanitary offices of district delegations. They were responsible for organising medical centres in the district and providing them with pharmaceutical supplies. Physicians and pharmacists tried to obtain as many representatives of the medical staff for cooperation as possible. They engaged hundreds of women to help the injured and sick. They tried to organize for the best possible medical care for members of PKB and to protect people in the self-defence centres.

In April 30th, 1943 Kazimierz Banach as a district delegate issued a proclamation 'To the society of Volhynia', in which he called the Polish population to count only on their own strength and focus in the ranks of self-defence [1].

He considered organising self-defence centres thriving more than ever and creating an improved social and health care to be the most important. These issues were included in the 'Guide for the resistance bases' developed by his staff, which contained fifteen orders and principles aiming to give a higher level of organization and combat effectiveness. It initiated a new nature of self-defence that occurred there in the second half of 1943. Self-defence centres have turned into bases grouping Poles from a dozen or so villages. In medical terms the Guide ordered: 'the resistance base should have an organised sanitary points provided with dressings, paramedics and dispensary [1].

Health care in the Second South Inspectorate

The commander of the Second Lutskyi Inspectorate, Zygmunt Strusiński 'Szeliga' was in the most convenient situation in this regard, because his wife Victoria was a physician. It is obvious that she was sworn and included into underground operations. The account of Jadwiga Haber indicates that she held a function of an organiser of medical aid in the Lutskyi Inspectorate. The confirmation of the fact that she belonged to the group of functional people is the fact that the briefings of the inspectorate leadership and ceremonial swearing-in of new members took place in her doctor's office [10].

The area of Lutskyi Inspectorate covered the following counties: Lutskyi, Horokhivskyi, Dubno Raion and Kremenets Raion. The underground administration was formed there in the first half of 1943. Sanitary offices worked in the inspectorate providing medical assistance to the Polish population in cities and self-defence centres. It seems that Wiktoria Strusińska, MD from the command of the Inspectorate took part in the appointments. The most physicians worked in Lutsk. Almost all of them joined the medical assistance to the Poles, who needed it. Among the organizers of the large role was played by Dr. Wladyslaw Jackiewicz 'Jacek'. beautiful example of dedication to this work was given by one of the oldest physicians, Franciszek Biłobran, MD who admitted hundreds of people in his private gynaecological-surgical infirmary. He sent his younger colleagues to remote villages. Other physicians i.e.: Kowalski, Tomalewicz and Machniewski left for more difficult cases [29].

The largest self-defence centre among all operating in Volhynia was formed in the area of the Lutskyi county. It was a village Przebraże, which having ca. two thousands villagers at the end of 1944, gave shelter to 28 thousands Poles. This true bastion of defence was created thanks to the good cooperation of the activists of delegation and AK officers. The residents of this village started spontaneously to transform it into a self-defence centre at the beginning of 1943 due to the news about the Ukrainian massacres. In April, the commander of the Lutskyi Inspectorate, Cpt. Leopold Świkla 'Adam', directed Lieutenant Henryk Cybulski 'Harry' there to organize the military defence. He created properly fortified sections and most of all the combat unit, which grew to the large battalion with four companies after few months. This fact effectively discourages UPA to attack the unit [5].

For such large concentration of people, it was necessary to organize the necessary medical care. During numerous combats, many people suffered because of injury. Infectious diseases requiring fast control also occurred there. Providing medical assistance to this self-defence centre was entrusted to Henryk Kałużyński, MD, the head of the hospital in nearby Kiwerce. He assigned some nurses, Józef Bogdański, MD and a paramedic Błażejczyk to Przebraże, where they formed a field hospital for slightly injured and temporary hospital for infectious diseases. Severely

injured defenders were transferred to the hospital in Kiwerce.

It should be emphasized that during fierce fights with similar forces of the both sides, they bear relatively little losses. So it was in August 31st, 1943 when several units of UPA attacked Poles working on the harvest on the fields of Przebraże and Rafałówka. The units commanded by 2nd Lt Cybulski were defending them In the daylong battle two defendants were killed and several were injured [5].

The major battle for Przebraże took place in August 31st, 1943. At this day at dawn a few thousands Bandera units surrounded the village and for many hours violently shoot in from all sides. Few self-defence units come to help from the neighbouring towns and the units of soviet partisans. Ukrainians being suddenly attacked from the outside retreated in panic [8].

Small town Dubno was constantly penetrated by German and Ukrainian police, whose officers arrested many Polish conspirators. For this reason, the Poles were forced to protect themselves in the rural centres of self-defence. The largest were formed in Pańska Dolina and in Młynów. They repulsed several attacks against Ukrainian nationalists. Medical assistance was organized by a young physician, Władysław Bogacki, who received a diploma of the Medical Institute of the University of Jan Kazimierz in Lviv in 1940. He came from Dubno, so he was familiar with the situation in the region. He prepared many women to help him in his work [4,25].

Maria Phaphius-Skibniewska, MD organised a medical assistance for the self-defence. The biggest centre was established in Rybcza, where she created an infirmary, where she directed Irena Sandecka, a qualified nurse from Kremenets, and she often came there, ignoring the danger that threatened from numerous UPA units [29].

Wiktoria Strusińska, MD 'Rita' was hiding in her home families of five physicians, who were led from the ghetto in Lutsk by Bolesław Haber 'Mateusz'. In this way, they survived the war. The physicians were incorporated into underground health service of this inspectorate [26].

Zygmust Strusiński was arrested by Germans in August 1943 and in November he was murdered. Despite the tragedy his wife Wiktoria did not stop underground activities [27].

From the account of Jadwiga Haber it is possible to learn about the work of the manager in a pharmacy in Lutsk, Danuta Diwinówna, for the self-defence in this county. Jadwiga Haber 'Baśka' directed the work of messengers. Most subordinate to her colleague, when carrying messages to the centres, also supplied them with medicines and sanitary materials acquired in the pharmacy. The functioning of specific pharmaceutical supply system was described in a following way: 'The conditions required to work not only due to materials, but also to facilitate underground contacts. The type and place of proposed work were especially beneficial for me, so without considering it for a long time, I took a job of a cashier in a pharmacy. The manager of a pharmacy was D., MA. She was a young, handsome, powerful lady, nice, friendly and having the skills to manoeuvre Germans, who had supervision over pharmacy or any other business connections. The task was not easy. As she learned German, she had not problems with communication. (…). I must say that during the work in the pharmacy I noticed how much good she did to people and workers. She was always helping me with medicines and dressings I should choose. Almost every day I took drugs for prescriptions written by Dr. >Wita< [in other accounts: .Rita<] and Dr. >Jacek< (Wł. Jackiewicz) for various, often invented names or without prescriptions under the pretext of the needs of an alleged nursing practice in a village, where there was no medical office. Without no doubt she was guessing that such a big amount and frequency of the needs must be intended not for one village, not for individuals, but some few self-defence centres. She never refused to help. She swindled signatures from German physicians on prescriptions prepared and already issued to cover the medication. Always in some way she tried to save the necessary medical supplies for which she has never asked me for whom and for what I take them. As a cashier I had facilitated contacts with institutions and connections [27].

Medical assistance in the Third Eastern Inspectorate

The most difficult conditions to organise Polish self-defence centres were in the Third Eastern Inspectorate, which included the following territories: Rivne Raion, Zdolbuniv Raion, Kostopil Raion. The city Rive was particularly dangerous to conduct underground activities by Poles. It was a seat of General Bezirk Wolhnnien und Podolien with the head Erich Koch, which had surrounded the apparatus is very extensive German security authorities with Ukrainian police. Their officers hunted all manifestations of the Polish underground in the city and arrested the participants. The numerous arrests conducted by them crashed many organisational cells of delegation and the Home Army. The initiators of these arrests were mostly Ukrainians, who thus wanted to eliminate Poles. The only underground service that had survived until the Red Army entered the area

in February 1944 was underground sanitary service managed by Dr. Wincenty Tomaszewicz 'Wilczur', who worked in a hospital in the suburbs of Tiutkiewicze. In this hospital he formed and conducted with Adela Kyć, a nurse, a special private room for the injured and sick Poles. He cooperated in conspiracy with the commanders of self-defence centres in the area of Rivne Raion, and i.a. in Alesandria, Hoszcz, Klewań, Korc, Międzyrzec, Tuczyn and Lubormierka. Even many years after the war, Dr. Tomaszewicz was questioned whether or not he secured his safety by signing a list of German nationality, which he denied [4, 10].

Physicians working in a county hospital in Zdołbunow and hospital personnel in Ostrog on Horyń organized the underground health service in Zdolbuniv Raion. The sanitary office of the delegation was directed by Mieczysław Rosyk, MD, 'Bartek' with help of a registered nurse Helena Różańska 'Jagoda' [23].

The largest centre for self-defence in this region was organized in Ostrog. This numbering about 15 thousand inhabitants town gave shelter to over 10 thousand inhabitants of surrounding villages and Polish settlements. Due to the hospital there they had a very good medical care. Particularly high activity was exhibited by the nurses working there e.g. Maria Korzeniowska-Wiercinska 'Czarna Marysia' [31].

Kostopolski county area, inhabited to a relatively small extent by the Poles, became the object of a very fierce and barbaric attacks of UPA units. None of the centres of organized self-defence there was not able to defend themselves against far superior forces attack the enemy. Already at the beginning of 1943 leading activists county delegation and organizers of the AK were murdered. Only Witold Jaroszyński, MD was not arrested even though he was a member of both organizations. In seems that he was spared, because as a physician working in a county hospital he was useful for Ukrainian population as well. But when the Soviets entered there, Ukrainian officials immediately denounced him to NKVD as an activist of Polish independence organizations [23].

Poles living there were left on their own. Many of them ran and was captured by Ukrainians and murdered [27].

One of the largest self-defence centres in the Kostopil Raion was organised in the village of Huta Stepanska in Kostopil Raion. Since 17 c. it was inhabited by Poles. In the interwar period the village was a local centre for the development of Polish national awareness, education and culture. It fulfilled an important role in Poles lives, as they had lived far away from the nearest cities. Both Kostopol and Sarny were 40 km away. Many organisations were operating there including female organisations such as: Polish Scouting Association, Riflemen's Association, Catholic Youth Association, Agricultural Circle, Rural Women Circle. Among them one of the most active members was Helena Sawicka. Before the war she was the platoon of the female commander 'Strzelec'. She completed a sanitary course of the Polish Red Cross in Warsaw. During Soviet occupation, she avoided deportation, even though she was on the list of people for deportation [23, 30].

In spring 1943 ca. 6 thousand people were hiding in this village. When a defence against UPA was formed there, Helena Sawicka set up a dozen girls, with whom she founded the hospital field. She obtained necessary equipment and supplies. The only rescue for many wounded were medicines made of herbs, gathered by girls and used according to the guidelines of the older women. As there was no physician, Helena Sawicka was managing the work of entire hospital during three-day combats with UPA in July 16th – 18th, 1943 [2].

The vast predominance of enemy forces has forced people in Huta to leave. In the morning in July 18th, after a surprise attack on the UPA troops encircling the village, they set up the corridor with a length of about 3 kilometres, which allowed for the village population, the column of cars, among other things, carrying the children, the elderly and wounded to pass through. After getting out of laps the population saved from massacre went to the nearby cities or moved to other centres of Polish self-defence [23].

Sanitary Service in the First Northern Inspectorate

The most powerful self-defence centres were established in the western districts of Volhynia province i.e. Volodymyr-Volynsky, Kovelskyi Raion and Lyubomlskyi Raion. A relatively high percentage of Polish population lived there, what facilitated the organization of underground activity. Therefore, it was the place where the emissaries of political, social and military organisation from central Poland came the most often to form the germs of their own organisation. Kazimierz Banach, district delegate and commander of Volhynia District made Kovel the seat of his staff [3].

As in other counties, so in this, county delegates were responsible for the organization of a underground medical assistance. Numerous reports indicate that the following physicians: Ignacy Jakira, N. Dudek and N. Liniewicz and a pharmacist John Kubalski participated in the work of the District Government Delegation in Volodymyr-Volynsky [10].

As for the listed physicians, their name are not to be found in 'Rocznik Lekarski' from 1938 and 1948. These were the names assumed by the physicians of Jewish descent, who decided to hide from Germans and Ukrainians in this way. They worked in the County Hospital and Hospital of Infectious Diseases in Volodymyr-Volynsky [20].

It is worth emphasizing that Ukrainian-Polish conflict was taking place also at the level of medical assistance. Ukrainians, following the Germans, treated health services as an instrument of political and national struggle against the Poles. Aiming at biological elimination of Poles, they deprived them of the access to medical assistance and prevented, or limited their access to medications. They persecuted many Polish employees in the hospitals, many were fired and replaced with Ukrainian employees. They could not fire every Polish physician, as they did not have their own [16].

However, the majority of Polish physicians working before war in Volhynia was deported or murdered by NKVD in 1940. Soviet authorities hired mainly physicians of Jewish descent at the time [10, 19].

In the chaos of war, especially during the change of the occupation authorities at the end of June 1941, there was a huge turnover among employees of various institutions, including hospitals. Relevant documents were necessary to take the job. These was no problems with acquiring them, as Polish institutions and priests often assisted in this process. The activists of county delegations helped some physicians of Jewish descent to come out from ghettos, providing them with appropriate documents and helped them to get a job in health service institutions. Therefore, the German authorities and Ukrainian nationalists constantly hunted and sometimes denounced such hidden Jews. Ukrainian head of the hospital in Lutsk, Dr. Mikołaj Zalewski, conducted especially zealous efforts in this field. Before war, he worked there and knew many Jewish physicians [24]. He revealed to the German authorities ca 40 Polish and Jewish physicians working in various town in Volhynia. He was convicted to death for a hostile activity by the AK Military Special Court of Lutskyi Inspectorate, but they failed to perform it because he fled to Germany [26].

Due to the lack of Polish physicians, the activists of county delegations recruited Jewish physicians. Some have played a crucial role in organising and providing medical assistance to Poles during the 'Volhynia massacre'. Jewish physicians and Polish medical staff developed in Volodymyr-Volynsky comprehensive and effective assistance to thousands of Poles who had taken refuge in this town after burning their villages by the Ukrainians. It was the hospital of infectious diseases that organised help. German authorities avoided this hospital, did not throughoutly control it what facilitated the underground activities. Among the underground activists there were several military medics i.a. Sgt Bolesław Skrzyński 'Jakosz', platoon Sgt Bolesław Szwat 'Smyczek', platoon Sgt Zbigniew Barański 'Zawisza' and platoon Sgt Jan Wierzyński 'Maj'. The two last played a big role, working with the medical committee qualifying workers for forced labour in Germany. Due to their efforts many Poles including many members of the conspiracy managed to avoid deportation. Staff of the hospital supplied nearby self-defence centres in surgical tools, vaccines, medicines and bandages [20].

Jan Kubalski 'Grot', MSc Pham was managing the sanitary office of delegation in Volodymyr-Volynsky. He was managing the only pharmacy in the city, which constituted one of the pharmaceutical supply sources for Polish population. Larger self-defence centres in the region were formed in the following villages: Spaszczyzna, Wodzinów, Wodzinek, Bielin, Sieliski, Aleksandrówka i Marianówka [29].

Physicians of Jewish descent i.e. Włodzimierz Zagórski and Cyma cooperated with the County Government Delegation in Kovel. It is possible that Mojżesz Aron Cymeryński was hiding under the name Cyma, who before war practised in Rovno and during the war died in unknown circumstances [14, 24].

They formed a sanitary office and closely cooperated with nurses Halina Grochowska 'Irys' and Janina Szmagalsk 'Idylla' for the hospital, Janina Włodarska 'Dana' from the rescue services and many other women, who joined a underground medical service centres, acting on behalf of self-defence. Their main task was to collect drugs, dressings and medical equipment for these facilities, as well as organizing points of sanitation for many refugees who came from the countryside to Kovel [6, 31].

Physicians and nurses from the hospital in Kovel also travelled to the self-defence centres across the county to provide medical assistance to the wounded after the battles fought with UPA units. The largest centres were established in its south region in the following villages: Zasmyki, Lityń, Radomle, Janówka, Suszybaba, Wierzbiczno, Ossa, Różyn i Zielona [17].

An increasing number of population in Zasmyki and the needs of the self-defence centre established there resulted in the need to organize sanitation offices. Therefore Dr. Zagórski assigned few nurses including Janina Szmagajska from the hospital in Kovel. City Hospital in Kovel also delivered there the necessary equipment, medical instruments, medicines and sanitary materials. Nurses had

engaged many local women in cooperation, therefore the wounded and injured had good sanitary care. Seriously injured were transported for treatment to hospital in Kovel. This simple system was functional and effective. To prove this, I will give the examples of Lieut. Michał Fijałka and Pvt Józef Turowski, whose severe wound were treated. After few weeks treatment they came back to their units and continued performing the combat tasks [7, 12].

There was a well-organised medical assistance in Lyubomlskyi Raion. A pharmacist living in a city, Tadeusz Rodziewicz MA, was the head of the County Delegation in Lyuboml. He was familiar with medical and pharmaceutical staff and engaged them into the activity in self-defence. He appointed Dr. Stanisław Lorenc, a head of the hospital in Lyuboml, for the head of sanitation office. Therefore, Polish population from neighbouring villages was provided with good medical assistance [26].

One of the largest self-defence centres as established in the village Rymacze. Sanitation services were organised by Jan Dyczko, a paramedic. Most of the smaller self-defence centres, however, were destroyed during the attacks by prevailing UPA units [18].

Almost the entire medical and pharmaceutical personnel working in Volhynia participated in a defence of their compatriots against the attacks of UPA units. With their dedicated work, they did not only heal the wounds and injuries, but also strengthen their fighting spirit. Its members were guided by the same patriotic motives in defending Polish reason of state as all participants of self-defence.

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Catastrophe Medicine

The establishment and functioning of a environmental pollution monitoring system

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Summary:

An effective performance of particular subsystems and the entire National Environmental Monitoring requires constant improvement of information transmitters, methodology of data gathering and analysis, methodology of forecasting environmental changes and methodology of visualisation and promotion of data concerning the state of environment. An essential tool to accomplish these tasks is the adequate information system. The tasks of such system include managing the process of monitoring the environment and the process of extraordinary threats prevention.

Key words: contamination detection system, National Environmental Monitoring, accident in Chernobyl.

Contamination detection system was established in Poland by the resolution of the National Defence Committee in 1965. Apart from the non-military system, the Armed Forces were also included, which due to the military doctrine in force had not performed any particular function.

Nowadays, the National Environmental Monitoring has been established which functions on the basis of the Act of State Inspection for Environment Protection according to which it is a system of measurements, assessments and forecasts of the condition of environment. The National Environmental Monitoring goal is to ensure the effective actions to protect the environment by measurements, gathering, analysis and promotion of the data concerning the condition of the environment and occurring changes.

The tasks of the National Environmental Monitoring are being accomplished in the following subsystems:

- atmospheric air monitoring, including:
  - air pollution,
  - noise,
  - non-ionising radiation emitted by electroenergetic, radiocommunication, radiolocation and radionavigation systems and television;
- surface water monitoring, including rivers, lakes and the Baltic Sea;
- monitoring of the groundwater;
- monitoring of hydrometeorological conditions;
- monitoring of the Earth surface including chemical contamination, waste and physical composition, the organisation of use and degradation;
- fire monitoring;
- monitoring of the living nature, including:
  - plant and animal species,
  - biocoenoses and ecological systems
  - forests;
- integrated monitoring realised on the basis of base stations, which are located in the areas of model ecological systems (outside urbanised and industrial areas).
- monitoring of the transport of hazardous substances;
- monitoring of radioactive contamination together with the subsystems of early warning of radioactive contamination and manual measurements of contamination.

Air pollution monitoring is performed on the basis of the Environmental Protection and Management Act. Supervision over its functioning is performed by the National Inspection for Environmental Protection. It aims at controlling the condition of air pollution, mainly in urban and industrial areas, particularly vulnerable to the atmosphere pollution. The monitoring is conducted basing on the following networks:

- state
- regional
- local.

Particularly important role is nowadays attributed to the proper functioning of the local networks. It is assumed that they should be related to the prevention of extraordinary threats to the environment. The tasks include:

- the assessment and analysis of exceeding the norms of air pollution on a local scale
- informing the population about the atmosphere pollution in the impact zone of a specified object
- verification of the effectiveness of company programmes to protect the atmosphere against the pollution.

Monitoring of the surface water pollution is a system of measurements, analyses and assessment of the condition of the flowing surface water (rivers), stagnant water (lakes) and the Baltic Sea. It consists of obtaining and gathering the data concerning surface water resources, causes and degree of its pollution. The monitoring holds a great importance in many fields of state economy including management of the water resources economy and protection. It is also a very helpful tool informing about the flood threat.

Surface water monitoring includes a cooperation with:

- drainage system (Regional Water Management Boards),
- administrative system (Departments of Environmental Protection Regional Offices and the Regional Inspectorates for Environmental Protection).

The monitoring of the surface water pollution is conducted basing on the following networks:

- state,
- regional,
- local.

Monitoring of groundwater pollution is a system of measurements, analyses and assessment of the condition of groundwater, conducted in order to control the cleanliness and usefulness of a water intended for consumption. It is implemented on the basis of the water wells, several epidemiological stations and laboratories.

Monitoring of hydrometeorological conditions is realised as a part of hydrological and meteorological services, functioning on a basis of organisational cells of the Institute of Meteorology and Water Management. In order to realise its statutory goals of monitoring the current condition of atmosphere and hydrosphere, the Institute maintains:

- observation and measuring network,
- forecasting services,
- telecommunications system,
- data gathering and spreading system.

Earth surface monitoring including chemical contamination is an activity aiming at gathering and processing information concerning the content of pollutants in the air, water and soil, their size and chemical composition. It is organized in accordance with the afore-mentioned Environmental Protection and Management Act and conducted on the basis of the following networks:

- state,
- regional,
- local,

and it is closely linked to air pollution monitoring and surface and groundwater pollution monitoring.

Fire monitoring is implemented i.a. at work places and in forested areas. At work places it is realized by installing a device serving as an automatic, early fire detector (smoke, flames). Under the implementing rules to the Act of Fire Protection, the number of such work places should be gradually increasing. It is also predicted to connect all devices from a specified group of work plant and objects to the nearest emergency-firefighting units of the State Fire Service, what will shorten to the minimum the time of free development of fire in the objects included in the system. In the forested areas fire monitoring is conducted during specified seasons in case of a large fire hazard and it is implemented with the use of observers and television cameras installed on observation towers and patrolling flights of helicopters and airplanes.

Monitoring of the transport of hazardous substances is to reduce the risk of associated with the transport of hazardous substances in all kinds of transport The satellite tracking system and radiotelephone system is considered to be the most effective way due to constant informing of the vehicle position, sending information and notifications, automatic sending a warning signal. However, the way to achieve such perfect system is still long, especially because the monitoring includes road, railway, pipeline, water and air transport, although the latter one seems to be the safest one, when it comes to the amount of contamination resulting from it. This monitoring is currently one of the least effective in Poland.

Radioactive contamination monitoring is one of the subsystem of state environment monitoring lead by Radioactive Contamination Measurement Service established pursuant to the resolution no 265 of August 1964 by the Council of Ministers using the measurements conducted by the National Atomic Energy Agency, Chemical Defence Troops, the Institute of Meteorology and Water Management and civil defence inspectorates.

The purpose of radioactive contamination monitoring is a systematic collection and analysis of data about the degree of environment and food pollution with radioactive isotopes that allows for:

- assessment of radiological situation in the country and evaluation of the irradiation degree of the population;
- forecasting of the effects caused by environment pollution with radioactive substances and formulating possible recommendations in this regard
- fulfilling the provisions of the convention and bilateral agreements on early notification of nuclear accidents;
- gathering information about radiological condition of the environment and following long-term changes of radioactive contamination of the environment;
- in the event of failure, starting a wide net of sampling procedures and measuring points for fast measurements in order to estimate the radiological threat in local and national scale.

The subsystem of radioactive contamination monitoring comprises a network of early waning and a network of manual measurements. The most essential for us is the first one, because it comprises the Contamination Detection System of the Armed Forces of the Republic of Poland, which core is constituted by the forces and means of chemical defence troops.

The early detection network is constituted by:

- nine measuring stations of the Institute of Meteorology and Water Management;
- ten ASS – 500 measuring stations of NAEA and State Inspection for Environment Protection;
- 27 SAPOS – 90 MS measuring stations of National Civil Defence;
- measuring stations in research institutions of various departments and universities;
- military network constituting a contamination detection system together with measuring stations of the Ministry of National Defence (localisation of SAPOS – 90 devices in the Armed Forces is shown in appendix 3).

An effective functioning of each subsystem and the entire system of state environment monitoring requires constant improvement of transmitters, methodologies of forecasting environmental changes, data transmission systems, methodologies of visualisation and promotion of the data concerning the condition of the environment. An indispensable tool to perform these tasks is a right information system. One of its tasks is management of the environmental monitoring process and process of preventing extraordinary threats.

The previous participation of chemical defence troops in the National Environmental Monitoring

The experience gained after the nuclear accident in Chernobyl helped us to reorganize and improve national monitoring of threats, which military part is constituted by Contamination Detection System (CDS). It is the efficiency of its operation which has a decisive influence on a prompt gathering of the information about radioactive contamination in the country, what in turn involves the reaction of the authorities concerning taking appropriate decision.

The activity of chemical defence troops after the afore-mentioned accident began in April 28th, 1986 in accordance with the order of the Minister of National Defence. It comprised two fields:

- gathering, verification and compiling information about the radioactive contamination in the territory of the entire country;
- control of the contamination degree of vehicles at border crossings.

The first notification about the possible radioactive contamination of the territory of Poland caused by nuclear accident was received by officer on duty of the Command of Chemical Defence Troops of the Ministry of National Defence at 5 p.m. in April 28th from the Central Laboratory of Radiological Protection. Simultaneously, the commanding officer of Chemical Defence Troops received a notification about the nuclear accident in Chernobyl power plant from the Minister of National Defence.

Therefore, the Commanding Office of the Chemical Defence Troops formed an operation group from command and the Central Office of Contamination Analysis and ordered to organise operation groups from the Command of Chemical Defence Troops of Army Circles and the Types of the Armed Forces. Afterwards, he ordered to introduce 24-hour shifts in the contamination analysis centres. Ninety stations for contamination observation were organised for contamination being observed by the forces of chemical defence subunits at constant dislocation and air reconnaissance patrols with 3 helicopters allotted.

Until 2 a.m. April 29th military network of contamination detection was organised in the entire country, which provided information every 2 hours about the size of the dose rate at 1 meter and at ground level. The helicopters of air contamination detection performed tasks in April 29th and 30th mostly in the east-north pat of Poland and in the coast. The detection was performed at 100-150 meters. Due to the fact that dose rates were minimal, a decision to stop air reconnaissance was taken and the crews remained in readiness to perform the tasks in case of their increase on the landing fields.

Moreover, since April 28th 5 AL-4 laboratories started working at the direction of the Commanding Officer of Chemical Defence Troops (in Komorow, Lomza, Krakow, Milicz and Gudziadz), which twice a day transmitted data concerning the contamination of feed, soil, water and milk.

On the basis of reports received from contamination analysis centres, the armed forces, the Military Institute of Chemistry and Radiometry, health services and information about air contamination received from the National Atomic Agency, operation group of Chemical Defence Troops of the Ministry of National Defence was twice a day making announcements about the contamination in Poland.

Based on these announcements reports and proposals were written down (daily at first, later periodically) for the Government Commission headed by Deputy Prime Minister Zbigniew Szałajda and for the Chief of Staff of the Polish Armed Forces, who was coordinating all the undertakings implemented in a department of the Ministry of National Defence. Daily reports about the radiation situation in the territory of the country were also made and sent every day to the general staff of the Ministry of Defence of USSR. First report about the contamination in Poland was made before 6 a.m. April 29th for presentation at the meeting of the Presidium of the Council of Ministers.

Due to the stabilisation of the contamination, since May 3rd the number of measurements of dose rate was reduced to be performed twice a day.

Since May 5th the forces of chemical defence troops started to perform inspections of the degree of contamination of the vehicles departing from the territory of Poland. The Commanding Officer of the Chemical Defence Troops ordered to allot 9 control groups composed of one officer and 6 dosimeterers to strengthen the offices of the Central Laboratory for Radiological Protection and SANEPID operating in the ports of Szczecin, Swinoujscie, Kolobrzeg, Gdynia, Gdansk and at the border crossings Swiecko-Slubice and Zebrzydowice.

In total the following units of the chemical defence troops were involved in the action after the nuclear accident in Chernobyl:

- 7 operation groups
- 12 Mi – 2 RS helicopters of air contamination detection
- 90 contamination observation posts
- 3 reconnaissance patrols in BRDM – 2 RS vehicles
- 9 control groups of the degree of contamination of the vehicles.

Circa 500 soldiers of chemical defence troops were involved in the action.

As the consequence of the activity of the Government Commission several legal acts were developed e.g. describing the tasks for the department of the National Defence. Department tasks in respect of Chemical Defence Troops included legal, organisational, training undertakings technical equipment and research projects.

The resolution of the Council of Ministers No 98/86 Art. 3 (1) imposed on the Minister of National Defence a duty to develop until 31.12.1986 a draft amendment to the principles of organisation, preparation and operation of Contamination Detection System also taking in the account the threats during peacetime. The task has been completed and the draft of resolution of the Council of Ministers on the CDS was sent to the Office of the Council of Ministers within the prescribed period after the inter-departmental consultations. The above-mentioned resolution did not appear because the Law Office of the Council of Ministers stated that there were no legal and formal grounds to accept it due to the lack of parliamentary act which would constitute the legal ground for such resolution. Regardless of this fact, the department of the National Defence undertook several actions to prepare allotted forces and measures, mostly including CDS, to perform the tasks in case of nuclear accidents. The problem was given a great importance due to construction of nuclear power plant in Zanowiec and planned construction of nuclear power plant in Klempicz.

In order to extend the knowledge necessary to undertake further actions in this field, in December 1986 a group of officer came to Chernobyl for a consultation concerning the conclusions after the failure. The report with the conclusions was send to the office of the Minister of the National Defence, general staff of the Polish Army and all those interested from the Custom Chamber of the Ministry of the National Defence in January 1987. Collected experiences constituted the basis for development of the prior directions for the development of the chemical defence troops.

The most important conclusions include:

- selected elements of CDS should operate also

during peacetime in the system of continuous duties guaranteeing immediate detection of radioactive contamination in the territory of the country;
- there is a need to equip chemical defence troops with new generation dosimeters with increased sensitivity;
- there is a need to organise a technical rescue unit (TRU) intended for elimination of the accident effects, equipped with special reconnaissance vehicles enabling to operate directly in the area of the failure in condition of strong radioactive contamination.

Owing to the importance of the issue, materials for the meeting of the Ministry of the National Defence concerning "Undertakings resulting from the nuclear accident taking into account the conclusions for Civil Defence and the Armed Forces from Polish delegation in Chernobyl" were made. The study presented in a comprehensive way further directions of preparing the Armed Forces and Civil Defence to participate in detection and elimination of the effects of potential nuclear accidents.

The decisions taken by listed bodies caused that several multidirectional operations were undertaken in the Armed Forces in order to prepare appropriate forces and measures to perform the tasks in emergency situations. The most important ones include:

1) in the organisational field:
   - establishment of special subunits of chemical defence troops, engineering and health services intended for participation in rescue operations after failures in chemical plants and nuclear power plants;
   - modernisation of existing CDS, including establishment of units on duty during peacetime (Early Warning System)
2) in the operational and training field:
   - on the operational and tactical level and especially in staff exercises and trainings, the assessment of threat and influence of industrial contamination on the organisation on combat actions should be included;
   - enrichment of the subject of chemical training with conclusions and experiences from nuclear accidents occurring in previous years;
   - improvement of the issues concerning the elimination of the contamination effects;
3) in the technical field:
   - development of new generation roentgen radiometers and radiometers with higher sensitivity and apparatus allowing for measurements of isotopic composition of radionuclides in the air, water, food and soil
   - equipping the information bodies (COAS, OAS, Military Circles, Types of the Armed Forces) in reliable means of communication (telex and long-distance telephones) and microcomputer kits.

The above-mentioned tasks were started to be implemented systematically, departing only from establishment of TRU due to the suspension of the construction of power plant in Zarnowiec.

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History of Medicine & Pharmacy

POSTHUMOROUS TRIBUTE to Col. Henryk Lesiewicz (RET) MD, PhD (1942 – 2011)

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Col. **Henryk Lesiewicz** MD, PhD was born on April 4th, 1942 in Kolumno and passed away on June 13th, 2011. After attending elementary school in Kolumno in 1948 – 1955, he graduated with first class honours in 1959 from XXVI Małgorzata Fornalska Secondary School in Łódź. In the same year, his father suddenly and prematurely passed away. As a consequence of this event, at that time seventeen years old Henryk took over the role of the head of the family as the eldest of all four siblings.

The next stage of his education were studies at the Medical Faculty in Maj.-Gen. Prof. B. Szarecki Military Medical University in Łódź in 1959 – 1965. He graduated with second class honours and gained the degree of Medical Doctor and promotion for lieutenant.

Since October 1967 he started to work as an officer doctor in the Polish Army and served in 57th Medical Battalion of 16th Armoured Division in Braniewo as senior assistant of Cleaning Platoon of the Medical Company, which he commanded from July 20th, 1970 to June 11th, 1971.

Between June 12th, 1971 and November 5th, 1975 he was a Commander of Medical Platoon of 47th Bomb Battalion of 16th Armoured Division in Tczew. In 1974 he obtained a first degree of specialisation in general surgery. In November 1975, Henryk Lesiewicz took up a job of senior assistant at surgical ward in 110st Military Garrison Hospital in Elbląg, where he worked until June 30th, 1978 that is until a moment when he obtained second degree of specialisation in general surgery.

After the arrival of longed order on July 1st, 1978, he became permanently employed as senior assistant at the Urology Clinic at the Institute of Surgery of Military Medical University in Łódź. It was a return to his beloved University, great academic city, but also to his small homeland Kolumno. Here, in the rapidly developing University he joined a scientific and didactic team of the Urology Clinic at the Institute of Surgery of Military Medical University.

Second degree of specialisation in urology was gained by Henryk Lesiewicz in 1980 under supervision of Ass. Professor PhD Stanisław Cieśliński then the Head of the Urology Clinic at the Military Teaching Hospital.

In 1983 he earned a degree of the Doctor of Medicine, PhD on the basis of the doctoral thesis entitled 'The results of surgical treatment of prostatic adenoma with the use of Millin's method' and afterwards he became Professor of the Urology Clinic

at the Institute of Surgery of Military Medical University, where he worked until April 20th, 2000 i.e. well-deserved retirement.

In 1989, when he was 47 years old, he was promoted to the rank of colonel.

Col. Henryk Lesiewicz MD, PhD had been recognized as very good and responsible physician, taking care of the patients, respected and loved university teacher, skilful surgeon with great organisational skills for many years of his work. He was a fair and righteous man. It was not due to his age, but his knowledge, experience and sense of responsibility why he was always substituting for the Head of the Clinic during his absence. His friendly attitude and loyalty towards superiors and respect for his subordinates are particularly worth emphasizing.

He was a sensitive and cultured man who actively participated in the implementation of research and teaching plans of the Clinic. His main interests included kidneys and bladder cancer, renal calculus treatment (ESWL), diseases of the prostate gland and laparoscopic surgery in urology.

Academic achievements of Col. Henryk Lesiewicz MD, PhD include 48 papers published in national and international medical journals, 79 papers concerning surgery and urology and he was also a co-producer of three scientific videos and co-author of a handbook entitled 'Battlefield medicine' published by the Military Medical University in 1988. He was also a co-author of the chapter entitled 'The damage to the organs of the urinary tract and male sexual organs in the battlefield'.

Other interests of Col. Henryk Lesiewicz MD, PhD include theatre, opera, operetta, history and geography. He represented Military Medicine University in football during his studies.

He was decorated with the following medals: brown, silver and gold 'The Armed Forces in the Service of the Homeland', brown, silver and gold medal 'Merit for National Defence', medal 'for Exemplary Work in Health Services', 40th Anniversary of PRL medal and the Gold Cross of Merit.

Farewells are a difficult period in people lives. Today the time has come. I bid You farewell on the behalf on all employees of the Urology Clinic of the Military Medical University, the Department of Urology and the Clinic of Urology of Medical University in Łódź, the employees of Military Teaching Hospital and the Medical University. Rest in peace!

Col. Henryk Lesiewicz MD, PhD was buried at the Catholic cemetery in Kolumno. The funeral was held with military honours with the participation of the company of honour and military orchestra. He was bidden farewell by family, friends from college and work, the employees of Maj.-Gen. B. Szarecki Military Medical University, University Teaching Hospital, Medical University in Łódź and his colleagues from the second course of the Faculty of Medicine of the Military Medical University.