Epidemiology of Illnesses and Injuries in Specific Climatic and Sanitary Conditions on the Example of Troops Deployed to Military Operations.* (Part One)

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RESUME

Epidémiologie des maladies et des blessures des soldats déployés lors des opérations militaires. (première partie).

Les opérations militaires contemporaines, singulièrement au Moyen Orient et en Asie Centrale ont eu lieu dans des conditions climatiques difficiles et dans un environnement sanitaire souvent inhabituel pour des soldats habitués à vivre en Europe en climat tempéré. Les différences extrêmes de température entre le jour et la nuit ainsi que les mauvaises conditions d'hygiène liées à la guerre ont entraîné de nombreux cas de blessures et de maladies non seulement dans la population locale mais aussi parmi les soldats déployés qui représentaient la population réceptive. Alors que certaines opérations de maintien de la paix comme celles des Nations Unies au Liban et sur les hauteurs du Golan ont été menées dans une ambiance géopolitique relativement stable, les opérations de stabilisation qui sont en réalité des activités de guerre, en Irak et en Afghanistan sa classent sans aucun doute parmi les actions militaires les plus dangereuses. Les problèmes sanitaires posant les plus de problèmes dans la zone des combats sont les maladies vectorielles, à transmission hydrique et alimentaire, les maladies respiratoires ainsi que les maladies sexuellement transmissibles, les zoonoses, les blessures liées ou non aux combats y compris les accidents de circulation et de sport. Un risque considérable est aussi constitué par les troubles psychiatriques qui peuvent apparaître immédiatement à la suite d'un événement traumatique dans la zone des combats ou de manière plus indirecte avec un espace de temps. En plus des blessures, maladies et troubles énumérés, les conditions environnementales comme les changements climatiques importants et la faune locale peuvent constituer un risque. Cet article passe en revue les problèmes de santé les plus fréquents survenant parmi le personnel des opérations de maintien de la paix ou des missions de stabilisation dans le contexte des conflits armés en cours.

KEYWORDS: Injuries, Illnesses, Soldiers, Military operations.
MOTS-CLÉS : *Blessures, Maladies, Soldats, Opérations militaires.*

INTRODUCTION

Present military operations constitute an epidemiological threat for participants who are not familiar with diverse climatic and sanitary conditions and the combat zone. Arthropod-borne diseases, food- and water-borne diseases, respiratory tract and sexually transmitted diseases, zoonoses, dermatoses, battle injuries resulting from combat activities, mines and unexploded ordnance, and non-combat injuries make up the studied group of health problems. A wide range of psychiatric disorders related to the warfare zone, including conditions like acute and posttraumatic stress disorder as well as injuries caused by environmental factors (high and low temperature, local fauna, desert or mountainous conditions) contribute to the overall morbidity and mortality.

INFECTIOUS DISEASES

Indisputably, battle injuries remain the major threat to lives and health of soldiers participating in operations conducted in any theater of war. Nevertheless, the most commonly occurring health problem in the population of military personnel are diseases and non-battle injuries[1]. They remain the major source of sick absenteeism, hospitalizations and temporary disability among peacekeepers of the U.S. Armed Forces within the last few decades[2]. The research conducted in the population of American soldiers home-bound for medical reasons from Iraq in 2003 indicated that patients suffering from diseases and non-battle injuries were subjected to evacuation from operational areas six times as often as patients who sustained battle injuries[3]. Infectious diseases in the population of soldiers participating in contemporary armed conflicts account for merely 2.8% of all diagnoses. However, owing to the absence of complex laboratory diagnostics some digestive, respiratory tract, and skin diseases diagnosed as non-infectious diseases may in fact be of contagious or parasitic etiology[3]. This fact is of great importance in terms of epidemic hazards, especially considering the fact that as much as 3/4 of the military personnel deployed in the *Iraqi Freedom* operation have reported episodes of diarrhea and over 2/3 of the population - episodes of upper respiratory tract infections, with the rates of morbidity rising as hostilities intensified[4]. Owing to the fact that contract soldiers (who typically break their contracts after termination of service) constitute a substantial part of military contingents (in the U.S. Army 36% of the personnel deployed in Iraq and Afghanistan are reservists and members of the National Guard) it needs to be taken into account that if a health problem occurs after being home-bound they will seek medical advice at doctors working at the civil health service[5]. Similar situation occurs as far as Polish Military Contingents are concerned. Their participants (recruited by the Military Recruitment Offices) are members of various professions, mainly medical and technical. Therefore, it is crucial to have the right knowledge of health hazards prevailing in the territories of military missions, to monitor health condition of military and civilian staff prior to their arrival into an operational zone, during their stay there and after their home-coming not only for medical but also for legal-judicial reasons. Major health hazards regarding infectious diseases have been discussed below. They need be analyzed in detail owing to the participation of the Polish Armed Forces in peacekeeping and stabilization missions abroad.

1. Vector-borne diseases

The number of vector-borne diseases which have been recently observed among military missions' personnel is insignificant. Nevertheless, a number of difficulties in implementing prophylactic action (lack of vaccines and desisting from applying drugs) result in the fact that they still pose a considerable threat as there exists the possibility of 'importing' vector-borne infections to a home country. Whereas monitoring water and food as well as vaccinating military personnel may help to prevent the spread of food and water-borne diseases, not much can be done as far as vector-borne diseases are concerned. Thus, a limited number of prophylactic measures make vector-borne diseases the main interest of medical services[6].

Malaria. Approximately 3 billion people, a half of the world's population, live in the territories where malaria is endemic. Highly developed countries such as the U.S. or the U.K. are free from the endemic focus of malaria. Yet, numerous cases of imported infections have been observed there[7, 8]. Approximately 1200 cases of the disease, including around a dozen deaths, are reported annually in the U.S. Over 50% of the cases are induced by *Plasmodium falciparum* and 25% by *P. vivax*[9]. In the U.K. 1722 cases of imported malaria were diagnosed in 2005 (including 1339 cases induced by *P.falciparum*) and 16 deaths were reported. Surveys have shown that merely 46% of the British were using full antimalarial chemoprophylaxis[7]. In Poland indigenous cases of malaria have not been reported since the late 1960s, however, 22 cases of imported malaria were diagnosed and 1 death was recorded in 2008[10]. Such insignificant number of infections does not prove our awareness of health hazards prevailing in tropical climate areas or proper application of prophylaxis but rather it indicates that there have been numerous cases of fever of unknown origin which have not been reported, diagnosed or treated[11]. In the Middle East and in the Central Asia the etiological factor in most cases of malaria is *Plasmodium vivax*[12]. The incidence of malaria rises significantly within combat areas, where local infrastructure had been destroyed and where sanitary-hygienic standards are highly unsatisfactory. In the territory of Iraq, despite the occurrence of factors facilitating the incidence of malaria, there is a low risk of an infection. Within the years 2003-2005 not a single case of malaria was observed among hundreds of thousands of American soldiers deployed in Iraq[13]. In contrast, over 40 000 soldiers of the U.S. Forces got infected with malaria during the conflict in Vietnam in the 1960s and 1970s[14]. Merely 48 cases of malaria were diagnosed during warfare in Somalia in 1993; those were mainly due to inappropriate chemoprophylaxis[15]. According to recommendations of the United States Central Command Air Forces (USCENTAF) American soldiers presently deployed in the territory of Iraq are not obliged to use antimalarial chemoprophylaxis. In cases of an increased risk of infection with malaria chloroquine is chosen as a means of prophylaxis[16]. Polish soldiers fulfilling mandatory tasks in Iraq have taken chloroquine (Arechin), which had no medical justification

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since, as it was said before, there is low danger of becoming infected. Not a single case of malaria was recorded in the population of the Polish Military Contingent serving in Iraq from 2003 to 2008.

In Afghanistan, a country where the prevalence of malaria among the local people has been estimated at approximately 2-3 million annually by non-governmental organizations[17, 18], incidences of the disease are also recorded among the population of immigrants. During military operations in Afghanistan conducted by the Soviet Armed Forces from 1981 to 1989 the number of clinically confirmed cases of malaria among Soviet soldiers amounted to 7 683 cases (the etiological factor *Plasmodium vivax*)[19, 20], out of which a great number of infections occurred after being home-bound. From 2002 to 2006 merely 85 cases of the disease, induced by *P.vivax*, had been diagnosed among American, British and German soldiers participating in *Enduring Freedom* and ISAF stabilization missions[21-23]. Representatives of 28 national contingents out of 36 countries being the members of the ISAF Coalition Forces apply different drugs as far as antimalarial chemoprophylaxis is concerned. Soldiers from 15 countries take mefloquine, from 5 countries - atovaquone/ proguanil or doxycyclinum, from 2 countries - chloroquine and proguanil, from 6 countries - chloroquine[24]. Soldiers of the Polish Military Contingents fulfilling mandatory tasks in Afghanistan since 2005 have taken chloroquine, which demonstrates incorrect epidemiological recognition of this territory, as plasmodia of malaria occurring in the territory of Afghanistan are resistant to the above mentioned drug. In 2005 Polish soldiers started taking mefloquine. In the beginning of 2009 doxycycline was used (the same drug was taken by soldiers deployed in Chad). Eventually, the medicament which is to be used as antimalarial chemoprophylaxis by soldiers of Polish Military Contingents is atovaquone/ proguanil, which in comparison to mefloquine and doxycycline has the fewest side-effects. Also, it is the best solution in short-term chemoprophylaxis intended for personnel sent into a mission's operational area for a period of several days/ months (air-crew, reconnaissance and visiting groups, transport of people and equipment)[25]. Until now, similarly to the situation in Iraq, not a single case of malaria has been reported among soldiers of the Polish Military Contingent deployed in Afghanistan and Chad. Nevertheless, due to a real risk of importing the disease into Poland or the occurrence of pathologic symptoms in the future, attention should be paid to each case of fever of the unknown origin occurring among soldiers returning from areas where malaria appears endemically. The exact number of malaria incidences in the population of American soldiers positioned in a given territory is difficult to establish due to a high rotation of the US military personnel deployed in different regions of the world where malaria occurs endemically. From 2000 to 2005, 423 cases of malaria were diagnosed in the population of the U.S. Forces soldiers participating in military operations overseas (mainly in Afghanistan, 78 cases). From 2003 to 2005 34% of American soldiers suffering from malaria got infected with the disease in more than one endemic region of the disease[26]. This issue needs to be considered in the aspect of the participation of Polish soldiers in more than one military operation abroad within the last 12-48 months. Recommendations of preventive medicine of the U.S. Forces clearly define the necessity to apply means of personal protection against vector-borne diseases (mosquito nets, DEET, Permethrin), and in the case of malaria – the necessity to use chemoprophylaxis[27, 28]. Regrettably, the research on discovering the vaccine against malaria has been unsuccessful[29]. According to the USCENTAF recommendations, anyone staying in the territory where malaria occurs endemically for the period of three or more days should use antimalarial chemoprophylaxis. Transmission of the disease in Afghanistan typically occurs since March until the beginning of November. However, incidences of the disease were reported late in November within the last years in the Kandahar province. In 2003 one person got infected with the disease in December during their 11-day stay in the Bagram province (the disease developed following the departure from the endemic region)[16]. Antimalarial chemoprophylaxis among the U.S. Forces personnel in Afghanistan is based on application of two types of drugs: doxycycline or mefloquine. In the case of the latter there are contraindications to its use by air-crew due to the occurrence of side-effects. Mefloquine is a medicament whose application may lead to some serious neuropsychiatric symptoms, a tendency to violence, suicidal thoughts. This problem was given some consideration following cases of homicide and suicide among 5 American soldiers home-bound in the summer of 2002 from Afghanistan, where they had used mefloquine as antimalarial chemoprophylaxis[30]. The most frequently occurring side- effects of mefloquine are as follows: anxiety and depressive mood, psychomotor hyper excitability, paranoia, fear, mood changes, aggression, panic attacks, amnesia, sleep disorders, hallucinations. All of the above-mentioned side-effects may persist long after the termination of treatment with mefloquine[31, 32]. Nevertheless, despite such serious side effects, their percentage in the population taking the drug is low. In addition to this, it has been observed that mefloquine is better tolerated than doxycycline which statistically has more side effects[33]. The U.S. military personnel deployed abroad have been routinely monitored in two directions. The first one is the risk of transferring the infection via blood transfusion, thus each honorary blood donor should be routinely tested in the direction of infection with malaria *Plasmodium*[34]. The second is the test in the direction of the glucose-6-phospate dehydrogenase deficiency[35]. Following termination of service in regions where malaria is endemic American soldiers are subjected to terminal chemoprophylaxis in the form of a 14-day treatment of primaquine, a drug which is a complement to chloroquine, mefloquine, atovaquone/proguanil or doxycyclinum. Such a treatment is justifiable in cases of infections with *Plasmodium vivax* and *P. ovale*, when in spite of implemented chemoprophylaxis in an endemic region; *Plasmodium* can survive in liver cells and induce the disease several years after returning from malarial regions[36]. Owing to the fact that 100%

of indigenous cases of malaria in Iraq and 80% of the cases of malaria in Afghanistan are induced by *P.vivax*, implementation of terminal chemoprophylaxis seems fully justifiable. However, the use of primaquine in patients with the glucose-6-phospate dehydrogenase deficiency (mainly in the form of hemolytic anemia) may have disastrous effects. Cases of hemolysis occurred in 2 American soldiers home-bound from Iraq. In both cases deficiency of the enzyme was confirmed[35]. Presently, soldiers of the U.S. Forces have been routinely tested in the direction of the glucose-6-phospate dehydrogenase deficiency. From October 2004 to January 2005 over 63 000 American soldiers had been tested. The test was positive in 2.5% of males and 1.6% of females. The highest percentage of patients with the glucose-6-phospate dehydrogenase deficiency was observed in the population of Afro-Americans (12.2% of males and 4.1% of females) and Asian males (4.3%)[37]. As far as Polish health service is concerned, in relation to soldiers of Polish Military Contingents, neither terminal prophylaxis of malaria (the use of primaquine) to prevent infections with *P. vivax* and *P. ovale*, nor tests in the direction of enzymatic deficiencies are implemented. Interestingly, a high percentage of military personnel seem to ignore health hazards regarding vector-borne diseases despite wide availability of means of personal protection as well as chemoprophylaxis against malaria. Anonymous surveys conducted among soldiers of the U.S. Forces, participants of the military operation in Afghanistan, revealed that merely 52% used chemoprophylaxis in the operational zone, 41% - terminal prophylaxis following their homecoming, 31% - prophylaxis both in the operational zone and after their return home, 82% applied Permethrin to uniforms and mosquito nets, and 29% applied insect repellents to bare skin (DEET)[6]. In other national contingents participating in the ISAF stabilization mission in Afghanistan the percentage of people using prophylactic means remains at a very low level. Insect repellents are used by 46% and mosquito nets by 39% of the surveyed[24]. Clearly, apart from appropriate medical coverage, a lot depends on the attitude of the military personnel towards prophylaxis, which, regrettably, leaves a lot to be desired.

Leishmaniasis. The disease is endemic in 88 countries inhabited by 350 million people in all continents except for Australia and Oceania. 1.5 million cases of cutaneous leishmaniasis and 0.5 million cases of viscerotropic leishmaniasis are recorded annually. 90% of all registered cases of the disease occur in Afghanistan, Iraq, Iran, Algeria, Saudi Arabia, Peru and Pakistan[38]. The disease is transmitted from a sick animal or a human to a healthy individual by infected *Phlebotomus* flies. Taking into account the fact that until now transmission of the infection via blood transfusion occurred only in the territories where leishmaniasis is endemic, and the course of its viscerotropic form is mild and asymptomatic in blood donors, blood transfusion cannot be unambiguously defined as a risk factor in transmitting the disease[39]. Leishmaniasis has been occurring among the population of soldiers participating in military operations in the Middle East for decades. During the Second World War, from 1943 to 1944 more than a thousand cases of cutaneous leishmaniasis were registered among the population of the U.S. Forces soldiers deployed in Iraq and Iran[40, 41]. During the Soviet war in Afghanistan in the 1980s infections with the cutaneous form of the disease among Soviet soldiers occurred on a mass scale, generally, following their return home, due to a long incubation period[42]. Within the years 1990-1991, during the *Desert Storm* operation 20 cases of cutaneous leishmaniasis (induced by *Leishmania major*) and 12 cases of its viscerotropic form (*L. tropica*) were observed in the population of American soldiers deployed in Saudi Arabia, Kuwait and Iraq[43-45]. Present-day military operations in Iraq and Afghanistan revealed high incidence of leishmaniasis among soldiers of the Stabilization Forces. The first report from Iraq, issued in October 2003, informed of 22 incidences of the disease. The report issued in April 2004 informed of 522 cases of leishmaniasis in the population of the U.S. Forces soldiers (the predominant etiological factor was *L.major*). In 2004 the U.S. Army epidemiological services employed in Iraq tested approximately 65 000 *Phlebotomus* flies and revealed that 1.4% were infected with *Leishmania* parasites[41]. From 2002 to 2005 827 cases of cutaneous leishmaniasis and 5 cases of its viscerotropic form had been diagnosed and laboratory confirmed among American soldiers deployed in Iraq, Kuwait and Afghanistan[13]. All the incidences of viscerotropic leishmaniasis occurred in Afghanistan (the etiological factor was *L. donovani*)[46]. Retrospective surveys conducted among soldiers of the U.S. Forces participating in operations *Iraqi* and *Enduring Freedom* from 2003 to 2004 revealed the occurrence of cutaneous leishmaniasis in 2.1% of respondents[4]. Within the given period the percentage of American soldiers evacuated from Iraq to the U.S. to undergo treatment of cutaneous leishmaniasis in a Walter Reed Army Medical Center (WRAMC) reached 4.4% of all evacuations for medical reasons[47]. The author of this article witnessed criticism of high costs of evacuation of hundreds of American soldiers to the U.S. (where they underwent a 20-day treatment of cutaneous leishmaniasis and after that they were sent back into the mission's zone) in a meeting with the U.S. Army Hospital commanders in Bagdad (Level 3). Eventually, American health services realized that cutaneous form of the disease is not life-threatening and changed the therapeutic procedures. Thus, it was decided that soldiers are to undergo treatment of leishmaniasis within the operational zone. The author of this article, while being deployed in Afghanistan in 2005, provided medical assistance for patients treated in the U.S. Army General Hospital w Bagram, where he treated cases of cutaneous leishmaniasis occurring among military and civilian personnel participating in the operation *Enduring Freedom* in an outpatient clinic. The incidence of leishmaniasis and other vector-borne diseases, which have already been mentioned in the context of malaria, constitute a serious health hazard largely due to the fact that basic principles of prophylaxis are neglected[48] In prophylaxis of leishmaniasis, owing to the absence of vaccine or chemoprophylaxis, mosquito nets and insect repellents remain the fundamental prophylactic

means. Questionnaires completed by 310 soldiers treated for leishmaniasis in the Walter Reed Army Medical Center in the U.S. demonstrated that merely 10% of the respondents used mosquito nets[49]. The most effective insect repellent is N,N-diethyl-*m*-toluamide (DEET)[50]. Although its application has been recommended by the U.S. Armed Forces not a lot of soldiers use it. Only 68.5% of the surveyed soldiers home-bound from Iraq and Afghanistan had known about its availability, 14.6% applied it regularly, and as much as 51.2% had never used it. In addition to this, conducted surveys revealed that only 41.1% of soldiers believed that DEET was effective, and 21.6% that it was safe, although it has been widely used for decades and both toxicologists and epidemiologists consider it to be safe and effective. So far not a single case of leishmaniasis has been diagnosed among soldiers of the Polish Military Contingent deployed in Afghanistan[51]. Similarly, leishmaniasis has not occurred in the population of Polish soldiers deployed in Iraq[52] even though the disease is endemic within the operational zone of the Multinational Division Central-South, especially in the Wasit Governorate, where cases of cutaneous leishmaniasis occurred in soldiers of the Ukrainian[53] and American contingents[54]. Owing to an exceptionally long incubation period (months, years) and the likelihood of importing the disease from the territory of its endemic occurrence particular attention needs to be paid to each case of a wound which is not healing (cutaneous leishmaniasis) and fever of unknown origin (viscerotropic form) among soldiers participating in operations *Iraqi* or *Enduring Freedom* after their return home.

Other diseases. Further vector-borne diseases which may be life-threatening for soldiers participating in military missions in Iraq and Afghanistan are sand fly fever, epidemic and endemic typhus and Crimean-Congo hemorrhagic fever. Cases of the diseases mentioned above occur among the local population inhabiting territories of both countries[55]. A sand fly fever - a viral infection, which similarly to leishmaniasis is transmitted by *Phlebotomus* flies, is particularly widespread. The disease occurred on a mass scale among Soviet soldiers occupying Afghanistan in the 1980s[56, 57]. In 2004, while being employed in the Polish Field Hospital in Iraq, the author of this article treated soldiers of the Coalition Forces for status past insect bites showing similar clinical picture as in a sand fly fever.

2. Food and water-borne diseases

This group of diseases constitutes the most frequently occurring health problem among soldiers participating in military missions, which is primarily due to unsatisfactory sanitary standards in the regions of the forces deployment, contamination of soil and water, incorrect system of purifying drinking water as well as a disastrous condition of plumbing and sewage systems[58, 59]. The occurrence of the diseases is further facilitated by neglect of military personnel to comply with recommendations regarding the rules of personal hygiene as well as food and feeding hygiene[60]. A good example of such disregard arose during the UN mission in Lebanon (UNIFIL), where, in1998, an epidemic of staphylococcal food poisoning occurred among soldiers of the Polish Military Contingent owing to the fact of admitting a cook with pyodermas (induced by *Staphylococcus aureus*) to work in the food-processing section[61]. Proper sanitary, hygienic and anti-epidemic safety regulations significantly diminish the risk of the occurrence of contagious and parasitic diseases of the digestive system. A perfect example of such an action was prophylactic measures taken by Croatian sanitary services during the Balkan war within the years 1991-1992. Regular sanitary inspections, mass vaccinations, registration of the sick and carriers of infectious diseases resulted in the occurrence of merely one focus of a contagious disease of the digestive system in the territory of the whole country (21 cases of typhoid fever)[62]. Typically, military personnel deployed in combat zones constitute a population of immigrants recruited from countries of high hygienic standards. Thus, a sudden change of environmental conditions results in their increased sensitivity to local pathogens. This gives rise to gastrointestinal disorders which typically occur among soldiers within the first few weeks after their arrival at a new post[63]. The individual research conducted in the population of American soldiers serving in the Multinational Division Central-South in Iraq from 2003 to 2004 revealed the highest incidence of the digestive system diseases (36.8%), among which acute gastroenteritis, with its typical symptoms (nausea, vomiting, diarrhea) lasting on average 1-3 days, was predominant. The incidence rate was the highest in the course of the first month after being relocated to a combat zone in the Middle East[54]. The most frequently occurring pathogen of contagious diseases of the digestive system among the population of the military personnel undergoing medical treatment in the MND SC Field Hospital in Iraq from October 2003 till March 2004 was enterotoxic *Escherichia coli* (bacteriologically confirmed in over 50% of all cases)[63]. Other pathogenic factors included *Shigella, Salmonella, Campylobacter, Cryptosporidium, Giardia intestinalis, Entamoeba histolytica, Rotaviridae*. In 20-30% of cases the etiological factor remained unspecified (negative microbiological test)[63, 64]. The occurrence of acute gastroenteritis, especially diarrhea, is widespread among military personnel deployed within an operational zone. A surge in incidence of diarrhea among American and British soldiers was observed during the initial stage of military operations in Afghanistan (2001) and Iraq (2003). The main etiological factors were *Norwalk* viruses and bacteria of the *Shigella* genus[65-67]. The majority of military personnel deployed within a combat zone reported at least 1 episode of diarrhea during their service in Iraq (77% of respondents) and Afghanistan (54%). Soldiers positioned in Iraq complained of a much longer and more severe course of the disease and went through more episodes of diarrhea than soldiers deployed in Afghanistan. Typically, symptoms of the disease lasted several days, in 10% of all cases symptoms persisted for over two weeks[68]. Questionnaires completed by American soldiers stationed in Iraq in the summer of 2004 revealed the occurrence of diarrhea in 66% of the

examined population, out of whom 50% complained of repeated episodes of the disease. The etiological factor of the disease which was most frequently detected in laboratory tests was *Escherichia coli* (35.5% of all cases). Other pathogens included *Norwalk* virus (2.5%) and parasites (7%) of which *Entamoeba histolytica* and *Giardia intestinalis* posed the most serious epidemiological hazard[69]. Research conducted among American soldiers deployed in Iraq in 2005 demonstrated a relatively high percentage of diarrhea induced by *Cryptosporidium*. In all cases of chronic diarrhea occurring in soldiers serving in overseas tours irritable colon syndrome or persistent parasitic infections induced by *Cryptosporidium sp., Entoamoeba sp.* or *Giardia sp.* should be taken into account[70]. On the basis of surveys conducted in American units among peacekeepers participating in the operations *Iraqi* and *Enduring Freedom* in 2004 the incidence rate of diarrhea was estimated at 4.9 cases in 100 patients treated each month. The main etiological factor was *Escherichia coli* (44%, including enterotoxic *E. coli* – 32%) and *Salmonella sp.* (6%)[71]. Subsequent research, conducted among 15 459 military personnel of the U.S. Army deployed in Iraq and Afghanistan from 2003 to 2004 demonstrated that the most commonly occurring diseases of the digestive system were diarrhea of a relatively serious course (more than 6 loose stools) going together with fever (26%) and vomiting (18%). Over 80% of patients showing symptoms of the disease were provided with medical help at Level 1[68]. 1 340 cases of diarrhea of semi-serious and serious course were noted in the population of British soldiers participating in operation *Iraqi Freedom* within the first few weeks of their deployment in the operational zone, 73% of patients required hospitalization. The main etiological factor was *Caliciviridae* (*Norwalk*)[72]. Research on morbidity rates conducted in the population of American peacekeepers as well as soldiers of other nationalities serving abroad for an extended period of time from 1990 to 2005 showed that episodes of diarrhea concerned 38% of the population deployed in the Near East and 29% of the population deployed in the South-East Asia. The most commonly occurring etiological factors were enterotoxic *Escherichia coli, Campylobacter* and *Shigella*[73]. Acute gastroenteritis also called 'traveler's diarrhea' is one of the most serious health problem occurring among people travelling abroad, observed in 60% of all travelers[74]. Military personnel sent into combat zones constitute a distinctive group of travelers among which the occurrence of gastroenteritis is particularly widespread[75-77]. Despite the application of specific sanitary regulations in the areas of military operations conducted in Iraq and Afghanistan as well as constant supervision by sanitary services of military contingents, episodes of diarrhea occur in the majority of soldiers deployed in the territory of both countries, in more than 50% of patients symptoms of the disease occur repeatedly[78]. A significant problem connected with the occurrence of food and water-borne diseases is the fact that a large number of the diseases were not diagnosed in terms of the etiology of their pathogens. For this reason data regarding the causes of sickness prevalence may not be fully credible[79]. The occurrence of acute gastroenteritis among military personnel is typically associated with the consumption of food from the local market and drinking water from unknown sources[68]. A survey conducted among American soldiers stationed in Iraq revealed that as much as 26.6% of them admitted the consumption of local food, in Afghanistan – 5.3%. When asked for the reasons of their decision to eat local food which had not been attested in terms of sanitary standards, surveyed soldiers gave the following answers: they wanted to add variety to the military menu (25%), to satisfy their curiosity as to the local cuisine (20%), they received food and drinks as a gift and did not want to offend their benefactors with refusal (15%)[68]. Implementing proper prophylactic measures which prevent the occurrence and spread of infectious and invasive diseases of the digestive system constitute a key factor in maintaining health in a given population, especially in a combat zone[80]. Simple sanitary procedures may considerably reduce the risk of the occurrence of pathological symptoms – washing hands by 42-47%[81], disinfection and correct disposal of excrement by 30-35%, disinfection of drinking water by 15-20%[82, 83]. Should the prophylaxis regarding contagious and parasitic diseases transmitted through food and water be neglected, the risk of the diseases' incidence may get particularly high[84]. The group of food and water-borne diseases occurring among the population inhabiting the territory of Iraq and Afghanistan, whose incidence is strictly connected to unsatisfactory sanitary and hygienic standards, include typhoid fever, hepatitis A and cholera. All military personnel participating in both of the stabilization missions are subjected to vaccination against typhoid fever and hepatitis A before being relocated to new posts. Also, while serving in a combat zone preventive medicine services pay particular attention to personal hygiene, purity of drinking water as well as food and feeding hygiene[85]. Thus executed sanitary regime reduces considerably the risk of sickness prevalence (until now cases of typhoid fever, hepatitis A or cholera have not been registered in the population of American military personnel participating in operations *Iraqi* and *Enduring Freedom*). The situation regarding the application of proper prophylactic measures (or rather absence of it) used to be completely different among 620 000 Soviet soldiers occupying Afghanistan in the 1980s. Within the given period 31 000 soldiers were hospitalized due to typhoid fever and further 115 000 were hospitalized due to viral hepatitis (hepatitis A constituted 95% of all cases), which considerably reduced the combat potential of the Soviet Forces[86, 87]. Sanitary losses suffered by the Russians in Afghanistan caused by nothing else but contagious and parasitic diseases ranged from 53.2% (1980) to 68.7% (1983) of the population. The occurrence of complex infections, i.e. typhoid fever + hepatitis A, typhoid fever + amebiasis, hepatitis A + shigellosis, etc. was widespread. The majority of contagious and parasitic diseases contributed to the evacuation of the sick from a combat zone back to their home country[88].

3. Respiratory tract diseases

Respiratory tract diseases belong to a group of health problems which are particularly widespread in combat

zones. This is undoubtedly influenced by mass migrations, overpopulation, and a breakdown in prophylactic vaccination system and changeable weather conditions. High morbidity occurs not only among civilians but also among soldiers participating in military operations[89, 90]. The etiological factors of the respiratory tract diseases occurring in the population of military personnel are primarily *Streptococcus pneumoniae, Mycoplasma pneumoniae*, and *Haemophilus influenzae*[91, 92]. During the Gulf War in 1991 diseases of the respiratory tract were the most frequently reported illnesses among soldiers of the Coalition Forces taking part in the *Desert Storm* and *Desert Shield* operations[93]. Acute respiratory infections resulted in the increased sick absenteeism among the population of Soviet soldiers deployed in Afghanistan in the 1980s. Within their first year of service in Afghanistan as much as 43% of Soviet soldiers suffered from acute bronchitis and/or pneumonia, mainly in the autumn/winter season, which was definitely caused by unfavorable weather conditions[94]. In the areas where contemporary military operations are conducted medical services put special emphasis on prophylaxis of airborne diseases, which is primarily based on preventive vaccination against influenza and pneumococcal infections as well as treatment by means of guided pharmacotherapy[90, 95].

The research conducted in the population of American soldiers taking part in the *Iraqi Freedom* and *Enduring Freedom* operations revealed that respiratory tract diseases still remain one of the biggest health problem diagnosed in participants of military operations deployed in territories where different climatic and sanitary conditions prevail. 69% of respondents complained of at least 1 episode of the respiratory tract infection, 14% of the surveyed – of more than 3 episodes[4]. The incidence of respiratory tract diseases was particularly high during direct combat activities[46]. Approximately 40% of patients reporting respiratory tract diseases admitted to smoking at least 10 cigarettes daily, which in connection with environmental conditions may notably increase the prevalence of the diseases[4]. In 3% of American soldiers complaining of respiratory tract diseases pneumonia was diagnosed. Patients with pneumonia were generally treated on an outpatient basis[46]. Apart from cases of bacterial or viral etiology which occurred in the population of American soldiers from March 2003 to March 2004 18 patients were diagnosed with idiopathic, eosinophilic pneumonia (two patients died)[96]. Research conducted during the initial stage of the operation *Iraqi Freedom* reveled fewer than 100 cases of pneumonia among American soldiers, 15% of patients suffered from acute respiratory failure and required treatment in the intensive care unit[97]. *Streptococcus pneumoniae* is the main pathogenic factor which induces pneumonia in the population of soldiers serving in the U.S. Forces in Iraq and Afghanistan[98].

Tuberculosis. The disease is widespread among the local people inhabiting the territory of ongoing military operations and it poses a serious threat to health of military missions' personnel. It must be kept in mind that tuberculosis is not only transmitted through respiratory but also through digestive tract. Thus, avoiding the consumption of non-pasteurized dairy products from the local market is essential[99]. Tuberculin tests PPD (*purified protein derivative of tuberculin*) are carried out in the population of American soldiers prior to their arrival into a mission's area as well as following their return home. Conversion index among American military personnel has been estimated at the level of 2.5%. During the Vietnam War at the turn of the 1960s and 1970s 3-5% of American soldiers deployed in the Indochina Peninsula for the period of one year demonstrated positive TB test. In the same period positive TB test did not exceed 1% in the population of soldiers stationed solely in the territory of the U.S.[100].

4. Sexually transmitted diseases

This group of diseases does not pose a serious epidemiological risk among soldiers of Stabilization Forces serving in the Near East and in the Central Asia under the condition of regular clinical and laboratory supervision of the missions' participants. The risk of infection rises drastically in cases of incidental intercourse without the application of basic preventive means (condoms). However, the risk of infection has increased recently since military service has ceased to be an all-male profession. In national contingents participating in military missions women account for a substantial part of contingents' population. In some of the U.S Forces units women represent up to 20% of the population, which certainly influences the fact that sexual intercourse among military missions' personnel is becoming increasingly commonplace. Gynecological examination of 1 737 women soldiers serving in the U.S. Army deployed in the Near and the Middle East from August 2003 to April 2004 demonstrated 77 cases of positive pregnancy test. 23% of women got pregnant during their deployment in the military missions' territory[101]. Further research conducted among female personnel of the U.S. Army stationed in dislocation camps in Kuwait before relocating them to Iraq or Afghanistan revealed clinical symptoms and/or positive results of laboratory tests in the direction of sexually transmitted diseases. Genital herpes (30%), genital warts (25%) and chlamydiasis (21%) prevailed among the diagnosed cases of STD. The results clearly indicate that a detailed venereal tests needs to be carried out before relocating soldiers to service abroad[102]. As regards sexually transmitted diseases chlamydiasis, gonorrhea and viral infections (HSV, HPV, HIV) prevail in the population of military missions' personnel. Chlamydiasis remains the most frequently diagnosed bacterial venereal infection in the United States. Over 929 000 cases of infections with *Chlamydia trachomatis* were registered in 2004. However, considering the fact that in 75% of females and 50% of males the disease is asymptomatic, it has been estimated that approximately 2.8 million Americans might have become infected with chlamydiasis[103]. Also, chlamydiasis belongs to a group of the most commonly occurring STD in the population of American soldiers[104]. Screening tests carried out in the U.S. Navy and Marines units demonstrated that 4.1% of

the examined males and 4.5% of the examined females were positive[105]. Further research, carried out among women about to begin their military service in the U.S. Army revealed that as much as 9.2% of the examined females were infected with *Chlamydia trachomatis*[106]. The epidemiological services of the U.S. Army recommend conducting screening tests in the direction of chlamydiasis in all candidates willing to enlist in the U.S. Forces[107]. Other STD also constitute a considerable epidemiological hazard in the American population. Each year 600 000 cases of gonorrhea are diagnosed in the U.S. more and more often with increasing refractoriness to pharmacotherapy. The incidence rate of gonorrhea is estimated at 2.5 per 100 000 persons[108]. HIV infections, estimated at 1.2 million cases in the United States until the end of 2005[109], have been registered and monitored in the U.S. Forces. Diagnostic tests (anti-HIV antibodies) have been routinely carried out in the U.S. Forces since 1985[110, 111]. Until the end of the 1990s the number of HIV infections among the personnel of the U.S. Forces remained at a relatively low and constant level[112]. The rate of HIV seroconversion amounted to 1 275 cases in all of the U.S. Forces[113]. In recent years, however, the number of infections has increased. 1 373 cases of HIV infections have been registered until January 2004 only among the U.S. Air Force personnel, 155 persons remain in active service, 561 persons died of AIDS[108]. The risk of infection via sexual intercourse also relates to cases of hepatitis B and C; yet the number of infectees is relatively small[114]. Examination of randomly selected 21 000 American soldiers revealed infection with the HCV virus in 0.5% of the examined population, whereas the number of infectees in the population of adult Americans has been estimated at 2.6%[115, 116]. The incidence rate of sexually transmitted diseases among military personnel surges drastically in times of warfare and is several times bigger in comparison to the times of peace. Military contingents generally consist of young, sexually active men susceptible to taking up sexual activities with incidental prostitutes as a means of working off stress[117]. In terms of venereal diseases the incidence rate is hugely influenced by the region of the deployment of forces. In Muslim countries of the Middle East and Central Asia, burdened with a number of moral restrictions, the access to sexual services is extremely limited. Therefore, an insignificant number of infections have been reported. In contrast to other diseases prevalent in hot climate areas or combat zones STD do not pose an epidemiological hazard for military missions' participants[118]. However, some consideration should be given to more and more commonly occurring HIV infections among inhabitants of Muslim countries. Muslims seem to ignore the risk thinking that extramarital sex, prostitution, homosexuality or drug abuse do not concern followers of their religion[119]. Such hypocrisy facilitates the spread of the infection, especially as becoming infected with HIV still remains a taboo subject and cases of the disease are purposely kept secret for fear of public condemnation[120]. During the operation *Desert Storm* in 1991 the incidence of STD among soldiers of the Coalition Forces did not exceed 1% of all diseases treated within the given period. The individual research carried out in the population of the U.S. Forces soldiers (N=7 000) deployed in Bagram, Afghanistan from March to August 2005 demonstrated that 17 out of 2 870 admissions to the U.S. Army General Hospital (on an outpatient basis) were due to STD (8 cases of chlamydiasis, 4 of gonorrhea, 2 of genital warts, 2 of genital herpes, 1 of trichomoniasis). 10 cases of STD, including 9 cases of gonorrhea were diagnosed in the population of the UN peacekeepers serving in the Golan Heights (UNDOF) from 1996 to 2000 (not a single case of STD was registered among soldiers of the Polish Military Contingent). Whereas, 24 soldiers were hospitalized due to STD (2 cases of HIV/AIDS, 12 cases of gonorrhea, 5 of lues, 5 of genital warts) during the following UN peacekeeping mission conducted in the Middle East (UNIFIL in Lebanon) from 1993 to 2000. 1 case of a venereal disease (gonorrhea) was diagnosed in the population of Polish peacekeepers deployed in Lebanon within the given period; it was treated on an outpatient basis[121]. In contrast to the above-mentioned countries, the epidemiological situation in other parts of the world, i.e. in Southeast Asia is completely different[118]. Unlimited access to sexual services provided by prostitutes of whom a vast majority is infected with STD results in the fact that the incidence rate in this part of the world is particularly high. This may be illustrated on the example of the Polish Military Contingent's population participating in the UN peacekeeping mission in Cambodia (UNTAC) from 1992 to 1993. Ninety-two cases of venereal diseases were diagnosed (gonorrhea was predominant) among 789 Polish patients subjected to medical examination, which amounted to 6.5% of all diseases treated within the given period[122]. Similar incidence rate occurred among American soldiers taking part in the Vietnamese conflict in the 1960s and 1970s[123, 124].

5. Zoonoses

Zoonoses pose a considerable epidemiological threat to soldiers participating in military missions in endemic regions as they typically occur among local populations, especially those inhabiting rural areas. The group of enzootic diseases which are of epidemiological importance includes rabies, brucellosis, and Q fever[125, 126]. Although the incidence rate among the population of soldiers participating in military operations is insignificant compared to other contagious diseases, after-effects of such infections are so serious that each suspicious case should be analyzed in detail, especially cases of diseases proceeding with fever of unknown origin[127]. The main source of rabies infection for people are dogs (95% of all cases and deaths in the world). Over 99% of deaths among people occur in Asia and Africa. Each year approximately 55 000 people, mainly children, die of rabies. Over 7 million people run the risk of becoming infected with rabies. The risk of an infection is particularly high in Afghanistan, where bites of stray, infected dogs cause several hundred fatalities among the local people every year[128]. Until now not a single case of the disease was registered in the population of soldiers deployed in Iraq, Afghanistan or Chad. Brucellosis occurs endemically in the territory of the Near and the Middle East; it is transmitted onto

people through contact with infected animals or consumption of non-pasteurized dairy products. The routes of infection for humans are food, air and contact with a carrier of the disease. 3 cases of brucellosis were diagnosed among American soldiers deployed in the Near East from 2003 to 2005. A helicopter pilot serving in Iraq became infected while he was witnessing sheep slaughter even though he refused to eat meat or dairy products of an infected animal[129]. The cause of the Q fever in humans may be a droplet infection in case of the direct contact with infected animals (sheep, goats), contact with their infected excrement or even clouds of dust produced by cars. Other routs of transmission are tick bites and consumption of non-pasteurized milk. Q fever proceeds in the form of acute flu-like infection going together with pneumonia or hepatitis. It may also take the form of a chronic infection often as endocarditis[130]. Cases of the Q fever were diagnosed in American soldiers participating in operations *Iraqi Freedom* who had initially been treated for pneumonia or hepatitis. Antibodies against *Coxiella sp.* were found in 8 patients suffering from pneumonia and 2 patients suffering from hepatitis[131]. Medical history of infected patients revealed that 3 of them had contact with animals, 2 of them were bitten by tikes, 1 was drinking non-pasteurized milk. Further 22 cases of the disease were diagnosed among the U.S. Marines serving in Southern Iraq. In these cases the disease took the form of a respiratory tract infection with high fever[132]. Q fever is a disease which poses significant epidemiological risk on a global scale. This is not merely the matter of the risk of becoming infected in the regions where military forces are deployed, but more importantly the possibility of exploiting its etiological factor (*Coxiella burnetii*) as biological weapon in bioterrorist attacks[13]. Another animal-borne disease whose etiological factor may be applied as biological weapon is anthrax. Vaccination against anthrax is included in the vaccination schedule of soldiers serving in the U.S. Forces. Until now the disease has not occurred among participants of *Iraqi* and *Enduring Freedom* operations. Yet, single cases of other rarely occurring zoonozes have been registered in the population of military personnel. Several cases of *ophtalmomyasis*, myiasis of severe course, occurred among American soldiers deployed in Iraq. A gadfly *Oestrus ovis* parasitizing in sheep's nostrils lays larva on a human eyeball, which in consequence may lead to some serious ophthalmological complications, including the loss of sight[133].

SUMMARY

Contemporary military operations, especially in the region of the Middle East and Central Asia have recently been executed in difficult climatic and sanitary conditions which are frequently unfamiliar for their participants, i.e. representatives of temperate climate from Europe. Extreme range of temperatures between day and night, low hygienic standards along with warfare determine the occurrence of numerous illnesses and injuries not only among local population but also among troops deployed to military operations, who represent the influent population. Some of military actions, i.e. the UN peacekeeping missions in Lebanon and Golan Heights have been realized in a relatively stable geopolitical environment, whereas stabilization operations in Iraq and Afghanistan, which actually are combat activities, undoubtedly fall into a group of the most perilous military activities in the world. Sickness and traumatic profile which poses the major epidemiological problem among troops in combat zones are vector-borne, food & water-borne, respiratory diseases, also, sexually transmitted diseases, enzootic diseases, battle injuries and non-battle injuries, i.e. sport and traffic accidents. Another considerable health hazard are psychiatric disorders which can either appear directly after the occurrence of a traumatic event in a combat zone or indirectly – after some time had elapsed. In addition to the injuries, diseases and disorders listed above, environmental factors such as changeable weather conditions and local fauna may also be life-threatening. The paper reviews the most common health problems occurring among personnel of peacekeeping and stabilization missions functioning within current armed conflicts.

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