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IMPLICATIONS OF THE ONE HEALTH CONCEPT IN AGRICULTURE

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Abstract

The new conception of the sciences of life, One health, logically combines, in a unitary whole, the knowledge and practices of human medicine, veterinary medicine, agronomy, environment that can influence the public health, in one way or another. The first selection and integration of these seemingly disparate areas was made by military medicine, based on the experience of war medical protection and counterterrorism. Epidemics and pandemics can spread quickly, through travel and international trade, uncontrolled migration, military or terrorist attacks. Most biological warfare agents kill or incapacitate humans but also animals or plants and then contaminate the environment for a variable time forming a reservoir of pathogens.Disease of the live - stock and cultivated plants can lead to food crisis and can be used to defeat a country or unfair economic competition, and their effect, regardless of whether they are real or false attacks, can be very important. As a result, is required not only a close civilian-military (CIMIC) collaboration but also between the different departmental components of the state: Ministry of Health, Ministry of Agriculture, Ministry of Defense, Ministry of Finance etc..

Key words*: agriculture, biological agents, One health concept, medical protection, public health.*

INTRODUCTION

The new conception of the sciences of life, ***One health***, logically combines, in a unitary whole, the knowledges and practices of human medicine, veterinary medicine, agronomy, environment that can influence the public health, in one way or another. The first selection and integration of these seemingly disparate areas was made by military medicine, based on the experience of war and counterterrorism medical protection (Ordeanu et al., 2012; Ordeanu et al., 2015). Epidemics and pandemics can spread quickly, through travel and international trade, uncontrolled migration, military (directly, through biological attack or indirectly through precarious living conditions following the battles) or terrorist attacks (through bio-chem attacks on the opponent). Most biological warfare agents (BWA) both living: bacteria and viruses, or nonliving: toxins and bioregulators, kill or incapacitate humans but also animals or plants and then contaminate the environment (soil, water, air, objects and beings) for a variable time (days, months or years) forming a reservoir of pathogens.

Disease of the live - stock and cultivated plants can lead to food crisis and can be used to defeat a country or unfair economic competition, and their effect, regardless of whether they are real or false attacks, can be very important.

As a result, is required a close collaboration between the different departmental components of the state: the Ministry of Health, the Ministry of Agriculture, the Ministry of Internal Affairs, the Ministry of Defense, the Ministry of Finance (because without funding, none of them can act effectively), the secret services, the non-governmental organizations, the local communities and citizens as well as the civilian-military cooperation (CIMIC).

1. ANTHROPOZOONOSES

Anthropozoonoses are infectious diseases common to humans and animals, can affect humans and other animals, and those that are contagious can cause epidemics and pandemics, respectively epizootics and panzootics. The pathogenic microorganisms involved are from almost all known kingdoms of the living world: on cellular (prions, DNA and RNA viruses), Monera (aerobic and

anaerobic eubacteria), Protista (protozoa), Fungi (yeasts and molds), Vegetables and Animalia (helminths and arthropods). They act directly, through multiplication and parasitism, and/or indirectly, through their metabolism products (endotoxins and exotoxins).

Human-specific living pathogens can be controlled by specific medical counter-measures: diagnosis (clinical and laboratory), anti-infectious treatment (specific and non-specific) and prophylaxis (epidemiological surveillance, hygiene, isolation, quarantine, vaccination). In this way, for example, the eradication of human smallpox was achieved; in 1977, progress was made in the eradication of polio and other human-specific infectious diseases. Barriers are not only the poor health education of the population and the "anti-vaccination" current, but also the existence of the "animal reservoir".

In the case of most infectious diseases, which are anthropozoonotic, medical countermeasures are no longer sufficient, because the animal reservoir of microorganisms cannot be known and / or eradicated, but only controlled and diminished. This is how, in the 21st century we still have cases and outbreaks of plague, because the *Yersinia pestis* bacillus has a natural reservoir in rodents (wild and peridomestic) and a natural vector, the flea, which can transmit it to humans. And the cases occur not only in undeveloped countries, but also in the US, China, Russia, etc. An example of particular gravity is the endemic Ebola hemorrhagic fever, with repeated epidemics in West Africa, where the animal reservoir of viruses is multiple: monkeys, bats and other wild animals of hunting interest to the locals. Although both the disease and the virus have been known for a long time, we still do not have specific antiviral chemotherapy, specific reagents and no authorized vaccine, and the medical care and health education in the area are inadequate. As a result, the risk of anthropozoonosis is permanent, with epidemic outbreaks at local, regional or even pandemic level (Soulsby, et al., 2005).

We are currently facing another evolving anthropozoonosis, caused by a new COVID-19 coronavirus, with a multiple animal reservoir: bats, owls, pangolins and possibly snakes. After the species barrier is overcome, the virus spreads by interhuman transmissibility with respiratory febrile illness, which can be complicated by lethal pneumonia. This epidemic, with its epicenter in China, has been declared by WHO as a high risk international health emergency (PHEIC).

2. BIOLOGICAL AGENTS

It is no coincidence that, some of the diseases we exemplified here are also on the list of biological warfare agents (BWA). Ever since Neolithic Antiquity, when *Homo sapiens sapiens* started organizing conquering wars, he has used, besides various cold weapons and some poisons, in fact toxic and/or infectious substances, to facilitate the defeat of the adversary by disease. The Hittites used the bodies of dead sheep from anthrax, the corpses of dead soldiers from plague, etc. Only in the nineteenth century, after Pasteur laid the foundation for microbiology, was the concept of ***biological weapon*** outlined, with "militarized" pathogens for an optimal effect. It disperses living pathogens (bacteria, viruses, etc.) or nevi (toxins, regulators, etc.) in order to disrupt enemy fighting forces, the civilian population, domestic animals (for work or food), wild animals (as microbial reservoir pathogens), cultivated and uncultivated plants (for food shortages) and to contaminate the environment (water, air, soil, objects). For example, in Romania, during World War I, German sabotage agents contaminated with moray and anthrax bacilli the ports of Braila, Galati and Constanta, to stop the export of horses and sheep to the allies. Biological attacks, whether up front or masked, have diversified into different parts of the world. But unpredictable "accidents" also occurred. In Vietnam, US aviation launched defoliants in the jungle to see Vietnamese fighters, but many pilots became intoxicated or became ill with cancer. In Iraq, the "Gulf syndrome" has emerged as an unwanted consequence of the combined protection (anti-anthrax vaccine, cholinesterase antidote and insecticide). In the USSR, at the biological agent factory in Sverdlovsk, an accidental aerosolization of mycotoxins "yellow rain" (from other sources - were anthrax spores) led to many deaths. After the last cases of smallpox recorded in 1977, an

aerosolization of smallpox virus in the laboratory in London led to the death of the photographer (the last death caused by smallpox), which prompted the design of Secure (BSL3) and Highly Secured (BSL4a and BSL4b) Labs (Ordeanu et al. 2008; Ordeanu at al. 2012).
Currently, military regulations list eight bacterial species (Table 1), three groups of viruses (Table 2) and five toxins (Table 3) that could be used as biological weapons with BWA [STANAG 4632] and for which we must be prepared, at least at the conceptual level, for medical countermeasures, in order to protect the troops and the civilian population in the affected area (Ordeanu et al., 2015).

Table 1. Bacterial warfare agents (STANAG no. 4632)

No.	BWA	Disease	Sickness	Effect
1	*Bacillus anthracis*	Anthrax	Anthropozoonosis	lethal
2	*Yersinia pestis*	Plague	Anthropozoonosis	lethal
3	*Francisella tularensis*	Tularemia	Anthropozoonosis	lethal
4	*Vibrio cholerae*	Cholera	Anthropozoonosis	lethal
5	*Brucella melitensis*	Brucellosis	Anthropozoonosis	-
6	*Burkholderia mallei*	Glanders	Anthropozoonosis	lethal
7	*Burkholderia pseudomallei*	Melioidosis	Anthropozoonosis	lethal
8	*Coxiella burnetti*	Q Fever	Anthropozoonosis	-

Table 2. Viral Biological Warefare Agents (STANAG no. 4632)

No.	BWA	Disease	Sickness	Effect
1	Venezuelean equine encephalitis virus	Venezuelean equine encephalitis	Anthropo zoonosis	lethal
2	Orthopox virus	Smallpox	-	lethal
3	Yelow fever virus	Yelow fever	-	lethal

Table 3. Biological Warfare Agents toxins (STANAG no. 4632)

No.	BWA	Sickness	Effect
1	Ricin	ricinism	Lethal
2	Saxitoxin		Lethal
3	Botulinum toxin	botulism	Lethal
4	Staphylococcal enterotoxin B	-	Lethal
5	T2 mycotoxin	mycotoxicoses	Lethal

It seems that at present the risk of ***biological warfare*** is minimal, because the effect is not immediate, the consecutive epidemic is random because of extremely different factors, and international law categorically prohibits the production, storage and use of biological weapons (BTWC 1972) (Chevrier et al. 2004; Dando, et al., 2000).
But here is another risk, validated by multiple episodes in recent times. ***Terrorism***, both national and international, uses ***bioterrorist attacks*** and ***biocrime***, for different purposes - political, economic, religious etc.. The problem is the great diversity, because it is unlikely for BWA to be obtained from military stocks, but they can use any pathogens they can harvest from nature, from hospitals, laboratories, etc., so the list is open to any living agent (virus, bacteria, fungus or parasite), toxin or bioregulator, even if lethality is reduced. This results in difficulties of diagnosis, treatment, prophylaxis but also panic, capable of leading to disturbances of the economic-social life, which is exactly what the terrorists want (Eremia et al., 2019; Popescu et al. 2016).

3. IMPACT ON PUBLIC HEALTH IN THE BROADER SENSE

Factors that lead, directly or indirectly, to the sickening of people, animals and plants may be common, or even if they are different, the result will be affecting the public health and the economy, thus reducing the standard of living, work capacity and the struggle of the population of the attacked country, a biological crisis with multiple implications.
The purpose of the military biological attack can be tactical (on the military in the field sector where the attack will occur), operative (on troop concentrations and reserves) or strategically (on large cities with political, administrative, economic etc. importance), the latter being able to cause devastating epidemics among the civilian population ("USAMRIID's, 2011).
The purpose of the bioterrorist attack may be motivated by any of the terrorist claims. The attack can be local (tactical or biocrime) or disseminated (as were multiple attacks with letters with anthrax spores from the US and EU) to gain various advantages.

Any one of these attacks can cause an out of control epidemic, to make the military and civilians sick, from both camps, having *in extremis*, a pandemic potential. Also, when it comes to anthropozoonotic agents, the animals in the area, on which the quarantine measures are not very efficient, can be sickened, and the environment remains contaminated for a variable time, depending on the nature of the agent (Gal et al., 2019).

The medical countermeasures m ust be taken by the Ministry of Health, through the human, state and private medical network, the Ministry of National Defense, the Ministry of Internal Affairs, the NGOs (for example the Red Cross National Organization), the local authorities and each individual citizen, as well as by the Romanian Intelligence Service, if there is a suspicion of a terrorist attack. These must be broadcasted, in a correct and quick manner, by the press (not as it is usually done) in order to reach everyone.

4. BIOLOGICAL ATTACK ON ANIMALS

A particular feature is presented by the pathogens specific to certain species of animals, especially mammals. They will not make people sick, but they can cause serious economic losses by killing or incapacitating work animals, by reducing the livestock septum and creating microbial reservoirs in wild animals. The result may be insecurity in regards to food from animal products, stopping exports, bankruptcy of some producers and huge economic losses.

The countermeasures must be taken by the Ministry of Agriculture, by veterinary medicine and animal husbandry for domestic animals, and by the Ministry of the Environment for wild animals.

The deliberate spread of infectious agents for animals, in time of peace or immediately before the start of a war, can be concealed, to produce economic instability. There is also the potential risk that this type of attack will be committed for reasons of unfair economic competition, in order to eliminate another strong competitor from the market. In these situations, exotic agents such as the Ebola virus (which the Aum sect had tried to bring from West Africa to Japan) would not be used, but biological agents that are naturally found in the targeted area and cause either anthropozoonoses, either bacterial or viral diseases specific to domestic and wild animals. (Tables 4, 5)

Table 4. Diseases caused by bacterial agents targeting animals (Ordeanu V. and col., 2012)

No.	Disease	Sick animals
1	Anthrax	Man, cattle, sheep
2	Brucellosis	Man, cattle, sheep, goats,dogs
3	Tularemia	Man, cattle, sheep, rabbits
4	Q Fever	Man, cattle, sheep
5	Glanders	Man, horses
6	Melioidosis	Rodents, mammals, humans

Table 5. Diseases caused by viral agents targeting animals (Ordeanu V. and col., 2012)

No.	Disease	Sick animals
1	Rift Valley Fever	Human, cattle, sheep, goats
2	African swine fever	Swine
3	Foot and mouth disease	Cattle, sheep, pigs
4	Classical/African Swine fever	Swine
5	Vesicular stomatitis	Cattle, horses, pigs
6	Newcastle disease	Birds

A special mention deserves *Salmonella* sp, Gram-negative bacillus enterobacteria, but which is always pathogenic, causing ***salmonellosis***, with different degrees of pathogenicity and virulence, according to the species incriminated, from the most serious (typhoid fever with *Salmonella typhi*, paratyphoid fever with *Salmonella paratyphi* A and B), to medium and light ones, which spread through water (water epidemics). But other animals also contaminate humans: mammals, birds, reptiles, etc. Currently, ***salmonellosis is the most widespread disease transmitted through food***, although in the collective diet special measures are taken for the processing and storage of poultry meat, eggs, dairy products, etc. (Humphrey T. et al., 2005).

It is known that zoonoses can be natural or caused (bioterrorism or biocrime) to reduce livestock and exports through infectious diseases. Veterinary medicine describes the most important 26 bacterial diseases, 14 viral diseases and 30 parasitic zoonoses, most of which can infect the human being (Soulsby et al., 2005).

Some infectious diseases are specific to certain animal species and do not infect humans, but by reducing the livestock this causes significant economic damage and even starvation. Here are some examples of zoonoses specific to

domestic animals that could be used in biological attacks:

Horned: Infectious epididymitis of rams (*Brucella ovis*); Contagious agalactia of sheep and goats (*Mycoplasma agalactiae*); Chlamydial bronchopneumonia of the calves (*Chlamydophila pneumoniae*).

Swine: Pig's Pleuropneumonia- *Actinobacillus pleuropneumoniae*; Classical swine fever - (the virus of classical swine fever); African swine fever (African swine fever virus).

Birds: Infectious coryza of birds (*Haemophilus paragallinarum*); Egg drop syndrome (*Duck Adenovirus A type 1*); Infectious anemia of chickens (*Chichen anemia virus*)

Rabbits: Mucous enteritis of rabbits (*Haemophilus paracuniculus*)

Dogs: Canine parvovirus (*Canine parvovirus type 2, CPV-2*)

Cats: Parvovirus of cats (*Feline parvovirus, FPV)* (Mânzat et al., 2001)

5. BIOLOGICAL ATTACK ON PLANTS

Attacks with phytopathogenic biological agents on a country's agriculture will have serious economic consequences, and in the event of a blockade, it could lead to a decrease in food production and hunger. The quantitative or qualitative impact on the cultivated plants used in food, the technical ones, the forage and the non-cultivated plants would have multiple, direct and indirect, implications on public health.

In modern agriculture the increase of the crops is obtained using plants resistant to different diseases, selected or genetically modified. Diseases that attack plants can be caused by viruses, fungi, bacteria and animals.

In the case of ***viruses***, the transmission of diseases needs a vector to attack the plant (wheat, corn, rice, etc.). Because genetically identical plants are grown on large areas, a disease against them that they cannot resist could compromise all the vegetation. A classic example is the Tobacco Mosaic Virus, the first scientifically described virion.

Bacteria penetrate the epidermis through open spots or wounds caused by blows, and then multiply inside. They can produce toxins or destructive enzymes that affect plants in different ways. There are 160 known species of bacteria capable of generating diseases to over 150 species of plants. An example is the "wet potato rot" *Erwinia carotovora*, a bacterium that especially destroys vegetables stored for long periods: potatoes, carrots, but also affects the growth of plants, such as salad. The biological attack can cause heavy losses, both to crop plants and to stored plants. An example was the natural infection of potatoes in Germany, during World War I, which led to famine and contributed to the defeat of the German Empire.

The plant diseases caused by microorganisms are in great part caused by ***fungi***. They form resistant spores in a dry environment and easily spread by the wind. Upon reaching the spores on plants, under suitable conditions of humidity, they germinate and then penetrate from the outside of the epidermis and then can reproduce in the leaves, stem and root. After one or more weeks the plant is destroyed, new spores are formed which continue to disperse (Ordeanu et al., 2012).

The most important molds are those that affect the basic food of the population in the respective area: in the wheat civilization (Europe, North Africa, North and West Asia) is the "wheat rust" *Puccinia graminis* and in the secondary, the "rye horn" *Claviceps purpureea*, in the civilization of rice is the "rust of rice", in the civilization of corn it is the "corn stains" and in the potato culture it is the "hand of the potato" *Phytophora infestans.*

Many of these molds (filamentous fungi) produce ***mycotoxins***, which have a pathogenic, carcinogenic, teratogenic, abortive or lethal effect. An example was the toxicity given by the "rye horn" in Ireland, which was widespread, which depopulated the country and led to mass emigration to the USA. Also, during World War II, corn remained unused on the field, in Ukraine, it molded. To those who used it, as food appeared the epidemic Aleucia, and at the siege of Leningrad the moldy flour from which the bread was made led to deaths by aflatoxicosis. The mold of the feed, due to negligence, can lead to the death of animals, for example thousands of rabbits (for example at the Cantacuzino Institute, during the severe economies of the 1980s), to mycotoxin contamination of the meat, organs and milk consumed by humans.

Defoliants and herbicides are another means of attack, on agricultural and/or wild crops, including forests, to cause damage to agriculture, forestry or to counter the masking of tactical objectives.
The various insect *plagues* capable of living in/on the plants are also designed as biological weapons, for example the Colorado bug (harmful to potato crops) that arrived in Eastern Europe at the beginning of the Cold War, sent with weather balloons (including in Romania). Currently, the planet is facing invasions of locusts from Africa, for which China has used an "army" of 100,000 ducks. The protection against the biological attack on the plants is managed by the Ministry of Agriculture, through the Agricultural Directions for cultivated plants and food storage, as well as by the Ministry of the Environment for wild plants and forests, with the support of all the competent entities (Ordeanu et al., 2015).

6. PROTECTION AGAINST THE BIOLOGICAL ATTACK

The countermeasures will be integrated at national level through the Country's Supreme Council of Defense (CSAT) and at governmental level through the Commission for disasters: according to the modern concept one health, are also involved the Ministry of Public Health, the Ministry of National Defence, the Ministry of Internal Affairs and other departmental structures, including the secret services.
The protection in this area is complex, interdepartmental, but it is mainly addressed to the sector concerned (people, animals, plants, environment or mixed) with the purpose of defending public health. The measures are phased (BTWC 1972) before the attack: national and international legislation in the field, control, external and internal information, *scientific intelligence*, counter-attacks at the source, organization of defense, including anti-terrorist intervention;
- during the attack: alarm, means of individual and/or collective protection, primary CBRN detection and identification (Chemical, Biological, Radiological and Nuclear), antidotes, combating living and nonliving vectors, as the case may be, including counterterrorism intervention;
- after the attack: specific decontamination, including Disinfection, Disinsection, Deratization (DDD) identification and confirmation, sanitary treatment, specific treatment, case-tracking, integrated epidemiological measures (human, veterinary, phytosanitary and environmental), professional medical, veterinary and phytosanitary intervention for limiting the effects of the attack and normalizing the situation.
The more the measures will be faster and more appropriate to the situation, the more the consequences on the public health and the economy will be reduced. In the planet's Biosphere, the life and health of all are interdependent from the largest living being to the smallest.

The human being as an individual is a cenosis, a superorganism composed of tens of billions of "own" eukaryotic cells and hundreds of billions of other useful living organisms, microorganisms (prokaryotes, eukaryotes, cells) that are in saprophytic relationships with it. But sometimes the relationship is parasitic and infectious diseases occur. In order to obtain the vital energy, the human who is at the top of the "trophic chain" uses foods of animal, vegetable, fungal or microbial origin, and their quality is reflected in the human health: "tell me what you eat, and I will tell you who you are" (Ionescu, 2018; Ionescu, 2006).

CONCLUSIONS

The new ***One health*** medical concept encompasses the reality of human interconnection in the Biosphere, and shows the important role for the public health of animal and plant health, so direct and indirect links with veterinary medicine, agriculture and the environment. Good public health cannot be achieved without the good health of animals and plants, of all living things that constitute the biosphere.
Apart from the natural risks, which as professionals, we know and combat, there is the artificially created risk, with bad intent, in order to cause a damaging impact on the public health, to create economic damages (material and financial) that we must identify, at the conceptual and practical level, to have it counteracted in order to ensure the health of the nation.

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