



BIOLOGICAL WEAPONS AND PANDEMIC VECTORS

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Biological warfare is not an invention of the modern age. It has been practised since ancient times, when the Hittites sent plague-sick people to Egyptian camps to decimate their enemies before the battle. The difference between the epochs is made only by current technology, capable of multiplying, selecting, diversifying and hybridising the vectors of biological warfare. Thus, at present, a bacterium, grown in a laboratory-transformed pantry, can be more lethal than any chemical weapon.

Considering that, in the modern age of public access to information, the line between spontaneous, natural pandemic and biological attack followed by the outbreak of a pandemic is narrowing, the vectors of a natural pandemic can always become, in the eyes of the public, vectors of a biological attack. Conversely, until the discovery of the “zero patient” – in which natural genomic mutations occurred – any biological weapon can be considered a “natural mutation” responsible for triggering a pandemic with devastating effects. Therefore, what are the characteristics of a biological weapon? What are the main categories of biological weapons? What are the main pandemic vectors?

Keywords: pandemics, biological warfare, pandemic vectors, phytoagents, Covid-19.

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Motto: "Influenza viruses have always spread very fast ..., this is a disaster that is about to happen".

*Peter C. Doherty, immunologist,
laureate of Nobel Prize in Medicine*

INTRODUCTION

Biological warfare is not an invention of the modern age. It has been practised since ancient times, when the Hittites sent plague-sick people to Egyptian camps to decimate their enemies before the battle. The difference between the epochs is made only by current technology, capable of multiplying, selecting, diversifying and hybridising the vectors of biological warfare. Thus, at present, a bacterium, grown in a laboratory-transformed pantry, can be more lethal than any chemical weapon. That is why the biological weapon is also called "*the nuclear bomb of the poor*"¹. Considering that, in the modern age of public access to information, the line between spontaneous, natural pandemic and biological attack followed by the outbreak of a pandemic is narrowing, the vectors of a natural pandemic can always become, in the eyes of the public, vectors of a biological attack. Conversely, until the discovery of the "*zero patient*" – in which natural genomic mutations occurred – any biological weapon can be considered a "*natural mutation*" responsible for triggering a pandemic with devastating effects. Therefore, *what are the characteristics of a biological weapon? What are the main categories of biological weapons? What are the main pandemic vectors?*

In the modern age of public access to information, the line between spontaneous, natural pandemic and biological attack followed by the outbreak of a pandemic is narrowing, the vectors of a natural pandemic can always become, in the eyes of the public, vectors of a biological attack.

WHAT ARE MICROORGANISMS?

According to the *Encyclopaedic Dictionary*, microorganisms are "*animal or plant organisms of microscopic size (...) widespread in air, water, soil, having an important role in the circulation of substances*

¹ *The Myth of Biological Weapons as the Poor Man's Atomic Bomb*, in *Bulletin of the Atomic Scientist*, 18 March 2015, https://thebulletin.org/roundtable_entry/the-myth-of-biological-weapons-as-the-poor-mans-atomic-bomb/, retrieved on 21.04.2020.



in nature"², which, depending on their effects on humans, animals and plants, may be:

- saprophytes – beneficial, make up the soil microflora and microfauna and intervene in the homeostasis of the environment in which they develop, some being used in the food, pharmaceutical industry (dough preparation, wine, vinegar etc. making, preparation of yogurts, antibiotics and vitamins etc.) and in genetic engineering;
- pathogenic – cause diseases in plants, animals and humans.

Microorganisms form a very large and heterogenous group of microscopic organisms, with different morphology and biological activity, structured as follows³:

- *Bacteria* – prokaryotic microorganisms in the class of *Bacteria*, with a length of several micrometres, with various morphology (spherical, elongated, spiral, polymorphic). Because they do not have a nuclear membrane and nucleoli, having a nucleoid instead of a nucleus, which limits their ability to survive independently, they live in symbiotic or parasitic relationships with humans, plants and animals. They can be real eubacteria/bacteria, with a fine cell wall, gram-negative or with a thick cell wall, gram-positive and mycoplasmas, without a cell wall (mycoplasmas);
- *Archaea* – single-celled, anucleate microorganisms belonging to the class of *Archaea*. They are found in many habitats, in the soil, oceans (plankton arch), in the human colon or human navel. No pathogenic archaea is known;
- *Microscopic fungi* (moulds and yeasts) – are eukaryotic microorganisms belonging to the class of *Fungi*, one of the three major classes of *Eukaryote*. They have complete nucleus and they can be saprophytes, parasites or symbiotics with plants (mycorrhiza) or with blue-green algae (lichens);

² Marcel D. Popa et al., *Dicționar Enciclopedic*, Editura Enciclopedică, 1993-2009, <https://dexonline.ro/definitie/microorganism>, retrieved on 10.04.2020.

³ Valeria Firă, Maria Năstăsescu, *Zoologia nevertebratelor*, Editura Didactică și Pedagogică, București, 1977.

- *Microalgae or microphytes* – single-celled eukaryotic microorganisms present in freshwater and marine systems, including sediments. They can exist individually, in chains or in groups, and can reach sizes from a few micrometres to a few hundred micrometres. Capable of photosynthesis, they produce about half of atmospheric oxygen. No pathogenic microalgae is known;
- *Protozoa* – the simplest single-celled eukaryotic organisms in the subclass *Protozoa*, make the connection between plants and animals. They live in the aquatic/liquid environment, some can reach visible dimensions, of the order of centimetres. 40 species of protozoa are pathogenic to humans;
- *Viruses* – are acellular entities, exclusively parasitic and pathogenic, on the border between living and non-living. They are made of genetic material (DNA or RNA), invisible to the light microscope, without the ability to self-reproduce outside a parasitic cell;
- *Infectious agents* (viroids, prions) – not considered microorganisms, they are infectious agents of a protein nature, free of any type of nucleic acid.

As we can deduce from the above classification, only bacteria, fungi, protozoa, viruses and subviral infectious agents are pathogenic to humans, plants and animals, the diseases caused by pathogenic microorganisms being called *infectious diseases*.

The pathogenic microbial agent has a number of properties, such as⁴:

- **Pathogenicity:** the ability of a microorganism to produce an infectious disease in a receptive host. The infection generated by the pathogenic microorganisms in animals is called *zoonosis*, when affecting animals, and *anthropozoonosis*, when affecting humans.

Bacteria, fungi, protozoa, viruses and subviral infectious agents are pathogenic to humans, plants and animals, the diseases caused by pathogenic microorganisms being called infectious diseases.

⁴ General Notions on Pathogenicity and Virulence, <https://www.scribd.com/doc/270695407/Notiuni-Generale-de-Patogenitate-Si-Virulenta>, retrieved on 10.04.2020.



- **Virulence:** the minimum amount of microorganism or its product capable of causing the disease or death of the biological testing system.

It represents a quantitative indicator of pathogenicity, dependent on three characteristics of the microbial agent, namely:

1. **Infectiousness** – the ability of the pathogenic microorganism to penetrate, localise and multiply in the host organism, despite the attacks of the immune system, and to produce a primary outbreak of infection;
2. **Invasiveness** or *aggressiveness*, namely the ability of the pathogenic microorganism to overcome, through own means, the epithelial barriers, and to penetrate and multiply in the host tissues;
3. **Toxicity** – the ability of the microbial agent to produce toxins. It is an essential property of the bacterial pathogenic mechanism.

There are three levels of virulence:

- *increased virulence*, specific to microbial strains that produce infections with severe clinical course;
- *diminished virulence*, specific to microbial strains that produce mild forms of disease;
- *attenuated virulence*, specific to the strains used to prepare vaccines.

Of the multitude of pathogenic microorganisms, very few are susceptible to generate pandemics, due to the properties of virulence and pathogenicity and, especially, due to the development of defence mechanisms in host organisms. Usually, pandemics⁵ are produced by microorganisms capable of generating new strains, having increased pathogenicity and virulence. In general, the most susceptible to naturally develop such strains capable of generating pandemics are *RNA*-type viruses, in which the frequency of genetic mutations increases with each multiplication in the nucleus of the host cell.

⁵ Epidemics present on minimum five continents.

However, there is also the possibility of human intervention, in the laboratory, on microbial genomes, in order to amplify these features and to transform microorganisms in biological weapons.

There are also other criteria for classifying pathogens, depending on:

- the target kingdom: phytoagents (acting on the plant kingdom – plants, shrubs and trees) and zoo/anthropoagents (acting on the animal kingdom – humans, animals, birds, insects);
- the effects on the host organism: haemolytic, cytolytic, necrotic etc. agents;
- the route of transmission: digestive, aerial, haematological etc.

BIOLOGICAL WEAPONS

What Are the Characteristics of a Biological Weapon?

According to the definition agreed by the World Health Organisation “*biological weapons are microorganisms like viruses, bacteria, fungi, or other toxins that are produced (in laboratory) and released deliberately to cause disease and death in humans, animals or plants*”⁶. They represent difficult challenges for healthcare services, economy, society, because of the large number of deaths/destinations in the livestock and harvest, they can generate in a short period of time.

Biological weapons represent a category of a larger class of weapons, called *Mass Destruction Weapons*, which also includes chemical, nuclear and radiological weapons.

The microorganisms transformed into biological weapons are **multiplied by biotechnology**, and the **genetic manipulation** induces **characteristics they do not initially possess**, namely:

- high pathogenicity;
- high infectivity;
- high virulence;
- multiple resistance to antibiotics, antivirals or antifungals;
- period of highly contagious asymptomatic incubation;

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⁶ *Biological Weapons*, World Health Organisation, https://www.who.int/health-topics/biological-weapons#tab=tab_1, retrieved on 10.04.2020.



- action on numerous systems and apparatuses in the human body;
- increased lifespan of the microorganism outside the reservoir organism;
- duration of action limited in time (to allow for the subsequent invasion of the respective depopulated territory);
- selective tropism of the biological agent to some population groups etc.

What must be kept in mind is that, in the case of a biological weapon, one can never identify the “zero patient” in whose body the lethal mutation occurred. *The identification of the “zero case” is the indisputable proof that a pandemic disaster broke out naturally.* However, although it is possible, it is not necessary for the “zero patient” to be identified in the event of a natural pandemic, a situation which may give rise to suspicions related to its origin. As a consequence, there is a very narrow boundary between natural pandemics and those produced by biological attacks, a limit shattered only by the identification of the “zero case”.

Unlike other weapons of mass destruction, a biological weapon can be manufactured in small spaces, being easy to transport, impossible to detect, as it is colourless, tasteless, and invisible.

The impact produced by these microorganisms on the human/animal population depends on several factors, as follows:

- the incubation period, in which the body becomes an asymptomatic and contagious reservoir, should be as long as possible;
- the route of transmission, which can be digestive, aerial or haematological;
- the existence or not of antidotes or effective treatments;
- the costs and duration of treatments;
- the death rate in the first 24-72 hours following the outbreak of the disease.

The most dangerous routes of transmission, because of the great number of individuals that can be infected, are the digestive and the aerial ones.

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In equal quantities, biological weapons are far more deadly than chemical ones. For instance, the lethal dose of botulinum toxin is 0.1 micrograms when ingested and 5 micrograms when inhaled. The lethal dose of *VX Lethal Nerve Agent*, the most toxic neuromuscular blocking agent, is 1,000 micrograms when inhaled, being 200 times higher than that of botulinum toxin⁷. Moreover, the proliferation of such types of weapons occurs naturally, as they are living organisms.

Therefore, a high-performance biological weapon can easily trigger a global pandemic, having demographic, social and political effects that are difficult to manage, surpassing, because of the complexity of consequences, any other weapon of mass destruction.

Although the processing, production and storage of biological weapons are prohibited by the *Convention of 10 April 1972*⁸, the reality has shown the continuation of the research and production in the field, even in improvised laboratories, as it was the case of the Japanese cult *Aum Shinrikyo*, led by Shoko Asahara, which had begun the production of anthracic bacillus⁹, for terrorist purposes. In this regard, biological terrorism or “**bioterrorism** represents the threat or use of biological weapons – microorganisms or biological toxins, capable of causing disease or death of humans, animals, insects and plants – in order to meet political/economic objectives”¹⁰.

What Are the Main Categories of Biological Weapons?

1. Biological weapons acting on human health

The Centre for Disease Control and Prevention Atlanta (C.D.C. Atlanta)¹¹ classified biological weapons acting on humans in three categories, depending on pathogenicity, morbidity, mortality

⁷ Eric Croddy, James J. Wirtz, *Weapons of Mass Destruction: Chemical and Biological Weapons*, ABC CLIO, 2005, p. 54.

⁸ *Convention of 10 April 1972 on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction*, <http://legislatie.just.ro/Public/DetaliiDocument/28190>, retrieved on 29.05.2020.

⁹ *Aum Shinrikyo: The Japanese Cult behind the Tokyo Sarin Attack*, BBC News, 06.07.2018, <https://www.bbc.com/news/world-asia-35975069>, retrieved on 29.05.2020.

¹⁰ Alba Iulia Catrinel Popescu, *Jucătorul din umbră*, Editura Militară, București, 2016, p. 229.

¹¹ Centers for Disease Control and Prevention (C.D.C.) Classification of Bioterrorism Microorganisms, Part 3 of 5, Johns Hopkins Bloomberg School of Public Health, 2006, <http://ocw.jhsph.edu/courses/BiologicalAgentsOfWaterAndFoodborneBioterrorism/PDFs/WaterFoodTerror3.pdf>, retrieved on 29.10.2015.



and easiness to procure, produce and disseminate in the environment as follows:

- *class A* (easily disseminated and transmitted from person to person, highly pathogenic, very high mortality, can generate public panic and civic insubordination, having major impact on public healthcare services, economy, social relations, political stability):
 - aerial transmission: *Bacillus anthracis* (anthrax), *Variola major* (smallpox), *Yersinia pestis* (plague), *Francisella tularensis* (tularaemia), *filoviridae* (Ebola and Marburg haemorrhagic fevers), *arenaviridae* (Lassa and Argentinian haemorrhagic fevers);
 - digestive transmission: neurotoxin *Clostridium botulinum* (botulism);
- *class B* (relatively easy to disseminate, moderate morbidity, low mortality, can generate public panic, having major impact on healthcare services and economy, as well as on the other sectors of the society):
 - aerial transmission: *Brucella* sp. (brucellosis), *Coxiella burnetti* (Q fever), *Rickettsia prowazekii* (exanthematous typhus), *alphaviridae* (viral encephalitis), *Burkholderia mallei* (snot), *Ricinus communis* toxin (haemorrhagic diarrhoea), *Clostridium perfringens* epsilon toxin (toxic infections, gaseous gangrene), *Staphylococcus aureus* B enterotoxin (sepsis);
 - digestive transmission: *Salmonella* sp. (salmonellosis), *Vibrio cholerae* (cholera), *Shigella dysenteriae* (dysentery), *Cryptosporidium* (cryptosporidiosis), *Escherichia coli* O157: H7 (entero-haemorrhagic infection), *Noroviridae* (viral gastroenteritis);
- *class C* (easy to procure, produce and disseminate, high morbidity and mortality, having major impact on the population): *Koch bacillus* resistant to anti-tuberculosis therapy (tuberculosis), *Nipah viridae* (viral encephalitis), *hantaviridae* (cardiopulmonary syndrome), *Flaviviridae* (yellow fever),

viruses of haemorrhagic fevers and encephalitis, transmitted by tick bite.

The discharge of certain bacteria, such as those that cause dysentery, typhoid fever and especially botulism, in the drinking water supply system of a metropolis, or the aerial dissemination by airplanes, drones or aerosol devices, of microorganisms such as those that cause influenza, smallpox or anthrax can generate uncontrollable epidemics.

Such an epidemic episode, we were already confronted with, when it was about to be transformed into a source of biological weapons for terrorist networks, occurred in 2014, in the west of Africa. Then, in Guinea, Liberia and Sierra Leone, it was an outbreak of *Ebola* haemorrhagic fever epidemics (included by *C.D.C. Atlanta* among class A biological agents). The main concerns were related to the possibility for Jihadist structures to procure viral strains from the secretions belonging to ill people or to transform infected militants in biological vectors, subsequently sent, using the illegal migration networks, in public transportation means, railway stations and international airports or in large Western urban agglomerations¹². Concerns were heightened by the state of panic and civic insubordination of the disaster-stricken population, as well as of the inability of African governments to manage the situation effectively. Under those circumstances, amid the major risk of multiplication and spread of disease to other West African states, the United States of America decided to send to Liberia more than 2,500 troops from the *101st Airborne Division* as part of *United Assistance* operation to provide aid to the local governments involved in counteracting the epidemic. The US military's mission was to contain outbreaks and counteract local panic, as well as to support the work of medical and paramedical personnel within the *United States Agency for International Development (U.S.A.I.D.)*. During the five-month mission, between 25 October 2014 and 27 February 2015, treatment centres were built, mobile laboratories were established,



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¹² Bruce Dorminey, *Ebola as ISIS Bio-Weapon?*, Forbes, 05.10.2014, <http://www.forbes.com/sites/brucedorminey/2014/10/05/ebola-as-isis-bio-weapon/>, retrieved on 26.09.2015.



and more than 1,500 local health workers participated in specialisation courses held by US military personnel^{13,14}.

Yet the biological weapon is not just for humans. It can also attack the rest of the ecosystem, from plants to animals, birds, fish and insects, in this case, the purpose being mainly an economic one, to destroy food sources.

2. Phytoagents

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The destruction of crops and food reserves was an ancient military tactic, also used in modern times, the Vietnam War (1955-1975) being an example in this regard. The effects of a massive infestation are measured in thousands of hectares of destroyed crops, famine, destruction of the ecosystem by the disappearance of trophic links, destruction of livestock, internal instability, high economic, human and animal costs, especially when such a plague occurs against the background of prolonged droughts or in overpopulated regions, the vulnerability of the country to an unforeseen event or conflict.

Phytoagents can be microorganisms or insects: locusts, Colorado potato beetles, wild bees, Japanese wasps, butterfly species etc.

A classic example of microbial phytoagent is the fungus *Prycularia oryzae cavara*, also called *rice agent*, responsible for the disease named "*rice fever*"¹⁵. Appearing in a field, within few hours, through the spores, it can infest the entire area, resulting in the death of all the plants. For instance, such an attack, of an *agroterrorist* type, focused on the rice crops in Asia or Australia, can result in the death of millions of people because of starving, the explosion of the food prices, and huge global financial imbalances.

¹³ Anthony P. Cardile, Clinton K. Murray, Christopher T. Littell, Neel J. Shah, Matthew N. Fandre, Dennis C. Drinkwater, Brian P. Markelz, Todd J. Vento, *Monitoring Exposure to Ebola and Health of U.S. Military Personnel Deployed in Support of Ebola Control Efforts – Liberia*, 25 October 2014-27 February 2015, *Morbidity and Mortality Weekly Report (MMWR)*, Centers for Disease Control and Prevention, 03.07.2015, <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6425a2.htm>, retrieved on 29.10.2010.

¹⁴ Alba Iulia Catrinel Popescu, *op. cit.*, pp. 229-231.

¹⁵ *Rice-Detailed Study of Diseases*, http://www.ikisan.com/links/ap_riceDetailedStudyofDiseases.shtml, retrieved on 01.01.2016.

Currently, there are more than 200 such phytoagents specialised in one type of plant: cereal, vegetable, fruit, shrub, tree etc.



3. Zooagents

Zooagents have as target organisms both humans and other mammals, birds, insects or fish. They are extremely numerous and diverse. Annually, new species highly resistant to antibiotics, antivirals and antifungals emerge, and their effects on public health and economy are devastating, as they can generate pandemics having huge demographic consequences and direct implications on the vast majority of the national power components, resulting in the vulnerability of the affected states and the area instability. When infesting livestock, fish stocks or birds, the consequences are epizootics which, especially in regions unsuitable for agricultural crops, lead to famine, with all the related social manifestations.

Rinderpest or cattle plague is an epizootic caused by the highly pathogenic *Rinder virus*, which affects both cattle and other ruminant herbivores. As in the case of swine fever/plague, the disease can be transmitted very easily, and can affect an entire herd in a few days.

The economic consequences of a widespread epizootic, even without the characteristics of a biological weapon, are in the order of tens of millions of dollars. For example, **African swine fever** or Montgomery's disease, a highly contagious and severe febrile haemorrhagic viral disease, has caused enormous damage, suffice it to mention:

- the episode in the USA, from 1975, resulting in losses of approximately \$ 65 million;
- the outbreaks in Romania in 2007, which cost Smithfield Company about \$ 12 million;
- the epizootic from 2018-2019, which led to the destruction of some pig breeding plants and the stopping of some national programmes for the revitalisation of the Romanian Bazna and Mangalița pig breeding.

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This is how an epizootic can cause the economic collapse of a region and the cessation of national programmes, especially when it becomes recurrent.



Other classic examples of epizootics are **mad cow disease or bovine spongiform encephalopathy**, which has resulted in loss of life and huge economic losses by mass slaughter of livestock in areas adjacent to a proven case, and the well-known **avian influenza**, which has caused economic losses, including in our country, by mass slaughtering the bird population in large regions of the country.

Avian influenza is the first pandemic/epizootic that has shown that the alarm signals sounded by the World Health Organisation (WHO) are not just meaningless discussions. The mode of transmission of the disease, through migratory birds, which can travel thousands of miles during a journey, is reminiscent of the air transportation system, through which a patient, an active reservoir of microbes, can reach, in a few hours, another continent, it can transmit the disease.

The fact that the United Nations (UN) appointed Dr David Nabarro¹⁶ as *UN Coordinator of Avian and Human Influenza*¹⁷ on 29 September 2005 demonstrated the concern about the risk of a pandemic, the consequences of which would involve, in addition to the potential loss of human lives, economic and ecological consequences, by involving food chains and ecosystems across bird migration routes.

According to former director general of the World Health Organisation, Margaret Chan, “*no country is prepared for the possibility of an avian flu pandemic. There will not be enough reserves, neither of medicines, nor of sanitary material such as masks (...), and the attack rate could reach 20% of the population*”¹⁸. The statement, dated November 2007, is still valid today, when the Covid-19 coronavirus wreaks havoc.

¹⁶ WHO Expert to Work with the UN System on Avian and Human Influenza, World Health Organisation, <https://www.who.int/mediacentre/news/releases/2005/pr45/en/>, retrieved on 01.04.2020.

¹⁷ System that reunites international organisations such as FAO/OIE – monitoring animal health, WHO – epidemiology and human health, UNEP – monitoring world migratory birds, UNICEF – public information campaigns, OCHA/WFP/UNHCR – planning, warning and humanitarian aid, UNDP – ensuring multi-sector government planning.

¹⁸ See https://www.who.int/mediacentre/influenzaAH1N1_presstranscript_20090611.pdf, retrieved on 05.04.2020; Alexandra Sandru, *Pericolul aviar: Crezi că ne vom confrunta cu o pandemie? (sondaj)*, ziare.com, 29.11.2007, <http://www.ziare.com/social/capitala/pericolul-aviar-crezi-ca-ne-vom-confrunta-cu-o-pandemie-sondaj-185674>, retrieved on 05.04.2020.

PANDEMIC VECTORS

What Are the Most Common Pandemic Vectors?

a) Viruses

The human flu. The pandemic episode at the beginning of the last century, known as the *Spanish flu*, resulted in 400 million diseases and 50 million deaths, the most affected being the 20-40 age bracket. The explanation is related to the fact that this age bracket is the one involved in social activities, knowing that the flu virus is transmitted through coughing, sneezing or contact with body fluids up to a distance of 10 meters from the recipient. Practically, in one year, 1918, the number of victims of this pandemic was higher than the loss of life in the world conflagration that had just ended, and the economic costs induced by the pandemic, combined with the post-conflict destruction, contributed to the recession in 1920s. Subsequently, in 1957 and 1968, there were two more pandemic episodes, known as the *Russian flu* and the *Hong Kong flu*. In the face of this reality, the WHO developed the annual preventive vaccination programme against influenza. It should be noted that the influenza virus undergoes mutations from one year to another, therefore the annual immunisation, corresponding to the new viral genotype, is mandatory.

WHO officials have repeatedly pointed out that it is likely that a new influenza pandemic will be triggered by a hybrid avian-human virus, easily transmitted to humans, caused by a nuclear combination in a human organism that has suffered double infection¹⁹. These mutant viruses are extremely dangerous, because they take pathogenic elements from the original viruses, neither humans nor animals have immunity to them, and there are no vaccines prepared for such a situation. In this regard, WHO representatives stated that, “*if the virus undergoes mutations that will provide it with the ability to spread*

These mutant viruses are extremely dangerous, because they take pathogenic elements from the original viruses, neither humans nor animals have immunity to them, and there are no vaccines prepared for such a situation.

¹⁹ OMS atrage atenția asupra riscului unei pandemii de gripă, Rompres, 17.10.2007, http://www.romedic.ro/stiri-medcale/Stiri_generale_0341/OMS_atrage_atentia_asupra_riscului_unei_pandemii_de_gripa_04178.html, retrieved on 08.01.2009; Neeti Mittal, Bikash Medhi, *The Bird Flu: A New Emerging Pandemic Threat and Its Pharmacological Intervention*, in *International Journal of Health Sciences*, 2007, July <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3068632/>, retrieved on 10.04.2020.



from one person to another, it is difficult to find a historical comparison with what will follow". The current pandemic, with the Covid-19 coronavirus, begins to fulfil the "prophecy" of WHO specialists.

Severe Acute Respiratory Syndrome-SARS is relatively recently known by the doctors at the forefront of the fight against major epidemics, more or less naturally occurring. In 2002, in the southern Chinese province of Guandong, a series of rapidly evolving respiratory infections were identified, through pneumonia resistant to any treatment. The reservoir species of this mutant virus has not been known yet. The fact that this epidemic has not reached global proportions is due to doctors from international organisations such as the WHO or *Médecins Sans Frontières* (Doctors Without Borders), who managed to stop this scourge in 2003. About 800 people have died as a result of the SARS epidemic, including doctors who worked to stop the disaster²⁰.

Enterovirus 71 infection. In May 2008, an epidemic broke out in China, mostly affecting children under the age of six. The infection was called "*hand-foot-mouth*" disease due to herpes rashes in the mouth and eczema on the hands and feet. Accompanied by high fever and diarrhoea, this enterovirus is extremely severe due to pathogenicity and infectivity. So far, researchers have not been able to discover the pathogenic mechanism of this virus²¹.

HIV-AIDS infection. Huge volumes have been written about this infection, huge sums have been allocated for the discovery of the virus involved in the onset of this disease, for finding a treatment, for information campaigns, for the safety industry, movies have been made, monuments have been erected, in a word, this infection was the emblem of the last century, a disease that has caused great anxiety in mankind and brought the greatest profits to the medical and sanitary supplies industries. The most affected continent was Africa,

²⁰ Feature: Colleagues and Patients Honor Doctor Killed by SARS (2), <http://www.highbeam.com/doc/1P2-13415220.html>, retrieved on 02.04.2020.

²¹ C. Chi, Q. Sun, S. Wang, Z. Zhang, X. Li, C.J. Cardona, Y. Jin, Z. Xing, Robust Antiviral Responses to Enterovirus 71 Infection in Human Intestinal Epithelial Cells, 16 May 2013, US National Library of Medicine National Institutes of Health, <https://www.ncbi.nlm.nih.gov/pubmed/23685430>, retrieved on 10.03.2020.

the place of many horrors and a space for confrontation of the great global economic interests in the field of oil, strategic ores, diamonds, uranium etc. Although the most powerful charitable organisations are financially involved in combating this scourge and large multinational companies are successfully marketing their latest technical wonders in identifying and assessing the frightening virus infection, the results on the ground are still negative.

During one of the many conferences held annually on acquired human immunodeficiency retrovirus infection, *Médecins Sans Frontières* released a number of realities on the ground, saying: “*A nurse in Malawi keeps 400 patients alive by giving them treatment, but she is only paid three dollars a day*” – a statement by Dr Moses Massaquoi, coordinator of the humanitarian organisation in Malawi²² – and that “*it is devastating to sit and see how people get worse and worse – and how they die sometimes – while waiting for weeks and even months before being treated simply because there are not enough health workers*” and those who exist are “*overworked, underpaid and undervalued*” – said Dr Mit Philips on the situation of doctors and average staff in states with a high prevalence of the disease, quoted by AFP. Indeed, the scourge of the century is far from being limited or controlled. Every day, new cases occur, the disease has exceeded the continental dimensions, becoming the most “*successful*” pandemic that has affected the Western as well as the Asian or African world. The fact that this disease has affected both the rich, the beautiful and the famous, as well as the poor, has shown, once again, that in the face of disease and death, we are all equal and that a microorganism, the fruit of unknown circumstances, ends up taking its toll, regardless of the name of its victim.

In the WHO annual report in 2007²³, it was mentioned that the risk of a global epidemic was higher and higher. In the report it was stated



The most affected continent was Africa, the place of many horrors and a space for confrontation of the great global economic interests in the field of oil, strategic ores, diamonds, uranium etc.

²² *Mind the Deadly Gaps: Health Care Worker Shortages in Southern Africa Causing Fatal Delays in Bringing AIDS Care to Those in Urgent Need*, <https://www.internationalbudget.org/wp-content/uploads/2011/04/newsletter46.pdf>, retrieved on 02.04.2020.

²³ *The World Health Report 2007 – A Safer Future: Global Public Health Security in the 21st Century*, WHO, <https://www.who.int/whr/2007/en/>, retrieved on 02.04.2020.



*WHO report:
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that “*in our world that is highly interconnected, new diseases occur with an unprecedented frequency, often with the possibility to cross the border and spread rapidly*”, the officials mentioning the emergence of **39 infectious diseases since 1967 up to the present moment**, among them HIV-AIDS, SARS, Ebola, enterovirus 71 etc. and of more than 1,100 epidemic episodes in different regions of the world. It was also mentioned that “*considering that approximately 2.1 billion people travel by airlines annually, the risk of a global epidemic is very high*”. Moreover, the WHO officials required for the world’s states to secure sufficient stocks of vaccines and emergency medicines. Unfortunately, their appeal had gone unheeded. In 2020, humanity is as exposed to the risks described by the WHO officials as it was before 2007.

Smallpox killed between 300 and 500 million people in the 20th century alone. In 1967, there were 15 million illnesses and two million deaths. In the same year, the WHO launched an intensive vaccination and public information campaign on the disease, so that 10 years later, smallpox was completely eradicated. Since then, no case has been reported, as smallpox is the only contagious disease whose germs, *orthopoxviridae*, have been completely eliminated from the environment. It is very contagious, being transmitted through direct contact or through contaminated objects. After a relatively long period of asymptomatic incubation, of 12-14 days, it triggers high fever, headache, violent lumbar pain and pustular rash. The vaccination and isolation of patients quickly stop the disease. As the smallpox vaccine contains attenuated germs, early vaccination is not justified, as the disease may occur if the body is weakened. Mortality varies between 20% and 50% of cases. Smallpox was the biological instrument of the genocide in 1763, when English colonists liquidated the Native American tribes in Ottawa. Smallpox-infected blankets were given as gifts to Native Americans. In two weeks, thousands of natives died²⁴.

Haemorrhagic fevers (Lassa, Ebola) are, probably, the great fear of the institutions having responsibilities in ensuring national security.

²⁴ Patrick J. Kiger, *Did Colonists Give Infected Blankets to Native Americans as Biological Warfare?*, History, 25.11.2019, <https://www.history.com/news/colonists-native-americans-smallpox-blankets>, retrieved on 03.04.2020.

The first official cases of Ebola were recorded in the region of the same name, from the current R.D. Congo, in the years 1970-1980, when numerous corpses of primates and humans were discovered, with blood dripping from dozens and dozens of wounds. The reservoir organisms have not yet been discovered with certainty, although some incriminate frugivorous bats. No effective treatment is known and no active prophylactic measures can be established. It is now known for sure that the Ebola virus is transmitted through contact with human feces and fluids from infected people. Fortunately, however, both Ebola and Lassa could not be very effective biological weapons in the hands of terrorists, as the sick die so quickly that they no longer have time to transmit the disease²⁵. The characteristic of these diseases is high fever, intense muscle pain and microhaemorrhages that affect the capillaries throughout the body, which is why Ebola fever has been called "*the disease of a million cuts*". Mortality easily reaches 90% of cases in the first two weeks.

Nipah virus is a recent discovery by microbiologists. In 1999, an epidemic encephalitis broke out in the Nipah region of Malaysia, killing 105 people without anyone being able to determine the cause of the disease. Virologists were able to isolate the Nipah virus, but were unable to establish the reservoir. It appears to be a zoonosis that affects humans and pigs, is transmitted through direct contact with infected fluids of humans and animals, has an incubation period of 4-18 days and, after an influenza-like prodrome, causes inflammation of the brain, followed by coma and death. There is no treatment²⁶. It is included in the category of biological weapons type B.

Chimera viruses are the result of military laboratories looking for the perfect weapon. They are named after the mythical character having the same name, Chimera, the three-headed monster with a snake head, a lion head and a goat head. Like Chimera, these viruses

Ebola and Lassa could not be very effective biological weapons in the hands of terrorists, as the sick die so quickly that they no longer have time to transmit the disease.

²⁵ L. Borio, T. Inglesby, C.J. Peters et al, *Hemorrhagic Fever Viruses as Biological Weapons: Medical and Public Health Management*, 8 May 2002, <https://www.ncbi.nlm.nih.gov/pubmed/11988060>, retrieved on 02.04.2020.

²⁶ *Nipah virus infection*, WHO, <https://www.who.int/csr/disease/nipah/en/>, retrieved on 02.04.2020.



are obtained by combining genetic material belonging to the most aggressive viruses currently available. In the 1990s, Dr Ken Alibek, a researcher in the Soviet Chimera programme, defected to the United States of America and declared before the Congress that the USSR had developed a virus that combined the pathogenicity of two of the deadliest microorganisms: Ebola and smallpox²⁷. Subsequently, Alibek published some of his knowledge in the field in the book *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons Program in the World – Told from Inside by the Man Who Ran It*²⁸.

It is known that some armies have stocks of smallpox virus combined with the Venezuelan encephalitis virus and there is intense discussion, for the time being, at the level of conspiracy theory, about the artificial, laboratory character of HIV, as well as about the possibility of a hybrid **HIV and influenza virus, airborne transmitted**. Of course, the first question that arises in such a case is related to the consequences of the release, even accidentally, of such a weapon. What would humanity become, how could even those who finance and plan such monstrosities survive without protective equipment? We have a first answer right now, when Covid-19 wreaks havoc on the elderly population and has paralysed the world economy.

b) Bacteria

The plague, the disease that has frightened mankind for thousands of years, is caused by a bacterium, *Yersinia pestis*, and can manifest itself in two clinical forms: *bubonic plague* and *lung plague*. The route of transmission of the disease is through contact with infected body fluids and through the bites of hematophagous insects, such as fleas and lice. In the absence of treatment, in the first 24 hours after infection, mortality is 70%-90%, which makes this microbe a significant bacteriological weapon. Plague, exanthematous typhus

²⁷ See <http://www.house.gov/jec/hearings/intell/alibek.htm>, retrieved on 02.04.2009.

²⁸ Ken Alibek, *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons Program in the World – Told from Inside by the Man Who Ran It*, Delta; Reprint edition, 11 April 2000.

and more recently infectious panconitis with *Bartonella rochalimae*²⁹ are diseases transmitted by insects that parasitise rats, rodents whose number, in some urban areas of Asian countries, Africa and beyond, exceeds the number of people. The mark of the disease is an infected axillary ganglion. If the ganglion abscess drains, the patient escapes, otherwise, in the absence of adequate antibiotic treatment, he dies of sepsis.

Anthrax is a condition caused by a bacterium, *Bacillus anthracis*, which can resist in dust, in the form of spores, for up to 40 years, which is extremely important in evaluating the long-term effectiveness of such a weapon. The route of transmission is air, skin and digestive, the lung form of the disease being 100% deadly. The mark of the disease is the so-called “*black spot*”, which occurs in the skin at the site of anthrax inoculation, where an area of necrosis is created, responsible for the dark colour of the skin. Death occurs by sepsis within a few hours of inoculation, its pathogenicity being so high that, even in the case of rapid treatment, mortality is 75%.

Military research on this microbe dates back to the 1980s, when both the Soviet and American armed forces accumulated stockpiles of anthrax-core missiles. In the context of the 2001 terrorist attacks, the Federal Bureau of Investigation (FBI) released information on a possible link between the 2001 anthrax attacks and people having connections with a US military centre³⁰.

Tularemia. The bacterium *Francisella tularensis* is one of the most infectious, being transmitted by air, digestive, blood, or by contact with contaminated animal fluids. Known as the *rabbit disease*, tularemia caused numerous casualties during the Second World War, when the German and Soviet armed forces mutually accused that they had used infected rabbits as biological weapons. The incubation



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²⁹ Scientists Discover 21st Century Black Plague that Spreads from Rats to Humans, Daily Mail, 24.11.2008, <https://www.dailymail.co.uk/health/article-1088887/Scientists-discover-21st-century-black-plague-spreads-rats-humans.html>, retrieved on 02.04.2020.

³⁰ A Study of the 2001 Anthrax Terror Attacks and the History of Biological Warfare, 01.04.2015, https://www.fasebj.org/doi/abs/10.1096/fasebj.29.1_supplement.735.3, retrieved on 02.04.2020.



period is 3-5 days, when the infected individual becomes a reservoir, which makes the disease more dangerous. This bacterium is included in the category of biological weapons. In the 1950s, the USA, the USSR, the UK and Canada developed production units, and in the 1990s, the Swedish researchers isolated an extremely dangerous strain, resistant to antibiotics³¹. As it is sensible to solar radiation, the experts in countering bioterrorism say that a terrorist attack using Francisella could be effective only in dark and crowded areas, such as subway stations or underground walkways³².

Untreated, botulism causes paralysis of striated muscles, including respiratory muscles, followed by death within 24-72 hours. The fact that this bacterium is transmitted by air, skin (if there is a deep wound) and food makes it maximum dangerous.

Botulism is a very serious paralytic disease caused by the neurotoxin of the bacterium *Clostridium botulinum*. The bacterium is common and widespread in nature, being present in a latent state, of spores, in soil and ocean sediments. If it reaches anaerobic environments, such as canned food, deep wounds or intestinal tract, spores germinate into active bacteria, which multiply and produce toxin. *Clostridium botulinum* produces eight types of toxins (from A to H), considered to be among the most potent toxins known at this time. For example, a highly diluted botulinum toxin A formula is used clinically as Botox and a highly diluted botulinum toxin B formula is used clinically as Myobloc³³. Untreated, botulism causes paralysis of striated muscles, including respiratory muscles, followed by death within 24-72 hours. The fact that this bacterium is transmitted by air, skin (if there is a deep wound) and food makes it maximum dangerous. Botulinum toxins are among the most effective biological weapons, because:

- they are extremely powerful and lethal, being necessary infinitesimal quantities to kill a 70 kg adult (inhalation of 0.7-0.9 µg aerosolised botulinum toxin);

³¹ Kristy Young Johnson, Paul Matthew Nolan, *Biological Weapons: Recognizing, Understanding, and Responding to the Threat*, Hoboken, NJ: Wiley, 2016, p. 98, https://books.google.ro/books?id=O4ebCgAAQBAJ&pg=PA98&lpg=PA98&dq=tularemia+Russia+2005+biological+weapon&source=bl&ots=d90NA_Zxoc&sig=ACfU3U3M16f5YjFVnmHFhqwNfJv_hUhjQ&hl=ro&sa=X&ved=2ahUKEwiEgpqMndfoAhULhcAKHdFqBO04ChDoATAAegQICxAq#v=onepage&q=tularemia%20Russia%202005%20biological%20weapon&f=false, retrieved on 02.04.2020.

³² Kristy Young Johnson, Paul Matthew Nolan, *op.cit.*, p. 98.

³³ *Botulinum Toxin (Botulism)*, UPMC Center for Health Security, 2014, 26.02.2014, <http://www.centerforhealthsecurity.org/our-work/publications/botulinum-toxin-botulism-fact-sheet>, retrieved on 02.04.2020.

- some of them are relatively easy to produce and transport;
- ill people need intensive care, which cause the paralysis of the healthcare system³⁴.

Cholera is an extremely serious and contagious condition caused by *Vibrio Cholerae*. It is a severe acute diarrheal disease, accompanied by heavy vomiting, which causes exsiccosis – rapid dehydration of the patient through massive loss of electrolytes. Mortality exceeds 85% of cases at the outbreak of the epidemic. The pathway of vibrio transmission is digestive, feces-oral. Under natural conditions, it is an epidemic specific to poverty and underdevelopment, being transmitted either through drinking water infected with feces as a result of poor sanitation, or through the consumption of infected fish and/or water from infected running or stagnant water. At the beginning of the last century, the great Romanian scientist, Dr Ion Cantacuzino (1863 - 1934) isolated the vibrio and produced the first cholera vaccine, which was administered to Romanian troops on the front during the Second Balkan War (16 June 1913 – 18 July 1913), saving them from extinction and radically changing the fate of the war³⁵. Transformed into a weapon, the cholera vibrio increases its contagiousness, virulence and pathogenicity, being included among the biological weapons of category B.

Global foodborne infections. Since 2006, the author of *The Omnivore's Dilemma: A Natural History of Four Meals*³⁶, American journalist Michael Pollan³⁷ has drawn public attention to the risk of *Salmonella* and *Coli bacillus* pandemics, following the consumption of food traded, at global level, by the large corporations in the food industry. These corporations have come to monopolise the entire manufacturing chain, from production to sale. In this regard, Pollan mentions that, in 2007, the USA was confronted with severe digestive



³⁴ *Botulinum Toxin (Botulism)*, op. cit.

³⁵ Raluca Băjenaru, Prof. Dr. Ioan Cantacuzino, fondatorul școlii române de microbiologie, 08.02.2012, <https://medicaacademica.ro/prof-dr-ioan-cantacuzino-fondatorul-scolii-romane-de-microbiologie/>, retrieved on 01.04.2020.

³⁶ Michael Pollan, *The Omnivore's Dilemma: A Natural History of Four Meals*, Penguin Books; First edition, 11 April 2006.

³⁷ Alex Koppelman, *What's Wrong with Our Food?*, Salon, 07.12.2006, http://www.salon.com/news/feature/2006/12/07/pollan_bad_food/, retrieved on 10.03.2020.



Medical branches such as major surgery, oncological chemotherapy, organ transplantation, therapies for degenerative diseases have begun to face increasing bacterial resistance to antibiotics, a consequence of drug abuse.

infections caused by the consumption of spinach cans infected with Salmonella, 2008 was the year of the tomatoes infested with the same entero-bacillus, stating that "*80% of the beef in the USA comes from the farms owned by four companies, other two process lettuce leaves, and 30% of the milk is processed by a single company*". This way, a pathogen insinuated in the line of production of the *fast food*, semi-prepared or canned food can reach, without any difficulty, to any region of the globe. Subsequently, cases of severe botulism toxin infections triggered by the consumption of insufficiently cooked chili cans (the case of Castleberry's Food Company in 2007) or epidemic alerts on certain foods (cucumbers contaminated with E-coli bacteria in 2011) confirm the American journalist's fears.

The global pandemic of antibiotic resistance is another topic of concern to public health professionals. Medical branches such as major surgery, oncological chemotherapy, organ transplantation, therapies for degenerative diseases have begun to face increasing bacterial resistance to antibiotics, a consequence of drug abuse. Under these conditions, the rate of antibiotics obsolescence has far exceeded the discovery rate of new and effective ones. It is notorious for the worldwide resurgence of multidrug-resistant tuberculosis and the emergence of methicillin-resistant staphylococci (synthetic penicillin, the antibiotic of choice in systemic staphylococcal infections) in the 1990s as a result of antibiotic abuse. Generally, if an infection is detected before germs enter the bloodstream, it is easily resolvable medicinally through targeted antibiotic therapy. But, if bacteraemia/sepsis has occurred, the only antibiotics that can destroy the germs are the reserve ones, so called, as they are the last option to treat the infection. The problem is extremely serious, because the appearance of bacterial strains with multiple resistance is faster than the rate of discovery of new antibiotics, being a matter of time until staphylococci or other lethal bacteria appear through the acquired resistance to any type of antibiotic³⁸.

³⁸ *Antimicrobial Resistance*, 15.02.2018, WHO, <https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance>, retrieved on 03.04.2020.

c) Protozoa

Malaria

Malaria is, without a doubt, one of the great killers of mankind. In 2018, malaria affected 228 million people, of whom over 405,000 died³⁹. It is endemic to tropical and subtropical regions of Africa, Asia, Central and South America, where the humid and warm environment, to which are added the puddles, swamps and sewer systems clogged in large urban areas, create ideal conditions for the development of anopheles mosquitoes. The cause of this blood parasitosis is a protozoan, *Plasmodium malariae*, with its four subtypes, of which the most common are *Plasmodium vivax* and *Plasmodium falciparum*. In some regions of sub-Saharan Africa, the prevalence of the disease exceeds 90% of the population. In addition to the loss of life, malaria also has major economic impact because:

- the incapacity to work because of recurrent fever episodes;
- the cost of treatment and hospitalisation;
- the frequency of genetic anomalies such as sickle cell anaemia or thalassemia, generated by the plasmodium infection;
- the decrease in tourist and associated economic activities etc.

It is considered that the economic impact of malaria on Africa exceeds \$ 12 billion annually⁴⁰, and in high-prevalence countries it can cost over 40% of healthcare spending. Mention should be made that, in Africa, HIV infection, tuberculosis and digestive infections are endemic, these debilitating diseases favouring the recurrence of malaria attacks. Practically, in the future, against the background of the worsening economic crisis and the deterioration of the living conditions in the above-mentioned regions, we can expect an increase in the number of victims of this scourge and an additional economic burden on the affected states.

³⁹ World Malaria Report 2019, World Health Organisation, 4 December 2019, <https://www.who.int/publications-detail/world-malaria-report-2019>, retrieved on 01.04.2020.

⁴⁰ B.M. Greenwood, K. Bojang, C.J. Whitty, G.A. Targett, *Malaria*, Lancet 365: 1487-1498, 2005, doi:10.1016/S0140-6736(05)66420-3. PMID 15850634, <https://www.ncbi.nlm.nih.gov/pubmed/15850634>, retrieved on 02.04.2020.



Insects are exemplary soldiers that can reach unnoticed the enemy lines and easily transmit lethal maladies.

Insects used as vectors for the disease transmission. In 2008, American entomologist Jeffrey A. Lockwood published a book called *Six-Legged Soldiers: Using Insects as Weapons of War*⁴¹, stating, as the title suggests, that insects are exemplary soldiers that can reach unnoticed the enemy lines and easily transmit lethal maladies. Such an example of lethal malaria transmitted by insects is *Rift Valley Fever*, named after the valley having the same name in Kenya. There, in the east of Africa, in 1931, an unusual epidemic broke out, killing people as well as animals. Subsequently, microbiologists identified the pathogenic agent as a virus transmitted through the direct contact with infected organic fluids or through mosquito bites. This zoonosis can have different forms of manifestation, meningo-encephalitic, haemorrhagic or ocular and, untreated, results in the death of the infected person. Another example is represented by the *Yellow (liver) Fever* and *Dengue Fever* viruses, transmitted through the bite of Aedes mosquito. In this context, Professor Lockwood argued that terrorist groups can easily launch a bioterrorist attack using infected insects transported in suitcases that can be introduced, without problems, by terrorists in the territory of the target states, declaring that “*it would be much easier for terrorists to use insects than to develop a nuclear or chemical weapon, as the raw material is in the backyard*”⁴². Lockwood’s statements are as serious and logical as possible. It is enough to imagine what would happen if infected Aedes mosquitos were released in a region where the population was not immunised? There would be a huge wave of illness and death, knowing that there is no cure for any of these diseases. Just as the reintroduction of anopheles mosquitos in a region such as the Danube Delta, where such insects existed in the past, would create a very serious epidemiological situation.

Last but not least, we should mention ticks, the vectors of Lyme disease. The topic of the military instrumentalisation of ticks resurfaced

⁴¹ Jeffrey A. Lockwood, *Six-Legged Soldiers: Using Insects as Weapons of War*, Oxford University Press, USA, 10 October 2008.

⁴² Stephen Adams, *Terrorists Could Use Insect Based Biological Weapon*, *The Telegraph*, 05.01.2009, <https://www.telegraph.co.uk/news/earth/wildlife/4123782/Terrorists-could-use-insect-based-biological-weapon.html>, retrieved on 02.04.2020.

in the US mass media in 2019, when the US Congress, following an amendment proposed by a New Jersey Republican Congressman, Chris Smith, required an investigation to establish if it was a link between Lyme disease and an alleged Pentagon military experiment. Smith argued the amendment saying that he was inspired by “*a series of books and articles suggesting that important research has been conducted in important US Government facilities, included Fort Detrick, Maryland and Plum Island, New York, to transform ticks and... insects into biological weapons*”⁴³. One of the books Smith referred to was *Bitten: The Secret History of Lyme Disease and Biological Weapons*⁴⁴, written by Kris Newby, researcher at Stanford University, he himself suffering from Lyme. In the mentioned book, it is stated that American entomologist Willy Burgdorfer (1925-2014), who discovered the disease etiologic agent, *Borrelia burgdorferi* spirochete, would have said that the Lyme epidemics, which affected the US population in the 1960s, could have been a failed military experiment. Moreover, Newby says, Willy Burgdorfer, former researcher in military biotechnologies for the US armed forces, would have stated that he had the mission to grow fleas, ticks, mosquitoes and other blood-sucking insects that he infected with human pathogens. The mentioned military programme had its roots in Nazi Germany, when Dr Erich Traub (1906-1985), who was allegedly involved in military research related to *foot-and-mouth disease*, *Rinderpest*, *pseudorabies*, *intestinal virus enterovirus 71* and *Borrelia*⁴⁵. Traub was supposed to be the chief of *Insel Riems*, a secret Nazi laboratory in the Baltic region, where he had the mission to produce biological weapons meant to destroy the USSR livestock⁴⁶. Arriving in the United States of America after the war, Traub worked as a researcher in the laboratory in Fort Detrick, Frederick, Maryland.

⁴³ Julian Borger, *House Orders Pentagon to Review If It Exposed Americans to Weaponised Ticks*, *The Guardian*, 16.07.2019, <https://www.theguardian.com/us-news/2019/jul/16/pentagon-review-weaponised-ticks-lyme-disease>, retrieved on 03.04.2020.

⁴⁴ Kris Newby, *Bitten: The Secret History of Lyme Disease and Biological Weapons*, Harper Wave; 1st edition, 14 May 2019.

⁴⁵ Karl Grossman, *Lyme Disease and Biowarfare*, Counter Punch, 14.08.2019, <https://www.counterpunch.org/2019/08/14/lyme-disease-and-biowarfare/>, retrieved on 03.04.2020.

⁴⁶ *Ibidem*.



Lyme disease, caused by the bite of a tick infected with *Borrelia burgdorferi*, is known for mobile erythema, accompanied by fever, facial paralysis, arthritis, intermittent pain in tendons, muscles, joints and bones, inflammation of the brain and spinal cord, severe headache and neck stiffness, which eventually leads to death.

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INSTEAD OF CONCLUSIONS

Unfortunately, the pandemic and bioterrorist dangers have been constantly placed second in the concerns of policymakers, as evidenced by the way in which the world's states managed the situation in the first months after the outbreak of the current coronavirus pandemics. However, the devastating, multisectoral effects of this pandemics at the state level have demonstrated, once more, that the microbial agent may be the “*David*” that can bring down the “*Goliath*”.

In the case of the natural mutation of the pathogen, pandemic effects can be cataclysmic, because genomic “*novelty*” brings about unusual pathogenicity and virulence, treatments that no longer work, panic, overloading the medical system, shutting down the economy, producing many human or animal victims.

In the case of a biological weapon, as the producer must also have an antidote, in order not to destroy his own army/people, the situation is easier to manage, the strains having a limited “*shelf life*” to allow the invasion of the biologically attacked territory.

In both cases, the knowledge of the pathogens, the understanding of their mode of action and, especially, proper preparation and organisation of the means of counteracting and containing the epidemic outbreaks can save lives, jobs, individual freedoms, crops, livestock etc.

BIBLIOGRAPHY:

1. ***, *A Study of The 2001 Anthrax Terror Attacks and the History of Biological Warfare*, 01.04.2015, https://www.fasebj.org/doi/abs/10.1096/fasebj.29.1_supplement.735.3
2. ***, *Antimicrobial Resistance*, 15.02.2018, WHO, <https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance>

3. ***, *Biological Weapons*, World Health Organisation, https://www.who.int/health-topics/biological-weapons#tab=tab_1
4. ***, *Botulinum Toxin (Botulism)*, UPMC Center for Health Security, 2014, 26.02.2014, <http://www.centerforhealthsecurity.org/our-work/publications/botulinum-toxin-botulism-fact-sheet>
5. ***, *Emerging Pandemic Threat And Its Pharmacological Intervention*, *International Journal of Health Sciences*, 2007, July, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3068632/>
6. ***, *Feature: Colleagues and Patients Honor Doctor Killed by SARS (2)*, <http://www.highbeam.com/doc/1P2-13415220.html>
7. ***, *Mind the Deadly Gaps: Health Care Worker Shortages in Southern Africa Causing Fatal Delays in Bringing AIDS Care to Those in Urgent Need*, <https://www.internationalbudget.org/wp-content/uploads/2011/04/newsletter46.pdf>
8. ***, *OMS atrage atenția asupra riscului unei pandemii de gripă*, Rompres, 17.10.2007, http://www.romedic.ro/stiri-medicale/Stiri_generale_0341/OMS_atrage_atentia_asupra_riscului_unei_pandemii_de_gripa_04178.html
9. ***, *Nipah Virus Infection*, WHO, <https://www.who.int/csr/disease/nipah/en/>
10. ***, *Rice-Detailed Study of Diseases*, http://www.ikisan.com/links/ap_riceDetailedStudyofDiseases.shtml
11. ***, *World Malaria Report 2019*, World Health Organisation, 4 December 2019, <https://www.who.int/publications-detail/world-malaria-report-2019>
12. Stephen Adams, *Terrorists Could Use Insect Based Biological Weapon*, *The Telegraph*, 05.01.2009, <https://www.telegraph.co.uk/news/earth/wildlife/4123782/Terrorists-could-use-insect-based-biological-weapon.html>
13. Ken Alibek, *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons Program in the World-Told from Inside by the Man Who Ran It*, Delta; Reprint edition, 11 April 2000.
14. Raluca Băjenaru, *Prof. Dr. Ioan Cantacuzino, fondatorul școlii române de microbiologie*, 08.02.2012, <https://medicaacademica.ro/prof-dr-ioan-cantacuzino-fondatorul-scolii-romane-de-microbiologie/>
15. Julian Borger, *House Orders Pentagon to Review If It Exposed Americans to Weaponised Ticks*, *The Guardian*, 16.07.2019, <https://www.theguardian.com/us-news/2019/jul/16/pentagon-review-weaponised-ticks-lyme-disease>



16. L. Borio, T. Inglesby, C.J. Peters et al, *Haemorrhagic Fever Viruses as Biological Weapons: Medical and Public Health Management*, 8 May 2002, <https://www.ncbi.nlm.nih.gov/pubmed/11988060>
17. Anthony P. Cardile, Clinton K. Murray, Christopher T. Littell, Neel J. Shah, Matthew N. Fandre, Dennis C. Drinkwater, Brian P. Markelz, Todd J. Vento, *Monitoring Exposure to Ebola and Health of U.S. Military Personnel Deployed in Support of Ebola Control Efforts – Liberia*, 25 October 2014-27 February 2015, Morbidity and Mortality Weekly Report (MMWR), Centers for Disease Control and Prevention, 03.07.2015, <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6425a2.html>
18. C. Chi, Q. Sun, S. Wang, Z. Zhang, X. Li, C.J. Cardona, Y. Jin, Z. Xing, *Robust Antiviral Responses to Enterovirus 71 Infection in Human Intestinal Epithelial Cells*, 16 May 2013, US National Library of Medicine National Institutes of Health, <https://www.ncbi.nlm.nih.gov/pubmed/23685430>
19. Eric Croddy, James J. Wirtz, *Weapons of Mass Destruction: Chemical and Biological Weapons*, ABC CLIO, 2005.
20. Bruce Dorminey, *Ebola As ISIS Bio-Weapon?*, *Forbes*, 05.10.2014, <http://www.forbes.com/sites/brucedorminey/2014/10/05/ebola-as-isis-bio-weapon/>
21. Karl Grossman, *Lyme Disease and Biowarfare*, *Counter Punch*, 14.08.2019, <https://www.counterpunch.org/2019/08/14/lyme-disease-and-biowarfare/>
22. Kristy Young Johnson, Paul Matthew Nolan, *Biological Weapons: Recognizing, Understanding, and Responding to the Threat*, Hoboken, NJ: Wiley, 2016, https://books.google.ro/books?id=O4ebCgAAQBAJ&pg=PA98&lpg=PA98&dq=tularemia+Russia+2005+biological+weapon&source=bl&ots=d90NA_Zxoc&sig=ACfU3U3M16f5YjFVnmHFhqwaNfJv_hUHjQ&hl=ro&sa=X&ved=2ahUKEwiEgpqMndfoAhULHcAKHdFqBO04ChDoATAAegQICxAq#v=onepage&q=tularemia%20Russia%202005%20biological%20weapon&f=false
23. Patrick J. Kiger, *Did Colonists Give Infected Blankets to Native Americans as Biological Warfare?*, *History*, 25.11.2019, <https://www.history.com/news/colonists-native-americans-smallpox-blankets>
24. Alex Koppelman, *What's Wrong with Our Food?*, *Salon*, 07.12.2006, http://www.salon.com/news/feature/2006/12/07/pollan_bad_food/
25. Jeffrey A. Lockwood, *Six-Legged Soldiers: Using Insects as Weapons of War*, Oxford University Press, USA, 10 October 2008.

26. Kris Newby, *Bitten: The Secret History of Lyme Disease and Biological Weapons*, Harper Wave; 1st edition, 14 May 2019.
27. Michael Pollan, *The Omnivore's Dilemma: A Natural History of Four Meals*, Penguin Books; 1st edition, 11 April 2006.
28. Alba Iulia Catrinel Popescu, *Jucătorul din umbră*, Editura Militară, București, 2016.
29. Alexandra Șandru, *Pericolul aviar: Crezi ca ne vom confrunta cu o pandemie? (poll)*, ziare.com, 29.11.2007, <http://www.ziare.com/social/capitala/pericolul-aviar-crezi-ca-ne-vom-confrunta-cu-o-pandemie-sondaj-185674>.