THE THREAT OF BIOLOGICAL AGENTS TO EXISTENT SOCIETY

Daniel MARSALEK, Radomir SCUREK
daniel.marsalek@prg.aero, radomir.scurek@vsb.cz

Delivered 2011-03-03, rewritten 2011-05-31, revised 2011-07-11, accepted 2011-07-12.
Available at <http://www.population-protection.eu>.
attachments/038_vol3n1_marsalek_scurek_eng.pdf.

Abstract

The paper describes the issue of biological agents existence and their possible abuse in civilian aviation. Due to the availability and feasible modification of B-agents, their noteless use and the follow-up induction of desease at infected individuals they are one of the most significant group of substances The second part contains a model situation of the virus Variola (smallpox) expansion in the terminal of a medium-sized international airport. Depending on the detailed properties of the virus, transport hub and expansion (the attack) there are two versions – summer and winter schedules which provide an expected progress of the virus expansion along with the following arrangements.

Key words

Airport, B-agens, bioterrorism, pandemic, security analysis, small-pox, transport hub, Variola virus.

Since the early age the human beings have made the weapons. At first they were for their protection and as a means of hunting and capturing prey. Gradually they needed to control the territory, groups of people or push through their interests and the faith. For this purpose they did not use only classical “hand” weapons, but they tried to develop more and more sophisticated devices in order to achieve their goals. Often there were devices primarily used and developed for other purposes than for purposes for which human beings used them at the end.

A specific fearful group is represented by biological agents (B-agens), or from them developed biological weapons which represent a serious hazard with regard to the threat to people and a modern society. These agents have been used, in considerably limited scale though, since the ancient times. The example can be the use of poisons and weapons on the base of B-agens applied on arrows or the use of weapons bearing biological agents in order to weaken the adversary during wars. However, in the past the mankind did not have the knowledge and information in the field of the effects and the extraction of these agents so their application often used to bring human losses also on the side of an attacker. Therefore nowadays it is supposed that they would be misused by attackers (bio-terrorists) rather than used by the army. The abuse of B-agens represents a serious security risk in the form of a threat or application to critical infrastructure and civilians. Critical infrastructure means both productive and non-productive systems whose inoperability would have serious impacts on security, economy and preservation of the necessary extent of other basic functions of a state in crisis situations.

The risk of these agents is determined first of all by the level of their dangerousness expressed by a constantly expanding range of subjects who have the access to them or try to obtain them. Further these substances represent high danger consisting in the possibility to capture a small number of agents by separatives or non-governmental groups. Last but not least they breed an extraordinary threat represented by terrorism in a number or world regions or a real threat of the use of destructive agents for blackmailing.

With the growing rate of infectivity, toxicity, resp. lethality of an infection, also the risk of abusing of an existing B-agens as a biological weapon has been growing. Each weapon is considered to be a biological weapon if its attacking filling is formed by so called warfare B-agens, in other words the causers of infectious diseases may contain also articulates as vectors. The term B-agens therefore mean all living organisms and their products (toxins). Biological weapons may be formed by six basic groups of B-agens. We talk about bacteria, viruses, reckettsie, mould (fungus), toxins and geneticly modified organisms. In order to create affective ways of protection and to minimize a mentioned risk, we have to know against what “we fight”. Therefore it is important to know by what the single B-agens is characterized and in which way it represents a serious danger and first of all how to protect against it. It is also contributive to carry out a safety analysis aimed at the rate of "abusability" of these B-agens in relation to our protected interest, e.g. a company, a critical infrastructure entity etc.

It is possible to say that the way of treatment for the most well-known, in the world occurring biological agens have been already discovered. The exceptions are for example HIV and Ebola. It is possible to strengthen our immunite system to such a degree that it will become highly resistant to viruses and bacteria. It seems that a human being is able to live with a “sort of” feeling of safety, that the majority of dangerous infections is something far behind. Nevertheless this feeling is somehow wrong. The situation in recent years has proved how all this “stability” is fragile. It is enough to spread such a biological agent against which is not a sufficient immunity, whose presence was not supposed in advance and whose way of spreding is quite fast (through respiraton ways and with high contagiousness). Such an infection might afflict a large number of people sooner than the society would be able to respond properly. We do not have to go far, a suitable example is Mexican (swine) flu – grippe virus stem A/H1N1 -, which was first discovered in Mexico in spring 2009 and followingly it has spread fast to other parts of the world. Thanks to the air traffic people are able to get almost everywhere at time shorter than one day. At time which is shorter than the incubation period of most infectious agens.

However there is another dimension, characteristic for several recent tens of years which might the rise of this pandemic accelerate - terrorism and extremism. Biological warfare agens are, when the same amount is spread, able to contaminate from ten to hundred times larger area than warfare chemical agens and the costs for B-agens which are spread in the area of one km^2 are 600 times lower [8]. The infrastructure of a stricken area remains undamaged but contaminated so it is possible to use it after a certain time again. As long as a terrorist or extremist group managed to get highly infectious B-agens and if they knew how to use them correctly whereas their objective would be to cause a worldwide chaos then we would have only a small chance to prevent such an act from occurring. It is therefore obvious that one of the simplest way would be to spread infectious agens in the airports where permanently many international lines depart or to transport infectious material into airplanes in other way and then only wait until in different parts of the world first symptoms of illnesses break up. Sooner than the World Health Organization (thereinafter WHO) would be able to respond to such massive spread of infection, millions of people would perish of its consequences.

It is not possible to introduce a complex set of regulations which would prevent the penetration of contaminated materials on board of planes both in the form of infected persons, animals or objects because the effective adjustment of detection mechanisms which would be able to detect the presence of dangerous B-agens inside the airport terminals is hard to solve and demands financial costs. Generally it is possible to say that in places with high concentration of people there are not enough appropriate systems of detection. Nevertheless, at present there are methods by which it is possible to detect B-agens. Most of detection mechanisms are based on specified and non-specified determination. As the name hints, non-specified devices detect only the presence of dispersed organic or inorgenic particles, they work on the base of a laser which scannes a given area. Specific devices are able to determine a specific originator. They work with a sample solution that is assessed. It is not complicated laboratory equipment. At present on the market there are e.g. diagnostic devices of the firm Idaho Technology´s BioDetection, R.A.P.I.D. ® System and RAZOR ® EX System. Both devices are based on the technology PCR analysis and they are able to identify present patogenes in a relatively short period of time from a submitted mixture of a sample. However, the devices are very costly and for the airport security forces a purchase of such device would be uneconomic. The effective detection mechanism appears the combination of two-level protection, it means a non-specific detection device (1^{st} level) ensuring continual scanning of a protected area, a specific detection device (2^{nd} level) by which in case of an alarm from a first level check it is possible to put the samples through a detailed analysis.

Biologic agens have in common just the fact that they attack a living tissue and then they start a malignant activity in it. However, all the other things are with particular agents more or less specific. Despite this fact it is possible to find and develop a set of technical and organization security measures which might minimize the risk of the infection of persons in the airport area as much as possible. In order to perform the efficient and effective protection of the airport infrastructure against B-agens, first it is necessary to carry out the analysis of the dangerousness of the agents. Not all of them would be “effective” for the attack.

There are such agents which are not commonly available, they spread slowly, have a long incubation period or they are easily liable to surrounding influences. These agents are for the extensive attack unsuitable and prospective attackers would not choose them for the attack. As long as we choose appropriately the most dangerous (in this meaning the most risky) agents, we are more able to setup detection mechanisms and suggest effective protection.

There is a range of aspects depending directly on specific intentions of attackers but with the highest probability it is possible to use for the attack biological agents which have the following properties:

- high contagiousness (the ability of biologic agents to penetrate into a host and survive and reproduce there);
- high pathogenity (the ability of the agents to create at a responsive host the disorder – the death, illness);
- low (small) infection dose (it means a dose of a relevant microorganism which is needed to cause the infection; usually it is given as a median of the infectious dose (ID50) – the dose needful for the infection of 50 % of stricken persons);
- short and forseeable incubation period (incubation period is a time interval between the exposition to the infectious dose and first symptoms of the disorder connected with the infection; a range of variables applies there including the amount of criminating dose, virulence, inlets, the speed of replication and immunite factors of a host);
- dissemination (a process of B-agens dispersion in order to cause the rise of a disorder or intoxication; B-agens get to the place of destination secretly in the form of aerosol; other inlets are supposed to be less important than inhalation, nevertheless, they are also potentially significant);
- sufficient stability in the environment (the ability of an agent to resist in the form of aerosol the influences of the environment factors such as solar radiation, air pollution, surface forces and dehydration when preserving responding infectiousness);
- availability of specific agents;
- sufficient stability of agents during storage and transport;
- proper receptivity of persons to given B-agens.

Among the most abusable B-agens which cover the above given criteria are the following microorganisms (they are given according to their dangerousness) [10]: Anthrax (*Bacillus anthracis*), Pestis (*Yersinis pestis*), Variola (*Poxvirus variole*), Hemorrhage fever, Tularemia (*Francisella tularensis*), Brucellosis (*Brucelos abortus*), Enteric fever (*Salmonella typhi*), Cholera (*Vibrio cholerae*).

In the airport area a prospective attacker might incline to a specially adapted container with selected agents. This containter might be discreetly placed at an in advance chosen place (prosp. more places) that is noteless and there is no fear of rapid detection of a subject from emploees or airport security forces. The container might be also an object which due to its shape “will merge” with a standard equipment of an airport terminal. To enhance the effect of the spread of biological agens the most convenient place is the place with fast circulation of the air or in the vicinity of an air-sucker of air-conditioning. The air conditioning system is in the facilities, such as for example the airport terminal, considerably elaborated and forked and by this step the attacker will ensure much more rapid spread of infection in a given area also provided that prospective installed HEPA filters able to catch bacteria, and ULPA filters able to catch viruses, will absorb a large amount of spores. However these filters are mostly installed in the area of the air-sucking from the outside towards the building, not between separate parts of buildings. It is necessary to say that we do not deal with the spread of agents within one facility but within countries - worldwide. For this purpose the travelers "help" the attacker because they bring the microscopic spores with them aboard the plane. Another type of an "attack" is simply leaving the spores of these agents in a given area. From one or more places the spores thanks to their microscopic dimensions will whirl up due to natural air-flowing. The effect is exponentiated by air-conditioning.

MODEL SITUATION OF THE SPREAD OF VARIOLA VIRUS

For better imagination of the seriousness of the bio-terrorism threat and the importation of an infectious agent through a transport hub into the whole world is presented in the following model situation. The presumption of the calculation is the spread of the Variola virus in the area of an airport terminal.

Note: *Input values which were used during calculations are real. They come out of the statistics of the plane travel at the international airport Prague/Ruzyně for a considered period.*

Characteristics of B-agens:

We consider one of the existing clinical forms of a virus – Variola major. The size of a virus is about 200 – 300 nm and is significantly resistant to external influences. The entering gate of a virus is the mucous membrane of respiratory ways. The incubation period varies in average about 12 days (generally 8 – 18). The receptivity is general and high. One person is able to infect up to 10 other persons. With regard to high virulence of the virus only 10 – 100 virions are sufficient to induce the disorder at man. The mortality of a virus at unvaccinated people reach 10 – 50 % (in average 30 %). The virus is resistant, it survives a 10-minute boiling and the sun exposure for 3 hours. During the incubation period the infected persons are without symptoms and in most cases are not infectious, i.e. they do not secrete the virus into the surroundings. The spread of a virus initiates after the expiration of this incubation period. After this period infected persons have symptoms similar to flu – fever, torpidity, backache, headache, prospective vomiting. After two or four days the fever damps out and typical symptoms for this virus start to appear – small pox rash on the skin (incrustations) and on the nose and mouth moucos membrane. For Variola is typical that the rash is much more distinct on the face and limbs than on the rest of the body. For the whole period of the occurrence of the rash the patient is infectious. With infected persons after four to seven days of the persistence of rash and recurrence of fever the persons die. It is necessary to remark that also ill people with a moderate course of disease secrete a virulent virus which may lead to a secondary spread of florid Variola with receptive persons [8,10].

An efficient form of defence against this virus is vaccination. This was in 1958 at the conference held by WHO in Moscow proposed and consequently implemented – with a success. In 1977 we succeeded in eradication of this disease and two yeras later the WHO claimed the Variola eradicated and the world has got rid of this virus. In our population there are then all people until aprox. 30 years of age quite irresistant. Moreover the vaccination of all who have never been vaccinated and are now more than one year old, the vaccination should be undertaken only in extraordinary high danger and under already proved spread of Variola epidemy. Failing which this step would be an irresponsible risk with the health of people and in a final result rather contra-productive because many complications would occur including lethal ones. Leaving the decision until the moment of proved threat of Variola to people is well-founded because it is possible to vaccinate successfully still after the infection of persons by Variola virus. Around four days after the infection the vaccination virus still may stop the effects of a Variola virus and when nothing else, at least cause that the developed disease will be moderate. More probably it will not occur. It would be therefore irresponsible on the base of some alarming, insufficiently verified messages to iniciate areal vaccination for fear against a bio-terrorist attack. The damage would be higher than waiting and verifying the situation by prompt diagnosis of the first occurrence of the disease or by the proof of a virus in spread aerosol (if it was absorbed).

Despite the fact that the virus was eradicated, several states, (e.g. the USA, Russia) and the Czech Republic belong among those who preserved the vaccination in depository. The amount of vaccination substances is however limited for the military needs, prospectively for other forces ensuring the operation of state apparatus and it would not be enough for the vaccination of the population. It would be limited only for application at extraordinary events of a local character, e.g. in place of an attack. Other prospective production of vaccination doses is real; however, it would take for a longer time.

As long as the therapy is concerned, there is an anti-virus drug based on anti-virotic n-metylisatin nB-thiosemicarbazon (Marboran ® Methisazone). The evidence of its effectivity is however missing. As potential candidates of the Variola treatment were suggested ribavirin and cidofovir; however, at present it is not possible to define any recommendations regarding the therapy [10].

The fact, that the vaccination against such a virus has not been made for a number of years together with the fact that it is a virus with high aggressivity, which has made of it a fearful biological weapon. If this virus was abused by an attacker or by a group of attackers, it could have fatal consequences. It is necessary to remark that the most massive spread of a virus is presumptive in towns and vast populated aglomerations because there would occur rapid saturation of available capacities of all hospital facilities and infection clinics, and other ill people would not be isolated in time. It is supposed the exponential course of the growth of infected people which is proved by an accomplished calculation.

Note: *Besides the mentioned form of virus Variola major there is still a less serious clinic form of a virus – Variola minor. The lethality is however less than 1 % and it is supposed that as long as a prospective attacker wanted to use this virus, he would choose just its more dangerous variant.*

Virus Variola (magnified 40 thousand times)

The Characteristics of a Transport Hub:

In the calculation we used the values representing an international airport with 12 million of checked-out passengers yearly with the average daily number of 490 plane operations (taking offs and landings) and 34 thousand checked out (arriving and departing) passengers daily. The structure of flights is composed of business, transfer and charter flights that correspond to chosen flight schedules. For a more precise calculation, both flight schedules (winter flight schedule and summer flight schedule) are opted. The flights are operated to 125 destinations together by 48 aircraft companies. A number of destainations serve as a transit hub for transfer flights to other worldwide destinations. Cargo transport is not by reason of a low number of travels taken in the calculations into account.

Relations applied in a model situation:

$$P_D = \sum_{f=1}^{f=f'} P_1.u \qquad (1)$$

$$P_A = \sum_{f=1}^{f=f'} P_2.u \qquad (2)$$

$$P_W = (P_D + P_A).w = \left(\sum_{f=1}^{f=f'} P_1.u + \sum_{f=1}^{f=f'} P_2.u \right).w \qquad (3)$$

$$P = P_A + P_D + P_W + P_S = \sum_{f=1}^{f=f'} P_1.u + \sum_{f=1}^{f=f'} P_2.u + \left(\sum_{f=1}^{f=f'} P_1.u + \sum_{f=1}^{f=f'} P_2.u \right).w + P_S \qquad (4)$$

$$I_0 = P.p \qquad (5)$$

The legend of calculations	
Unknown	***Explanation***
P_D	The number of leaving persons (passengers and the plane crew) in a given time period
P_A	The number of leaving persons (passengers and the plane crew) at a given time
P_W	The number of waiting persons who are at a given time in the airport terminal (persons who accompany or wait for their relatives and friends).
P_S	The number of employees in the airport terminal at a given time (approximate number of staff in the shift who might get into touch with B-agens).
P	Total number of persons occurring in the airport terminal in a given time period
f,f´	The number of flights (arrivals/departures) in a given time period
u	Utilization of set flights - plane engagement in %
w	The coefficient reflecting the average number of persons who are in the airport terminal and wait for the arrival of passengers or they accompany them.
I_0	The number of infected persons at time t_0 dirrectly at a source of infection (i.e. in the airport terminal)
p	The probability of infection – probability that a given B-agens will infect a transported person and the symptoms of infection will show.This person is more over able to spread B-agens further around him /her/.
I(t)	The number of infected persons at time t
M(t)	The number of deceased persons at time t
t	Considered period in days

Note 1: *In the calculations a period of 12 hours is considered as a given time period. (see below).*

Note 2: *Final values are round down.*

MODEL SITUATION

Day D (time t = 0):

At 11.00 hours in the airport terminal at certain places several grams of virus *Variola major* in the form of contaminated crashed incrustations are released. The number of places for virus spreading is not specified, because this factor depends on the division of the airport terminal area. We anticipate that the period necessary for relatively equal virus spreading is one hour. Therefore the calculation will start at time – 12.00 hours. The virus is in an open space resistant and keeps moving there even several days (after its virulentness decreases) [8] for our calculation we will use the time period only for first 12 hours i.e. within 12.00 – 24.00 hours. In the airport terminal area the virus merges with the air and contaminated aerosol is created. Air conditioning helps further spread the aerosol into the entire area of the airport terminal. However, by reason of the rapid exchange of the air through an air-conditioning unit, the contaminated aerosol after mentioned 12 hours gets mostly out, outside the airport terminal. It is necessary to say that air conditioning systems are equipped by HEPA filters able to absorb bacteria. These filters are mostly installed in the area of air sucking from the outside towards the building, though, and not among separate parts of buildings, moreover in case of insufficient filters exchange they are blocked and their efficiency is lowered.

Note: *Time interval 12.00 hours - 24.00 hours is chosen deliberately by reason of equally represented so called busy hours and quiet hours. During the day there are several air traffic peaks and as long as a model situation was related only to a daytime, prosp. a night, the calculations would be considerably biased.*

Variant A (winter flight schedule):

Winter flight schedule is characterized by the decrease of the number of flights where there are mostly regular lines, business and transit flights. Charter flights are less operated. The period of the validity of the winter flight schedule is from the end of the tenth month to the end of the third month the following year. It is therefore 2 months shorter than a summer flight schedule. For the calculation of the Variant A we will consider the following values:

Unknown (description)	***Value***
$P_1 = P_2$ (average capacity of a plane at departure/arrival)	126
f´(departures)	104
f´(arrivals)	110
at (departures/arrivals)	60 % = 0,6
w	30 % = 0,3
P_S	1000
p	50 % = 0,5

The airport under consideration checks-out several types of planes with various capacity of passengers. However the planes with the capacity of about 120 passengers + 6 crew members prevail. In order to simplify the calculation the number is under consideration. The engagement of planes by passengers is lower in a winter period. For planes both at the departure and arrival we count with the value of 60 % of the use of plane capacity. The coefficient which expresses a proportional number of persons who wait in the airport terminal for arriving passengers or accompany departing passengers is set to 0.3, i.e. 30 % of passengers are accompanied by one person. The number of persons of the staff who work in a given time period in the airport terminal is set to the value of 1000. We stem from a proportional number of employees which is in the airport terminal lowered by one quarter with regard to the number of shifts (4) which are doubled due to half shifts. This value is approximate, though, and it is quite complicated to get more precise values.

After completion into the relations mentioned above (1) - (3) we come up to the following values:

$$P_D = \sum_{f=1}^{f=f'} P_1.u = \sum_{1}^{104} 126.0,6 = 7863$$

$$P_A = \sum_{f=1}^{f=f'} P_2.u = \sum_{1}^{110} 126.0,6 = 8316$$

$$P_W = (P_D + P_A).w = \left(\sum_{f=1}^{f=f'} P_1.u + \sum_{f=1}^{f=f'} P_2.u \right).w = \left(\sum_{1}^{104} 126.0,6 + \sum_{1}^{110} 126.0,6 \right).0,3 = 4854$$

For the calculation of the total number of persons who go through the airport terminal in a given time period of 12 hours, we use the relation (4):

$$P = P_A + P_D + P_W + P_S = \sum_{f=1}^{f=f'} P_1.u + \sum_{f=1}^{f=f'} P_2.u + \left(\sum_{f=1}^{f=f'} P_1.u + \sum_{f=1}^{f=f'} P_2.u \right).w + P_S = 22033$$

From the relation (4) we can see the total number of persons who are in a given time period in the airport terminal and at the same time they got in touch with the virus. Despite the fact that all persons are generally highly receptive to the mentioned virus, there is a range of factors which might prevent from the infection of alleged persons (lower receptivity of a person, circulation of the air, the transit through the area with lower concentration of contaminated aerosol etc.). Therefore the final value is lowered to the half. When introducing into the relation (5), we come up to the number of persons who were in a given time period infected by a virus and with which the symptoms will show later and followingly they will spread the illness further:

$$I_0 = P.p = 22033.0{,}5 = \underline{11017}$$

Variant A (summer flight schedule):

Summer flight schedule is characterized by an increased number of flights which are in addition represented by charter flights. Summer flight schedule is valid from the end of the third month to the end of the tenth month of a year. For the calculation of the Variant B we will consider the following values:

Unknown (description)	***Value***
$P_1 = P_2$ (average capacity of a plane at take-off/arrival)	126
f´(departures)	145
f´(arrivals)	138
at (departures/arivals)	70 % = 0,7
w	30 % = 0,3
P_S	1150
p	50 % = 0,5

In comparison with the variant A, the following values changed: The number of departures and arrivals is higher by reason of a higher number of flights which is caused by higher migration of people in summer months. Also the engagement of planes increased to 70 %. In connection with a higher number of flights also the number of staff working in airport terminal increased. Other values remained the same.

Again after completion into the relations mentioned above (1) - (3) we come up to the following values:

$$P_D = \sum_{f=1}^{f=f'} P_1.u = \sum_{1}^{145} 126.0{,}7 = 12789$$

$$P_A = \sum_{f=1}^{f=f'} P_2.u = \sum_{1}^{138} 126.0{,}7 = 12172$$

$$P_W = (P_D + P_A).w = \left(\sum_{f=1}^{f=f'} P_1.u + \sum_{f=1}^{f=f'} P_2.u \right).w = \left(\sum_{1}^{145} 126.0{,}7 + \sum_{1}^{138} 126.0{,}7 \right).0{,}3 = 7489$$

Calculated values are introduced into the relation [4]:

$$P = P_A + P_D + P_W + P_S = \sum_{f=1}^{f=f'} P_1.u + \sum_{f=1}^{f=f'} P_2.u + \left(\sum_{f=1}^{f=f'} P_1.u + \sum_{f=1}^{f=f'} P_2.u \right).w + P_S = 33600$$

Followingly, by analogy as in the previous variant we introduce a resulting value into the relation (5) and we get the number of infected persons in the airoport terminal:

$$I_0 = P.p = 33600.0,5 = \underline{16800}$$

Consequent development of an event:

According to a medical study it implies that the mankind is nowadays by reason of missing vaccination against the virus of smallpox more receptive to this virus and some specialists estimate that the transfer of it would occur in proportion to 10 new infections per each ill person [7]. We start therefore from the fact that each ill person will infect during the following 12 days other 10 persons around themselves. This presumption is, however, hypothetic. The number of infected will grow but with a decreasing tendency. In each next 12-day period pays approximately that the number of infected persons per one ill person decreases by number one. The reason is the quarantine, massive epidemiologic measures, vaccinations etc.

The occurrence of deaths is not expected until time t = 12 days. At that time it is still low though, because at first the individuals with a weakened immunite system will succumb to the illness, older people, ill people etc. Followingly this number is possible to express by the coefficient 0.3, i. e. 30 % mortality from the virus. We consider an average mortality stated in medical documents. In a ideal case the growth of infected persons is possible to express by the following table:

t	0	12	24	36	48	60	72	84	96
I(t)	I_0	$10. I_0$	$100. I_0$	…	…	…	…	…	…
	$I_0\,10^0$	$I_0\,10^1$	$I_0\,10^2$	$I_0\,10^3$	$I_0\,10^4$	$I_0\,10^5$	$I_0\,10^6$	$I_0\,10^7$	$I_0\,10^8$
M	0	…	0,3I(t)	0,3I(t)	0,3I(t)	0,3I(t)	0,3I(t)	0,3I(t)	0,3I(t)

The growth of the number of ill persons is generally expressed by the relation $\underline{I(t) = I_0.10^x}$, where x is a 12-day cycle.

The number of casualties of the virus is possible to express by the relation $\underline{M(t) = 0,3.I_0 = 0,3.\left(I_0.10^x\right)}$, where x is a 12-day cycle.

D+12:

The average incubation period of the virus *Variola major* is 12 days. After this time first symptoms similar to flu appear with infected persons, therefore the practitioners might come to a false diagnosis, eventually to malpractice. Most persons are treated only at G.P. and therefore the virus might spread further. For sure the virus is not possible to diagnose until the second phase of illness where the body of an infected person is covered with blisters. In this phase a person is highly infectious. It is necessary to remind that the infected persons will be as a result of migration via air traffic spread all over the world. After the expiration of an incubation period and the first phase of the illness, it will be already clear that it is a very dangerous and insidious form of a virus *Variola major* and relevant authorities of state administration in individual countries (ministry of health, bodies of protection of public health, hygiene) will start the massive epidemiological and quarantine measures. Nevertheless the number of infected persons will grow and the first casualties will appear.

D+24:

The transfer of the infection to other persons is partly slowed down. The reason is the adoption of strict infection measures. In all countries crisis states and states of emergency are declared. The army participates in the activities necessary for state government operation (it is given by the legislation of individual states, e.g. in the Czech Republic the states of emergency and the possibility of their declation are defined by the Act N. 240/2000 Coll. and the case where the army takes over the provision of national security e.g. the Act N. 110/1998 Coll.). The number of newly infected persons moves orderly 8 new infected persons per one ill person. The rate of mortality in average equals cca 30 %. There is a presumption that at time D+24 the focal point of the infection is already obvious. However, by reason of high infectiousness of the virus and the spreading the strict quarantine measures do not result in expected outcomes. In all places with the occurrence of the infection, the number of casualties increases, at most there where neither ordinary health care is self-evident.

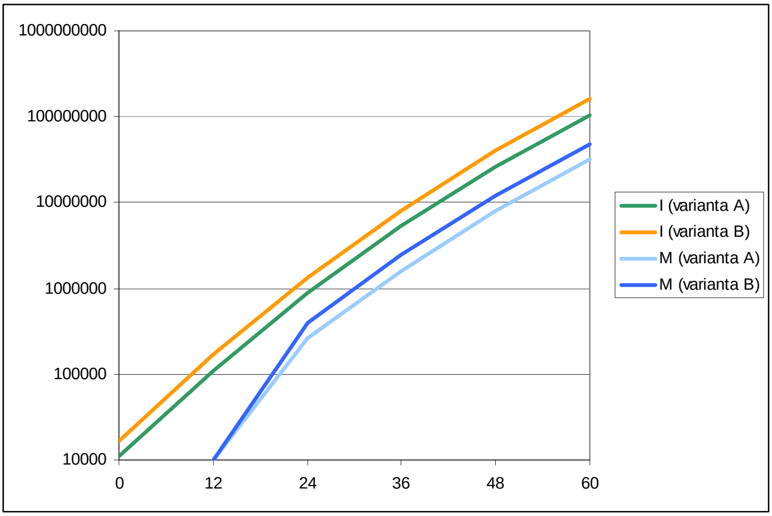
D+36:

More than one month after the infection spreading, the continuously growing number of newly infected persons (cca 6 new infected persons per one ill person) is better manageable. The threshold of mortality however exceeded one and a half million (almost two and a half million for the variant B) casualties all over the world. It is worked on the provision of sufficient amount of vaccinations for their surface setting.

Further expected development of the event:

The number of newly infected persons even two months after the spreading of the infection has been still growing but not so fiercely as during the first days of the infection. It is caused by the started epidemiological measures. However, there is the supposition that the number of infected persons will be still growing. The infection has been occurring in all continents and the pandemic starts to become strong. Massively and almost on full-area the vaccinations are applied. They effectively slow down the virus spreading.

The graphic expression follows (a graphic model according to suppositions mentioned above). The number of infected persons is in every other period lowered by 1 – 2 by reason of the adoption of epidemiological measures.



Data for graphic expression:

t	0	12	24	36	48
I (variant A)	1,10E+04	1,10E+05	8,81E+05	5,29E+06	2,64E+07
I (variant B)	1,68E+04	1,68E+05	1,3E+06	8,06E+06	4,03E+07
M (variant A)	0,00	10 000,00	2,64E+05	1,59E+06	7,93E+06
M (variant B)	0,00	10 000,00	4,03E+05	2,42E+06	1,21E+07

Data for graphic expression: (continuation of the table):

t	60	72	84	96
I (variant A)	1,06E+08	3,17E+08	6,35E+08	1,27E+09
I (variant B)	1,61E+08	4,84E+08	9,68E+08	1,94E+09
M (variant A)	3,17E+07	9,52E+07	1,90E+08	3,81E+08
M (variant B)	4,84E+07	1,45E+08	2,90E+08	5,81E+08

Note: The values in the table are by reason of the size expressed by scientific notation $a.10^x$.

Partial conclusion:

It is necessary to say that it is only a model development of events which is set on the base of given presuptions. Actual development of the infection spreading might be more or less different due to many influencing factors. Also the development of events described here is mostly of a hypothetical character although grounded on real data. In the first phase the model deals with an average size of planes. To more distant places also the planes with a higher capacity of passengers move. The engagement of planes is supposed to be around 60 – 70 %. First of all in summer months this number could be again higher. It means that the value P might be higher in actual situation. Versus P, also the value I_0 will grow. Also the receptivity of persons to the given virus might be much higher than considered value of 50 %. By this reason the following calculations get much higher values. The consequent development of events is dependent on the virus mortality (in the calculation 30 % mortality is considered) or on the presumption that it is a more advanced, cultivated form of the virus etc. The whole event is influenced by the operability of health institutions in individual countries (both on the national level and the level of lower administration entities), and all states in a global scale.

Also the study of M.I.Meltzer et al. which solves through mathematic modeling the aswer to the question, how would the epidemic develop after a bioterroristic attack that would affect a 100 of persons. The work reflects complex understanding of all associated problems by the team of specialists and in spite of taking exceptions to the fact that a mathematic model might bring rather biased results, it is necessary to admit that it is not only an excellent intellectual exercise but it is also significant for the practice. It indicates that it would be necessary to suppress and supervise the epidemic all the year round as long as for its suppression would be used quarantining of 25 % of the number of the daily increase of new cases (three quarters of newly infected), and at the same time the vaccination would be used in a limited extent in order to lower the spreading from every infected person for 2.25 other persons. [3]

CONCLUSION

The risk of the threat of biological agents is not neglectable. The protection against biological agents has been the most difficult protection ever and requires the highest investments for its implementation. The safest protection of people is generally considered the consistence in the fight against bioterrorists, destruction of their nets, bases and disallow them to produce the stocks of viruses and devices for their mass dispersion in the form of aerosol wherever. Be it so our consolation that nothing has proved that the bioterrorists without the assistance of any state would be able to produce such an efficient weapon. Therefore it is necessary to force such states militarily, economicaly and diplomaticly to give up the idea of helping the terrorists. A favourable point for us is also the fact that e.g. the generator of the smallpox is hardly available and according to an international agreement it has been temporarily deposited at two world powers; at the Center for Disease Control and Prevention in Atlanta USA and at the State Research Center of Virology and Biotechnology VECTOR in Kolcov in Russia. It took quite a long time before the number of places where the virus is deposited dropped to only two. The occurrence of the infection with a human being outside these laboratories would become a signal of using this virus as a biological weapon. For example states such as Iraq and other countries with the indicium of religious fanatism are suspected that they did not give up the possibility to use the smallpox virus as warfare means. [3]

Generally we can say that the preparedness to the risk of the threat of biological agens should be the objective of the security management of each center where the acummulation of higher number of persons occurs. For prospective bioterrorists is just such a place the imaginary magnet for the realization of an attack.

Literature

[1] BENEDIK, J., LINHART, P., MATOUSEK, J. *CBRN – biological weapons.* Ostrava: SPBI, 2007. Pp 186. ISBN: 978-80-7385-003-6.

[2] BRZOBOHATY, M., MIKA, O. *Protection against chemical and biological terrorism.* Prague: Police Academy, 2007. Pp 106.

[3] DANES, L. What is bioterrorism? Professional part of the text, 2001.

[4] GAFRIK, A., DURDIAK, J., PULIS, P., SUSKO, M. *Weapons of mass destruction – actual security threat.* Bratislava: Ministry of Defence SR, 2005. Pp 262. ISBN 80–88842–76–X.

[5] L 14 – Airport regulation 14 [online]. Available at WWW: www.petrmatula.com/_staticfiles/predpisy/dokumenty/L/L-14/data/effective/P1.pdf. ais.ans.cz/predpisy/predpisy/dokumenty/L/L-14/data/effective/hl1.pdf.

[6] LINHART, P., MATOUSEK, J., URBAN, I. *CBRN – detection and monitoring, physical protection and decontamination.* Ostrava: SPBI, 2008. Pp 232. ISBN 978-80-7385-048-7.

[7] PETVALDSKY, T. *Protection against biological factors at the airport of Leos Janacek Ostrava.* [Graduation theses.] Ostrava: Faculty of security engineering VSB-TUO, 2008. Pp 75.

[8] PLESNIK, V. Variola (Smallpox). December 2001. Available at WWW: <http://www.zuova.cz/informace/smd/smd106.pdf>.

[9] PRYMULA, R. et al. *Biological and chemical terrorism.* 1st edition Prague: GRADA PUBLISHING, joint venture, 2002. Pp150. ISBN 80-247-0288-6.

[10] NATO/EAPC: Reviewed suggestion of protocols on the therapy in case of the affection by a warfare biological agent – UNCLASSIFIED. Annex 1, EAPC (JMC) WP (2004)0003-REVI.

[11] Web Idaho Technology [online]. Available at WWW: <http://www.idahotech.com>.

[12] Basics of the disaster medicine [online]. Available at WWW: <http://zsf.sirdik.org/obsah>.

[13] Act No. 281/2002 on certain measures related to the prohibition of bacteriological (biological) and toxin weapons and on the change of Trade Certificate Act according to later ammendments and regulations.