

Chapter 3

A New Method of Differentiation Between a Biological Attack and Other Epidemics

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Abstract The main obstacle in identifying a biological attack (BA), while preventing false alarms, epidemics of panic and unnecessary expenditures is the insufficient data on which to rely. This new method of outbreak analysis is based on our original model of bioterrorism risk assessment. The intention was to develop a model of quick and accurate evaluation of an unusual epidemiologic event (UEE) that would save time, money, human and material resources and reduce confusion and panic. This UEE analysis is a subtle and detailed differentiation through assessment of BA feasibility in comparison with three other types of outbreak scenarios. There are two types of differences between these four scenarios: qualitative and quantitative. Qualitative and quantitative differences are defined with 23 and 10 indicators, respectively. Both types of indicators can have three different values: N/A, 0 or 1. We have carried out a feasibility analysis for subtle and detailed differentiation among four outbreak scenarios. As a tool for feasibility analysis we have introduced a “system of elimination”. System elimination is applied if one component contains all indicators scored with 0 or as N/A – the related scenario is then eliminated from further consideration. The system was applied to four UEEs: (1) an intentional attack by a deliberate use of a biological agent (Amerithrax), (2) a spontaneous outbreak of a new or re-emerging disease (“swine flu”), (3) a spontaneous outbreak by an accidental release of a pathogen (Sverdlovsk anthrax), and (4) a spontaneous natural outbreak of a known endemic disease that may mimic bioterrorism or biowarfare (Kosovo tularemia). It was found that “agent” was the most important and the most informative UEE component of the new scoring system. This system might be helpful in the analysis of unusual epidemic events and a quick differentiation between biological attacks and other epidemics.

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3.1 Introduction

Most diseases caused by potential biological warfare agents have low natural incidence rates. The lack of clinician experience with these diseases can impede rapid diagnosis and reporting to public health authorities [5]. The main obstacle in identifying a biological attack (BA), while preventing false alarms, epidemics of panic and unnecessary expenditures is the lack of data to rely on [23]. We are trained to consider common causes for syndromes first – and unless we have a high level of suspicion – we may not realize that we need to apply non-standard methods to identify an intentional use and to detect the kind of biological agents that a terrorist might use. Basically, any unexpected occurrence of one or more patients or deaths in humans or animals which might have been caused by an intentional release of pathogens may be the first clue of an unusual epidemic event (UEE). Also, the occurrence of a single case or death caused by an unknown or already eradicated disease or agent may be considered as “unusual”.

Three systematic models of assessing differences between natural and deliberate epidemics have been published. Grunow et al. [12] put emphasis on three groups of characteristics: (1) political, military and social analysis of the afflicted region (two criteria), (2) specific features of the pathogen (three criteria), and (3) characteristics of the epidemic and clinical manifestation (six criteria). Dembek et al. [7] proposed 11 potential clues to a deliberate epidemic which are focused on epidemic characteristics. These two models are accurate, but time consuming. However, saving time is crucial in the case of an UEE. Radosavljevic et al. [20] suggested a model for early orientation and differentiation between natural and deliberate outbreak.

Our new method of outbreak analysis is based on an original model of bioterrorism risk assessment [19]. The intention was to develop a model of quick and accurate evaluation of a UEE that would save time, money, human and material resources and reduce confusion and panic.

This UEE analysis is a subtle and detailed differentiation through assessment of BA feasibility in comparison with other outbreak scenarios, in particular: (1) a spontaneous outbreak of a new or re-emerging disease (NR) (such as “swine flu”), (2) a spontaneous outbreak by an accidental release of a pathogen (AR) (such as the Sverdlovsk anthrax outbreak), and (3) a spontaneous natural outbreak of a known endemic disease that may mimic bioterrorism or biowarfare (NE) (such as the Kosovo tularemia outbreak).

3.2 Subtle and Detailed Differentiation of an UEE

After identification of an UEE we introduced a new method for the subtle and detailed differentiation of such an event. In our previous paper [19] a BA was defined by four components, and now we propose their equivalent terms in an UEE: reservoir/source of infection vs. perpetrator, pathogen vs. biological agent, transmission mechanisms and factors vs. media and means of delivery, and susceptible population vs. target.

Indicators of a deliberate outbreak can be conclusive and non-conclusive [12]. Conclusive indicators are direct and comparatively objective indicators for an intentional event. Non-conclusive indicators estimate only the likelihood of an intentional event on the basis of circumstantial evidence. There are three conclusive indicators of deliberate outbreaks: evidence of intelligence/secretcy activities coincident or related to an outbreak, confirmed presence of a known bio-agent (has characteristics of traditional biological weapons or genetically modified as agent), and evidence of a means of delivery (munitions, delivery systems or dispersion systems). All other indicators are more or less non-conclusive.

3.2.1 Reservoir/Source of Infection vs. Perpetrator

Equivalent to the perpetrator in a biological attack is the source, or reservoir of infection in a natural epidemic. Perpetrators may behave in two ways. Some bioterrorists want to avoid attribution for an attack, others want to claim credit for it, or, at least want the authorities to recognize that a disease outbreak was deliberate, and not of a natural origin. People who are accidentally included in natural outbreaks (as a source or reservoir of infection) and look like perpetrators at first sight, are always highly afraid and cooperative. Also, a source/reservoir of infection always completely behaves according to epidemiological characteristics (incubation period, period of communicability) [18].

If political, military, ethnic, religious or other motives can be identified, this would lend credence to the assumption that an attack using pathogens or toxins as biological agents has taken place. In natural outbreaks usually there is no motive, but if we find them, motive(s) are commonplace and simple. In natural epidemics sources of infection may be discovered by usual epidemiological and microbiological routine investigations, and there are no tendencies to keep themselves unknown (no secrecy) [19].

There are some coincident points related to an outbreak that may be an indicator of secrecy/intelligence inclusion in a biological attack. Intelligence presents an ability to get true and on-time information on a global and local level related to biological attacks [19]. If some activities related to a biological attack are kept unobserved before an attack as well as after an attack, it is a parameter of secrecy and should be considered in the context of a biological attack. It would also be conceivable that certain persons or groups may be given sufficient prior warning about a biological attack and could have been spared from an epidemic by preventive measures (e.g. receiving vaccinations, adhering strictly to instructions to boil drinking water).

Quantitative parameters. In natural outbreaks the number and distribution of sources of infection are related to the incubation period and period of disease communicability. Such regularity is seldom seen in a biological attack. Here we also have to consider special situations in natural outbreaks when the incubation times and communicability may be changed: for instance in the case of an exposure to massive doses of pathogens by contaminated water or food, such as may be the

case with natural disasters or accidents in water treatment plants and distribution systems or hygienic failures in kitchens. Then we may have epidemiological, microbiological and clinical patterns which could resemble the characteristics we would also expect in a biological attack.

Strategic (large-scale) biological attack. States' institutions such as military forces, intelligence services or well-funded and possibly state-supported organizations can be perpetrators in a strategic biological attack. The present threat analysis states that in the next years only a very few so called "rogue" countries with clandestine offensive biological warfare programmes would be able to launch strategic biological attacks [19]. Such attacks include politically, military and/or ideologically motivated ones. In natural, large-scale epidemics, infection is mainly unintentionally and individually disseminated and strictly related through periods of incubation and communicability of disease. The period between deployment of a bioweapon and its effects, however, is long enough to give a terrorist a chance to escape. So, it could be very difficult to find a perpetrator.

Operational (middle-scale) biological attack. This type of attack could be carried out by all three types of perpetrators (government supported institutions/organizations, terrorist groups, individuals) [19]. If psychological effects (fear and panic) are greater than the biological losses (diseased and died) it might also be a biological attack [21, 22].

Tactical (small-scale) biological attack. The terrorist or criminal groups dominate as perpetrators in this type of attack. If "hard" targets are hit, perpetrators likely have to be highly skilled, or with suicidal tendencies, and politically or ideologically motivated [19].

Qualitative indicators. Qualitative indicators related to BA have no equivalents (not applicable – N/A) in two cases: natural outbreak of a known endemic disease that may mimic bioterrorism (biowarfare), or outbreak of a new or re-emerging disease. In the case of an accidental release of a pathogen, motivation, ability and intelligence information are N/A.

Three quantitative indicators of a BA have their equivalents in the other three outbreak scenarios – AR, NE and NR.

3.2.2 Pathogen vs. Biological Agent

The most difficult scenario of a BA for investigators is if an endemic pathogen was used. In such a case microbial forensic tools for identifying a deliberate outbreak should be given priority.

Type of agent. There are two types of biological agents: conventional (natural form of the pathogen) and biological warfare agent. A qualitative parameter may be if some pathogen species or strain (subspecies) is unusual, atypical or antiquated, e.g. is identified in the region concerned for the first time ever or again after a long

absence, or if an agent has certain characteristics like: a special genetic signature, mixed with a stabilizing agent, highly concentrated, filled in munitions, high toxicity, more virulent, resistant to antibiotics, and multiple modes of transmission. Many potential biological warfare agents could be obtained from natural sources (infected animals, patients, or contaminated soil). Many pathogens, perhaps the majority concerned, cause zoonoses, i.e. infect animals as well as humans [16]. The sudden occurrence of a zoonotic disease, such as brucellosis, in the absence of the natural animal host or reservoir and other likely sources of transmission may be suggestive of an unnatural cause. The so-called “zoonotic” potential should be considered in this differentiating evaluation. A regionalized animal die-off may provide a clue that something is present or may have been released that might also infect humans. This phenomenon of animal illness heralding human illness was observed during the West Nile virus encephalitis outbreak in New York City in 1999, when many local crows, along with exotic birds at the Bronx Zoo, died [17, 24]. In the case of a so-called “reverse spread”, where human disease precedes animal disease, or human and animal disease occur simultaneously, one should consider an unnatural spread. This is often also the case in plague or tularemia outbreaks and has led to speculations like in Surat (India) in 1994 or Kosovo. Many strains isolated from nature have low virulence. Therefore, a terrorist must isolate many different strains before finding one sufficiently potent as a warfare agent. Considering the technical difficulties to obtain virulent microorganisms from nature, terrorists may find it easier to steal well-characterized strains from a research laboratory, or to purchase the known pathogenic strains from a national culture collection or commercial supplier. Between 1985 and 1989, the Iraqi government ordered virulent strains of anthrax and other pathogens from culture collections in France and the United States, presumably for public health research – a purpose that was legal at the time, and approved by the U.S. Department of Commerce [25, 26]. It is speculated that one reason for the lack of success in causing illness following dissemination of anthrax spores by the cult Aum Shinrikyo was the inadvertent selection of a non-pathogenic strain of *Bacillus anthracis* [14].

Strategic (large-scale) biological attack. Respiratory agents are almost always candidates for strategic use because of the possibility for their clandestine use, their high dispersal potential, and their high contagiousness. Category A agents, and the agents causing SARS, avian influenza, and pandemic influenza (including swine flu) might be candidates for use at the strategic level [19].

Operational (middle-scale) biological attack. For this type of attack, the spectrum of suitable agents is wider than for large-scale attacks, and possibilities include (in addition to the agents mentioned above) Hanta viruses, multi drug resistant *Mycobacterium tuberculosis*, hepatitis A virus, Noroviruses, *Cryptosporidium spp.*, and toxins [19]. Consequently, measures of detection and identification are more difficult. Also, the accessibility of these agents for terrorists is easier, and the amounts of the available agent are larger.

Tactical (small-scale) biological attack. The agents from all three categories and emerging biological agents are potential candidates for this purpose. Biological

agents are still the preferred materials of hoax perpetrators at the tactical level, probably because perpetrators could easily produce and safely handle these simulants of potential biological warfare agents.

Amount of agent. If there is a non-proportional, large amount of biological agent present in sources/reservoirs or environmental sampling, or an epidemiologically unexplainable transmission or distribution of an agent, there is a high probability of a biological attack.

All four outbreak scenarios could have the same values for indicators related to agent.

3.2.3 Transmission Mechanisms and Factors vs. Media and Means of Delivery

If we find some kind of munition, delivery system or dispersion system (means of delivery) at the outbreak focus it should be the proof of a deliberate epidemic. If food, water, or fomites are the media of delivery it should be possible to trace it and find out the source of infection and type (natural or artificial) of epidemic. But, air as a medium of delivery remains the most complicated for investigation. Looking for people who came in contact with the agent through this method of exposure may be very difficult. However, several other parameters may help (type, strain and approximate amount of released agent, period of incubation, and period of communicability). Also, natural epidemics will feature paths of transmission that are typical for the pathogen and its natural hosts. Such deviations from natural paths of infection could indicate that biological agents have been deliberately disseminated. Many diseases exhibit vastly different clinical presentations, periods of incubation, and mortality rates depending upon the route of transmission. Therefore, outbreaks due to an atypical route of transmission, particularly aerosol transmission, such as in the inhalation anthrax example above, are more suggestive of an intentional use. Weather factors, especially wind direction, temperature, and humidity, are important determinants of pathogen dissemination and disease occurrence and must be taken into account in an outbreak investigation. A disease outbreak occurring downwind (or downriver) of a suspected biological warfare agent production facility, such as in the Sverdlovsk anthrax disaster, provides compelling evidence for an accidental or intentional release [27]. It is useful to plot locations where cases occur on a geographic map. If affected cases are clustered in a downwind pattern, an aerosol release should be considered like in the 1979 anthrax outbreak in Sverdlovsk [7].

Many people are becoming increasingly mobile and interactive with indigenous populations. As a result, they have a correspondingly greater potential for translocating diseases to previously non-endemic areas through unknown transportation of infected vectors or people during incubation or clinical symptom stages. Therefore, knowledge of the at-risk population's travel and contact histories may be essential

in determining the etiology and likely source of an outbreak. Tourists, military personnel, traders, settlers and immigrants, and travel adventurers may carry new pathogens to unsuspecting and susceptible populations. People, storms, and floods can transport arthropods, rodents, snails, birds, and other creatures that can also bring new infections to previously unaffected areas. Changes in human behaviour, technologic devices, the environment, institutional living, and poor nutrition or vitamin deficits can spark new epidemics. The speed at which an epidemic spreads is determined by the virulence, resistance and concentration of the pathogen, the contagiousness of the disease and the intensity of the transmission process, on the one hand, and on the susceptibility and disposition of the exposed population, on the other. It is unclear how changes in household sizes, working patterns, and mobility would affect transmission patterns today. Incorporating detailed data on demographics and human mobility into spatially explicit models offers one method by which such extrapolation can be made more reliable, but the scale of changes mean that much uncertainty will inevitably remain.

Qualitative indicators: Air, water, food and fomites could be the media or means of delivery for all four outbreak scenarios.

Quantitative indicators: Three quantitative indicators of BA – munitions, delivery systems, and dispersion systems – will not exist in the other three UEE scenarios – AR, NE, and NR.

3.2.4 Susceptible Population vs. Target

In natural outbreaks there is no target, but there is a susceptible (affected or endangered) population. In both natural and deliberate epidemics there can be two types of consequences: direct (death and/or illness), and indirect (political and economic). However, in a deliberate outbreak, indirect (political and economic) effects are usually intended and have great impact. In natural epidemics indirect (political and economic) effects every time are “collateral damage” or sometimes expected consequences of disasters. In addition, the use and even the threatened use of certain biological agents can have intense psychological effects on the population at large [19, 21].

In naturally occurring epidemics “soft” targets are mainly affected, because “hard” targets (e.g. heads of state or other VIPs) are better protected than “soft” targets (e.g. the unprotected population). There are no signs or indicators of intelligence/secret activities (e.g. repeated visits by individuals or vehicles identified as out of place, prior warning of a possible biological attack such as active or passive immunoprophylaxis or chemo-prophylaxis of a non-target population, threats, or hoaxes). There is no suspicious behaviour: unexplained contamination of a media (air, food, and water), or use of unusual fomites (office equipment, postal letters). There is also no obvious target in a natural outbreak. Some parameters of an outbreak

(location of the exposure/target site, importance and number of people in the site, and distribution of people from the site) may also point to a deliberate attack.

Large-scale attack. Nowadays, one of the main objectives of a bioterrorist is to propagate fear, anxiety, uncertainty, and depression within the population, induce mistrust of the government, inflict economic damage, and disrupt travel and commerce [19, 21]. Causing significant outbreaks of disease may be a secondary objective. The ultimate goal of biological attacks is to cause political consequences. Bioterrorists want to produce an epidemic of fear and panic [19, 21]. This cannot be evoked in such manner if the attack is clandestine and mimics a natural outbreak. Naturally occurring large-scale epidemics or pandemics are only possible by aerosol transmissible agents. All other large-scale outbreaks should raise suspicion as a potential deliberate outbreak.

Middle-scale and small-scale attack. In the case of “hard targets” (highly prominent and protected institutions like governmental buildings, media centres, and persons such as politicians, scientist, or high military officials) being affected, the probability of a deliberate outbreak is high. Consequences even in small-scale attacks can be of strategic importance. “Soft targets” are considered ordinary people in public places (e.g. respiratory agents in crowded and closed places like theatres, cinemas, sports events, and political meetings). Small-scale outbreaks in “soft targets” are more difficult to differentiate and may be of less strategic importance.

Except for the most blatant violations of natural principles, bioterrorism will continue to remain difficult to differentiate from naturally occurring outbreaks. Certain attributes of a disease outbreak, while perhaps not pathognomonic for a biological attack when considered singly, may in combination with other attributes provide convincing evidence for intentional causation. The possibility of mixed epidemics must always be taken into consideration when assessing the outbreak of a disease, since they complicate the epidemiologic situation and can present additional difficulties for the investigation of unusual outbreaks.

3.2.5 General Differentiating and Scoring

There are two types of differences between these four scenarios: qualitative and quantitative. Qualitative differences are defined by 23 indicators, and quantitative by ten indicators. Both types of indicators could have three different values: N/A, 0, or 1.

In our previous article [19] numerous parameters – indicators were defined. By using them we have carried out feasibility analysis for subtle and detailed differentiation among four outbreak scenarios. As a tool for feasibility analysis we have introduced a “system of elimination”. System elimination is necessitated if one component contains all indicators scored with 0 or as N/A, then the related scenario is eliminated from further consideration.

3.3 Examples of Different Outbreak Scenarios (Table 3.1)

3.3.1 *Spontaneous Outbreak of a New or Re-Emerging Disease (Swine Flu)*

Reservoirs. Reservoirs of infection are pigs [4, 6, 9] and turkeys, and all six qualitative indicators are not applicable (NE, NR scenarios). In consideration of BA scenario there are likely no terrorists who intend to create an uncontrolled pandemic originating in a Mexico rural area. Later events also showed that there was no misuse or intent either for commercial purposes by pharmaceutical industries or from military experiments. Therefore this scenario has been eliminated. With pigs and turkeys as the reservoir, accidental release of the pathogen is also not likely, and therefore this scenario is eliminated.

Agent. Undoubtedly, this is a new and emerging pathogen [6, 10]. This clearly eliminates a natural outbreak of a known endemic disease.

Transmission mechanisms and devices vs. media and means of delivery. Air and fomites could be the media of delivery in a new or a re-emerging disease [1, 2, 13, 15].

Susceptible population vs. target. In the “swine flu” pandemic, intelligence and secrecy are both scored with 1 because of the early detection of the outbreak, and identification of the agent and reservoirs of infection.

Conclusion. “System elimination” clearly discriminates a spontaneous natural outbreak of a known endemic disease, a biological attack, outbreak by an accidental release of a pathogen because they do not have the components “agent” or “perpetrator”. Considering the first component (perpetrator or reservoirs/sources) in the third scenario, the first six qualitative indicators are N/A. The three quantitative indicators are each scored 1. Taking into account the scores of 1 for intelligence and secrecy, as well as the absolute absence of material evidence of biological attack, we should accept the scenario as a spontaneous outbreak of a new or re-emerging disease.

Emerging diseases, both new to a region like West Nile virus encephalitis, and totally “new” like SARS and avian influenza, have occurred in the last decade. Examples include the appearance of West Nile virus encephalitis in New York City in 1999 [8], bubonic plague cases in New York City in 2002 [3], or monkey pox outbreak in the USA in 2003.

The West Nile virus encephalitis outbreak in New York City in 1999 constituted a true emerging infection, as the disease became established in a new location, while the plague cases were simply imported by out-of-state residents. Until the epidemic in New York City in 1999, West Nile virus had never been isolated in the Western hemisphere. Many diseases, such as dengue fever in Cuba having been imported from Vietnam, or vivax malaria in Korea, represent a re-establishment of endemic transmission in areas from which they were once eradicated. About 40 new pathogens have been found in the last 35 years [11]. The United States was caught off-guard by the

Table 3.1 Assessment of four unusual epidemiologic events by a differentiation scoring

| Parameter | Swine flu | | | Amerithrax | | | Kosovo tularemia | | | Sverdlovsk anthrax | | |
|---|-----------|-----|-----|------------|----|-----|------------------|----|----|--------------------|----|----|
| | BA | NE | NR | AR | BA | NE | NR | AR | BA | NE | NR | AR |
| Perpetrator | | | | | | | | | | | | |
| Source/Reservoir of infection | | | | | | | | | | | | |
| Sophistication | 0 | N/A | N/A | 0 | 1 | N/A | N/A | 0 | 0 | 1 | 0 | 1 |
| Motivation/Intention | 0 | N/A | N/A | 0 | 1 | N/A | N/A | 0 | 1 | 0 | 0 | 0 |
| Ability | 0 | N/A | N/A | 0 | 1 | N/A | N/A | 0 | 0 | 0 | 0 | 1 |
| Capacity | 0 | N/A | N/A | 0 | 1 | N/A | N/A | 0 | 0 | 0 | 0 | 1 |
| Intelligence | 0 | N/A | N/A | 0 | 1 | N/A | N/A | 0 | 0 | 1 | 0 | 1 |
| Secrecy | 0 | N/A | N/A | 0 | 1 | N/A | N/A | 0 | 0 | 0 | 0 | 1 |
| Number of perpetrators / sources / reservoirs | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Accessibility to sources of agent | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| Accessibility to targets | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Agent | | | | | | | | | | | | |
| Pathogen | | | | | | | | | | | | |
| A category | - | 0 | 0 | - | 1 | - | - | - | 1 | 1 | - | 1 |
| B category | - | 0 | 0 | - | 0 | - | - | - | 0 | 0 | - | 0 |
| C category | - | 0 | 0 | - | 0 | - | - | - | 0 | 0 | - | 0 |
| Emerging agent | - | 0 | 1 | - | 0 | - | - | - | 0 | 0 | - | 0 |
| Amount of the available agent | - | 0 | 1 | - | 1 | - | - | - | 1 | 1 | - | 1 |
| Means/Media of delivery | | | | | | | | | | | | |
| Transmission mechanisms | | | | | | | | | | | | |
| Air | - | - | 1 | - | 1 | - | - | - | 0 | 1 | - | 1 |
| Food | - | - | 0 | - | 0 | - | - | - | 0 | 1 | - | 0 |
| Water | - | - | 0 | - | 0 | - | - | - | 0 | 1 | - | 0 |
| Fomites | - | - | 1 | - | 1 | - | - | - | 0 | 1 | - | 0 |

| | | | | | | | | | | | | | | | | |
|------------------------------------|---|---|-----------|---|-----------|---|---|---|-----------|---|---|----|---|---|-----------|--|
| Vectors | - | - | 0 | - | - | - | - | 0 | 1 | - | - | 0 | - | - | 0 | |
| Munition | - | - | 0 | - | - | - | - | 0 | 0 | - | - | 0 | - | - | 0 | |
| Delivery systems | - | - | 0 | - | - | - | - | 0 | 0 | - | - | 0 | - | - | 0 | |
| Dispersion systems | - | - | 0 | - | - | - | - | 0 | 0 | - | - | 0 | - | - | 0 | |
| Target | | | | | | | | | | | | | | | | |
| Susceptible population | | | | | | | | | | | | | | | | |
| Intelligence | - | - | 1 | - | 1 | - | - | 0 | 1 | - | - | 0 | - | - | 1 | |
| Secrecy | - | - | 1 | - | 1 | - | - | 0 | 0 | - | - | 1 | - | - | 1 | |
| Personal control | - | - | 0 | - | 1 | - | - | 0 | 0 | - | - | 1 | - | - | 1 | |
| Control of means / media | - | - | 0 | - | 1 | - | - | 0 | 0 | - | - | 1 | - | - | 1 | |
| Physical protection | - | - | 0 | - | 1 | - | - | 0 | 0 | - | - | 1 | - | - | 1 | |
| Protection by chemo-prophylaxis | - | - | 0 | - | 1 | - | - | 0 | 0 | - | - | 1 | - | - | 1 | |
| Protection by immuno-prophylaxis | - | - | 0 | - | 1 | - | - | 0 | 0 | - | - | 1 | - | - | 1 | |
| Importance of target | - | - | 1 | - | 1 | - | - | 0 | 1 | - | - | 0 | - | - | 1 | |
| Number of people in a target | - | - | 1 | - | 1 | - | - | 0 | 1 | - | - | 0 | - | - | 1 | |
| Distribution of people in a target | - | - | 1 | - | 1 | - | - | 0 | 1 | - | - | 0 | - | - | 1 | |
| Location of target | - | - | 1 | - | 1 | - | - | 0 | 1 | - | - | 0 | - | - | 1 | |
| Total | 0 | 3 | 13 | 0 | 25 | 0 | 0 | 0 | 15 | 3 | 0 | 15 | 0 | 0 | 22 | |

BA Biological attack, NE Natural epidemic, NR Outbreak of a new or re-emerging disease, AR Accidental release of a pathogen

0 = Low probability, 1 = High probability, N/A = not applicable, -- = Eliminated from further consideration

Total: 0-8 = Lowly probable type of outbreak, 9-16 = Possible type of outbreak, 17-24 = Highly probable type of outbreak, 25-33 = Certain type of outbreak

increasing AIDS epidemic that began in the early 1980s. Today, the AIDS epidemic – at the beginning of the twenty-first century – is worse than the worst-case scenarios that were predicted in the early 1990s. Tuberculosis, re-emerged in the United States in the 1980s after decades of decline, and includes newer multidrug-resistant strains.

3.3.2 Intentional Attack by Deliberate Use of a Biological Agent (Amerithrax)

Perpetrator. There were repeated and separate BAs using this agent (e.g. multiple letters sent), which is not very probable in an accidental release.

Agent. The causative agent in this scenario is a category A agent (Ames strain from the US Army Medical Research Institute for Infectious Diseases, Fort Detrick) that was misused by an experienced insider and specially prepared and released deliberately in a significant amount. Because of this, a natural outbreak of a known endemic disease and a spontaneous outbreak of a new or re-emerging disease are clearly eliminated from further consideration.

Transmission mechanisms and devices vs. media and means of delivery. The perpetrator used postal letters (fomites) and the American Postal Service (delivery system) for the BA.

Susceptible population vs. target. Three indicators – intelligence, secrecy and personal control (of employees with access to the agent) – were not successfully applied at the initial phase of the BA. Intelligence is a cornerstone of prevention. Information is provided using electronic surveillance methods, local intelligence systems, and observation of possible targets. Repeated visits by individuals or vehicles must be identified. The impact of secrecy has been evident in some recent incidents. Such an incident occurred in the aftermath of the 2001 anthrax letter attacks. Although the US Postal Service and the CDC knew that the Brentwood postal facility in Washington, D.C., was contaminated, they waited for 4 days before closing the facility and treating workers with antibiotics. By that time, one worker had died of anthrax, another was close to death, and two were gravely ill. Another example is China in 2003, when the government denied the SARS epidemic for 6 weeks, causing international alarm and spread of the disease. These examples illustrate that government secrecy is a persistent jeopardy, leaves the public in ignorance, and allows narrow-minded political agendas to undermine healthcare goals. Personal control includes physical control of people (their health status) and behavioral control (CV review, control of suspect behavior, control of contacts) [19].

Conclusion. “System elimination” clearly eliminates the other three scenarios by the “agent” and “perpetrator” components. Therefore, we should accept the BA scenario as the likely event.

During 1900–2001, 77 biological “events” (i.e. episodes involving the deliberate use of a biological agent to harm people) were perpetrated. Of these, just four

post-1945 events generated more than ten casualties [28]. Besides this, about a thousand anthrax hoaxes occurred alone between 1996 and 2001 which concerned the public, administration, and public health authorities, prompting excessive decontamination and post-exposure measures and intensive forensic and laboratory investigations in order to discriminate the events as false alarms.

3.3.3 Spontaneous Natural Outbreak of a Known Endemic Disease That May Mimic Bioterrorism or Biowarfare (Kosovo Tularemia Outbreak)

Reservoirs/sources. In the Kosovo tularemia outbreak, only an insider could be a possible perpetrator as others would not have the ability or knowledge because of the unpredictable war and after-war events. The secrecy and capacity needed would be possible only from highly sophisticated insiders. The qualitative indicators from BA and natural epidemic scenarios are not similar (rodents were reservoirs) and their differences are assessed in the rest of the indicators. Quantitative indicators are also different. The number of perpetrators should be numerous but were not identified, however the number of rodents as reservoirs were numerous. Comparing the accessibility to sources of the agent with the distribution sources of the agent, as well as accessibility to the target by perpetrators (humans) and rodents as reservoirs, there are significant differences. Because of the timing and geographically very dispersed occurrence of cases, quantitative indicators related to a perpetrator were scored with 0, and those related to a natural epidemic were scored with 1. A spontaneous outbreak by an accidental release of a pathogen and BA were not likely scenarios because of the timing, geographic separation, and repeated occurrence of cases.

Agent. The implicated agent was *Francisella tularensis holarctica*, that causes a milder form of tularemia and is endemic in the Balkan region. Because of this, a spontaneous outbreak of a new or re-emerging disease is clearly eliminated.

Transmission mechanisms and devices vs. media and means of delivery. There was no convincing and conclusive evidence for devices of delivery [12]. It is well known tularemia could be spread by multiple natural transmission sources like water, food, or animals, as was the case in this outbreak.

Susceptible population vs. target. This component should provide the final information to solve the conundrum between a BA and a natural epidemic scenario. There was no intelligence information (no convincing or conclusive indicator was documented regarding a possible perpetrator), no secrecy (no attempts to control information after the first diagnosed cases), no control of means/media, no physical protection, chemical protection, or immunological protection (all three types of protection and ways to control transmission were absent or implemented late), and a lack of significance from a military/terrorist BA logistical standpoint in the importance and location of the target, and the number and distribution of the people affected.

Conclusion. “System elimination” clearly excluded a spontaneous outbreak of a new or re-emerging disease because of the agent type (not new or re-emerging). The scenario of spontaneous outbreak by an accidental release of a pathogen was also not likely because of timing, geographic dispersion, and repeated occurrence of cases without any convincing and conclusive indicator. The total score supports a scenario of a spontaneous natural outbreak of a known endemic disease that could mimic bioterrorism or bio-warfare.

3.3.4 Spontaneous Outbreak by an Accidental Release of a Pathogen (Sverdlovsk Anthrax Outbreak)

Perpetrator. In the Sverdlovsk anthrax outbreak, the large amount of agent (enough to contaminate a city with thousands of inhabitants and the surrounding area) was not likely spread from a natural source or reservoir of infection unobserved and in such a short time. These facts eliminate two scenarios: natural epidemic and a spontaneous outbreak of a new or re-emerging disease. Regarding the circumstances in the 1960s in the former Soviet Union with an isolated city (Sverdlovsk) in Siberia, for a BA scenario, capacity and secrecy are scored with 0.

Agent. There was a large amount of spores of a virulent strain of *Bacillus anthracis* (Category A agent) as the causative agent. Accordingly, we scored those two indicators with 1.

Transmission mechanisms and devices vs. media and means of delivery. There were no delivery devices identified. However, the only way to spread such large quantities of anthrax spores during this short period of time was by air.

Susceptible population vs. target. This component should solve the doubt between a BA and accidental pathogen release scenario. In terms of intelligence, no conclusive or inconclusive perpetrator activities or other evidence related to BA were documented, but there was very conclusive evidence related to an accidental release. In terms of secrecy, there was prolonged and stringent secrecy and disinformation supported by Soviet officials about the event. Personal control, control of means/media, physical protection, chemical protection, immunological protection were carried out quickly. The last four indicators – importance of target, number of people in the target, distribution of people in the target, and location of target – were without significance and any military/terrorist logic in a BA scenario. An accidental release scenario was possible, especially accounting for the circumstances (military compound dealing with production of a biological warfare agent close to the city).

Conclusion. “System elimination” clearly eliminates a natural epidemic and a spontaneous outbreak of a new or re-emerging disease through the perpetrator/sources/reservoirs component. Large amounts of the agent in the Sverdlovsk anthrax outbreak were not possible from natural sources/reservoirs of infection in such a short time and would not likely have been otherwise undetected before human cases occurred.

The total score supports a scenario of a spontaneous outbreak by an accidental release of a pathogen as the most likely scenario. Also, if a country rejects foreign help and experts and hides the circumstances of an epidemic it could raise suspicion for an accidental release epidemic scenario.

3.4 General Conclusion

The author has developed a new scoring method of outbreak analysis: for subtle and detailed differentiation. The method was applied to four UEEs: (1) an intentional attack by a deliberate use of a biological agent (Amerithrax), (2) a spontaneous outbreak of a new or re-emerging disease (“swine flu”), (3) a spontaneous outbreak by an accidental release of a pathogen (Sverdlovsk anthrax), and (4) a spontaneous natural outbreak of a known endemic disease that may mimic bioterrorism or biowarfare (Kosovo tularemia). It was found that “agent” was the most important and the most informative UEE component of the new scoring method. This method might be helpful in the analysis of unusual epidemic events and a quick way to differentiate between biological attacks and other epidemics.

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