

## **THE IMPROVISED EXPLOSIVE DEVICE (IED) AS A THREAT TO INFECTIOUS HOSPITAL WARDS**

Michal PTÁČEK, Radomír ŠČUREK, Věra HOLUBOVÁ

### **Abstract**

*Nowadays, when various pressure and/or terrorist groups try to incite panic among people, potential risk of attack against a healthcare facility cannot be underestimated in the Czech Republic, either. It is the infectious wards in hospitals that are considered to be possible targets of terrorist attacks in this article. A terrorist attack against infectious wards would, apart from causing fear of personal injury and infrastructure damage, add to the panic concerning a possible escape of dangerous biological agents.*

*As concerns a possible way of attack, this report takes into consideration improvised explosive devices because of their simplicity and an easy application requiring minimal technical and personnel skills.*

### **Key words**

*Improvised Explosive Device (IED), Terrorism, Types of IED, Infectious medicine departments.*

### **METHODS OF SCIENTIFIC WORK**

Scientific methods used in the article:

Exploration - Classifies and describes the problem or situation.

Prediction - Describes the relationships between the phenomena under investigation.

Explanation - Explanation of these phenomena and their dependencies.

### **INTRODUCTION**

Terrorists and pressure groups generally use various actions to achieve their aims: to cause fear in the general public. Where there is fear everywhere, it is easier to keep the society subdued.

The pressure groups tend to choose as a target of their attacks usually those locations or institutions the assaults to which generally induce great response. The recent years saw big terrorist attacks e.g. in shopping centres, marketplaces, railway stations or for example on major town squares.

Hospitals also present a very good target for terrorists. A hospital is a place where there are many people in a small area [1].

Reports in the mass media - preferably with abundant picture documentation of evacuated wounded children or sick elderly people - create a deserved effect for the pressure groups.

Very interesting from the point of view of panic attackers can be an attack on the infectious ward of a hospital. In addition to the general effect of hospital infestation itself, its decommissioning and the ensuing fear of the inability to provide adequate health care in the region, there may also be the risk of spreading the infection to the environment around.

For the above stated reasons, a possible terrorist attack against a hospital's infectious diseases separation ward should be considered a priority.

Some attacks against hospitals have already been registered. Between 1981 and 2013, about 100 terrorist attacks at hospitals were committed worldwide, in 43 countries on every continent, killing more than 775 people and wounding at least 1,217 others [12].

The available literature does not mention any terrorist attack directed against an infectious ward in order to enhance the destruction on the biological basis.

Fortunately, the concept of health care and the occurrence of high-risk infections in the Czech Republic is currently not a subject to significant epidemiological risk. A significant epidemiological risk is not even likely to arise where an improvised explosive device system is used. Such system is most commonly applied by terrorists who assault a hospital which cares for rare patients suffering from a highly dangerous infectious disease.

## **INFECTIOUS DISEASES**

Infectious diseases are considered to be those where their agents are live microorganisms. In general, bacteria, viruses and fungi are the pathogens of infectious diseases. The transmission of pathogenic microorganisms between hosts occurs under certain conditions necessary for the transmission of diseases. In the past, infectious diseases were the focus of non-surgical medicine disciplines [2].

The incidence of infectious diseases is closely related to the maturity of society. In low-sanitation environments, drinking water shortages, floods, natural disasters or in areas with significant cumulative incidence, infectious diseases occur more frequently. As an example of the past we can use plague wounds (originator was the Gram negative bacteria *Yersinia pestis*) in the absence of sewerage in large urban agglomerations with low levels of hygiene.

Although infectious diseases are numerous in general, socially or epidemiologically serious infections number only a few dozen. Only a few of such dangerous infectious diseases naturally occur in the Czech Republic.

There is a law in the Czech Republic applicable to the individual diseases. A list of illnesses is set out in the relevant legal regulation [3].

The epidemiological situation in the Czech Republic is not a serious risk from the point of view of infectious diseases in general. Although we can find at least one infectious department in the hospital in every district of the Czech Republic, the incidence of infectious diseases is in decline in the region.

## **THE PRESENT CONCEPT OF INFECTIOUS DEPARTEMENTS IN THE CZECH REPUBLIC**

The overview of infectious diseases inpatient departments in the hospitals in the Czech Republic (2018) is shown in Figure 1 [4].

Not all infectious diseases require treatment (e.g. common cold – caused by respiratory viruses). Much of the infection goes away without treatment. Another substantial part of infectious diseases is to be treated by GPs (general practitioners) or specialized physicians (community pneumonia, uncomplicated urinary tract inflammation). Infectious departments of hospitals are designated only for very severe, rare or obligatorily isolated infectious diseases.

The current main field of infectious medicine in the Czech Republic is in the outpatient part of vaccination and prevention. Hospitalized people in hospitals are treated for HIV infection, viral hepatitis, herpes (severe skin, genital or neural form) infections, infectious diarrheal diseases, infections of the nervous system, rarely parasites. Part of the field of infectious medicine is also sexually transmitted diseases.

No terrorist attack on some of the Czech infectious diseases departments would probably pose a significant epidemiological risk from the point of view of the epidemiologist (meant to hundreds of people). Mandatory hospitalized transmissible diseases in the Czech Republic usually have a different way of spreading than airborne (e.g. blood contamination, sexual intercourse, etc.), they would probably not be a significant threat to the population.

The impact on society would be rather in the level of fear and panic than the risk of infection. A terrorist attack led against the infectious disease ward in the Czech Republic would probably have an effect rather in the level of general panic than in the form of a hygienic-epidemiological risk because of the composition of the diseases and the paths of their spread and dissemination. The greatest risk of using an explosive in infectious wards is when exploding, the blood contamination seems to be less severe. The risk of the free movement of “infectious patients” during and after the terrorist attack outside the ward is minimal in the ordinary intermittent contact with the healthy individuals.



- Infectious ward
- Infectious ward as part of an Internal medicine clinic

*Figure 1*  
*The overview of infectious wards in the Czech hospitals (May 2018)*

The basic principles of the treatment of infectious diseases in particular: Isolation, rehydration, pain relief, treatment of the inner environment, and especially causative treatment of drug-inducing agents (antibiotics, antivirals, antimycotics). Infectious diseases are mandatorily to be reported and patient information is required to be handed over to the health service.

**BIOSAFETY LEVEL**

Several scales have been developed to assess the possible risk of infection. BSL (Biosafety level) is the most commonly used scale in the literature. For biostatistics, the BSL classification is problematic in the conditions of the Czech Republic; the BSL is not required for reporting in the statistics (BSL was created for laboratory rather than clinical practice).

A biosafety level is a set of bio containment precautions required to isolate dangerous biological agents in an enclosed laboratory facility. The levels of containment range from the lowest biosafety level 1 (BSL-1) to the highest at level 4 (BSL-4). A brief overview can be found in Figure 2 [13].

Biosafety Level	BSL-1	BSL-2	BSL-3	BSL-4
Description	<ul style="list-style-type: none"> <li>· No Containment</li> <li>· Defined organisms</li> <li>· Unlikely to cause disease</li> </ul>	<ul style="list-style-type: none"> <li>· Containment</li> <li>· Moderate Risk</li> <li>· Disease of varying severity</li> </ul>	<ul style="list-style-type: none"> <li>· High Containment</li> <li>· Aerosol Transmission</li> <li>· Serious/Potentially lethal disease</li> </ul>	<ul style="list-style-type: none"> <li>· Max Containment</li> <li>· "Exotic," High-Risk Agents</li> <li>· Life-threatening disease</li> </ul>
Sample Organisms	E.Coli	Influenza, HIV, Lyme Disease	Tuberculosis	Ebola Virus
Pathogen Type	Agents that present minimal potential hazard to personnel & the environment.	Agents associated with human disease & pose moderate hazards to personnel & the environment.	Indigenous or exotic agents, agents that present a potential for aerosol transmission, & agents causing serious or potentially lethal disease.	Dangerous & exotic agents that pose a high risk of aerosol-transmitted laboratory infections & life-threatening disease.
Autoclave Requirements	None	None	Pass-thru autoclave with Bioseal required in laboratory room.	Pass-thru autoclave with Bioseal required in laboratory room.

*Figure 2*  
*Examples of BSL categories*

The BSL 3 regimen is to be found in one hospital in Prague – The Bulovka Hospital; The BSL 4, both beds and laboratory services, can be provided by the Armed Forces of the Czech Republic within its facilities.

Infections under the BSL 4 regimen occur in the Czech Republic quite sporadically and only as imported diseases. The patients infected or suspected as being infected are to be transported in bio boxes by the Health Emergency Service. The technical handling of the transfer and the following decontamination of the bio boxes or, as the case may be, of the health service personnel, may be provided by the fire-fighters. The fire-fighters, however, may not under any circumstances enter specialized workplaces nor render any care. Any provision of health care falls within the exclusive competence of the facilities' especially trained medical employees and a specially accredited laboratory. Such facility is also responsible for maintaining the applicable documentation. The decontamination may also be carried out by the anti-chemical troops of the Armed Forces of the Czech Republic.

## HIGHLY DANGEROUS INFECTIONS

A certain hygienic-epidemiological risk could be attacking an infectious ward by terrorists at the (rare) time of hospitalization of a patient experiencing a high-risk infectious disease.

A highly dangerous infection is usually thought to be the airborne route of transmission, where a small amount of infectious agents creates a disease in the other victim and where no strong/effective treatment is known/available. The highly dangerous diseases are caused by pathogens of BSL 3 and 4. Such diseases are not commonly found in the Czech Republic. Several times a year, however, they occur as imported infections. The most often is tuberculosis (BSL 3, up to 100 persons/year, others are much more rare, there was no BSL 4 infection in the Czech Republic last years). As the BSL 4 we can mention as an example bleeding fevers, such as the Ebola fever or plaque.

Because high-risk infections require special personnel, technical and spatial equipment, their treatment in the Czech Republic is centralized into a single medical facility in Prague.

The Clinic of Infectious, Parasitic and Tropical Diseases in the Bulovka Hospital in Prague is a workplace that focuses besides on patients with a threatening or proven high-risk disease. This facility is able to provide intensive care to these patients as well. In case of exceeding the capacity of the workplace, under certain circumstances it is able to provide further care to the Army of the Czech Republic through its Medical Base. Then it would probably be the use of a military medical facility in Techonin.

Recommendations on the diagnosis, transport and treatment of the patient are also covered by legislation [5, 6].

The terrorists' attack against the medical care facility with a highly contagious airborne disease could pose a high hygienic-epidemiological risk to the environment and society.

The IMPROVED EXPLOSIVE EQUIPMENT (IED) appears to be the most likely means of carrying out a terrorist attack against the hospital's infirmary department. The next part of the message briefly approaches the IEDs.

## IMPROVISED EXPLOSIVE DEVICES (IED)

IED consists of a system of functional elements that can under certain given circumstances threaten the security of persons or property. Generally, it is a system using mechanical, explosive, incendiary, noxious, radioactive and other materials, or their combination. Mainly, an IED is composed of an explosive device, explosive or incendiary fill and is commonly placed in a container or its exterior is of such form that can hide the real function of the device. IEDs fall into two categories: tactical and strategic. The tactical IEDs are designed primarily against physical persons and incorporate nail bombs, mines or bombs placed in drains, cable covers, shafts etc. The strategic IEDs are designed to draw attention e.g. at airports, shopping malls, aircraft etc. The IED illustration is shown in Figure 3 and 4.



Figure 3

*IED - beads for greater destruction of the effect*



Figure 4

*IED hidden in the bag*

## EFFECTS OF IED

- *Primary effects of IED*

The direct action of explosion on objects and persons (pressure wave, shock wave, seismic wave and high temperature) [7, 8, 9]. The explosion acts on the environment by means of consequent expansion of waste from explosive transformation. However, in the case when a large amount of explosive material is involved (dozens kilograms), the seismic wave must be taken into account (ground vibration), because it may damage buildings.

- *Secondary effects of IED*

Secondary effects originate in the effects of explosion itself on persons or object. The secondary effects of IED are the following:

- a) Damage of lines and tanks – electrical, water, vapour, gas, furnace oil, oil, petrol, paints, thinners etc. is caused by heat action, pressure and seismic wave that originate in the explosion and can affect such lines and tanks. In case of any larger explosion a check of all lines and tanks located underground must be carried out in order to prevent possible consequent damages, especially ecological.
  - \* Explosion conditions at the hospital's infectious wards include, for example, damage to the power supply, hot service water, cold water, sewage, piping, and in particular possible damage to medical gas distribution - such as explosion or burning.
- b) Fall of loose objects on the objects in the explosion surroundings as a result of pressure or seismic wave caused by the IED explosion. Regarding the fact that the pressure wave spreads in all directions, the insufficiently fastened objects and those located in heights can be thrown down. Particularly dangerous are the objects with a board shape (e.g. glass panels used as a siding) that do not necessarily fall in vertically downwards direction but can glide and thus the impact point does not have to be the same as the fixing point.
  - \* Falls of parts of buildings are at risk in the hospital environment, particularly by the presence of a large number of old immobile persons or children whose evacuation becomes very difficult. Some patients must also be evacuated with instrument support.
- c) Fire is caused by action of heat, which is released in the explosion, on easily burning substances.
  - \* Burning in the hospital environment, especially in the stores of linen, diapers, further medical gases (oxygen, air). Risk of explosion of pressure vessels.

- d) Panic is caused by the action of explosion on the human psyche. A human being when panic-struck is not able to think reasonably and all his/her actions are driven by the self-preservation principle. In such case he/she acts regardless of other people. In the course of panic several injuries can occur, or eventually people might be killed e.g. trodden down.  
\* In the environment of a healthcare facility, it can be exacerbated by stoning, pain, disturbed consciousness, the presence of invasive inputs into the body (infusion set, ...).
- e) Shell effect originates in the explosion pressure wave affecting the container of IED and the objects in the explosion surroundings. The container and some other objects fall into small pieces (shells - fragments), that are speeded up by the pressure wave and, if hitting the human organism, they can cause injury or death.

For the risk assessment it is possible to use many existing computer based programmes, for example EMOFF (Emergency Office), TerEx program, RISKAN. Author's workplace has experience concerning licences for such tools. These computer programmes enable fairly quick prognosis of impacts and consequences, caused by dangerous substances or explosive devices, especially when categorically abused. However, their accuracy is not always on satisfactory level and the results are slightly inaccurate.

For the healthcare facility, it is especially important to anticipate the reduced mobility of some people as a result of poor health. In the case of a highly dangerous disease, evacuations with appropriate protection against biological agents must be provided.

## COMPONENTS OF IEDs

The basic components of IED are

- *An initiation system, trigger mechanism*

The initiation systems of IED are based on different mechanical systems, which react to tension, pressure, concussions, heat, radio signal etc. Along with it, different variations of time-related mechanisms (alarm clock, kitchen timer, digital time system) and various types of industrial fuse and combinations of these systems are used. Factory-made or homemade systems that use the chemical reaction of various substances and mixtures corrupting the retention mechanism of the trigger belong to less usual. The initiation systems can be further divided according to time, sensibility to outer stimulation and possible combinations.

- *Container of IED*

IED systems are transported or conserved mostly in various containers. In most cases they are pipes and tubes (using gunpowder and simple fuse, both explosion and shells can become a lethal weapon), cases, plastic soapboxes, cigarette packets, cigar boxes, glass bottles, tins, cans, electric appliances (irons, toasters, radios), fruit baskets, containers with magnets for easy grip, parcels, playing cards, projectile and cartridge shells, bins (functioning as additional IED container), stone containers, flower vases etc.

- *Explosive fill*

Explosive substances can exist as high explosives (military, commercial or homemade), explosives (standard or homemade), propellants (variations of gunpowder) or explosive gases (propan-butan, acetylene etc.) Most usually, the following kinds are used: Nitrate-based explosives, Chlorate-based explosives, Peroxide-based explosives, Fuel-air explosives and Hypergolic mixture explosives.

## TYPES OF IEDs

Basic distribution of explosive charges according to design. Following types of IED could be suitable for use at the hospital department [10]:

### *Pipe bomb*

This explosive device is widely used. Its main characteristics are: good availability of components, easy preparation and considerable variability of use. This explosive device is mainly a steel or cast-iron pipe filled with explosive material, where one end of the pipe is sealed and the other one ends with a holed screw cap through which the explosive pulse is brought. Particularly important for explosive effect is the pipe size, quantity of explosive material, type of used explosive and pipe wall thickness.

### *Shrapnel bomb with rectified effect*

The shape of shrapnel bomb is similar to pipe bomb. The iron pipe is equipped with an ignition, propellant explosive (smokeless or black powder) and one end is covered with a layer of small stones or scrap-metal. After initiation of propellant charge the expansive force shoots up the pieces of scrap-metal in the direction of iron pipe orientation. The initiation is produced either mechanically using the booby-trap or remotely (electrically).

### *Nail bomb*

The surface of the explosive charge is covered between two layers of nails that are fastened with sello tape, adhesive or else way. The nails accelerated to a high speed act as grenade shrapnel with similar consequences.

### *Letter bomb*

Letter bomb is a type of IED placed in a mail (envelope), containing a miniaturized charge of explosive. The initiation system is miniaturized and the trigger system is derived from the opening mechanism of an envelope.

### *Parcel bomb*

The charges placed in the postal packets can be of various designs and are designed to kill or injure the recipient. Its initiation system often derives from the packet opening.

### *Large improvised explosive devices*

Usually, large explosive devices are mostly used in terrorist attacks. As a main explosive fill, simple mixtures of ammonium nitrate and oil (or furnace oil), or ammonium nitrate and sugar (or flour) are often used. The ratio of large explosive devices to the overall number of explosive devices is relatively small; nevertheless their social threat is enormous, considering their highly destructive effect and the large number of casualties that are caused by explosion. Large explosion devices are therefore used to create an atmosphere of fear and an attitude of insecurity within the society and thus are very effective because their medial publicity is extraordinary.

## IED PLACEMENT INTO THE HOSPITAL ENVIRONMENT

To carry out a bomb terrorist attack on the hospital's infectious ward, the IED bomb is to be placed in the hospital. The above stated IED can be carried to hospital by many ways.

The most likely ways seem to be:

1. By mail or in a shipment of medical materials - IED can be placed into ordinary-looking luggage that was left unattended in corridors or in parcels with medical devices, in parcels with lingerie or medication. Goods are delivered via courier services, external companies and other channels outside the hospital.
2. By meal supplies - usually delivered in special cabin trucks which are often left alone in hospital technical areas.
3. Together with patients or with their visits. In the Czech Republic, the charge is still more likely to be introduced and installed than a by a suicide bomber.
4. By personnel - with the current shortage of workers across the health sector, recruiters and agency workers are employed. Some activities are often outsourced - cleaning, IT service. *Hospitals (except for military hospitals) often have very little control of third party employees.*
5. Direct offensive from the outside - unlikely in the Czech Republic. E.g. bombing, explosive vehicles into the medical department, etc.

The environment of Czech hospitals *with the exception of the Czech military hospitals* is rather insufficient for physical security. There are workplaces where entry and departure are not fully monitored during most days. The protection against an intrusion of a stranger into the clinical workplaces is in some cases next to none. Most of the health care facilities are attended daily by students and trainees from various schools whose records are virtually non-existent. The current personnel sub-dimensioning of Czech medical system does not systematically prevent any possible terrorist bombing.

Multilevel security checks at hospitals – such as at airports – practically does not exist. Mechanisms for locating IED systems in Czech hospitals are not at all available. Although the traumatological plans take the possibility of a bomb terrorist attack into account, no practical experience with the issue in hand yet have been experienced in the Czech health care.

## CONCLUSION

The article briefly discussed the possibility of a terrorist attack against the infectious diseases departments within the Czech Republic. *Fortunately, no such direct terrorist bomb attack has been experienced recently either in the Czech Republic or in the neighbouring countries. However, more than one hundred have been described in the world.*

For a terrorist organization that aims to cause as much panic as possible, the hospital is an appealing target. A successful terrorist attack may be a good basis for extortion.

If the terrorists choose an appropriate infectious ward, the public might get convinced that in addition to a further possible attack, there is a risk of infection caused by the escaping infectious agents. Possible attack on the infectious ward is associated with a devastating impact on critical infrastructure (hospital), panic from the attack itself (injured elders, children, ...) and epidemiological risk (from possible spread of infection to the environment).

However, infectious patients in the Czech Republic are not, for the most part, an epidemiological risk to the rest of the population, even if they move freely in the environment. Some problems would probably arise in the case of a hospital infection that would threaten a patient with a highly contagious disease. However, such coincidents are rare in the Czech Republic. The care for high-risk patients is centralized.

Nevertheless, it has been repeatedly shown that prevention and defence against a hospital attack is currently inadequate in the Czech Republic. In many places, not least due to staff sub-dimensioning of the medical staff, the access to the infectious diseases department is

not monitored at all. This situation enables possible criminal behaviour. In the future, it will be necessary to take certain measures to increase safety in Czech hospitals.

The article, in its second part, provides a brief summary of the issue of the Explosive Systems (IED), which could be used by the terrorists to carry out the attack.

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