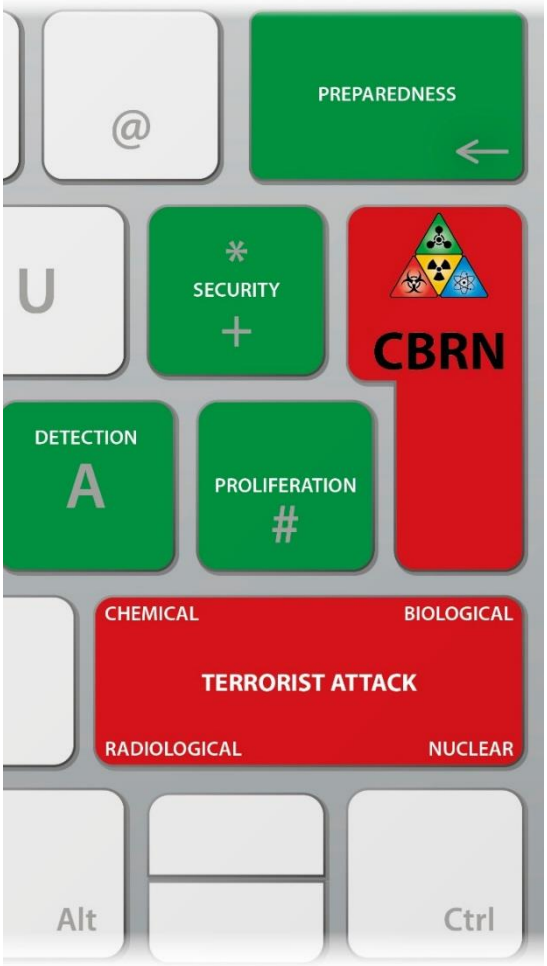
STUDY
for the TERR committee

European Parliament

Member States' Preparedness for CBRN Threats

Terrorism



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TERRORISM

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STUDY

Abstract

This study, commissioned by the European Parliament's Policy Department for Citizens' Rights and Constitutional Affairs at the request of the Special Committee on Terrorism outlines the threats posed by Chemical, Biological, Radiological and Nuclear (CBRN) weapons, examines how well Europe is prepared for these threats and assesses where preparedness and response could be improved. It suggests that to date, terrorist attacks in Europe have largely utilised conventional weapons where medical staff are able to respond using conventional medicine and medical practices. However, threats from the use of CBRN materials for terrorism remain high and evolving. The future threats are likely to come from the use of chemical and biological weapons.

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LIST OF ABBREVIATIONS

ACHE	Acetylcholinesterase
BARDA	Biomedical Advanced Research and Developemnt Authority
CCHV	Crimean Congo Haemorrhagic virus
CBRN	Chemical, Nuclear, Radiological and Nuclear
CDC	Center for Disease Control
CRISPR	Clustered Regulatory Interspaced Short Pandromic Repeats
DNA	Deoxy Ribo Nucleic Acid
IAEA	International Atomic Energy Commission
EIDS	Emerging Infectious Diseases
EU	European Union
JPM	Joint Procurement Mechanism
MOU	Memorandum of Understanding (UK)
NHS	National Health Service
PHE	Public Health England
SNS	Strategic National Stockpile
EU	European Union
IS/ISIS	Islamic State
EUROPOL	European Agency for Law Enforcement Cooperation
NHS	National Health Service (United Kingdom)
R&D	Research and Development
UK	United Kingdom
US	United States
UN	United Nations
WHO	World Health Organization

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EXECUTIVE SUMMARY

Increasing indications, reports and studies provide good reason to believe that threats from the deliberate use of Chemical, Biological, Radiological and Nuclear (CBRN) materials remain high and are evolving. The future threats are likely to come from the use of chemical and biological weapons. These include nerve agents such as Novichok and sarin, blister agents such as mustard gas, choking agents such as chlorine and a range of bacterial and viral pathogens such as anthrax and smallpox. Chemical weapons have already been used in Iraq and Syria and there are indications that organisations such as the Islamic State (ISIS) are experimenting with biological weapons.

The potential scale of destruction which chemical and biological attacks is significantly higher than conventional weapons. Moreover, countries are less equipped to deal with consequences medically and in terms of infrastructure, further adding to their hazard. The anthrax attack in the US in 2001 exemplified the potential these weapons have to disrupt government and the reach even a small amount of a chemical weapon can have, with multiple deaths and 30,000 citizens requiring antibiotic treatment.

The threat emerges from both state and non-state actors. The attack on 4 March 2018 in Salisbury (United Kingdom) using Novichok has demonstrated to Europe the real threat emerging from Russia while evidence proves non-state actors such as ISIS are realising the potential of CBRN weapons. This analysis acknowledges that it is the primary responsibility of individual Member States to protect citizens but it also highlights the lack of specific EU legislation which can lead to, amongst other things, unequal distribution of medical supplies. However, one important piece of legislation was adopted on 15 March 2017, the Directive of the European Parliament and of the Council on combating terrorism which obliges Member States to treat victims of terrorism. While key initiatives have been taken at the EU level to strengthen preparedness and response against CBRN attacks, no state is currently as prepared as the United States which signals room for improvement.

As a result of this analysis it is recommended that further improvements be made in order to improve Europe's preparedness and response capability. Countermeasures need to be used within hours and days after an attack to be effective and are not normally available off the shelf. The recommended solution is to establish adequate stockpiles of countermeasures within the EU. Products could be acquired through the EU Joint Procurement Mechanism, and this mechanism should be further strengthened so that it is more attractive to Member States and suppliers. Another gap identified in the analysis is the lack of protection for first responders: it is recommended that we protect them with medical countermeasures. Throughout this analysis the importance of Industry is also taken into consideration; it is clear that governments alone do not have the capabilities to manage this multifaceted challenge alone. Without co-operation with Industry, EU Member States will not realise their full potential to respond to CBRN threats.

1. THE MAJOR CBRN THREATS

KEY FINDINGS

- There are a number of chemical, biological and radiological agents that can be used as weapons by terrorist groups or state actors where the technology for weaponisation already exists.
- The types of threats we are likely to face going forward come from the use of chemical and biological weapons.
- Emerging diseases pose a new threat in Europe as changes in climate, global trade and travel allowing some of these diseases to move further into Europe. Some of these could be used by terrorists as they become more common in the European environment.

Several experts[1] have warned that there is a genuine risk that terrorist groups and/or state actors may use chemical, biological, radiological or nuclear (CBRN) weapons in future attacks in Europe. This Chapter serves to define the nature of these threats, identify likely weapons and determine what type of threats we will face in the future.

1.1. Definitions of CBRN threats

Chemical weapons are defined as synthetically manufactured non-living agents that can be dispersed as gases, solids or liquids and can be delivered through inhalation, ingestion or absorption through the skin. These types of agents produce incapacitating, damaging or lethal effects in humans and are usually very fast acting. There are several classes of small molecules that can or have been weaponised for chemical attacks. The most common threats come from mustard gas (blistering), chlorine (choking, respiratory problems and burns), sarin, VX and Novichok (nerve agents) and cyanide (blood agents).

There is also the possibility of using readily available materials such as pesticides as chemical weapons. Chlorine and mustard gas are considered to pose the biggest threat because of their greater accessibility and ease of use although the use of Novichok in Salisbury (UK) on 4 March 2018[2] known to be part of a Russian chemical weapons programme, poses a new threat given that these are supposedly highly controlled substances.

Biological weapons comprise weaponised living disease causing agents such as bacteria and viruses or non-living agents such as toxins which are derived from bacterial pathogens.

[1] Nomi Bar-Yacov 'What if ISIS launces a chemical attack in Europe', The Guardian 27 November 2015; Wolfgang Rudischhauser, 'Could ISIL go nuclear?', NATO Review magazine, May 2015, Weimeng Yeo, 'Salafi Jihadists and chemical, biological, radiological, nuclear terrorism: Evaluating the threat', Risk management, solutions, 24 August 2015. Unal, Beza. "Use of Chemical, Biological, Radiological and Nuclear weapons by non-state actors: Emerging trends and Risk Factors" Emerging Risk Report, 2016 Innovation series, Chatham House: The Royal Institute of International Affairs, January 2016.11. Immenkamp, Beatrix, "ISIL/Da'esh and 'Non-conventional weapons of terror", Briefing, European Parliamentary Research Service, May 2016.

[2] Hay, Alastair, 'Novichok: the deadly story behind the nerve agent in Sergei Skripal spy attack' The Independent 28 March 2018.

The technology already exists with regards to biological weapons; there are a number of bacteria, viruses and toxins that can be considered as threats. Those considered the highest threat in terms of virulence, transmissibility and lethality are anthrax and plague (bacteria), botulinum and ricin (toxins) and smallpox (virus).

The technology for weaponising these agents is known as they have previously been developed by state actors. Anthrax and neuro-toxins (such as botulinum) are considered to pose the biggest threat because of their relative ease of production and their suitability for weaponisation. These agents can also be isolated and cultured from the environment which further increases the risk of their use as they do not need to be acquired from a secure facility.

Radiological weapons combine a radiological material with a dispersion method such as an aerosol or liquid which can result in ingestion or inhalation of the radioactive material. The exposure to alpha and beta particles and gamma rays leads to incapacitating and lethal effects. The greatest fear is that these types of weapons could be used in a dirty bomb where it is combined with conventional explosives or by contaminating the food or water supplies.

Nuclear weapons comprise explosives and the means for their delivery. Use of such weapons by a rogue state or terrorist group would result in devastating consequences through the powerful blast and exposure to thermal radiation with far-reaching effects into the future through the presence of residual radiation.

The most likely threat agents to be used are further detailed in Table 1.

The types of threats we are likely to face going forward are likely to come from the use of chemical and biological weapons as described below. In addition there are concerns that Emerging Infectious Diseases (EIDs) could become more prevalent in Europe and could possibly be used as weapons in their own right.

1.2. Likely CBRN threats in the future

Chemical attacks are becoming increasingly easier to carry out because the knowledge barrier is low and equipment and materials are readily accessible. There is also a fear that dual-use chemicals, such as pesticides could also be used as weapons. Increasing evidence suggests that terrorists can access chemical weapons stockpiles in unstable states such as Syria.[3] Chlorine and mustard gas are the recent chemical weapons of choice and have been used in chemical attacks with increasing frequency relative to other agents due to their greater accessibility and ease of use.

Biological threats remain a continuing threat with evidence that terrorist groups are experimenting with such weapons. Biological agents have traditionally been challenging to handle and contain but advances in technology and dissemination of knowledge via the internet have reduced these barriers. The advent of molecular biology techniques allows the easy manipulation of bacteria and viruses providing the means to synthesise pathogenic organisms without having to source the organisms themselves. From an attack perspective, anthrax and toxins are the most prominent threats due to their ease of manufacture and weaponisation compared to other biological agents.

[3] Deutsch, Anthony, 'Weapons Achieving Universality of the Chemical Weapons Convention in the Middle East.179. Inspectors find undeclared Sarin and VX traces in Syria – Diplomats', Reuters, 8 May 2015.

The use of radiological weapons is considered to be a lower threat in terms of probability of use and severity of consequences. However, the threat still exists, it is known that terrorist organisations have an interest in obtaining materials for radiological weapons and it is known that there are many incidents of material going missing each year through theft and loss. For example, in 2014, the European Commission noted that 150 cases of trafficking of radiological and nuclear materials are reported annually to the Incident and Trafficking database of the International Atomic Energy Agency (IAEA).[4]

The threat of the use of a nuclear weapon is thought to be less likely because there are global treaties limiting their use and it would be difficult for non-state actors to acquire them. The biggest threat from a nuclear incident is more like to come from a major accident or a cyber-attack on a nuclear facility.

1.3. Emerging infectious diseases as a new threat

Europe is one of the best prepared regions in the world for dealing with pandemics such as influenza. However, given it has a central role in global trade and travel emerging diseases can quickly be transmitted from endemic areas to Europe. There is also evidence that due to global warming, some disease vectors such as mosquitos can move further into Europe, therefore increasing the risk of spread of disease. This has given rise to concerns that diseases such as Crimean Congo Haemorrhagic fever (CCHV), Lyme disease, west Nile fever, leishmaniosis, dengue fever and chikungunya may spread more widely in Europe, facilitating their use by terrorists as they become more widely available in the environment.[5]

[4] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions on a new EU approach to the detection and mitigation of CBRN-E risks (COM(2014) 247 final), https://ec.europa.eu/home-affairs/sites/homeaffairs/files/what-we-do/policies/crisis-and-terrorism/explosives/docs/20140505_detection_and_mitigation_of_cbrn-e_risks_at_eu_level_en.pdf

[5] Lingren, Elisabet, Anderson, Yvonne, Suk, Jonathan, Sudre, Bertrand and Semenza, Jan. "Monitoring EU emerging infectious disease risk due to Climate change", Science magazine, Public Health 336 (27 April 2012): 418.

Table 1: Threat agents with significant weapons potential

Biological Agents	Chemical Agents	Radioactive Agents
Bacterial Anthrax Plague Tularaemia Brucellosis Salmonella	**Blistering** Sulphur Mustard Nitrogen Mustard Lewisite	**Radiological agents** Polonium 210 Caesium chloride Phosphorous P32
Toxins Botulinum toxin Ricin Staphylococcal enterotoxin B Trichothecene T2	**Choking** Chlorine Phosgene Diphosgene	Accident in a nuclear power plant
Viruses Smallpox Ebola Marburg Influenza CCHV	**Nerve** Sarin VX Tabun Soman Novichok	Nuclear attack by terrorists or foreign state

Source: Author

2. REALITY OF THE THREATS AND THE CONSEQUENCES

KEY FINDINGS

- Europe is facing the most significant threat from terrorists in 10 years.
- The major threat actor is likely to be Islamic State (ISIS) and ISIS inspired extremists. The decentralisation of ISIS may increase the threat to Europe as trained fighters return home and ISIS has opportunistically uses the refugee crisis to smuggle fighters into Europe.
- A growing threat is the use of synthetic biology, through genetic manipulation, to create antibiotic or antiviral resistant pathogens for use as biological weapons and to potentially create highly infectious pathogenic organisms without the need to have access to the virus itself.
- In terms of consequences, chemical and biological attacks have the potential to maim and kill on a much greater scale than conventional weapons, overwhelm medical responses, paralyse governments, transport systems and severely impact economies.
- The anthrax attack in the United States (US) in 2001 provides a good example of the impact of the use of a biological weapon. Envelopes containing anthrax spores were sent to various news media outlets and two US senators. This only involved around 1gm of anthrax spores but unfortunately resulted in five deaths, 22 illnesses and 30,000 needing to be treated with antibiotics. This also resulted in the need to de-contaminate three buildings including Capitol Hill which resulted in the disruption of government. The direct economic cost of this event was estimated at more than $1 billion.
- The US has also carried out an assessment of the impact of an aerosol attack where 1-2 kg of anthrax spores would be spread over a major city using a crop duster. They estimate it would cause approximately 380,000 deaths, 450,000 illnesses and up to more than 3 million requiring antibiotic treatment. Decontamination would need to be city wide and the projected economic cost has been estimated at more than $1.8 trillion.
- The 4 March 2018 attack with Novichok, although relatively small, involved a huge amount of resource requiring specialist capabilities from first responders and the military. In addition to the three victims who were taken seriously ill, it is now believed that at least 130 civilians were exposed to the nerve agent with the long term consequences being unknown. This relatively small incident put huge pressure on emergency services and chemical response capability with multiple sites, objects and vehicles being identified as potentially contaminated and requiring subsequent decontamination.

According to the Head of Europol, Europe is facing the most significant terrorist threat in 10 years.[6] Between 2012 and 2016 Europe has experienced a rise in the number of terrorist

[6] Immenkamp, Beatrix, "ISIL/Da'esh and 'Non-conventional weapons of terror", Briefing, European Parliamentary Research Service, May 2016.

attacks resulting in fatalities and the total fatalities from such attacks has risen dramatically (see table 2 below). The high number of fatalities is mainly as a result of a combination of a few highly co-ordinated and pre-planned attacks such as those in Paris and Nice in 2015 and 2016 respectively.

Europe's threat actor landscape includes both non-state and state actors such as home grown violent extremists, what remains of Islamic state in Syria and Iraq and European citizens returning home from fighting for ISIS as it is driven from its territorial bases. In terms of state actors, it has become clear that a nerve agent developed by the Russians has been used in an assassination attempt in the UK[7] and Syria continues to use chemical weapons against its own citizens.[8]

The security of CBRN material is also an issue and it is known that thefts and misplacements of such material occur on 100's of occasions each year.[9] An additional threat for the development of biological weapons is the advent of biotechnology and genetic manipulation. In terms of consequences, CBRN attacks have the potential to kill and maim on a much greater scale than conventional weapons and could quickly overwhelm medical responses and resources. This Chapter further explores the threats and the consequences posed by CBRN weapons:

Table 2 :Terrorist attacks in Europe 2012 – 2016

Metric	Incident				
	2012	2013	2014	2016	2017
Number of Fatal Terrorist Attacks	5	5	2	23	30
Total Fatalities from Terrorist Attacks	10	6	5	175	238
Number of Non-Fatal Terrorist Attacks	185	249	213	312	239

Source: Global Terrorism Database, START

2.1. The major threat actors

The Islamic State (ISIS) still represents a major threat as a source of CBRN attacks even though it has lost most of its ground in in both Syria and Iraq due to the intervention of coalition forces. In fact, the threat to Europe may be greater as a consequence of this decentralisation as the ability of the ISIS network to inspire extremism is high and its ability to influence in Europe is particularly effective. In addition, large numbers of European citizens (estimated at 5000–7000)[10] who joined ISIS are now returning home. They are trained and willing to carry out attacks in their home country. The bomber who carried out the atrocities in Manchester in 2017 was associated with others who had fought in Syria for ISIS and travelled to Syria and Libya himself before carrying out the bombing.

[7] Hay, Alastair, 'Novichok: the deadly story behind the nerve agent in Sergei Skripal spy attack' The Independent 28th March 2018.
[8] Loveluck, Louisa and Cunningham, Eric. 'Dozens killed in apparent chemical weapons attack on civilians in Syria, rescue workers say'. The Washington Post, 8 April 2018.
[9] Communication of the European Commission on a new EU approach to the detection and mitigation of CBRN-E risks 2014. https://ec.europa.eu/home-affairs/sites/homeaffairs/files/what-we-do/policies/crisis-and-terrorism/explosives /docs/20140505_detection_and_mitigation_of_cbrn-e_risks_at_eu_level_en.pdf
[10] Fellman, Zack, Sanderson Thomas and Donnelly, Maria. "Fallout: The future of foreign fighters" Washington Centre for Strategic and International Studies. 1 September 2017.

A Europol report suggests that ISIS is likely to use chemical or biological weapons in Europe at some stage.[11] Chatham House's International Security Department stated that there is very real risk of ISIS using unconventional weapons in Europe[12] and a UK National Security Study concluded that chemical and biological attacks against the UK may become more likely/or have a greater impact long term.[13]

ISIS is known to have used mustard gas and chlorine in Syria and Iraq, and it is thought to have the ability to produce these gases itself. In addition, ISIS is likely to have recruited scientists who were involved in Iraq's chemical and biological weapons programmes. There is already evidence that ISIS is experimenting with biological weapons. For example, in 2014, a laptop owned by a Tunisian scientist fighting with ISIS was found to contain details on how to develop a bubonic plague weapon.[14]

It is also presumed that ISIS would have had access to Iraq's, Syria's and Libya's stockpile of weapons. It is believed that some chemicals and biologicals such as sarin and ricin are still in the country and potentially accessible.

The Syrian and Libyan civil war, plus the destabilisation of North Africa and other central regions, has resulted in the large influx of refugees into Europe. ISIS has opportunistically used this mass movement of people to smuggle fighters into Europe. Some of these ISIS members posing as refugees have already carried out terrorist attacks in Europe[15] Due to the Schengen agreement it has been easier for refugees to cross borders unencumbered making it difficult to limit the dispersal of terrorists.

[11] Europol. 'Changes in Modus Operandi of Islamic State (IS) revisited' The Hague, November 2016.
[12] Unal, Beza. "Use of Chemical, Biological, Radiological and Nuclear weapons by non-state actors: Emerging trends and Risk Factors" Emerging Risk Report, 2016 Innovation series, Chatham House: The Royal Institute of International Affairs, January 2016.11.
[13] HM Government: UK International Chemical, Biological and Nuclear Security Assistance Programs. Report 2013-2015.
[14] Doornbos, Harald and Moussa, Jennan, 'Found, the Islamic States terror laptop of doom' Foreign Policy, 28 August 2015.
[15] "Germany Attacks: What is going on?" BBC News, 20 December 2016.

The table below shows the notable cases of ISIS using or planning to use CBRN materials:

Table 3: Notable cases of ISIS using or planning to use CBRN materials

Country	Incident
Iraq	In 2014, ISIS gained access to bunkers that were once used to produce and develop the Iraqi chemical weapons programme, which included mustard gas. Nerve agents held in rockets may still be in Iraq.
Iraq	Mosul Militants linked to ISIS stole low grade nuclear material from university.
Iraq	Reports indicated that in late 2015, radioactive material was stolen by unknown individuals from a storage facility near Basra. Iraqi officials speculated that ISIS could use the radioactive material in a weapon if either they were the group responsible for stealing it or they purchased the material from whoever stole it.
Kenya	In May 2016, Kenyan security services arrested individuals affiliated with ISIS in Kenya who were planning a biological attack using anthrax. All of the individuals involved in the anthrax plot had medical backgrounds.
Libya	Sources speculate that since ISIS began operating in Libya, they may have gained access to the chemical weapons programme that was once under the control of the Libyan government.
Morocco	In early 2016, Moroccan law enforcement arrested 10 members of an ISIS cell who had trained in Libya. The cell was preparing to carry out a biological attack using a homemade device involving explosives and unsophisticated bio weapons containing tetanus.
Syria	ISIS reportedly has access to weapons in Syria that are similar to sarin and ricin.
Syria	A laptop owned by a Tunisian physics and chemistry graduate fighting alongside ISIS in Syria was found containing a 19 page document describing how to develop the bubonic plague from infected animals as well as to how to weaponise it.

Source: Booz Allen Hamilton. 'The CBRNE Threat and Preparedness Landscape in Europe' November 2017.

Russian aggression also has security implications for Europe. In addition to the illegal annexation of Crimea and their continued aggression in Ukraine, there is ample evidence that they are meddling in the democratic processes of EU Member States, trying to influence the outcome of foreign elections for example. The Russian state has also been implicated in

the assassination of Alexandra Litvinenko, a former Russian spy, using a radiological weapon, polonium 210[16].

On 4 March 2018, the threat posed by Russia took a new turn when Novichock, a very potent nerve agent was used in an attempted assassination attempt of Yulia and Sergei Skripal in Salisbury, UK. It is believed that this attempt was either carried out by the Russian State or they had lost control of the agent which is known to have been developed as part of the Soviet chemical weapons programme. Either scenario represents a very disturbing new threat emanating from Russia.

North Korea poses an indirect threat to Europe, however, it now claims to have ballistic missiles that can reach Europe and it is known to maintain a large stockpile of chemical and biological weapons.

2.2. The use of synthetic biology is a growing threat

An additional threat for the development of biological weapons stems from the advent of synthetic biology, particularly molecular genetics, which is not well regulated in some countries. According to Jan Eliasson, former deputy secretary of the United Nations (UN), new discoveries in science have reduced the barriers for making a bioweapon.[17] One specific example is the discovery and now widespread use of the gene editing technology known as Clustered Regulatory Interspaced Short Pandromic Repeats (CRISPR) which allows scientists to alter any stretch of DNA in any organism with ease using commercially available mail order kits.

This technology provides the ability to genetically manipulate pathogenic bacteria and viruses to alter their virulence properties and make them more resistance to antibiotics and anti-virals. Fears have been expressed for some time that it is possible to engineer an anthrax strain that is resistant to ciprofloxacin, the main antibiotic used to treat the infection and the antibiotic stockpiled by Member States to treat civilians who may be exposed to anthrax though a terror attack. This has led to calls that more attention should be focussed on the stockpiling of an anthrax vaccine which would protect against antibiotic resistant strains.

More worryingly, synthetic biology now allows the construction of infectious viruses though the chemical synthesis of DNA fragments which are then 'stiched together'. In 2016 a group of Canadian scientists described the complete synthesis of a horsepox virus using synthetic biology and mail order commercial kits with the aim of producing an improved small pox vaccine. The methodology for constructing the virus was subsequently published in 2018.[18] The implications of this research are far-reaching. The World Health Organization (WHO) noted that the project did not require exceptional biomedical scientific skills or significant time and cost[19] which highlights the concern that this type of work can no longer be confined to controlled laboratories with multiple layers of oversight. The risk implication is that malicious actors could use similar techniques to create highly lethal contagious viruses.

[19] BBC News, 21 January 2016. Alexander Litvinenko: Profile of a Russian spy.
[17] Eliasson, Jan."Remarks – The WMD threat from non-state actors."Arms control association, March 2017.
[18] Noyce RS, Lederman S, Evans DH (2018) Construction of an infectious horsepox virus vaccine from chemically synthesized DNA fragments. PLoS ONE 13(1): e0188453. https://doi.org/10.1371/journal.pone.0188453
[19] Kupferschmidt, Kai. "How Canadian Researchers reconstituted and extinct poxvirus for $100,000 using mail order DNA." Science. 6 July 2017.

2.3. The consequences of an attack

In terms of consequences, chemical and biological attacks have the potential to maim and kill on a much greater scale than conventional weapons, overwhelm medical responses, paralyse governments and transport systems and severely impact economies. In addition the use of a chemical or biological weapon may not become obvious for hours or days after the attack, when the population start presenting with symptoms, which would not immediately be recognised as the result of the use of a chemical or bioweapon by medical practitioners. This delays the opportunity for treating victims with the appropriate countermeasures and increases the risk of long term injuries and fatalities.

2.3.1. US anthrax attack

The anthrax attack in the US in 2001 provides a good example of the impact of the use of a biological weapon. Envelopes containing anthrax spores were sent to various news media outlets and two US senators. This only involved around 1gm of anthrax spores but unfortunately resulted in 5 deaths, 22 illnesses and 30,000 needing to be treated with antibiotics. This also resulted in the need to de-contaminate three buildings including Capitol Hill which resulted in the disruption of government. The direct economic cost of this event was estimated at more than $1 billion.

Since that event the US has carried out an assessment of the impact of an aerosol attack where 1-2 Kg of anthrax spores would be spread over a major city using a crop duster. They estimate it would cause approximately 380,000 deaths, 450,000 illnesses and up to more than 3 million requiring antibiotic treatment. Decontamination would need to be city wide and the projected economic cost has been estimated at more than $1.8 trillion.[20] There are now fears that drones could be used as a very efficient way to deliver biological and chemical weapons which is likely to go unnoticed until victims start to exhibit symptoms.

2.3.2. The attempted assassinations in Salisbury

The attempted assassination of the Skripals in Salisbury (UK) on 4 March 2018, although not intended to be a mass attack on a civilian population, nevertheless has far-reaching consequences in terms of the response to such events. This attack was supposedly a targeted assassination using Novichok, a deadly nerve agent developed by the former Soviet Union during the cold war. This has a similar mechanism of action to other nerve agents such as sarin or VX although it is reported to be much more potent.[21]

Nerve agents are essentially organophosphates which inhibit the enzyme acetylcholinesterase (AChE) which regulates the message from nerve to muscle by inactivating the neurotransmitter acetylcholine. If the enzyme is inactivated muscles are constantly stimulated sending the muscles into spasm meaning that they no longer function normally. The effects are wide ranging with the most critical being on heart and lung function.

For such a relatively small attack the response involved a huge amount of resource requiring specialist capabilities from first responders and the military. It was not initially recognised as a chemical attack by those first on the scene which resulted in inadvertent contamination of a policeman and several emergency vehicles which subsequently had to be

[20] President's Council of Economic Advisors 2008.
[21] Hay, Alastair, 'Novichok: the deadly story behind the nerve agent in Sergei Skripal spy attack' The Independent, 28 March 2018.

removed from service for decontamination. In addition to the three victims who were taken seriously ill, it is now believed that at least 130 civilians were exposed to the nerve agent with the long term consequences being unknown. This relatively small incident put huge pressure on emergency services and chemical response capability with multiple sites, objects and vehicles being identified as potentially contaminated and requiring subsequent decontamination

3. HOW EU MEMBER STATES ARE PREPARING TO MEET THE THREAT

KEY FINDINGS

- The primary responsibility to protect citizens from public health and CBRN threats lies with each individual Member State. There is no specific legislation at the EU level that targets or controls CBRN materials.

- At present, Member States have different views and perceptions on the CBRN threats and therefore, different levels of preparedness. No country in Europe matches the preparedness level of the US suggesting there is room for improvement in Europe.

- Key initiatives have been taken at the EU level to strengthen preparedness and response against CBRN attacks. These include, in particular:

  The revised EU CBRN Action Plan which proposes, for the first time, that medical preparedness for CBRN attacks be a specific EU priority action and policy commitment. Previously, this policy area was considered to be the responsibility of national governments;

  The Directive on combating terrorism which, in particular, aims to prevent terrorist attacks by criminalising acts such as undertaking training or travelling for terrorist purposes as well as organising or facilitating such travel and provides for adequate medical treatment for victims; and

  The Joint Procurement Mechanism which aims to secure more equitable access to specific medical countermeasures: Member States can jointly procure pandemic vaccines and other medicines and equipment through a centralised procedure.

3.1. The level of threat and preparedness for selected European countries

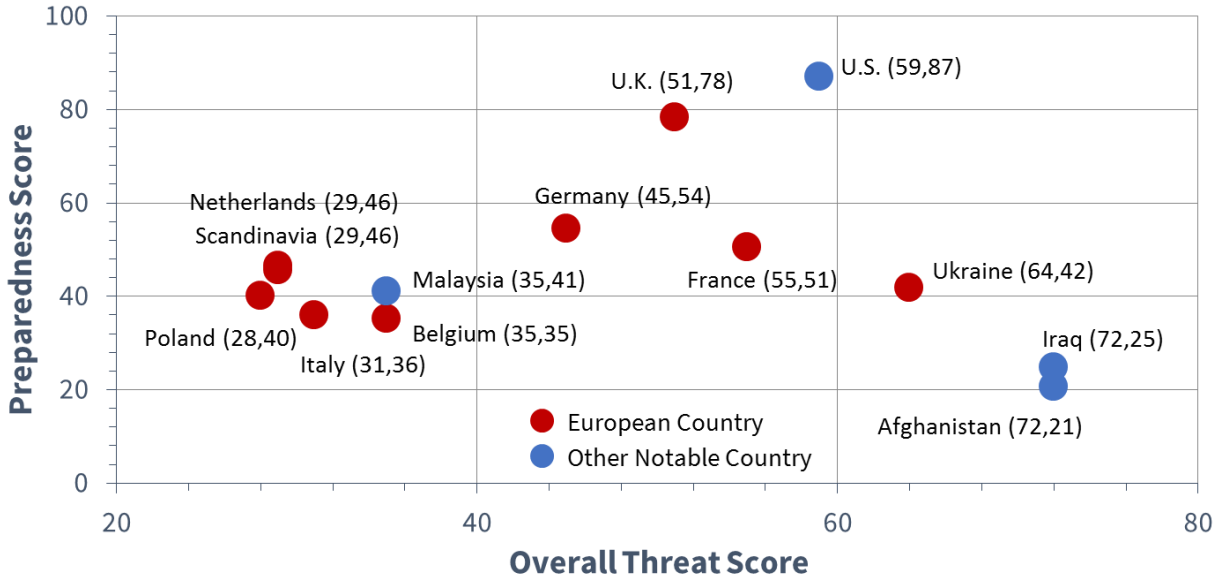
An analysis was carried out by Booz/Allen/Hamilton[27] on the threat and preparedness of selected European countries and compared this to notable (non-European) countries. They presented the analysis in terms of scores (see figure 1 below) based on a combination of quantitative data from published indices and qualitative assessment by subject matter experts. A weighted sum model was used to calculate current threat and preparedness score for each country. The quantitative scoring was based on raw data collected from twenty four indices grouped into six categories. These were :

1) Terrorist threat;
2) CBRNE Incidents and Attacks;
3) EID threat;
4) Material access and Targets;
5) Chemical/Biological/Nuclear State Conflict, and
6) Response/Preparedness capacity.

Notable countries outside of the evaluated set that possess high threat (e.g. Iraq) or preparedness scores (e.g. US) are included in the figure as points of reference and comparison. In summary, European countries exhibit varied levels of preparedness and an even larger range of threat exposure. Germany, the United Kingdom, France and Ukraine coalesce into a higher threat group due to targeting by Islamic terrorists, greater material access, and a heightened threat from Russia, and/or exposure to dangerous pathogens. No country in Europe matched that of the US in terms of preparedness, suggesting that Europe has much room for improvement. Additionally the authors of this analysis noted that there is not necessarily a linear relationship between threat level and preparedness among European countries indicating that preparedness is not adequately linked to threat level.

The country in Europe with the highest preparedness score is the UK and will be used as an example in the next section, providing more detail on containment, and the organisations involved in training.

Figure 1 Threat and preparedness scores in selected countries and regions



Source: Booz Allen Hamilton. 'The CBRNE Threat and Preparedness Landscape in Europe' November 2017.

3.1.1. Individual Member State's level of preparedness

United Kingdom The analysis in Figure 1 shows that the UK ranks 3rd highest in overall threat score and 1st in preparedness indicating that there is a concentrated focus on preparedness from a high threat landscape.
The threat landscape in the UK is driven by an increase in foreign fighters (decentralisation of ISIS) returning from conflict zones and radicalisation of UK citizens at home via the internet and other means. There are also unseen economic, political, social and security consequences of the UK leaving the EU.

The number of terror-related incidents has escalated in the UK over the past few years, probably as a direct result of it being a key player in involved in the war on terror. There have been attempts and attacks using both biological and conventional weapons. As mentioned earlier, a chemical weapon, Novichok, was used in March 2018 in an attempt to murder a Russian dissident. It is reported that Al-Qaeda on the Arab Peninsula successfully developed a ricin (a biological nerve agent) weapon in labs in the UK. However, the main attacks have come through the use of conventional weapons such as explosives and knives

and the use of vehicles as weapons. The Manchester bombing in 2017 was carried out by ISIS-inspired terrorists who had travelled to the conflict zones and the vehicle attacks in Westminster and London Bridge were also carried out by suspected ISIS followers.

In terms of preparedness the UK has several high level containment facilities where it holds and is able to study some of the most dangerous pathogens. This enables an agent to be quickly identified in the event of an incident. However, this also poses a risk as there are potentially a rich panel of targets already in the UK that could be used by threat actors. This risk is mitigated through the establishment of the Anti-Terrorism Crime and Security Act of 2001 that covers the security of toxins and pathogens in all UK laboratories[22] Each Lab has a Biosafety officer who reports details to the local police who carry out annual visits.

In terms of response the National Health Service (NHS) maintains the Reserve National Stock, a stockpile of emergency medical supplies for treating the public after major incidents such as CBRN attacks and disease outbreaks. Large stocks of antibiotics and antivirals are held as well as limited stocks for treatment of nerve agents. The UK is also unique in Europe as it produces and stockpiles its own anthrax vaccine. However, according to The Hague, the UK still lacks adequate or up to date stockpiles of vaccines.[23]

Stockpiles are strategically located in England, Scotland, Wales and Northern Ireland so that they can be distributed quickly to areas of need. In terms of training for preparedness and response to CBRN events The Defence Chemical, Biological, Radiological and Nuclear Centre (DCBRNC) designs and runs 18 courses per year for all three arms of the military and supports the civilian entities such as the NHS, public health England, (PHE) and the fire and police services which have responsibility for civil protection for such events, and Memorandums of Understanding (MOUs) are in place to ensure co-operation.

Germany. The analysis in Figure 1 shows Germany's overall threat and preparedness score in relation to the rest of Europe. Germany ranks 4th highest in overall threat score and 2nd in preparedness. This indicates that Germany is well prepared in relation to the threat landscape.

In Germany the key drivers of the threat landscape include an increase in foreign fighters returning from conflict zones in Syria and Iraq and the high influx of migrants who may be susceptible to radicalisation. The majority of terrorist attacks have been carried out at the hands of political extremists but Islamic extremists have been responsible for some of the most deadly attacks. The deadliest attack in recent history was carried out by a lone wolf actor inspired by ISIS. He stole a truck and drove it through a Christmas market killing 12 and injuring 48.[24]

In terms of preparedness, the Federal Office of Civil Protection and Disaster Assistance (BBK) is the lead federal authority to carrying out tasks related to civil protection and cooperation between the German Federation and its 16 states. Individual states are responsible for disaster response in times of peace while the Federal government is responsible for civil protection during times of war. The BBK will support the individual

[22] Anti-terrorism Crime and Security Act 2001 https://www.legislation.gov.uk/ukpga/2001/24/contents
[23] Frinking, Erik, Sweijs, Tim, Sinning, Paul, Bontje, Eva, Frattina della Frattina, Christopher and Abdalla, Mercedes. "The increasing threat of Biological Weapons" Security. The Hague: The Hague Centre for Strategic studies 2016, 30.
[24] National Consortium for the Study of Terrorism and Responses to Terrorism (START). Global Terrorism Data Base 2016.

states with training and specialised equipment.[25] Germany has taken steps to secure CBRN material through regulations, for example spent nuclear fuel rods are kept in terror proof casks. However, there is no similar direct legislation in Germany on biosecurity.

Germany has several specialised treatment centres for highly contagious and life threatening disease across the country operated and supported by the Robert Koch Institute in cooperation with the German public health service. This cooperative ensures the continuous training on the use of personal protective gear and other technical measures to prevent infection.[26] The Robert Koch Institute also helps to identify pathogenic organisms that could be used as potential bioweapons as well as enhancing preparedness and response efforts to biological incidents.[27] In 2016, Germany announced its plans to increase their stockpile of small pox vaccines and antibiotics in case of a biological attack.

Belgium. The analysis in Figure 1 shows that Belgium ranks 5th highest in the overall threat score but is the lowest in preparedness. This indicates a potentially significant deficiency to respond to threats, particularly if Belgium's landscape continues to grow.

The threat landscape in Belgium is largely confined to the threats posted by ISIS. The activity of this group has increased significantly over the past few years with multiple attacks resulting in 36 fatalities between 2014 and 2016.[28] There have been multiple threats to Belgium's nuclear facilities over the past decade and the strength of ISIS in the country, coupled with a vulnerable nuclear infrastructure could potentially lead to a scenario where ISIS targets a nuclear facility or try to steal nuclear material. In a survey conducted by Belgium, 138 hospitals were asked to complete a survey based on their level of preparedness for CBRN incidents.[29] In general, Belgium hospitals are fairly well prepared for pesticide/insecticide incidents as shown by the broad coverage of atropine and naloxone stockpiles, but they are not well prepared for nerve agent attacks which often require a combination of atropine and oxime. Countermeasures against other toxic chemicals such as cyanide are also not broadly distributed throughout the hospital network. Based on open source research Belgium is not sufficiently prepared for biological attack (in terms of vaccine and therapeutic stockpiles), for example, the country may only have enough smallpox vaccine to protect 10% of the population.[30] In 2017, it was decided to distribute iodine tablets to all residents living within 100 km of a nuclear facility (effectively the whole population) following the revelation that a senior nuclear official was being watched by ISIS.

Italy. The analysis in Figure 1 shows Italy's overall threat and preparedness scores in relation to the rest of Europe. Italy ranks 4th lowest in the overall threat score and is 2nd lowest in preparedness.

The threat landscape in Italy is driven by anarchists, the uncontrolled level of migrants entering the country from conflict zones and the radicalisation of lone wolf actors by

[25] Nieves, Murillo, "12th International Symposium on Protection against Chemical and Biological Warfare Agents" 131. Stockholm 2016.
[26] "Competence and Treatment Centres for Highly Contagious and Life Threatening Diseases". Robert Koch Institute, 15 September 2014.
[27] Centre for Biologic Threats and Special Pathogens. Robert Koch Institute, 4 September 2017.
[28] National Consortium for the Study of Terrorism and Responses to Terrorism (START). Global Terrorism Data Base 2016.
[29] Hamid, Sarfarpour, "Preparedness of Belgian Civil Hospitals for Chemical, Biological, Radiation and Nuclear Incidents: Are we there yet? Presented at the European Journal of Emergency medicine: Journal club presentation, Tehran, 2014.
[30] Centre for Biosecurity of the University of Pittsburgh Medical Centre (UPMC), the Centre for Transatlantic Relations of the Johns Hopkins Universities and the Transatlantic Biosecurity Network, 2005.

organisations such as ISIS. However, Italy does not seem to have the same radicalisation problem as other countries such as the UK, Belgium and Germany and far fewer fighters joined ISIS.

The majority of attacks in over the years have been carried out by anarchists. Since 2001, there have been more than 20 Islamic extremist plots but none of them have caused fatalities. However, these plots have involved the intended use of chemical weapons. For example, in 2007, three Moroccans were arrested with chemical agents and instructions on how to fly a plane.[31] However, Italy has been spared the consequences of successful terrorist attacks even though these types of plots have been uncovered.

Italy has begun to organise and practice its CBRN efforts. In 2016, Italy held its first non-conventional drill involving all entities involved in responding to a CBRN incident.[32] There are two national organisations involved in responding to a CBRN incident, civil protection and civil defence, the former handling natural or man-made incidents and the latter handling deliberate incidents. A recent study surveyed all Emergency departments based on their level of preparedness for a CBRN event. It was found that stockpiles were inadequate and it is only the dedicated poison centres that maintain a relatively complete stockpile.[33]

3.2. The EU CBRN action plans on CBRN

The first EU CBRN Action Plan on chemical, biological, radiological and nuclear security[34] was established in 2009 by the Commission. It aimed at strengthening CBRN security in the EU and reducing the threat and damage from CBRN incidents. The action plan focussed on:

- Prevention: ensuring that unauthorised access to CBRN material is as difficult as possible;
- Detection: having the capacity to detect CBRN materials in order to prevent or respond to CBRN incidents;
- Preparedness and Response: improving the ability to respond to incidents involving CBRN material and to recover as quickly as possible.

A progress report in the plan was published in 2012[35] and it was reported that good progress had been made in establishing lists of high risk CBRN materials, identifying good practices in security training and education, developing EU guidelines for minimum security training requirements, developing scenarios in the CBRN detection field and improving emergency response plans. The progress report also noted that Europol had played a strong role in facilitating communication between Member States and importantly, taking the initiative to organise joint training exercises. Although it was a goal for the action plan to strengthen countermeasure capacity by assessing the amounts and types required to

[31] Four accused of running real terror school, Chicago Tribune, 22 July 2007.
[32] Rossodivita, Alessandra et al. "CBRN Preparedness. Metropolis the First Italian Non-Conventional Biological Drill". Cambridge University Press, Abstracts of Scientific Peers, WADEM Congress on Disaster and Emergency Medicine 2017, 32, no.S1,20 April 2017.
[33] International Congress of the Association of Poison s Centres and Clinical Toxicologists (EAPCCT) 28-31 May 2013, Copenhagen, Denmark. Clinical toxicology 51, no.4 2013:363,
[34] Communication from the Commission to the European Parliament and the Council of 24 June 2009 on Strengthening Chemical, Biological, Radiological and Nuclear Security in the European Union – an EU CBRN Action Plan https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=LEGISSUM:jl0030&from=EN
[35] Progress Report on the Implementation of the EU CBRN action plan, May 2012 (public version), https://ec.europa.eu/home-affairs/sites/homeaffairs/files/what-we-do/policies/crisis-and-terrorism/securing-dangerous-material/docs/eu_cbrn_action_plan_progress_report_en.pdf

respond to an incident, it is interesting to note that the update did not make reference to any improvements or outcomes in this area.

Overall, it was concluded that the implementation of the plan had been uneven across Member States and it was concluded that in the longer run it would be important to focus on the development of a more strategic and overarching approach to CBRN policies.

On 18 October 2017, an update to the Action Plan was published[36]. In its new Communication on the Action Plan to enhance preparedness against chemical, biological, radiological and nuclear security risks, the Commission proposes, for the first time, that medical preparedness for CBRN attacks be a specific EU priority action and policy commitment. This action is to be taken in co-operation with Member States and other stakeholders. The Communication clearly indicates that the EU directive on combating terrorism, with obligations on Member States to provide medical assistance to all victims of terrorism, has provided a legislative base which will underpin the action plan.

Commitment 2.6 of the Communication is devoted to improved preparedness of Member States through the procurement of medical countermeasures (see Table 4 below). This has clearly now been recognised as a priority by the Member states. In addition, the Action Plan specifically endorses the legitimate role of Industry in supplying medical countermeasures recognising that closer relationships are required from Industry when it comes to ensuring that medical countermeasures are available.

[36] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee on Regions 0f 18 October 2017 on the Action Plan to enhance preparedness against chemical, biological, radiological and Nuclear security risks (COM (2017) 610 final). https://ec.europa.eu/home-affairs/sites/homeaffairs/files/what-we-do/policies/european-agenda-security/20171018_action_plan_to_enhance_preparedness_against_chemical_biological_radiological_and_nuclear_security_risks_en.pdf

Table 4: EU CBRN Action Plan 2017

	Commitment	Action	Deliverable and Timeframe
2.6	Increase preparedness of Member States for cross-border threats to health	Increase preparedness of Member States for cross-border threats to health via joint procurement of medical countermeasures (based on Article 5 of Decision 1082/2013/EU on serious cross-border threats to health). Strengthen preparedness as well as actions at points of entry (air, maritime and ground crossing). Member States and the Commission to develop a shared vision at EU level on how to improving vaccine coverage in the EU, and start actions to strengthen vaccine supply and stock management, enhance the interoperability and interaction of immunisation information systems, improve vaccine confidence and tackle hesitancy, and increase the effectiveness of vaccine research and development at EU level.	Joint procurement of vaccines together with the Member States concerned; 2018 (preparations ongoing) 2017-2020 (Joint Action in preparation) 2017-2020 (Joint Action in preparation)

Source : Commission Communication (COM (2017) 610 final)[37]

3.3. The EU Directive on combating terrorism

The adoption on 15 March 2017 of the Directive of the European Parliament and of the Council Directive on combating terrorism[38] should go a long to ensuring that Europe is better prepared for CBRN attacks. It will, first of all, help prevent terrorist attacks by criminalising acts such as undertaking training or travelling for terrorist purposes as well as organising or facilitating such travel:

Article 9

Travelling for the purpose of terrorism

[37] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee on Regions 0f 18 October 2017 on the Action Plan to enhance preparedness against chemical, biological, radiological and Nuclear security risks (COM (2017) 610 final), https://ec.europa.eu/home-affairs/sites/homeaffairs/files/what-we-do/policies/european-agenda-security/20171018_action_plan_to_enhance_preparedness_against_chemical_biological_radiological_and_nuclear_security_risks_en.pdf

[38] Directive (EU) 2017/541 of the European Parliament and of the Council of 15 March 2017 on combating terrorism and replacing Council Framework Decision 2002/475/JHA and amending Council Decision 2005/671/JHA (OJ L 88, 31.3.2017, p. 6–21). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32017L0541

1. Each Member State shall take the necessary measures to ensure that travelling to a country other than that Member State for the purpose of committing, or contributing to the commission of, a terrorist offence [-- --] for the purpose of the participation in the activities of a terrorist group with knowledge of the fact that such participation will contribute to the criminal activities of such a group [-- --] or for the purpose of the providing or receiving of training for terrorism [-- --] is punishable as a criminal offence when committed intentionally.

2. Each Member State shall take the necessary measures to ensure that one of the following conducts is punishable as a criminal offence when committed intentionally:

a) travelling to that Member State for the purpose of committing, or contributing to the commission of, a terrorist offence [-- --] for the purpose of the participation in the activities of a terrorist group with knowledge of the fact that such participation will contribute to the criminal activities of such a group [-- --] or for the purpose of the providing or receiving of training for terrorism [-- --]; or

(b) Preparatory acts undertaken by a person entering that Member State with the intention to commit, or contribute to the commission of, a terrorist offence [-- --].

Article 3 of the Directive sets the legal definition for terrorist offences and in this context also refers to CBRN weapons:

Article 3

Terrorist offences

1. Member States shall take the necessary measures to ensure that the following intentional acts, as defined as offences under national law, which, given their nature or context, may seriously damage a country or an international organisation, are defined as terrorist offences where committed with one of the aims listed in paragraph 2:

(f) manufacture, possession, acquisition, transport, supply or use of explosives or weapons, including chemical, biological, radiological or nuclear weapons, as well as research into, and development of, chemical, biological, radiological or nuclear weapons; [-- --]

The Directive also strengthens the rights of the victims of terrorism: according to Article 24, Member States need, in particular, to ensure appropriate support services and adequate medical treatment to victims of terrorism immediately after an attack and for as long as necessary:

Article 24

Assistance and support to victims of terrorism

[-- --] 2. Member States shall ensure that support services addressing the specific needs of victims of terrorism are in place [-- --] and that they are available for victims of terrorism immediately after a terrorist attack and for as long as necessary. Such services shall be provided in addition to, or as an integrated part of, general victim support services, which may call on existing entities providing specialist support.

3. The support services shall have the ability to provide assistance and support to victims of terrorism in accordance with their specific needs. The services shall be confidential, free of charge and easily accessible to all victims of terrorism. They shall include in particular:

(a) Emotional and psychological support, such as trauma support and counselling [-- --]

4. Member States shall ensure that mechanisms or protocols are in place allowing for activation of support services for victims of terrorism within the framework of their national emergency-response infrastructures. Such mechanisms or protocols shall envisage the coordination of relevant authorities, agencies and bodies to be able to provide a comprehensive response to the needs of victims and their family members immediately after a terrorist attack and for as long as necessary, including adequate means facilitating the identification of and communication to victims and their families.

5. Member States shall ensure that adequate medical treatment is provided to victims of terrorism immediately after a terrorist attack and for as long as necessary. Member States shall retain the right to organise the provision of medical treatment to victims of terrorism in accordance with their national healthcare systems.

According to Article 24, victims will be given emotional, psychological support, such as trauma support and counselling. This is an aspect of support that requires particular attention when it comes to CBRN attacks: unlike the use of conventional weapons it may not be immediately apparent who the victims are, the effects may not manifest themselves for several days or weeks after the event and there maybe uncertainty about how to treat victims until more is known about the agent used. There could be long term effects requiring long term follow up and treatment. The recent attack in Salisbury highlights some of these issues with victims getting conflicting advice as more became known about the nature of the agent used.

3.4. The Joint Procurement Mechanism (JPM)

The Joint Procurement Mechanism (JPM) was established with the Decision No 1082/2013/EU of the European Parliament and of the Council of 22 October 2013 on serious cross-border threats to health:[39]

Article 5

Joint procurement of medical countermeasures

1. The institutions of the Union and any Member States which so desire may engage in a joint procurement procedure with a view to the advance purchase of medical countermeasures for serious cross-border threats to health.

2. The joint procurement procedure referred to in paragraph 1 shall comply with the following conditions:

[39] Decision No 1082/2013/EU of the European Parliament and of the Council of 22 October 2013 on serious cross-border threats to health and repealing Decision No 2119/98/EC on serious cross-border threats to health and repealing Decision No 2119/98/EC https://ec.europa.eu/health/sites/health/files/preparedness_response/docs/decision_serious_crossborder_threats_22102013_en.pdf.

(a) participation in the joint procurement procedure is open to all Member States until the launch of the procedure;

(b) the rights and obligations of Member States not participating in the joint procurement are respected, in particular those relating to the protection and improvement of human health;

(c) the joint procurement does not affect the internal market, does not constitute discrimination or a restriction of trade or does not cause distortion of competition;

(d) The joint procurement does not have any direct financial impact on the budget of Member States not participating in the joint procurement.

[-- --]

The Decision 1082/2013/EU provides for a variety of measures including surveillance, monitoring, early warning of, and combating serious cross-border threats to health, including preparedness and response planning related to those activities, in order to coordinate and complement national policies. It further endeavours to strengthen Member States' cooperation notably through the Health Security Committee, aimed at sharing best practice and promoting interoperability.

Most notably however, the Decision established the procedure for the joint procurement of medical countermeasures. This initiative arose because of the H1N1 flu pandemic of 2009 which highlighted weaknesses in the access and purchasing power of EU countries to obtain pandemic vaccines and medications. In essence, members with the largest economies were able to negotiate preferential contracts which meant that some of the smaller members were unable to obtain vaccine or had to wait for it while other contracts were being fulfilled. The establishment of the JPM was intended to put all Member States on a level playing field when trying to access specific medical countermeasures.

The principle is that DG SANTE manages the procurement process, identifying and negotiating the contract on behalf of interested Member States. This should result in Member States securing more equitable access to medical countermeasures and an improved security of supply, together with more balanced prices for the participating EU Member States. This is also of benefit for the supplier as they only have to deal with one contract rather than a number of contracts with each individual Member State. Although it does not specifically mention that it can be used to procure medical countermeasures to protect against CBRN events, it does state that vaccines, antivirals and medical countermeasures for serious cross border health threats could be procured.

In addition, pooling Member State requirements ensures that Industry continues to manufacture some low volume products that are on the verge of commercial viability such as botulinum anti-toxin. In fact, the JPM was first used for the procurement of Botulinum antitoxin (BAT) for five Member states. Although the JPM could be the tool that facilitates Member States fulfilling their obligations under the Terrorism Directive it is still quite complicated with individual Member States still having to negotiate their own contracts. For the JPM to be a really effective mechanism it needs to be strengthened and this will be covered in the Chapter on Conclusions and Policy Recommendations.

3.5. Research and development investment in CBRN

A considerable amount of money has been invested in Research & Development (R&D) to improve preparedness and response to CBRN events. The Preparatory Action on "Enhancement of the European industrial potential in the field of Security Research 2004–2006" (PASR)[40] focused in particular on the development of a European security research agenda to bridge the gap between civil research supported by EC Framework Programmes and national and intergovernmental security research initiatives. In this initial period, in total EUR 65 million were allocated to such research. Security research became afterwards an integral part of the 7th RTD Framework Programme (2007-2013) – FP7, with a total budget of about EUR 1.35 billion.[41] The key activities in this area relate to restoring safety and security in case of crisis.

The current EU framework programme for Research and Innovation for the period 2014–2020 (Horizon 2020)[42] has increased the amount allocated to security to EUR 1.65 billion.

This research has mainly focussed on improving methods for detection, decontamination and training. One of the biggest projects to be funded was EDEN, a demonstration project involving a consortium of 15 EU Member States. Its aim was to develop and ensure the resilience capacity of European societies and focussed on prevention, preparedness and response. The goal was to integrate and co-ordinate existing EU capacities and competences to deal with the CBRN threat.

Although all of these projects have advanced European capabilities for dealing with CBRN threats they have not been focussed on the research and development of medical countermeasures for unmet needs for countering CRRN threats. In the US, the Centers for Disease Control and Prevention (CDC) and the Biomedical Advanced Research and Development Authority (BARDA) has been an instrumental tool in driving the research and development of medical countermeasures for procurement by funding companies and academics to develop products. This funding is allocated on a constantly reviewed threat perception level form the US government.

Europe has, as yet, not taken such an approach. However, on 26 March 2018, the Commission published a Roadmap on protecting citizens against health threats.[43] Even though not legally binding, the Roadmap lays out the Commission's thinking for a long term strategy based on three pillars. One of the pillars is to strengthen the impact of research and innovation and the development of innovative medical countermeasures including via new models of collaboration with the private sector.

[40] Commission Decision 2004/213/EC of 3 February 2004 on the implementation of the Preparatory Action on the Enhancement of the European industrial potential in the field of security research, OJ L 67, 5.3.2004, p. 18–22 http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32004D0213

[41] https://cordis.europa.eu/programme/rcn/837_en.html

[42] Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC, OJ L 347, 20.12.2013, p. 104–173. (https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1523547525048&uri=CELEX:32013R1291)

[43] Communication from the Commission on Improving Health Security in the EU – a one health approach to counteracting the threat from infectious diseases (Ares(2018)1651235) (https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2018-1651235_en)

4. GAPS IN PREPAREDNESS AND RESPONSE

KEY FINDINGS

- There are gaps in Europe's ability to treat victims of chemical and biological attacks with the most appropriate countermeasures. In the event of an attack, countermeasures will need to be administered within hours and days after the incident in order to be effective. The only viable solution is to establish central or regional stockpiles of such specialist countermeasures ahead of the incident occurring.

- Many EU countries rely on being able to obtain medical countermeasures from the US through sharing agreements with via the global Health Security Initiative (GHSI) which poses a risk to security of supply and to distribution challenges when countermeasures are needed immediately.

- First responders such as ambulance, fire and police services are not adequately protected with respect to vaccines and therapeutics against chemical, biological and radiological attacks. First responders can therefore also become the victims of terrorism themselves when entering the arena of a possible CBRN attack which can compromise their ability to adequately treat other victims.

- Only Industry has the capability to develop, manufacture and supply medical countermeasures and protective equipment that can be deployed following a CBRN incident. However, the majority of the facilities operated by Industry are dedicated single product facilities and do not have the flexibility to quickly change to providing surge capacity for new products in an emergency. Governments could collaborate with Industrial partners that have more flexible manufacturing capability through public/private partnerships to improve response in these situations.

4.1. Inadequate stockpiles of medical countermeasures

Unfortunately there are still gaps in Europe's ability to treat victims of chemical and biological attacks with the most appropriate countermeasures. To date, terrorist attacks in Europe have largely utilised conventional weapons where medical staff are able to respond using conventional medicine and medical practices. In the event of a chemical and biological attack specialist countermeasures will be required which normally need to be administered within hours and days after the incident in order to be effective. Some of these countermeasures such as vaccines and antibody therapies cannot be purchased off the shelf in the large volumes that would be required following the incident. It may take several months to manufacture and supply by which time it would be too late to impact the outcome of the event.

EU Member States do not generally maintain broadly applicable stockpiles of CBRN medical countermeasures and preparedness is inadequate. Many countries rely on access to shared stockpiles of certain vaccines such as smallpox through the WHO. Specific countries such as Germany, UK, France, the Netherlands and Denmark have their own supplemental stockpiles of smallpox vaccination which can cover a large proportion of the population

whereas other countries only maintain a stockpile that cover a fraction of the populace.[44] Stockpiles of vaccines and therapeutics for post exposure prophylaxis of pathogens such as anthrax, plague, botulism, and tularaemia are even rarer.

Many European countries rely on being able to obtain medical countermeasures from the US SNS through sharing agreements with via the global Health Security Initiative (GHSI).[45] This approach poses a risk to security of supply and to distribution challenges when countermeasures are needed immediately after an event. In addition, the new administration has made it clear that 'America comes first' and therefore it may be more difficult to obtain countermeasures in the future.

The only viable solution to this problem is to establish central or regional stockpiles of such specialist countermeasures ahead of the incident occurring. There is already a precedent for establishing centralised stockpiles of countermeasures in Europe as animal vaccines are stockpiled centrally. The US has already taken the step of establishing the Strategic National Stockpile (SNS) which aims to deliver medicines and countermeasures to an incident within 12 hours. More detail is provided in the next section.

4.2. Lack of model for strategic stockpiling of medical countermeasures

As mentioned above, the US has established a Strategic National Stockpile to ensure that citizens can receive rapid medical assistance following a major public health incident such as a terrorist attack or emerging disease threat. The National Pharmaceutical Stockpile was established in 1999 to ensure the nation's readiness against potential agents of bioterrorism such as anthrax, botulinum, smallpox and plague. The mission was to establish sufficient quantities of medical supplies that could be delivered to states and communities within 12 hours of the attack. This was further strengthened following the terrorist attacks in 2001 with the introduction of the Project Bioshield legislation which committed £5 billion to the procurement of medical countermeasures and protective equipment. Today, the Strategic National Stockpile is managed by the CDC and it works with governmental and non-governmental partners (including Industry) to ensure the ability to respond to a national public health emergency, ensuring that federal state and local agencies are ready to receive, stage and distribute products.

The stockpile currently contains more than $7 billion worth of medicines and medical supplies including antibiotics, chemical antidotes, vaccines and anti-viral drugs. The appropriateness of the stockpile is reviewed annually in order to make recommendations regarding changes based on current scientific evidence about future procurements. The stockpile is organised for a flexible response and is structured in four categories:

Managed inventory: The majority of products are held in storage at various locations around the country as managed inventory. Maintaining a supply of medications and medical supplies for specific health threats allows CDC to respond with the right product when a specific disease agent is known. This can be used in the initial response or to support the 12-hour push package.

[44] Centre for Biosecurity of the University of Pittsburgh Medical Centre (UPMC). The Centre for Transatlantic Relations of the Johns Hopkins Universities and the Transatlantic Biosecurity Network 2005.
[45] U.S. Department of Health and Human Services. "2015 Public Health Emergency Medical Countermeasures Enterprise (PHEMCE) Strategy". us.gov. 2015.

12-hour push package: If a community experiences a large scale public health incident in which the disease agent is unknown, the first line of support from the stockpile is to send a 12-hour push packages which contain a broad range of pharmaceuticals and medical supplies. Contents are pre-packed in transport ready containers for rapid delivery within the US within 12 hours of the decision to deploy.

CHEMPACK's: These are containers of nerve agents placed in secure locations around the country to allow rapid response to a chemical incident.

Federal Medical Station: This provides the ability to provide a rapidly deployable reserve of beds, supplies and medicines and equipment to pre-determined sites in order to care for up to 250 people in the event of a public health emergency. This can operate for three days before resupply is needed and the intention is to increase local health care capabilities.

In order to sustain the stockpile there are key management controls in place which includes, overseeing the shelf life of medicines to ensure the stock is rotated and kept within FDA potency shelf life times, conducting routine quality assurance on all products, performing annual inventory of all products, inspecting environmental conditions, security and package maintenance, ensuring stockpile holdings are based on the latest scientific data and threat levels and ensuring the ability to transport items during a public health emergency.

It is appreciated that this model would be much more difficult to establish in Europe as it would require the willingness to co-operate amongst all Member States and would likely require significant legislation at both Member State and EU level. However, it does provide an example of what can be achieved with the right commitment.

4.3. Inadequate protection of first responders

First responders such as ambulance, fire and police services are not adequately protected with respect to vaccines and therapeutics against chemical, biological and radiological attacks. Therefore our first responders could also become the victims of terrorism themselves when entering the arena of a possible CBRN attack. This would compromise their ability to adequately treat other victims at the scene.

In addition, hospital staff that are likely to receive victims of terrorism should also be adequately protected in order to ensure that they can still provide medical treatment and maintain the infrastructure and critical mass required to treat victims of terrorism. Where countermeasures are available they should be available to first responders, and where vaccines are available to protect against biological threats such as anthrax and smallpox first responders should be offered these immunisations.

4.4. Lack of engagement with industry

In reality, only Industry has the capability to develop, manufacture and supply medical countermeasures and protective equipment that can be deployed following a CBRN incident. However, Industry does not define the threat so close co-operation is required between EU agencies, Institutions and governments to ensure that Industry can respond in a timely manner, as already mentioned, many of the countermeasures are not available off the shelf in volumes that may be required to deal with an incident.

This issue is further compounded by the lack of flexible manufacturing capability in Europe. The majority of the facilities operated by Industry are dedicated single product facilities and do not have the flexibility to quickly change to providing surge capacity for new products in

an emergency. In addition virtually all of the large scale manufacturing capability is in the hands of the global pharmaceutical industry and very few countries within the European region have their own manufacturing capabilities, this is particularly relevant with regard to vaccines.

One way to overcome this is for governments to collaborate with Industrial partners that have more flexible manufacturing capability. For example, the US has established three centres for Innovation in Advanced Development and Manufacturing (CIADM) in partnership with Industry. Government provides investment into these facilities which are operated by the industrial partner and in return has access to the expertise that is required to manufacture the products to FDA requirements. Government also provides contracts to make it sustainable for the industrial partner.

These public/private partnerships provide the capacity to produce products for stockpiling as well as the ability to provide surge capacity in time of emergency. The UK, as part of its Industrial Strategy, is looking to follow a similar model and is looking to invest £66 million into the construction of a flexible vaccine manufacturing centre (in partnership with Industry) to accelerate the development of UK vaccine innovation and provide surge capacity to provide countermeasures in times of emergency.

These types of approaches could be expanded further within Europe to provide the capability for supplying stockpiles and responding in times of emergency.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

KEY FINDINGS

- The JPM needs strengthening to make it more attractive to EU Member States and suppliers.
- Establish stockpiles of medical countermeasures within the EU so that they can be distributed to victims quickly and effectively to victims of CBRN incidents.
- It is only Industry that has the capability to develop and distribute approved medical countermeasures to prevent and treat victims of CBRN incidents. Close collaboration with Industry is required to ensure adequate levels of countermeasures are obtained.
- It is imperative that first responders are adequately protected when entering a CBRN incident arena.

Following the completion of the in-depth analysis several gaps have been identified and the following policy recommendations are respectfully made to the Committee on Terrorism of the European Parliament:

5.1. Strengthen the JPM to make it more attractive to Member States and suppliers

As mentioned previously, the JPM has already been established and would be a very good tool to enable the Member States to acquire their medical countermeasures in order to fulfil their obligations under the directive on combating terrorism where Member States are required to provide medical treatment to victims of CBRN attacks for as long as required. However, in practice the use of the JPM has proved to be complicated. Although the Commission (through DG SANTE) has taken the lead on identifying and negotiating terms for products requested by Member States it has still proved necessary for the supplier to have separate contracts in place with each Member State it is supplying. This has proved to be frustrating for both the Member States and suppliers. In addition, although signing up for the JPM, some of the Member States are still procuring without using the JPM.

It is recommended that the contractual system be examined to try and simplify the process. It is advised that the Commission agree a 'boiler plate' contract with Member States that can be used with suppliers. The Commission then has full authority from the Member States to negotiate a contract that can be 'rubber stamped' by individual Member States. If there are specific Member State requirements that cannot be included in the boiler plate contract specific wording can be included in a section of the boiler plate agreement once negotiations are complete. The advantage to this approach is there would be one single contract agreed on behalf of Member States agreed with the supplier.

An additional recommendation is to communicate to Member States is the JPM is the 'preferred mechanism' to acquire CBRN medical countermeasures and get the Commission to lead a process to determine Member State requirements for the most relevant portfolio of medical countermeasures.

5.2. Establish stockpiles of medical countermeasures within the EU

As mentioned in the previous chapter medical countermeasures for CBRN attacks need to be used within hours and days after the attack to be fully effective and are not normally available off the shelf in the volumes required. The recommended solution is to establish adequate stockpiles of medical countermeasures within the European region with associated stockpile management and distribution systems in place so that countermeasures can be supplied anywhere within the EU within a 12 hour period. Products could be procured using the centralised procedure offered through the use of the JPM and stockpiles could be managed at the Commission level or by individual Member States (funded through the EU).

5.3. Establish new ways of collaborating with industry

As previously mentioned it is really only Industry that has the ability to develop, manufacture and supply medical countermeasures in the volumes required. However, Industry does not define the threat, they can only respond to the threat once they are defined. It is recommended that closer links are required between Industry, EU Member States and EU Institutions to ensure that Industry is aware of future procurement needs. It could be beneficial if one of the CBRN centres of excellence in Europe was charged with interacting with Industry in order to inform them of the European view of the threat and identify potential products that could be acquired to counter the threat. Where there are unmet needs it may also be beneficial to provide funding to develop countermeasures to meet these needs.

There is also a gap in terms of manufacturing and surge capacity in Europe for some countermeasures such as vaccines and therapeutics. This was brought into focus during the Ebola crisis when Europe could not produce a vaccine in a timely manner. One option for improving our response in these situations is through public/private partnerships. A good example is the initiative in the US where the government has formed public private partnerships with Industry to provide manufacturing capability that can be used to produce countermeasures for stockpiling or surge capacity when required.

5.4. Ensure that first responders are protected with available therapeutics and vaccines

As previously mentioned, it is imperative that we provide medical countermeasures (where available) to our first responders and medical staff. This will ensure that first responders do not themselves become victims of terrorism and will give them added confidence to work in a CBRN environment. It will also ensure that the capability and infrastructure of national first responder organisations will be able to function throughout the crisis.

REFERENCES

Anti-terrorism Crime and Security Act 2001
https://www.legislation.gov.uk/ukpga/2001/24/contents

BBC News, 21st January 2016. Alexander Litvinenko: Profile of a Russian spy.

Booz Allen Hamilton. 'The CBRNE Threat and Preparedness Landscape in Europe' November 2017.

Centre for Biologic Threats and Special Pathogens. Robert Koch Institute, 4 September 2017.

Centre for Biosecurity of the University of Pittsburgh Medical Centre (UPMC). The Centre for Transatlantic Relations of the Johns Hopkins Universities and the Transatlantic Biosecurity Network 2005.

Commission Decision 2004/213/EC of 3 February 2004 on the implementation of the Preparatory Action on the Enhancement of the European industrial potential in the field of security research, OJ L 67, 5.3.2004, p. 18–22 http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32004D0213https://cordis.europa.eu/programme/rcn/837_en.html

Communication from the Commission on Improving Health Security in the EU – a one health approach to counteracting the threat from infectious diseases (Ares (2018)1651235) (https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2018-1651235_en)

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee on Regions 0f 18 October 2017 on the Action Plan to enhance preparedness against chemical, biological, radiological and nuclear security risks (COM(2017) 610 final)
https://ec.europa.eu/home-affairs/sites/homeaffairs/files/what-we-do/policies/european-agendasecurity/20171018_action_plan_to_enhance_preparedness_against_chemical_biological_radiological_and_nuclear_security_risks_en.pdf

Communication of the European Commission on a new EU approach to the detection and mitigation of CBRN-E risks, COM(2014)247 final, 5 May 2014. https://ec.europa.eu/home-affairs/sites/homeaffairs/files/what-we-do/policies/crisis-and-terrorism/explosives/docs/20140505_detection_and_mitigation_of_cbrn-e_risks_at_eu_level_en.pdf

Communication from the Commission to the European Parliament and the Council of 24th June 2009 on Strengthening Chemical, Biological, Radiological and Nuclear Security in the European Union – an EU CBRN Action Plan. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=LEGISSUM:jl0030&from=EN

"Competence and Treatment Centres for Highly Contagious and Life Threatening Diseases". Robert Koch Institute, 15 September 2014.

Decision No 1082/2013/EU of the European Parliament and of the Council of 22 October 2013 on serious cross-border threats to health and repealing Decision No 2119/98/EC on

serious cross-border threats to health and repealing Decision No 2119/98/EC (https://ec.europa.eu/health/sites/health/files/preparedness_response/docs/decision_serious_crossborder_threats_22102013_en.pdf).

Deutsch, Anthony, 'Weapons Achieving Universality of the Chemical Weapons Convention in the Middle East.179. Inspectors find undeclared Sarin and VX traces in Syria – Diplomats', Reuters, 8 May 2015.

Directive (EU) 2017/541 of the European Parliament and of the Council of 15 March 2017 on combating terrorism and replacing Council Framework Decision 2002/475/JHA and amending Council Decision 2005/671/JHA (OJ L 88, 31.3.2017, p. 6–21) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32017L0541

Doornbos, Harald and Moussa, Jennan, 'Found, the Islamic States terror laptop of doom' Foreign Policy, 28th August 2015.

Eliasson, Jan."Remarks – The WMD threat from non-state actors."Arms control association, March 2017.

Noyce RS, Lederman S, Evans DH (2018) Construction of an infectious horsepox virus vaccine from chemically synthesized DNA fragments. PLoS ONE 13(1): e0188453. https://doi.org/10.1371/journal.pone.0188453

Europol. 'Changes in Modus Operandi of Islamic State (IS) revisited' The Hague, November 2016.

Fellman, Zack, Sanderson Thomas and Donnelly, Maria. "Fallout: The future of foreign fighters" Washington Centre for Strategic and International Studies. 1 September 2017

Four accused of running real terror school, Chicago Tribune, 22 July 2007.

Frinking, Erik, Sweijs, Tim, Sinning, Paul, Bontje, Eva, Frattina della Frattina, Christopher and Abdalla, Mercedes. "The increasing threat of Biological Weapons" Security. The Hague: The Hague Centre for Strtaeic studies 2016, 30.

Germany Attacks: What is going on? BBC News, 20 December 2016.

Hay, Alastair, 'Novichok: the deadly story behind the nerve agent in Sergei Skripal spy attack' The Independent 28th March 2018

HM Government: UK International Chemical, Biological and Nuclear Security Assistance Programs. Report 2013-2015

Hamid, Sarfarpour, "Preparedness of Belgian Civil Hospitals for Chemical, Biological, Radiation and Nuclear Incidents: Are we there yet? Presented at the European Journal of Emergency medicine: Journal club presentation, Tehran, 2014.

Kupferschmidt, Kai. "How Canadian Reserachers reconstituted and extinct poxvirus for $100,00 using mail order DNA." Science. 6 July 2017.

Immenkamp, Beatrix, "ISIL/Da'esh and 'Non-conventional weapons of terror", Briefing, European Parliamentary Research Service, May 2016.

International Congress of the Association of Poisons Centres and Clinical Toxicologists (EAPCCT) 28-31st May 2013, Copenhagen, Denmark. Clinical toxicology 51, no.4 2013:363

Lingren, Elisabet, Anderson, Yvonne, Suk, Jonathan, Sudre, Bertrand and Semenza, Jan. "Monitoring EU emerging infectious disease risk due to Climate change", Science magazine, Public Health 336 (April 27th 2012): 418.

Loveluck, Louisa and Cunningham, Eric. 'Dozens killed in apparent chemical weapons attack on civilians in Syria, rescue workers say'. The Washington Post. 8 April 2018.

National Consortium for the Study of Terrorism and Responses to Terrorism (START). Global Terrorism Data Base 2016

Nieves, Murillo, "12th International Symposium on Protection Against Chemical and Biological Warfare Agents" 131. Stockholm 2016.

Nomi Bar-Yacov 'What if ISIS launces a chemical attack in Europe', The Guardian 27 November 2015.

Osbourne, Samuel. 'Salisbury nerve agent attack: More than 130 people could have been exposed, Theresa May says' The Independent, 26 March 2018.

President's Council of Economic Advisors, 2008.

Progress Report on the Implementation of the EU CBRN action plan, May 2012 (public version)https://ec.europa.eu/home-affairs/sites/homeaffairs/files/what-wedo/policies/crisis-and-terrorism/securing-dangerous-material/docs/eu_cbrn_action_plan_progress_report_en.pdf

Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC, OJ L 347, 20.12.2013, p. 104–173(https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1523547525048&uri=CELEX:32013R1291)

Rossodivita, Alessandra et al. "CBRN Preparedness. Metropolis the First Italian Non Conventioanl Biological Drill". Cambridge Uivesity Press, Abstarcts of Scientific Paers, WADEM Congress on Disaster and Emergency Medicine 2017, 32, no.S1, April 20th, 2017.

Unal, Beza. "Use of Chemical, Biological, Radiological and Nuclear weapons by non-state actors: Emerging trends and Risk Factors" Emerging Risk Report, 2016 Innovation series, Chatham House: The Royal Institute of International Affairs, January 2016.11.

Wolfgang Rudischhauser, 'Could ISIL go nuclear?', NATO Review magazine, May 2015, Weimeng Yeo, 'Salafi Jihadists and chemical, biological, radiological, nuclear terrorism: Evaluating the threat', Risk management, solutions, 24 August 2015.

U.S. Department of Health and Human Services. "2015 Public Health Emergency Medical Countermeasures Enterprise (PHEMCE) Strategy". us.gov. 2015.

This study, commissioned by the European Parliament's Policy Department for Citizens' Rights and Constitutional Affairs at the request of the Special Committee on Terrorism, outlines the threats posed by Chemical, Biological, Radiological and Nuclear (CBRN) weapons, examines how well Europe is prepared for these threats and assesses where preparedness and response could be improved. It suggests that to date, terrorist attacks in Europe have largely utilised conventional weapons where medical staff are able to respond using conventional medicine and medical practices. However, threats from the use of CBRN materials for terrorism remain high and are evolving. The future threats are likely to come from the use of chemical and biological weapons.

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