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SCIENCE AND TECHNOLOGY COMMITTEE

CHEMICAL, BIOLOGICAL, RADIOLOGICAL AND NUCLEAR TERRORISM: THE RISE OF DAESH AND FUTURE CHALLENGES

DRAFT REPORT*

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* Until this document has been approved by the Science and Technology Committee, it represents only the views of the Rapporteur.

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ACRONYMS

BWC	Biological and Toxins Weapons Convention
CAS	Chemical Abstract Service
CBRN	Chemical, Biological, Radiological and Nuclear
CWC	Chemical Weapons Convention
EU	European Union
OPCW	Organisation for the Prohibition of Chemical Weapons
WMD	Weapons of Mass Destruction

I. INTRODUCTION

1. Two days after the November 2015 attacks in Paris, Prime Minister Manuel Valls told the French National Assembly: “I say this with obvious precaution but we know and are aware that there is also the threat of chemical or bacteriological weapons”. Similar words of caution were uttered by a number of other high ranking decision makers, including UK Prime Minister David Cameron. Indeed, the terrorist organisation Daesh employs military grade chemical weapons on the battlefields in Iraq and Syria, marking the first time in over 20 years that a non-state actor has done so (In 1995, the religious cult Aum Shinrikyo attacked the Tokyo subway).

2. As the recent spate of terrorist attacks in NATO countries demonstrates, conventional arms and makeshift weapons remain the weapons of choice for terrorist groups. Terrorists face little difficulty in acquiring or manufacturing them and can employ them with ease to create significant damage – both in terms of casualties and psychological effects. Still, today’s most dangerous terrorist organisations have the stated intention to acquire Chemical, Biological, Radiological and Nuclear (CBRN) weapons. History shows that only a small number of individuals and non-state actors have attempted to develop CBRN capabilities. Furthermore, those who had a certain level of capabilities most often failed in their attempts to manufacture a weapon, and those who did succeed in carrying out a CBRN attack caused few casualties compared to conventional attacks.

3. Despite the historical record, two developments in particular make it imperative to increase the vigilance of the international community: first, the rise of Daesh in Iraq, Syria, and beyond presents difficult new CBRN challenges; second, the science, technology, and material required for CBRN weapons is increasingly accessible and becoming cheaper and easier to employ. The international community must not be complacent in the face of these emerging CBRN challenges.

4. In a NATO context, Allies have been developing NATO’s capacity to defend against the threat of CBRN weapons – no matter if an attack comes from adversary states or non-state actors. NATO first acknowledged the risk of CBRN weapons falling into the hands of terrorists in the 2006 Comprehensive Political Guidance, which is the framework and political direction just below the Strategic Concepts. In the current Strategic Concept from 2010, Allies note that “[e]xtremist groups continue to spread to, and in, areas of strategic importance to the Alliance, and modern technology increases the threat and potential impact of terrorist attacks, in particular if terrorists were to acquire nuclear, chemical, biological or radiological capabilities”. At the 2014 NATO Summit in Wales, Allies reiterated that “[t]he proliferation of nuclear weapons and other weapons of mass destruction (WMD), as well as their means of delivery, by states and non-state actors continues to present a threat to our populations, territory, and forces”.

5. This draft report has been prepared to inform the transatlantic parliamentary debate on the risks of CBRN terrorism and the required responses. It does not claim to be exhaustive, but focuses on the most pressing current and future challenges. It analyses and discusses potential terrorist CBRN weapons; the CBRN efforts undertaken by Daesh; key international responses to the terrorist CBRN threat; and CBRN security in light of emerging science and technology. The Science and Technology Committee (STC) will first discuss this draft report at the NATO PA Spring Session in Tirana, to be held on 29 May 2016.

II. POTENTIAL TERRORIST CBRN WEAPONS

6. Many of today’s principal terrorist groups – first and foremost al-Qaeda and Daesh – are attracted by the potential effects of CBRN attacks, including mass casualties, massive psychological impact, societal disruption, and financial losses. However, terrorist groups still face high hurdles to buy, steal, or manufacture CBRN weapons and subsequently find the right opportunities and methods to employ them.

7. The term Weapons of Mass Destruction (WMD) is term commonly used to describe CBRN weapons. However, the term can be misleading, as not all CBRN weapons cause mass destruction. For example, large amounts of chemicals are needed to do so. Hence, CBRN attacks may only produce mass disruption or psychological effects. In addition, existing weapons with the potential to kill many people, such as high explosives and incendiary munitions, are excluded from the definition of WMD. For clarity's sake, this draft report uses the term "CBRN weapons".

8. CBRN weapons should not be treated as a monolithic or uniform category. Chemical, biological, radiological, and nuclear weapons are very different from each other, and every category also has different subcategories. For example, CBRN weapons differ in terms of complexity and cost of production; difficulty of acquisition, handling, and delivery or dispersal; likelihood of effectiveness; worst-case consequences; and types of effects – from tactical to strategic. CBRN threats should therefore be carefully disaggregated in analyses.

9. At the most basic level, four types of terrorist chemical attacks exist. Terrorists could:

- deliver military-grade or civilian chemical agents in a weaponised way, for example in mortar shells;
- attack or sabotage a chemical facility to release large amounts of chemical agents;
- contaminate the public's water or food supplies; or
- employ chemical agents in a targeted way for assassinations.

10. In a biological attack, terrorist would intentionally release a pathogen, i.e. a disease-causing agent, or a biotoxin, i.e. a poisonous substance produced by living organisms. Some pathogens and biotoxins, like anthrax or botulinum toxin, only cause adverse effects in the targeted persons. Others, such as smallpox or Ebola, will make these persons contagious, leading to epidemics or even pandemics if the spread is not properly contained. Biological weapons can either be manufactured in laboratories or obtained in nature.

11. A radiological attack involves the release of radioactive material in ways other than with a nuclear weapon. Four types of radiological weapons exist:

- a radiological dispersal device, which is often called a 'dirty bomb', is a conventional or improvised explosive device packed with radiological material which will be dispersed over a target area;
- a radiation emitting device simply emits radiation, ranging from individual assassinations to advanced irradiation of an area;
- a radiological incendiary device would couple an explosive device with incendiary material to complicate first responses;
- terrorists could also attack or sabotage a nuclear facility in order to release radiological material over a large area.

12. A nuclear attack by a terrorist group would involve the detonation of a nuclear weapon, i.e. with a warhead that uses the destructive forces of nuclear fission or a combination of nuclear fission and fusion.

III. THE CBRN EFFORTS OF DAESH

13. Over the last two decades, al-Qaeda has been the main terrorist group interested in acquiring CBRN weapons. The group continues to harbour these ambitions, but for a number of years, it has been on the defensive. The CBRN threat posed by al-Qaeda should not be discounted – also because the terrorist group might feel it needs a spectacular success in its rivalry with Daesh. Still, the history of al-Qaeda's efforts to acquire CBRN weapons is well-illustrated in other reports and documents, including in previous STC reports, and little new

information has emerged in the public realm since the last time the Committee examined the issue. Therefore, this section will focus on the CBRN efforts of Daesh – arguably the biggest CBRN threat for the Euro-Atlantic area at this point in time.

14. Ever since Daesh has looked beyond Iraq and Syria, it has demonstrated that it has the ability to carry out acts of terrorism with high numbers of casualties. By most accounts, over 1,000 people died in Daesh terrorist attacks in 2015, and in the first quarter of 2016 over 230 people have already been killed in such attacks. Conventional terrorist attacks, with considerable operational innovation, will likely remain its modus operandi.

15. Fundamentally, the risk of a CBRN attack by Daesh has risen due to a number of underlying factors. First, Daesh has a high recruitment rate of university-educated fighters, including some that have CBRN-related expertise. Second, a successful CBRN attack would fit well with its media strategy. Third, despite recent setbacks, the group still has access to high levels of funding. Fourth, it controls significant swathes of territory with advanced industrial facilities. Daesh has already used chemical weapons in Iraq and Syria, but a growing risk exists that the group could send foreign fighters back to their home countries for CBRN terrorism or charge home-grown terrorists to act on its behalf.

16. Daesh has reportedly put into place a special unit for chemical weapons development, drawing upon the expertise of former officials under Saddam Hussein and foreign experts, for example from Chechnya and Southeast Asia. The United States believes that Daesh has employed chemical weapons in at least a dozen incidents in Syria and Iraq. The Organisation for the Prohibition of Chemical Weapons (OPCW), the implementing body of the Chemical Weapons Convention (CWC), has officially confirmed the use of sulphur mustard in Iraq by a non-state actor, and while the OPCW was not assigned to attribute responsibility, it appears very likely that Daesh was the side using chemical weapons.

17. Daesh has so far resorted to chlorine gas and low-grade sulphur mustard delivered by improvised explosive devices, mortars, rockets and missiles. Both agents – at least in the way the group currently uses them – are weapons of terror, rather than weapons of mass destruction, as the concentration is not high enough to kill. The attacks involving chemical agents have indeed caused few casualties, and US officials have emphasised that the deaths were most likely caused by the artillery hits – not the chemical agents.

18. The extent of Daesh' chemical weapons infrastructure is still largely unknown. Much of the sulphur mustard appears to be stolen from Saddam Hussein's old stock. Some of Saddam's sulphur mustard-filled shells were sealed in bunkers in Iraq, as they were considered to be too unstable to be moved or destroyed safely. Daesh could be using these degraded shells. Experts also argue that the group has succeeded in producing a limited amount of sulphur mustard. Daesh has also allegedly used agricultural chemicals, for example insecticides. It is unknown to what extent the group has access to chemical facilities in Syria. As doubts linger whether the Syrian government declared its entire chemical infrastructure, the risk of Daesh having access to such sites certainly exists. So far, however, experts do not believe Daesh has the wherewithal to launch large-scale chemical attacks. While it can draw on a limited amount of expertise, equipment, and materials as well as a partial supply chain, it is a long way from having a proper chemical weapons programme.

19. The coalition against Daesh has recently stepped up its air strikes and raids against the chemical infrastructure in the group's hands. In February 2016, US Special Forces and Iraqi intelligence captured Daoud al-Afari, a key chemical weapons engineer for Daesh in Iraq. Al-Afari is believed to be a former industrial engineer in Saddam Hussein's military. Information obtained from al-Afari should reveal important details about Daesh' CBRN capabilities. Reportedly, the coalition against Daesh was able to conduct at least two strikes in Iraq that targeted Daesh' chemical programme based on intelligence acquired from al-Afari.

20. Some military analysts believe that the increased use of chemical weapons in Daesh' attacks signals their weakness on the battlefield. In particular, Daesh has increasingly been using chemical weapons in the north of Iraq as Kurdish local and Iraqi national forces are making gains against the group. This dynamic could further heighten the risk for the Euro-Atlantic community, as experts already view their increasing attacks in Europe as a sign of diminishing capabilities in Syria and Iraq.

21. It would be difficult, but not impossible, for Daesh to smuggle chemical agents and/or their methods of delivery into NATO member states. However, the group has been discussing on social media sites how its followers can use cyanide and sulphuric acid to launch attacks on American soil. And while it may be hard to transfer the necessary material and components for chemical weapons, the expertise gained in Iraq and Syria could be transferred to operatives in Europe.

22. In terms of Daesh' biological efforts, in 2014, a laptop captured from a Tunisian member of the group contained instructions on how to develop biological weapons, including the bubonic plague. In fact, Wolfgang Rudischhauser, Head of NATO's WMD Non-Proliferation Centre, has argued that Daesh "would not face many hardships in obtaining the bio-reactors and agricultural sprayers required to weaponise naturally occurring pathogens". However, the group could have trouble obtaining the more advanced scientific expertise involved in biological weapons.

23. Observers have been concerned with Daesh' attempts to obtain radiological material as well. In June 2015, the Australian intelligence community argued that Daesh had amassed enough radiological material for a radiological dispersal device. Daesh acquired unenriched uranium from the University of Mosul when it took over the town, and Iraqi authorities are also concerned that 10 grams of Iridium-192, a small quantity of a highly dangerous radioactive isotope, have fallen into the hands of the group. Moreover, Belgian counterterrorism authorities found a video shot by suspects connected with the Paris attacks which contained more than ten hours' worth of surveillance footage of the Belgian official in charge of nuclear research and development. It is unclear why the video was made, but Daesh could have plotted to kidnap the scientist either to gain access to radiological material or gain access to a nuclear facility. Furthermore, in the latest issue of the Daesh magazine *Dabiq*, the group claimed that it wants to buy nuclear weapons from Pakistan. This has however been judged as baseless propaganda by experts.

IV. INTERNATIONAL RESPONSES TO THE TERRORIST CBRN THREAT

24. Efforts to counter CBRN attacks by non-state actors demand action at all policy levels – from international treaties on multinational cooperation and state efforts down to local authorities. At the treaty level, the CWC, the Biological and Toxins Weapons Convention (BWC), and the Treaty on the Non-Proliferation of Nuclear Weapons represent the backbone of CBRN arms control, disarmament, and non-proliferation efforts among states. However, the acquisition of CBRN weapons by non-state actors does not lie at the core of these agreements, as they first and foremost govern state behaviour. This section therefore examines the most important counter-CBRN terrorism efforts at the multinational and international level, including within NATO and the European Union (EU).

A. KEY INTERNATIONAL EFFORTS

25. In 2004, the UN Security Council unanimously adopted Resolution 1540 on the non-proliferation of WMD. The resolution obliges states to refrain from any means of supporting non-state actors in developing, acquiring, manufacturing, possessing, transporting, transferring, or using WMD as well as their delivery systems. States are required to establish national rules and regulations to prevent such proliferation. A "1540 Committee" has been tasked to collect comprehensive reports from states on progress towards the implementation of mandatory steps. The mandate of the resolution was extended in 2011 for a period of ten years to 2021.

26. In June 2002, the G8 decided on a ten-year, USD 20 billion Global Partnership (GP) against the Spread of Weapons and Material of Mass Destruction. The initiative aims to provide effective measures concerning CBRN weapons and related materials, in order to prevent the acquisition or development of CBRN weapons by terrorists or by states that support them. Since then, the GP has grown to 29 members. In 2011, the G8 decided to extend the GP's mandate for another decade and to raise an additional USD 20 billion. In conjunction with the Global Partnership, the Nuclear Safety and Security Group was established, in order to provide technically informed strategic policy advice that could have a bearing on safety and security in peaceful uses of nuclear energy.

27. The Proliferation Security Initiative, established in 2003, seeks to stop trafficking of CBRN weapons, their delivery systems, and related materials to and from state and non-state actors of proliferation concern. One hundred and five countries have endorsed the informal Initiative that aims to detect and disrupt black markets for CBRN material, inter alia by intercepting illicit goods. Members have pledged to act when necessary to help seize or foil dangerous trade at sea, in the air, or on land and readily share information among one another.

28. Interpol runs several CBRN operations. The Interpol Chemical Anti-Smuggling Enforcement (Chase) Programme is ''a global effort to counter the international smuggling of chemicals used in the manufacture of weapons designed to kill and injure indiscriminately'' (Interpol factsheet). Operation S^{3}OMMET was launched to enhance the safety and security of biological materials and introduce and enhance disease surveillance in regions where it is most needed. Operation Fail Safe has the aim to gather information on individuals known or suspected to be involved in the illicit trafficking of radioactive material.

29. The Australia Group is an informal group of 42 countries, including all EU member states, Canada, Norway, Turkey, and the United States. The group works together to harmonise export controls to ensure that exports do not contribute to the development of chemical or biological weapons. The group meets annually to assess how national-level export licensing measures can be made more effective in non-proliferation efforts.

30. The World Health Organization is involved with several aspects of biological safety and security. It has instruments in place that handle outbreaks of international significance, such as the Global Outbreak Alert and Response Network.

31. The Global Health Security Agenda, launched in 2014, is a growing partnership of nearly 50 nations, international organisations, and non-governmental stakeholders that help build countries' capacity to create a world safe and secure from infectious disease threats and elevate global health security. The Agenda helps strengthen the capacity to prevent, detect, and respond to threats of human and animal infectious diseases whether naturally occurring or accidentally or deliberately spread.

32. In 2005, the UN General Assembly approved the International Convention for the Suppression of Acts of Nuclear Terrorism, which obligates states parties to cooperate in preventing or prosecuting nuclear terrorism.

33. The 1980 Convention on the Physical Protection of Nuclear Material is the only international legally binding convention that governs the physical protection of nuclear material, albeit only during international transport of such material. In 2005, an amendment to the Convention opened for ratification, which would make it legally binding for states party to the convention to protect all nuclear facilities and material in peaceful domestic use, storage and transport, but it has not yet entered into force.

34. The IAEA has a host of recommendations, standards, and services to support nuclear safety and security, e.g. the Action Plan on Nuclear Safety and the Nuclear Security Fundamentals and Recommendations. These are not legally binding on the IAEA's member states. The IAEA also

has an International Physical Protection Advisory Service that provides peer advice on implementing international instruments and on the protection of nuclear and other radioactive material and associated facilities.

35. The Global Initiative to Combat Nuclear Terrorism is a voluntary international partnership committed to strengthening global capacity to prevent, detect, and respond to nuclear terrorism. Currently, 86 states and five international organisations have joined the Initiative. It conducts multilateral activities that strengthen the plans, policies, procedures, and interoperability of partner nations.

36. In the UN Conference on Disarmament, 65 states have been discussing to propose a Fissile Material Cut-off Treaty, which would prohibit the production of the two main components of nuclear weapons: highly-enriched uranium and plutonium. However, discussions have been stalled by Pakistan for many years, as the treaty does not address current stockpiles, which would, Pakistan argues, leave them in a disadvantageous position vis-a-vis its neighbour, India.

37. In US President Barack Obama's famous 2009 speech in Prague, he called for a global summit on nuclear security, which would help "secure all vulnerable nuclear material around the world within four years". Four Nuclear Security Summits have been held since (Washington DC 2010, Seoul 2012, The Hague 2014, and again Washington DC 2016). Important goals of the Summits have been the minimisation and securing of weapons-usable nuclear materials; enhancement of international cooperation to prevent the illicit acquisition of nuclear material by non-state actors, most importantly terrorist groups and organised crime; and steps to strengthen the global nuclear security regime. States attending the Summits primarily made national pledges and came together in smaller groups to further these goals. The 2016 Washington DC Summit was the final one and led to action plans and initiatives that ensure that the work undertaken at the Summits could be continued at the UN level as well as in the IAEA, Interpol, Global Partnership, and the Global Initiative to Combat Nuclear Terrorism.

B. NATO EFFORTS

38. The spread and potential use of CBRN weapons and the possibility that non-state actors could acquire them are viewed as major threats by the Alliance. NATO is engaged in preventing the proliferation of CBRN weapons by both state and non-state actors, through an agenda of arms control, disarmament and non-proliferation, as well as by developing and harmonising defence capabilities. Should the Alliance suffer a WMD attack, NATO is prepared for recovery efforts through a military, political, and civilian approach. NATO's counterterrorism efforts are directed towards improving awareness of the threat, developing capabilities to prepare and respond, and engage in cooperation with partners and international organisations. At the NATO Headquarters level, the WMD Non-Proliferation Centre and the Counter Terrorism Section in the Emerging Security Challenges Division are the main focal points in dealing with CBRN terrorism.

39. In terms of counterterrorism efforts, NATO increases its awareness of the terrorist threat through consultations, intelligence-sharing amongst member countries, partners and international organisations, as well as strategic analysis and assessment. The NATO Headquarters Intelligence Unit is the main body that deals with awareness within the organisation. Capability development and advancement of innovative technologies dealing with asymmetric and terrorist threats is mostly conducted through the Defence against Terrorist Programme of Work. Engagement is carried out via different agreements with partners and international organisations. Interested partners are encouraged to include a section on counterterrorism in their individual cooperation agreements with NATO, for example. At the international level, NATO cooperates, in particular, with the EU, the UN, and the OSCE. NATO's Science for Peace and Security Programme, where cooperation between scientists and experts from allies and partner countries occurs, has counterterrorism as one of its main focuses as well. Finally, NATO also serves as a forum for comparing and analysing national programmes to ensure that plans and procedures are being put

in place and that enough is being done for addressing emergency situations should they occur. In 2011, a civil emergency planning action plan on CBRN was adopted. Within NATO, the Civil Emergency Planning Committee and the Euro-Atlantic Disaster Response Coordination Centre are key actors in this regard.

40. In terms of CBRN efforts, the Alliance launched a WMD Initiative in 1999, designed to integrate political and military responses to the proliferation of CBRN weapons. A direct result of this was the 2000 WMD Non-Proliferation Centre. The 2009 WMD Strategy currently frames the Allied response to CBRN terrorism and is built upon three pillars: prevention of CBRN weapons, protection against CBRN attacks or events, and recovery from such attacks or events. NATO's core areas in terms of countering the proliferation of CBRN weapons are:

- standardisation, training, research and development;
- arms control, disarmament and non-proliferation;
- deterrence;
- improving civil preparedness;
- creating standard agreements amongst allies;
- cooperating with partners; and
- international outreach activities.

41. Five CBRN defence initiatives were endorsed by the Alliance, in order to create:

- a Prototype CBRN Joint Advisory Team that can assess the effects of a CBRN attack;
- deployable analytical CBRN laboratories that can be transported rapidly into theatre for investigation purposes;
- a CBRN virtual pharmaceutical stockpile shared amongst members for immediate support in the event of an attack;
- a Virtual Centre of Excellence for CBRN defence to enhance visibility and transparency of NATO CRBN training and education; and
- a Near Real Time Disease Surveillance System to rapidly collect, identify, analyse and disseminate information related to any outbreak, which was declared initially operational in 2007.

42. The first two initiatives have now become the Combined Joint CBRN Defence Battalion and Joint Assessment Team, which together form the NATO Combined Joint CBRN Defence Task Force. This Task Force and the NATO-certified Centre of Excellence on Joint CBRN Defence are designed to respond to the CBRN threat, including by non-state actors.

C. EU EFFORTS

43. The European Security Strategy of 2003 identified the proliferation of WMD as "potentially the greatest threat to our security". In the same year, the EU adopted its Strategy against Proliferation of WMD to "prevent, deter, halt and, where possible, eliminate" the spread of these weapons and their means of delivery. It called for enhanced programmes to promote disarmament and incorporate the non-proliferation obligations in all political, diplomatic, and economic EU activities. In the 2005 Counter-Terrorism Strategy, the EU reiterated its support for enhanced cooperation in the fields of non-proliferation of WMD.

44. In November 2010, the European Council adopted the EU CBRN Action Plan to strengthen CBRN security in the European Union over a five-year period, particularly in the areas of prevention, detection, preparedness, and response. The Action Plan aims to secure CBRN materials, to improve member states' capacity to detect such materials and to respond to incidents involving these materials. Subsequently, the EU also launched the CBRN Mitigation Centres of Excellence Initiative seeking to strengthen the institutional capacity of countries outside the EU to mitigate CBRN risks.

45. A review of the CBRN Action Plan and its implementation was provided by a 2012 Progress report, which noted that the implementation process across member states was uneven. The report, in particular, highlighted the strong role of Europol as a facilitator of information-sharing and good practice, of joint training exercises, and of data collection. It also underlined the importance of developing a more strategic and overarching approach to CBRN and explosives (E) policies. In November 2012, draft Council conclusions started a discussion on a new CBRN-E Agenda. On 5 May 2015, the Commission adopted a Communication on a new approach to the detection and mitigation of CBRN-E risks at EU level, proposing a set of 30 actions. However, as of yet, no new legislation has been proposed.

46. Another Regulation from 2009 set up restricted access and control on exports, transfer, brokering, and transit of dual-use items. The regulation derives from the international commitment to counter the proliferation of CBRN weapons. A 2003 Regulation on the marketing and use of explosive precursors established a tighter regulatory regime for high-risk chemical precursors, with the aim of reducing their accessibility to the general public. At the same time, the report established regulations to ensure the appropriate reporting of any suspicious transactions involving both the restricted precursors and other non-restricted substances of concern.

47. In order to avoid unnecessary and expensive duplication efforts in worst-case-scenario emergencies, including CBRN attacks, the Commission has set up an Emergency Response Coordination Centre, to respond speedily to disasters inside the European Union, within the Directorate-General for Humanitarian Aid and Civil Protection.

V. CBRN SECURITY AND EVOLVING SCIENCE AND TECHNOLOGY

48. To acquire a CBRN weapon, terrorist groups would need to buy, steal, or manufacture the warhead as well as a method of delivery. The international community's responsibility is to block, through all available means, the terrorists' pathways to both. The previous section has outlined key international efforts in this regard. Perhaps the most crucial element of CBRN security is, however, the security of the material necessary to manufacture the warhead. If terrorists cannot get their hands on the chemical, biological, radiological, or nuclear material needed to fabricate a CBRN weapon, their efforts are in vain.

49. It is in any state's interest to safeguard military CBRN-related materials. The international community should not be complacent, however, as states with weak governance structures face higher risks that CBRN material could be illicitly diverted. Nevertheless, the biggest risks emerge from dual-use science and technology. The fundamental problem is that science, technology, and material required for CBRN weapons is increasingly accessible in the public domain and becoming cheaper and easier to employ. A main reason is that dual-use science, technology, and materials hold enormous potential in terms of human advancement. Chlorine is essential to modern water treatment; research on strains of dangerous diseases helps find the cures to them; and agricultural nuclear technology increases crop production in developing countries. Still, all three types of material could be used to make a CBRN weapon. In terms of CBRN security, the international community thus faces a double conundrum: how to secure existing military and civilian stocks and how to manage the enormous proliferation of dual-use materials which could be used in CBRN attacks.

A. CBRN SECURITY

50. The international chemical security regime, under the principal leadership of the OPCW, is strong compared to the regimes governing biological and nuclear security. The CWC is still not universal, even though only four countries have not ratified it: Egypt, Israel, North Korea, and South Sudan. Israel has signed, but not yet ratified, the treaty. As mandated by the CWC, states party to the treaty have established national authorities to implement it. The CWC has also created a detailed verification scheme. The OPCW inspects both facilities that produce chemicals that have previously been used in chemical weapons production, and facilities that produce chemicals that have not been used in military production, but are nevertheless of concern to party states. There are roughly 5,000 factories in the latter category.

51. The risks of chemical agents getting into the hands of a terrorist group is largest in states with previous chemical warfare programmes where the state is not entirely in control of its territory. As previously mentioned, Daesh is tapping into expertise and material in Iraq and Syria, but Libya also represents a potentially dangerous theatre, as terrorist groups could expand into areas with relevant chemical facilities. Libya's stockpiles of sulphur mustard were destroyed in 2014, but more than 800 megatons of mostly chemical precursors remain in a storage depot, whose destruction is planned by the end of 2016. Large risks exist regarding dual-use items such as agricultural chemicals or chlorine. Experts believe that today there already exists a black market in the Middle East and North Africa for chemical agents that could be weaponised and for their precursors. As chemical attacks are becoming increasingly prominent in Iraq and Syria, they also judge that more and better information on weaponisation and methods of delivery exists on the internet.

52. Radiological and fissile material is plentiful in the civilian world, as it is essential in various fields, such as agriculture, medicine, and energy production. Experts estimate that material that could be used in radiological devices is contained in 70,000 sources located in over 13,000 buildings. No globally binding regulations on nuclear security exist. The Nuclear Security Summits process is geared towards filling in some of the gaps at international level, but the problem is that many sources of radiological and even fissile material are still not adequately secured.

53. A thriving black market for radiological material exists. Over 130 states participate in the IAEA Incident and Trafficking Database, which records and analyses incidents of illicit trafficking in nuclear and other radioactive material. All incidents in which nuclear and other radioactive material is out of regulatory control are contained in this database. Between 1995 and 2014, the IAEA recorded 27,341 confirmed incidents. A recent Associated Press investigation on nuclear smuggling reveals that nuclear security fears are real. Between 2009 and 2015 at least four attempts were made by criminal networks with suspected ties to Russian organised crime to sell radiological material to terrorists. Although the investigation did not reveal how widespread nuclear smuggling is, it did show that a nuclear black market emerged in the Republic of Moldova. The ring offered to sell radiological material, including highly enriched uranium, plutonium, and caesium, as well as blueprints for a radiological dispersal device to extremists in the Middle East. While it is good news that Moldovan investigators together with the US Federal Bureau of Investigation have disrupted these plots, it is unclear whether the smuggling ring has been shut down.

54. The BWC, unlike the CWC, does not have a permanent secretariat or strong verification mechanisms. Review conferences are held every five years, which have led to limited institutionalisation. Since the 1986 Review Conference, politically-binding annual confidence-building measures have been promoted. Seven categories of confidence-building measures exist: exchanges of data and information on a) research centres and laboratories, b) national biological defence research and development programmes as well as c) outbreaks of infectious diseases and similar occurrences caused by toxins; d) active promotion of contacts;

declarations of e) legislation, regulations and other measures, f) past activities in offensive and/or defensive biological research and development programmes and g) vaccine production facilities. Ultimately, however, transparency on biological material that could be weaponised is very low.

B. EMERGING SCIENCE AND TECHNOLOGY AND CBRN

55. There is no clear governance approach on the horizon for emerging science and technology fields and their potential misuse of CBRN weapons. This presents great proliferation risk, but at the same time it is not clear what this governance approach would actually look like. In particular, biological and chemical scientific knowledge grows at very high rates and policymakers have not yet come to terms with the massive changes underway in the natural sciences.

56. As Dr Jonathan E. Forman, a Science Policy Adviser at the OPCW, told the Members of the STC in 2014, since the early 1990s, roughly 15,000 entries for new chemical and oligomers are logged into the Chemical Abstract Service (CAS) registry per day. The CAS registry is the most authoritative collection of disclosed chemical substance information, containing more than 109 million organic and inorganic substances and 66 million sequences. Inevitably, some of these substances and sequences could be used in an adverse fashion. For example, some drugs to treat Alzheimer that are currently under development work similarly to nerve agents. Moreover, chemicals are not only more commercially available, but also more precise and lethal. Furthermore, chemistry and biology are no longer so easily separated. Indeed, converging science is becoming the norm, as chemistry, biology, physics, engineering, informatics, and many other fields are coming together to work for the development of human lives.

57. The biggest story in CBRN-weapons-related science and technology is, however, the so-called ‘biotech revolution’. Since the early 1990s, roughly 2.1 million entries for new genetic sequences are logged into the GeneBank each day, as Dr Forman told the STC in 2014 as well. The GeneBank is the US National Institute of Health’s annotated collection of all publicly available DNA sequences. The biotech revolution has the potential to change the risks of biological terrorism in profound ways. Biotech knowledge is mostly freely available in the public domain, and the government has little control over biotech innovation and materials. Instead, the market is shaped by a multitude of private sector agents, ranging from one-person companies to large-scale pharmaceutical companies.

58. The exploitation of biotechnologies for human development has brought enormous benefits, but it is the responsibility of all actors to balance these benefits against the prevention of nefarious use of biotechnology. National security concerns often clash with biotech investment and innovation. The fundamental problem often comes down to the fact that the science and technology that can cure diseases can also enable the development of more harmful pathogens.

59. Synthetic biology in particular is an emerging field that has been worrying security professionals for a number of years. It aims to a) design and fabricate biological components and systems which do not yet exist in the natural world or b) redesign and fabricate existing biological systems. While biology plays a key role, electrical and chemical engineering are central to synthetic biology as well. Synthetic biology harbours many exciting possibilities to improve standards of living. It could revolutionise the pharmaceutical industry. New biological systems could be used as data storage. Biosensors that monitor the environment and report anomalies could be developed. New materials that optimise desired properties could be designed. Space could be more easily explored if astronauts are enabled to manufacture material from local resources. In contrast, experts looking at synthetic biology through the lens of security see many potential dangers. If one can more easily manufacture ‘designer materials’, one could also more easily fabricate very harmful substances. Today, there is already a vibrant “do it yourself” biology movement where people with no formal background in biology design new materials. While many in this movement profess progressive technology ethics, it is easy to understand that a dark side could emerge, as it has in the field of cyber technology.

60. Europe and United States remain the market leaders in biotech, but the lead is narrowing as biotech investment increases in developing and emerging economies. Biotech innovation often takes place in countries without the regulatory barriers to biological terrorism, not only as emerging countries build up their industries, but also because many companies have begun to outsource key technical operations. These developments have many experts worried.

61. The old approach of relying purely on government regulation is no longer sufficient. In light of the shortcomings in the BWC and the low possibility that more binding regulations will be agreed upon in the 2016 Review Conference, arms control, disarmament and non-proliferation efforts concerning biological agents must go beyond the treaty. Pathogen and laboratory safety measures, for example, remain insufficient in many countries, especially in light of the rapid advances in science and technology. As scientists find it increasingly easy to synthesise deadly viruses, measures to control biological substances are struggling to keep pace. Instead the industry needs to be incentivised to play along. Academia and industry need to increase efforts to put self-governance tools in place, without governments abdicating the responsibility for biosecurity to academia and industry. A new overall paradigm of biosecurity is needed; yet the international community seems at a loss on how to achieve this. If one is concerned with the dark side of new biotechnologies, it must be noted that it is very hard to regulate. It would involve high costs for other interests. For example, consumers might not profit from all the promising possibilities of new biotechnologies. Furthermore, strict regulation might not work very well. Advanced biotech seems likely to legally proliferate in countries which do not regulate it very strictly, as it is an increasingly global phenomenon. Even in countries which do regulate it strictly, individuals and groups could develop advanced biotech skills because it often requires only very little infrastructure. A cultural change must nevertheless take place in the discipline. The development of a global code of ethics or conduct for scientists engaged in the life sciences has therefore been suggested by many experts.

VI. CONCLUDING REMARKS

62. The world has only seen a small number of terrorist CBRN attacks, and much of the information pertaining to attempts to procure CBRN capabilities remains classified. As a result, experts differ on the severity of the CBRN terrorist risk, which for most observers is a function of the threat posed by terrorist groups, the vulnerabilities of prospective targets, and potential consequences of an attack. Gregory Koblentz, Director of the Biodefense Graduate Program at George Mason University, who has briefed the STC in the past, differentiates between three groups in the expert community:

- Optimists believe that terrorist groups ultimately have little real intention and few capabilities to acquire a CBRN weapon. Even if a group could successfully employ such a weapon, the consequences would likely be minimal. They argue that CBRN terrorism is a ‘very low probability, very low consequence’ risk.
- Pessimists see the probability of a successful attack as growing because technological barriers become lower and terrorists ever more unconstrained. Moreover, they believe that a successful CBRN attack could have catastrophic effects. They thus view CBRN terrorism as a ‘low probability, high consequence’ risk.
- Like the pessimists, pragmatists do not think that the stated intentions to acquire CBRN capabilities should be underestimated and also believe that technological barriers are steadily falling. Nevertheless, unlike the pessimists, they point out that the difficulties are still significant and that not every successful attack would lead to catastrophic effects, but depends on the specific circumstances. To increase vigilance, pragmatists advocate more fine-grained analyses of terrorist groups. They thus see CBRN terrorism as a ‘low but growing probability, low consequence’ risk.

63. A pragmatist stance is perhaps the best frame of analysis. The Alliance and its member states are faced with a growing number of security challenges in its neighbourhood and across the globe. Parliaments must match scarce defence and security resources in the most efficient to cope with all of these challenges. The international community needs to counter terrorism in all its variations in a much more effective manner. This includes addressing CBRN terrorism in a clear headed manner. Terrorist groups have the stated intention to acquire CBRN weapons, and they act upon it, steadily increasing their capabilities. Moreover, new possibilities are opening up in science and technology. Therefore, complacency must be avoided, and constant vigilance maintained. Understanding the threat, including through vulnerability analyses and adequate intelligence efforts, is necessary to devise the most efficient policy responses at the international, multinational, state, and local level.

64. Policies need to address the full spectrum of CBRN terrorism. As it is very difficult to deter terrorist groups, perhaps even impossible, the transatlantic community needs to focus on preventing terrorist groups from acquiring CBRN weapons in the first place. Furthermore, resilience is key. NATO and its partners need to:

- be adequately prepared and protected for an attack;
- rapidly detect when an attack occurs;
- manage the consequences of an attack, including through first responses and long-term medical care, decontamination, as well as management of the psychosocial impact;
- clean up the affected site of an attack; and
- deal with the long-term consequences.

65. The risk of terrorist attacks with CBRN weapons will increase as science and technology innovation, research, development, and distribution are becoming more easily accessible and globalised. The increasing diffusion and accessibility might enable innovative terrorist groups to reach levels of technology previously only achieved by highly developed states. The increasing ubiquity of material that could be used in terrorist CBRN weapons as well as the insecurity of some existing stocks could, in the future, give individuals with a modest education and a certain level of technical proficiency the power to bring about massive damage. Indeed, history shows that terrorist groups often innovate and exploit new technologies to make up for what otherwise they lack in capacities.

66. As the Irish Republican Army once famously stated after a failed assassination attempt against Margaret Thatcher: “You have to be lucky all the time. We only have to be lucky once.” Fortunately, CBRN weapons are still difficult to acquire and use. One could turn this saying around: terrorists have many opportunities to get unlucky along the long path to a CBRN attack. It is the responsibility of the international community to increase the likelihood that terrorist groups do indeed get unlucky. Yet, the possibility that a CBRN attack might take place should not be discounted. As Brigadier General Russell D. Howard (ret) and Margaret J. Nencheck put it, “[t]he best we may be able to achieve [against terrorist groups] is to understand that we live in danger, without living in fear.”

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