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Non-State actors' pursuit of CBRN weapons: From motivation to potential humanitarian consequences

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Abstract

This paper discusses non-State actors' motivation and capacity to develop and use chemical, biological, radiological or nuclear (CBRN) improvised weapons in attacks, as well as the possible consequences of such use. Six types of groups have been identified as potential CBRN weapons users that may increasingly be able to acquire relevant CBRN weapons-related knowledge, skills and possibly materials. As technical barriers still form a gap between the theoretical possibility and the operational reality, any potential future CBRN attacks would most likely be crude, low-level attacks, including chemical or radiological materials. CBRN attacks carried out by non-State actors in the future are likely to be more disruptive than destructive.

Keywords: CBRN, non-State actors, weaponization, humanitarian consequences.

Recent developments in Syria[1] and its neighbouring countries have revitalized awareness of the threat of attacks involving chemical, biological, radiological or nuclear (CBRN) weapons or weapons of mass destruction (WMD).[2] Within this threat, which has historically included conventional use (that is, use in State versus State conflicts), there is a steadily growing concern about the potential use of these weapons by non-State actors. There are increasing indications that certain types of non-State groups have planned or are planning to carry out attacks using CBRN weapons. In relation to Syria, for example, claims of rebels using chemicals, including sarin, in furtherance of their goals have been made.[3] Islamic State (IS) specifically has been accused of using low-grade chemical weapons on several occasions, including chlorine and mustard gas against Kurdish fighters on a number of occasions in 2015.[4] The possibility that such groups may continue to use such weapons, both within and outside battle zones, was emphasized once

1 In August 2013, the nerve agent sarin was used on a relatively large scale in the outskirts of Damascus – resulting in numerous casualties predominantly among civilians, including children – and there is compelling evidence that chlorine was used "systematically and repeatedly" as a weapon in villages in northern Syria from April to August 2014. United Nations (UN) Mission to Investigate Allegations of the Use of Chemical Weapons in the Syrian Arab Republic, Report on Allegations of the Use of Chemical Weapons in the Ghouta Area of Damascus on 21 August 2013, UN Doc. A/67/997-S/2013/553, 16 September 2013, p. 8; Organisation for the Prohibition of Chemical Weapons (OPCW), "OPCW Fact Finding Mission: OPCW, 'Compelling Confirmation' that Chlorine Gas Used as Weapon in Syria", press release, 10 September 2014, available at: www.opcw.org/news/article/opcw-fact-finding-mission-compelling-confirmation-that-chlorine-gas-used-as-weapon-in-syria/ (all internet references were accessed in November 2015); OPCW, Third Report of the OPCW Fact-Finding Mission in Syria, S/1230/2014, 18 December 2014.

2 The terms "CBRN weapons" and "WMD" are often used interchangeably. The latter term is particularly used in official texts (e.g. by the UN since 1947), defined as "atomic explosive weapons, radioactive material weapons, lethal chemical and biological weapons, and any weapons developed in the future which have characteristics comparable in destructive effect to those of the atomic bomb or other weapons mentioned above". UN Convention on Conventional Armaments (CCA), UN Doc. S/C.3/32/Rev.1, August 1948, as quoted in UN, Office of Public Information, *The United Nations and Disarmament, 1945–1965*, UN Publication 67.I.8, 1967, p. 28. The term "WMD" is sometimes considered to be misleading, as CBRN weapons are not necessarily massively destructive while non-CBRN weapons can be massively destructive. In this paper, therefore, the term "CBRN weapon" is used rather than "WMD". For an elaboration on the history of the WMD definition and further developments of the terminology, see, e.g., Seth Carus, "Defining 'Weapons of Mass Destruction'", Occasional Paper No. 8, Center for the Study of Weapons of Mass Destruction, Washington, DC, January 2012.

3 Damian McElroy, "UN Accuses Syrian Rebels of Chemical Weapons Use", *The Telegraph*, 6 May 2013, available at: www.telegraph.co.uk/news/worldnews/middleeast/syria/10039672/UN-accuses-Syrian-rebels-of-chemical-weapons-use.html.

4 Associated Press in Iraq, "Islamic State Used Chemical Weapons against Peshmerga, Kurds Say", *The Guardian*, 14 March 2015, available at: www.theguardian.com/world/2015/mar/14/islamic-state-isis-used-chemical-weapons-peshmerga-kurds; *BBC News*, "Islamic State 'Used Mustard Gas' against Peshmerga", *BBC News*, 7 October 2015, available at: www.bbc.com/news/world-middle-east-34471237; Ollie Gillman, "ISIS are Making and Using Chemical Weapons in Syria and Iraq Says US Official as Horrific Pictures of Kurdish Soldiers' Injuries Caused by Mustard Gas Emerge", *Daily Mail*, 11 September 2015, available at: www.dailymail.co.uk/news/article-3230295/ISIS-making-using-chemical-weapons-Syria-Iraq-says-official-horrific-pictures-Kurdish-soldiers-injuries-caused-mustard-gas-emerge.html.

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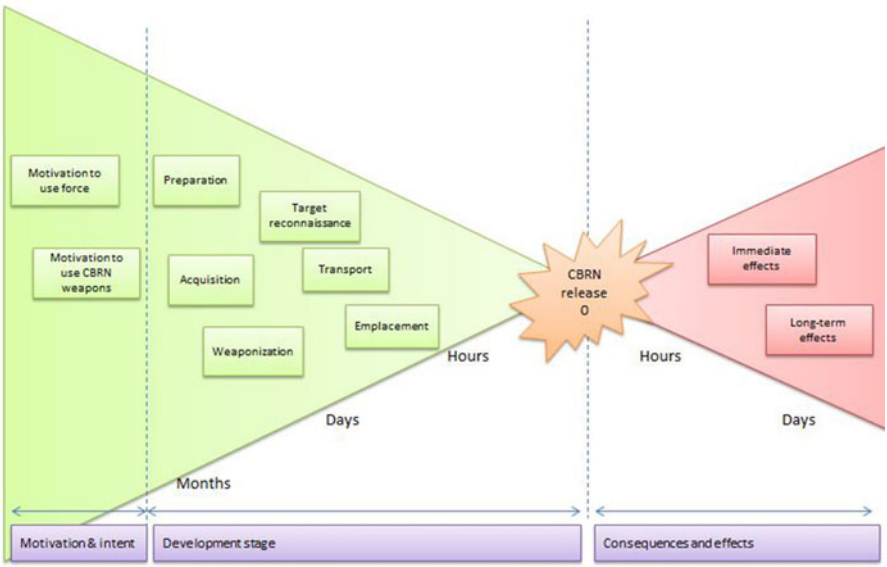

Figure 1. Overview the various elements of the threat and the stages of the process, from the formation of motivation and intent to the actual completion and triggering of a CBRN weapon, as well as the impact of a CBRN attack.

again by French Prime Minister Valls in the aftermath of the 13 November 2015 Paris terrorist attack.[5] These developments all feed the debate about security of CBRN weapons and the possibility of them falling into the "wrong hands", as well as availability of raw materials, knowledge on handling and weaponizing such materials and tools of dissemination. Chemical weapons seem to be relatively easily obtainable, biological and radiological weapons fall somewhere in the middle, and nuclear weapons are likely beyond the reach of non-State actors.

In recent decades, no significant increase in actual incidents of CBRN attacks by non-State actors has occurred.[6] In fact there are only a handful of prominent cases, including the 1995 sarin attack on the Tokyo subway in which a dozen people died and hundreds were injured when the deadly gas was released in five different trains during morning rush hour,[7] and the 2001 anthrax letters in

5 See, e.g., Adam Withnal, "Paris Attacks: Isis 'Chemical Weapons' Warning Issued by French PM Manuel Valls", *The Independent*, 20 November 2015, available at: www.independent.co.uk/news/world/europe/paris-attacks-french-pm-manuel-valls-issues-isis-chemical-weapons-warning-a6740156.html; Philippe Wojazer, "French PM Valls Says Chemical Warfare Risk Not Ruled Out", *Reuters*, 19 November 2015, available at: www.reuters.com/article/2015/11/19/us-france-shooting-chemicalweapons-idUSKCN0T80W220151119.

6 The Monterey WMD Terrorism Database provides an overview of worldwide incidents involving the acquisition, possession, threat and use of weapons of mass destruction by sub-State actors, based on open sources. Available at: http://wmddb.miis.edu/.

7 See, e.g., Robyn Pangi, "Consequence Management in the 1995 Sarin Attacks on the Japanese Subway System", Discussion Paper, Belfer Center for Science and International Affairs, February 2002, available at: http://belfercenter.ksg.harvard.edu/files/consequence_management_in_the_1995_sarin_attacks_on_the_japanese_subway_system.pdf.

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the US, when, soon after the 9/11 attacks, letters containing anthrax spores were sent to a number of news agencies and two US senators, causing the deaths of five people and infecting seventeen others.[8] Some argue that the perception of the probability/possibility of CBRN attacks by non-State actors may be different from the real probability as a result of sensationalism or fear. This article explores and discusses the actual threat posed. In order to do so, it describes the process from developing the intent to use force, including CBRN materials, to the actual completion and triggering of a CBRN weapon and the release of CBRN materials, which requires careful preparations and actions.

Figure 1 shows the several steps of the development, use and consequences of a CBRN weapon in chronological order. It is also a depiction of how this article is set up. First, motivation and intent to employ CBRN weapons are described. The article discusses several types of non-State groups that may have an intention to use force in the pursuance of their goals. If the use of CBRN materials matches the outcomes sought through the perpetration of an attack, these actors may be motivated to use them rather than "conventional" weapons. This leads to the development stage. Second, conditions for developing CBRN capabilities and weaponization of such capabilities, as well as the probability of actors being able to complete different development tasks and actually execute a CBRN attack, are described. Finally, the potential humanitarian consequences of such attacks, both immediate and long-term, are discussed.

Similar to CBRN attacks, CBRN accidents may also cause enormous destruction and create thousands of victims, as was demonstrated by the 1984 Bhopal pesticide plant gas leak accident in India.[9] The accident happened at a Union Carbide pesticide plant three miles (4.8 kilometres) from the central Indian city of Bhopal. Toxic methyl isocyanate gas had escaped when a valve in the plant's underground storage tank broke under pressure. Chaos and panic broke out in the city and surrounding areas as tens of thousands of people attempted to escape. More than 20,000 people required hospital treatment for symptoms including swollen eyes, frothing at the mouth and breathing difficulties. It may be understood from the underlying topic, however, that such accidental disasters do not fall within the scope of this article.

Although attacks on CBRN facilities which ultimately lead to the release of CBRN materials, such as an attack on a nuclear facility or chemical transport or plant, do fall within the scope of this paper, this type of attack will not be elaborated upon here. One can think of the sabotage of a reactor, which could lead to a meltdown, or on-site damage or destruction of a facility leading to the

8 See, e.g., FBI, "Amerithrax or Anthrax Investigation", *Famous Cases & Criminals*, available at: www.fbi.gov/about-us/history/famous-cases/anthrax-amerithrax.

9 For information about the Bhopal incident, see Jackson B. Browning, *Union Carbide: Disaster at Bhopal*, report, 1993, available at: www.environmentportal.in/files/report-1.pdf; "1984: Hundreds Die in Bhopal Chemical Accident", *BBC On this Day: 3 December*, available at: http://news.bbc.co.uk/onthisday/hi/dates/stories/december/3/newsid_2698000/2698709.stm.

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release of harmful materials. Usually, this would likely require insider cooperation. As for resources, arguably, a commando-style or drone attack may be able to cause the release of materials and would probably need no more than moderate financial resources: "Such attacks are not only within the realm of possibility, but are also within the reach of most non-State groups."[10] For example, in June 2012, an unidentified armed group of men attacked a uranium plant in the southeast of the Central African Republic.[11] Additionally, in June and July 2015, in France, explosions occurred at a chemical and petrochemical plant, respectively, as a result of attacks on those facilities.[12]

Cyber-attacks on CBRN facilities may have serious consequences as well. For example, the possibility of breaching even a highly secured nuclear facility was demonstrated by the Stuxnet virus, and the potential consequences of hacking into a plant's control station via computers and digital devices has been made evident by the so-called "Aurora Project".[13] Experimenters were ultimately able to direct a mock-up chemical plant to self-destruct. This demonstrated not only that a plant's information systems can be penetrated and controlled by cyber-commands, but also that cyber-commands alone can destroy industrial equipment. Arguably, this could cause the release of CBRN materials. In this article, however, the main focus is on the use of CBRN materials in a weapon – that is, a specific improvised delivery device.

Ideology and motivation to perpetrate CBRN attacks

This section addresses the question of which non-State actors would pursue CBRN attacks and why. The term "non-State actor" refers to groups other than States that may use CBRN materials in an attack. Although the possibility of so-called "lone

10 Jeffrey M. Bale and Gary Ackerman, *Recommendations on the Development of Methodologies and Attributes for Assessing Terrorist Threats of WMD Terrorism*, Center for Nonproliferation Studies, Monterey Institute of International Studies, 2005, p. 39.

11 RFI, "Gunmen Attack French Uranium Plant in Central African Republic – Army", *RFI English*, 25 June 2012, available at: www.english.rfi.fr/africa/20120625-gunmen-attack-french-uranium-plant-central-african-republic.

12 In June 2015, an employee of a chemical plant in south-eastern France decapitated his boss, took photographs of himself with the head and an IS flag, and caused an explosion by driving his van into a warehouse containing chemicals. "France Put on High Alert after Attack on Chemical Plant", *Al Jazeera*, 26 June 2015, available at: www.aljazeera.com/news/2015/06/attack-reported-factory-southeastern-france-150626091038049.html. In July 2015, two explosions at a petrochemical plant took place that were believed to be a malicious act due to the distance between the two tanks. Rebecca Trager, "Failed Terror Attack Raises Alarms about Chemical Plant Security", *Chemistry World*, 2 July 2015, available at: www.rsc.org/chemistryworld/2015/07/failed-terrorist-attack-chemical-plant-security; Henry Samuel, "Two Blasts in French Chemical Plant Caused by 'Malicious Act'", *The Telegraph*, 14 July 2015, available at: www.telegraph.co.uk/news/worldnews/europe/france/11739009/Two-blasts-in-French-chemical-plant-caused-by-malicious-act.html.

13 Kim Zetter, "An Unprecedented Look at Stuxnet, the World's First Digital Weapon", *Wired*, 11 March 2014, available at: www.wired.com/2014/11/countdown-to-zero-day-stuxnet/; Mike M. Ahlers, "Inside a Government Computer Attack Exercise", *CNN News*, 17 October 2011, available at: http://edition.cnn.com/2011/10/17/tech/innovation/cyberattack-exercise-idaho/.

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wolves" conducting CBRN attacks cannot be ruled out,[14] the fact that a number of sophisticated steps need to be taken before CBRN weapons can be developed or acquired, for which specific knowledge, expertise and skills are needed, makes it unlikely that this could be accomplished by a single person. Rather, one needs a network of individuals with dedicated tasks. Such a network may be comprised of leaders, financers, suppliers, transporters, bomb builders, those who plant the weapons, triggermen and those who exploit the attack. Research has shown that networks are used not only to recruit, train and prepare for an attack, but also to compensate for elements that a single person may lack, such as resources, elite access or ideological support.[15]

Possible CBRN-oriented non-State actors

There is a paucity of studies that analyze why groups would want to acquire and use CBRN weapons.[16] Nevertheless, it is possible to make a number of relevant observations. For example, ideology plays a decisive role in a group's objectives and *modus operandi*. The use of CBRN weapons may or may not fit a non-State actor's ideological agenda, or encompass overall and specific operational objectives. Based in part on previous CBRN incidents, a number of ideological groups have been identified as groups that may use violence in the pursuit of their goals, including possibly CBRN weapons. These include nationalist, separatist or irredentist groups; radical religious fundamentalist groups; apocalyptic or millenarian "new religious movement" groups; single-issue groups; right-wing groups; and social revolutionary or secular left-wing groups. The sections below provide a brief overview of the main features of such groups.

A few general remarks can also be made regarding all six types of groups that have been identified as potentially motivated to use CBRN means in furtherance of their goals. For example, social alienation of a particular group plays an important role as it creates, maintains or strengthens the notion of "us" versus "them".[17] A charismatic leader may make use of this notion to motivate his followers not only to adhere to his ideology, but also to undertake actions that

14 In fact, there are strong suspicions that the anthrax letters case of 2001 was due to the actions of a single person with access to a US biological defence laboratory. "FBI Concludes Investigation into 2001 Anthrax Mailings", *CNN News*, 19 February 2010, available at: http://edition.cnn.com/2010/CRIME/02/19/fbi.anthrax.report/.

15 Bartosz H. Stanislawski, "Transnational Organized Crime, Terrorism, and WMD", in Andrew Blum, Victor Asal and Jonathan Wilkenfeld (eds), "Nonstate Actors, Terrorism and Weapons of Mass Destruction", in *International Studies Review*, Vol. 7, No. 7, 2005, p. 159; Christian Leuprecht and Kenneth Hall, "Why Terror Networks are Dissimilar: How Structure Relates to Function", in Anthony J. Masys, *Networks and Network Analysis for Defence and Security*, Lecture Notes in Social Networks, SpringerLink, 2004, p. 86.

16 Due to the lack of (statistical) studies, empirical analysis of CBRN attacks is virtually impossible and it is difficult to comprehend the potential extent of attacks by non-State groups using CBRN weapons. Reshmi Kazi, "The Correlation Between Non-State Actors and Weapons of Mass Destruction", *Connections: The Quarterly Journal*, Vol. 10, No. 4, 2011, p. 2.

17 Amuary Vergely, "CBRN Weapons and Non-State Actors", *Theriskyshift.com*, 13 May 2013, available at: http://theriskyshift.com/author/amaury-vergely/.

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they would not normally perform. His decisions may suppress members' moral constraints, as the leader holds the truth, but also, because the leader will be responsible for the actions, individuals fade away into the group as a whole.

Nationalist, separatist or irredentist groups

Traditional nationalist or separatist groups are organizations whose purpose is focused on achieving some type of political objectives for a given group.[18] For example, they may want to establish an independent State for the ethnic, linguistic, cultural or national community with which they are affiliated, or, if they already have their own independent State, to unite all of the members of their community.[19] Indiscriminate acts against an adversary, in particular in areas where the group's supporters are not present, can be rationalized by such a group.

The prospect of CBRN weapon use in such areas is conceivable, but nationalist/separatist groups will generally steer clear of CBRN weapons because of concerns about alienating their constituencies.[20] For example, Chechen separatists demonstrated that they had the capacity to produce a so-called "dirty bomb" by placing a shielded cancer treatment device containing a caesium-137 source, strapped to an explosive, in Moscow's Ismailovsky Park in 1995.[21] The separatists then alerted the press that they had left the device in the park, and on the very spot the rebels indicated, authorities indeed found the partially buried device.[22]

Radical religious groups

Radical religious groups are comprised of religious extremists who embrace political objectives and/or forcibly insert religion into the political sphere.[23] Such groups are often hierarchical in nature, and their leaders may provide interpretations of religious texts that justify violence and which are adopted by their "true believer" followers.[24]

There is no ambivalence within such groups concerning the use of religiously commanded violence. These groups rely heavily on acts of terror that

18 Charles D. Ferguson and William C. Potter, *The Four Faces of Nuclear Terrorism*, Routledge, New York, 2005, p. 19.
19 J. M. Bale and G. Ackerman, above note 10, p. 7.
20 Charles D. Ferguson, "WMD Terrorism", in Nathan E. Busch and Daniel H. Joyner (eds), *Combating Weapons of Mass Destruction: The Future of International Nonproliferation Policy*, Studies in Security and International Affairs, University of Georgia Press, Athens, GA, 2009, p. 40.
21 Andy Oppenheimer, "A Sickening Episode: Nuclear Looting in Iraq and the Global Threat From Radiological Weapons", *Disarmament Diplomacy*, No. 73, October–November 2002; Sonia Ben Ouagrham-Gormley, "An Unrealized Nexus? WMD-related Trafficking, Terrorism, and Organized Crime in the Former Soviet Union", *Arms Control Today*, 1 July 2007, available at: www.armscontrol.org/act/2007_07-08/CoverStory.
22 A. Oppenheimer, above note 21; S. Ben Ouagrham-Gormley, above note 21.
23 C. D. Ferguson, above note 20, p. 39.
24 Jerrold M. Post, "The Psychology of WMD Terrorism", in A. Blum, V. Asal and J. Wilkenfeld (eds), above note 15, p. 149.

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target the purported "enemies of God" and other evildoers.[25] As such, what constraints there are against using CBRN as a means to achieve their goals may be overcome. For example, Al Qaeda and IS draw part of their strength from a radical interpretation of Islam that seeks to create a caliphate which would unite the Muslim world under strict religious law. Interest in CBRN weapons was proclaimed by Osama bin Laden, who stated that acquiring CBRN weapons is a religious duty. He referred to the Hiroshima bombing to emphasize his search to acquire and use nuclear weapons "not only because it is God's will, but because he wants to do to American foreign policy what the United States did to Japanese imperial surrender policy".[26] Similarly, there are indications that IS has promulgated among its members a religious edict that sanctions the use of CBRN against civilians.[27]

Apocalyptic millenarian groups or "new religious movements"

Apocalyptic millenarian groups or "new religious movements" show certain similarities with radical religious fundamentalist groups. In contrast to the latter, however, apocalyptic groups do not necessarily pursue change; rather, they aspire to bring about Armageddon, or world destruction. Leaders of such groups may reason that the use of CBRN weapons can trigger the apocalypse, thus, in their view, cleansing the world of evil.[28]

For example, the Aum Shinrikyo cult has conducted CBRN attacks. The most notorious example is the 1995 sarin attack on the Tokyo subway system, but this group has also used anthrax and botulinum toxin in attacks (the former ultimately failed to cause any damage due to the use of incorrect strains), experimented with Q fever and attempted to acquire the Ebola virus.[29] Additionally, it reportedly attempted to purchase nuclear weapons components to pursue its nuclear ambitions, but never succeeded in developing a nuclear weapon.[30]

25 J. M. Bale and G. Ackerman, above note 10, p. 8.

26 Steve Coll, "Nuclear Nightmares: What Bin Laden Sees in Hiroshima", *Washington Post*, 6 February 2005, available at: www.washingtonpost.com/wp-dyn/articles/A365-2005Feb5.html.

27 See, e.g., Damien McElroy, "Islamic State Seeks to Use Bubonic Plague as a Weapon of War", *The Telegraph*, 29 August 2014, available at: www.telegraph.co.uk/news/worldnews/middleeast/iraq/11064133/Islamic-State-seeks-to-use-bubonic-plague-as-a-weapon-of-war.html.

28 C. D. Ferguson and W. C. Potter, above note 20, p. 39.

29 See, e.g., Amy E. Smithson, "Rethinking the Lessons of Tokyo", in Amy E. Smithson and Leslie-Anne Levy (eds), *Ataxia: The Chemical and Biological Terrorism Threat and the US Response*, Henry L. Stimson Center, Washington, DC, 1999, available at: www.stimson.org/images/uploads/research-pdfs/atxchapter3.pdf; Richard Danzig, Marc Sageman, Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosford, *Aum Shinrikyo: Insights Into How Terrorists Develop Biological and Chemical Weapons*, 2nd ed., Center for a New American Security, December 2012, available at: www.cnas.org/files/documents/publications/CNAS_AumShinrikyo_Danzig_1.pdf.

30 For more information, see Robert Jay Lifton, *Destroying the World to Save It: Aum Shinrikyo, Apocalyptic Violence, and the New Global Terrorism.* Macmillan, New York, 2000.

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Single-issue groups

Single-issue groups focus on very specific or relatively narrowly defined causes of various sorts – e.g. anti-abortion groups, eco-groups and animal rights activists – and are committed to acting as a catalyst to change policies or behaviour.[31] It is unlikely that these groups will use CBRN weapons to achieve their goals, as indiscriminate weapons may target too wide a spectrum of victims outside their targets, which may adversely affect public acceptance of their agendas. Rather, they have targeted goals that do not include mass casualties. An odd sub-category is "green anarchists", who apply similar perspectives as social anarchists but also critique the way humans interact with the non-human world (animals, nature, etc.).[32] According to these groups, not only social hierarchy but all hierarchy should be abolished. In its most extreme form, this could happen by rebirth of the earth through the annihilation of the human race. As such, this particular group also shows strong similarities to apocalyptic groups.[33] The possibility of single-issue actors such as these using CBRN agents thus cannot be ruled out.

Right-wing groups

Right-wing groups seek to restore national greatness (radical nationalists), suppress "dissident" opponents, expel or subordinate ethnic and cultural minorities (racists) or overthrow the existing democratic and "plutocratic" capitalist systems in order to establish a revolutionary "new order" (neo-fascists).[34] Right-wing non-State actors generally dehumanize their enemies and seek to delegitimize the government to justify their attacks. Individuals in this category are a significant threat for low-level chemical or biological attacks, but probably do not represent a threat for mass-casualty chemical or biological attacks due to resource limitations.[35]

Despite these limitations, right-wing extremists have managed to acquire CBRN material that they have planned to use. For example, in the United States, evidence has been found that right-wing extremists acquired CBRN material between 9/11 and August 2012, which they planned to use against the general public or government employees.[36]

31 C. D. Ferguson and W. C. Potter, above note 18, p. 20.
32 "Green Anarchism: Towards the Abolition of Hierarchy", *Freedom*, 29 August 2014, available at: http://freedomnews.org.uk/green-anarchism-towards-the-abolition-of-hierarchy/; Nick Harding, "Eco Anarchists: A New Breed of Terrorist?", *Independent*, 18 May 2010, available at: www.independent.co.uk/environment/eco-anarchists-a-new-breed-of-terrorist-1975559.html.
33 Robin M. Frost, "Terrorist Psychology, Motivation and Strategy", *The Adelphi Papers*, Vol. 45, No. 378, 2005, p. 46.
34 J. M. Bale and G. Ackerman, above note 10, p. 8.
35 J. M. Post, above note 24, p. 150.
36 Peter Bergen and Jennifer Rowland, "Right-Wing Extremist Terrorism as Deadly a Threat as Al Qaeda?", *CNN News*, 8 August 2012, available at: http://edition.cnn.com/2012/08/07/opinion/bergen-terrorism-wisconsin/.

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Social revolutionary or secular left-wing groups

Social revolutionary or secular left-wing groups seek to overthrow the capitalist economic and social orders and establish either a "dictatorship of the proletariat" (for example, Marxist-Leninists) or, more rarely, a decentralized, non-hierarchical socio-political system (for example, anarchists).[37] These groups are constrained from indiscriminate acts that cause significant casualties among their own supporters or cause negative reactions in domestic and international audiences, but they can rationalize discriminate acts against government or symbolic capitalist targets.[38] No publicly available, explicit examples of actual attacks perpetrated by this kind of non-State group have been identified.

Motivation for using CBRN weapons

Ideology and motivation are closely linked. Both play a decisive role in the selection of targets, tactical methods and weapons. Terrorist attacks, for example, are often primarily a form of psychological warfare in which a localized incident is intended to spread fear and anxiety among a wider audience or specific society.[39] This psychological aspect is vital to the success of a group.[40] Many of the groups described in the previous sections have been able to conduct attacks that spread fear with conventional weapons. This raises the question of why they would seek to conduct CBRN attacks, which are much more complicated. The objectives behind CBRN attacks vary greatly, in terms of impact sought as well as goals or motivations. The threat alone of using CBRN weapons gives a non-State group many advantages, because the thought of being the victim of a CBRN attack spreads greater and even disproportionate fear among potential target groups. The fact that psychological symptoms are more likely to occur when facing CBRN agents than when facing conventional weapons is possibly the most important motivational incentive that might make the acquisition and/or use of CBRN weapons attractive to non-State actors.[41]

Similar to, for instance, the psychological impact of chemical warfare in the First World War, the concept of a CBRN attack today is anxiety-provoking not only because of the intangible nature of most of the harmful agents being used, but also because of the doubt as to whether or not one has been exposed. During the Tokyo subway attack, for example, the majority of the people who reported to medical

37 J. M. Bale and G. Ackerman, above note 10, p. 8.
38 J. M. Post, above note 24, p. 149.
39 With regard to fear relating to terrorist attacks with a focus on CBRN materials, see, e.g., Brooke Rogers, Richard Amlot, G. James Rubin, Simon Wessely and Kirstian Krieger, "Mediating the Social and Psychological Impacts of Terrorist Attacks: The Role of Risk Perception and Risk Communication", *International Review of Psychiatry*, Vol. 19, No. 3, 2007, pp. 279–288.
40 J. M. Bale and G. Ackerman, above note 10, p. 21.
41 *Ibid.*, pp. 11–12. Arguably, given the frequency of bombings resulting in mass casualties, it could be argued that only conventional attacks which result in hundreds or thousands of deaths and injured (9/11-style attacks) are likely to have a similar psychological impact as successful acts of CBRN terrorism, even those that are small in scale.

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facilities showed no symptoms of nerve agent exposure and were classified as "worried well".[42] Increased public fear can be anticipated from the possibility of suffering slowly and for a long period of time or the fact that the effects of CBRN weapons may be delayed. In the case of biological agents, a considerable amount of time may pass before symptoms occur and are recognized. In the meantime, there may be nothing the public can do to prevent themselves from becoming victims. In contrast to a naturally occurring flu epidemic, many people will come to the hospital at the slightest sign of influenza-like symptoms following the report of an attack, flooding hospitals and possibly crippling medical services. For example, in the period around the 2001 anthrax letters in the United States, an estimated 200,000 people made inquiry calls about anthrax to health departments across the nation.[43]

The fear factor may thus convince non-State actors to pursue CBRN weapons. On the other hand, similar fears about possible contamination, infection and disease caused by CBRN agents that beset the general populace may be shared by non-State actors themselves. This may deter non-State actors from pursuing use of CBRN weapons. They are aware that, in particular during the development and weaponization phases, handling CBRN materials poses risks. Fear of retaliation may also deter a group. For example, it would be risky for established groups like Hezbollah, Hamas, and Al-Jihad al-Islami to engage in CBRN attacks, in particular against Israel or the United States, since the territories they control could be occupied or destroyed in response.[44] Likewise, for some particular groups, such as Al Qaeda or IS, this would be counterproductive to obtaining their goal of a Muslim caliphate, although recent attacks by these groups have been reported.[45] However, this restraint does not apply to transnational groups that are spread all over the globe and do not depend for their survival on their continued presence in or control over specific territories. Additionally, if a non-State group genuinely believes that it can successfully conceal its involvement in a CBRN attack, it may not fear retaliation.

Non-State actors may also consider the negative impact on their support systems of using CBRN weapons. Generally, non-State groups depend on financial or other support from external sources, and it can be questioned whether these sources will be willing to support CBRN warfare. Certain types of actions may be considered "beyond the pale" principally for moral reasons. The use of CBRN materials, in particular if it has the potential to inflict mass

42 For more information on the "worried well" phenomenon, see Fred P. Stone, "The Worried Well Response to CBRN Events: Analysis and Solutions", The Counterproliferation Papers, Future Warfare Series No. 40, USAF Counterproliferation Centre, June 2007, pp. 6–7, available at: https://fas.org/irp/threat/cbw/worried.pdf.

43 Fran Pilch, *The Worried Well: Strategies for Installation Commanders*, USAF Institute for National Security Studies, USAF Academy, Colorado Springs, CO, 2004, p. 12.

44 J. M. Bale and G. Ackerman, above note 10, p. 31.

45 Lizzie Dearden "Isis 'Manufacturing and Using Chemical Weapons' in Iraq and Syria, US Official Claims", *The Independent*, 11 September 2015, available at: www.independent.co.uk/news/world/middle-east/isis-manufacturing-and-using-chemical-weapons-in-iraq-and-syria-us-official-claims-10496094.html.

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casualties, likely falls into this category for most non-State groups and their supporters. Carrying out such actions may be difficult to justify and, therefore, rather than impress or inspire, actors are likely to alienate support systems and potential international sponsors and discourage individuals from being recruited. Ultimately, this could lead to a group's demise. Only the most fanatical or desperate extremists will fail to recognize the broader negative impact that their violent actions are likely to have on their cause.[46]

Incidentally, the actual perpetrators of an attack may not necessarily be motivated to undertake certain actions, and may not have the freedom to make their own decisions. For instance, in certain cultures husbands or fathers have the authority to make decisions on behalf of women, and could thus force women to perform suicide bombings. Islamic restrictions against searching women provide possibilities to hide explosive-laden suicide vests underneath their burqas undetected. Similarly, there are reports of children being used as bombers; Boko Haram, the Taliban and IS, among others, have recruited and trained children to become suicide bombers.[47] As for the topic of suicide actions, the question arises as to why, as of yet, hardly any suicide CBRN attacks have taken place, although the chlorine bombings in Iraq from 2006 to 2007,[48] described in more detail later, may belong to this category. Biological weapons, for example, could be effectively combined with suicide tactics to create mass casualties, such as using a contaminated person to propagate a contagious pathogen in a public area. Additionally, after each CBRN incident, there are fears that others may copy such attacks, but no attack has been duplicated as of yet. This so-called "copycat" phenomenon does not seem to apply to CBRN attacks, although one source explicitly refers to certain cases in Japan that showed similar features to Aum Shinrikyo's attacks.[49]

In short, there are several reasons why non-State actors may pursue the use of CBRN weapons as a preferred route of action, particularly because inspiring fear is vital to the success of terrorist groups and CBRN attacks are more likely than conventional weapons to achieve this among both the target group and wider audiences. In practice, however, it seems that non-State actors who choose to resort to tactics designed to create terror are quite reluctant to use CBRN materials for a number of reasons. As discussed above, they may be fearful of handling these materials; as the use of CBRN weaponry is very controversial, they may risk losing the support of their networks and/or followers; or the retaliation

46 J. M. Bale and G. Ackerman, above note 10, p. 35.

47 Lara Logan, "Child Suicide Bombers", *CBS News*, 12 May 2015, available at: www.cbsnews.com/news/child-suicide-bombers-lara-logan-60-minutes/; "Nigerian City of Maiduguri 'Attacked by Five Child Bombers'", *BBC News*, 2 October 2015, available at: www.bbc.com/news/world-africa-34423311; Marisol Seibold, "Child Suicide Bombers: 'They Told Us the Bombs Would Not Kill Us …'", *Jihad Watch*, 14 January 2012, available at: www.jihadwatch.org/2012/01/child-suicide-bombers-they-told-us-the-bombs-would-not-kill-us-only-the-americans-would-die-and-you.

48 Jim Garamone, "Terrorists Using Chlorine Car Bombs to Intimidate Iraqis", *American Forces Press Service*, 6 June 2007, available at: http://archive.defense.gov/news/newsarticle.aspx?id=46311.

49 Tim Ballard, Jason Pate, Gary Ackerman, Diana McCauley and Sean Lawson, "Chronology of Aum Shinrikyo's CBW Activities", *CNS Reports*, 2001.

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may be very severe. Additionally, even if they are motivated to do so, they may lack the necessary knowledge, technological skills and safety measures to use CBRN weapons. Certain developments indicate, however, that several of these restraining factors may be gradually breaking down. For example, globalization makes information increasingly available, including information on how to handle and process CBRN materials. The following sections will discuss such issues in order to assess the probability of CBRN attacks perpetrated by non-State actors.

Probability of CBRN attacks perpetrated by non-State actors

The probability of threat realization is often determined by the motivation of the perpetrator and its capabilities. Obviously, the motives behind why a group would choose to develop and use a particular agent not only depend on the ideology, objectives and characteristics of the group, but are also context-dependent. Desperate needs lead to desperate deeds. With respect to capabilities, analysis of existing literature foresees significantly fewer hurdles to CBRN acquisition for both State and non-State actors in the future, with increasing availability of knowledge, techniques and dual-use materials as a result of knowledge diffusion and economic globalization, as well as fewer hurdles to CBRN development, which is the prerogative of State actors.[50] Conditions that facilitate CBRN capability development, weaponization and execution of an attack may thus grow over time.

Conditions for developing CBRN capabilities

To carry out CBRN attacks, a non-State actor needs to possess or acquire certain capabilities. A large number of activities need to be conducted, supported by personnel and resources. For example, one needs to acquire the knowledge on what materials to use and how to handle them, the financial means to obtain these materials, the support of one or more suppliers, and the knowledge and capabilities to actually manufacture the materials in such a way that they are suitable to use as a weapon. In particular, if a non-State actor intends to create a CBRN weapon from scratch, specific expertise and skills are needed that are not likely to be found in one single person. Even if a non-State actor manages to acquire a completed weapon or components thereof, specific skills are needed to create the desired effects for proper dispersion etc.[51] Thus, small networks of

50 See, e.g., The Hague Centre for Strategic Studies, *Future Issue: The Future of CBRN*, Vol. 12, No. 3, 2010, pp. 7–8.

51 For example, IS took control of the Al Muthanna facility, a former chemical weapons complex of Saddam Hussein's, in July 2014. Most of the remaining chemicals are no longer intact, and experts therefore believe that transforming them into military-grade weapons and delivery systems may be beyond the facility's current capability. "Isis Seizes Former Chemical Weapons Plant in Iraq", *The Guardian*, 9 July 2014, available at: www.theguardian.com/world/2014/jul/09/isis-seizes-chemical-weapons-plant-muthanna-iraq.

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persons are likely to be established, which will likely include a number of individuals with dedicated tasks.

To assemble such a network of skilled individuals, recruitment activities have to be performed. The potential solicitation of the services of personnel formerly employed by State-level weapons programmes is an issue of concern, as the current global climate does not present many State-level employment opportunities. Former weapons scientists may, therefore, be susceptible to recruitment by non-State employers. Within this category, the greatest threat may stem from disgruntled former weapons experts who have the ability either to aerosolize biological agents properly or to activate radiological or nuclear devices.[52] Of particular concern are scientists from the weapons programmes of the former Soviet Union, South Africa and Iraq.[53] The United States, for example, has spent millions of dollars in an attempt to keep key Russian former weapons experts above the poverty line.[54]

An issue taken into account in the recruitment process is that every introduction of a new member is a risk for a non-State group; recruitment is therefore based on trust and secrecy. Secrecy in general helps reduce the risk of detection.[55] Recruits will often be sought in trusted social networks and in particular among long-standing business or personal contacts. Considering the number and complexity of tasks to be completed before a CBRN weapon can be deployed, however, small, secretive cells will likely have a support base of people from a larger identity group, whose members accept their goals even if they reject their tactics. Non-State actors thus likely take careful political and security measures to subsist and to ensure that they suppress potential opposition from, or defection by, their supporters.[56]

In order to maintain a network and to be able to entice potential recruits to join that network, finances must be generated. Non-State actors derive income from a variety of sources, often combining both lawful and unlawful funding.[57] Finance generation can include donations and fundraising or charitable initiatives, derived from States, organizations, communities or individuals. The actors involved do not always know the illegitimate end of the activities. Revenue can also be generated from criminal activities, for example extortion or fraud, or from working together with criminal groups that do not necessarily have an intention to commit terrorist acts. If criminals trade with terrorists,

52 J. M. Bale and G. Ackerman, above note 10, p. 69.
53 *Ibid*., p. 51.
54 Amy E. Smithson, *Toxic Archipelago: Preventing Proliferation from the Former Soviet Chemical and Biological Weapons Complexes*, Report No. 32, Henry L. Stimson Center, Washington, DC, December 1999.
55 Ted Robert Gurr, "Which Minorities Might Use Weapons of Mass Destruction?", in A. Blum, V. Asal and J. Wilkenfeld, above note 15, p. 144.
56 *Ibid*., pp. 144–145.
57 See, e.g., Financial Action Task Force, *Terrorist Financing*, OECD, Paris, 29 February 2008, available at: www.fatf-gafi.org/media/fatf/documents/reports/FATF%20Terrorist%20Financing%20Typologies%20Report.pdf.

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both may be able to receive whatever they might need: materials, weapons and information.

Additionally, some sort of infrastructure to facilitate the development of source funding must be built and maintained, as funds must be channelled to all network participants – that is, everyone who provides services or materials. Scrutiny of funds presents considerable challenges to domestic as well as international financial institutions because non-State groups navigate loopholes in the international financial system. Financial institutions attempt to control international financing through sanctions or other coercive measures as directed by international instruments on suppression of all forms of financing for non-State actors, but often with limited success.[58] Furthermore, outside the traditional banking systems, there are also alternative methods for making financial arrangements – for example, via Hawala banking.[59] This is a means to provide financial services to the unbanked in countries with limited financial access. In significant numbers of jurisdictions, and sometimes even within the same jurisdiction, law enforcement views this as one of the leading channels for terrorist financing and money laundering.[60]

"Criminal enclaves" or "black spots" are environments in which criminal and other non-State actors can interact. Such environments can be found in weak States with little or no governmental control or societies with subcultures that feature precedents and justifications for violent conflict.[61] As such, this is similar to the concept of failed States. Black spots may also be found in smaller areas and can exist as part of border regions. For example, the tri-border area in South America serves as a hub for arms smuggling, money laundering, illicit trafficking and fundraising for extremist organizations, allegedly including Hezbollah.[62] In addition to black spots being able to facilitate interaction between non-State groups and criminals, they also provide potential for collaboration between non-State groups. The oldest alliance patterns adopted by States within the international system – those based on the notion that "the enemy of my enemy is my friend" – also influence the behaviour of non-State actors.[63] One can observe this in the conflict areas in and around Iraq and Syria, where armed groups ally and split in pursuance of their goals and their desire to defeat common enemies.

Black spots also provide relatively protected places where CBRN weapons can be developed and where people with malicious intent and skills may already reside. Due to the complexity of producing CBRN weapons and the fact that preparing, transporting and employing CBRN weapons involves safety risks,

58 Javaid Rehman, *International Human Rights Law*, 2nd ed., Pearson, Harlow, 2010, p. 901.
59 Financial Action Task Force, *The Role of Hawala and Other Similar Service Providers in Money Laundering*, October 2013, available at: www.fatf-gafi.org/publications/methodsandtrends/documents/role-hawalas-in-ml-tf.html.
60 *Ibid*.
61 A. Blum, V. Asal, J. Wilkenfeld, above note 15, pp. 135–136.
62 Cyrus Miryekta, "Hezbollah in the Tri-Border Area of South America", *Small Wars Journal*, 10 September 2010.
63 Gary Ackerman, "WMD Terrorism Research: Whereto from Here?", in A. Blum, V. Asal and J. Wilkenfeld, above note 15, pp. 142–143.

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non-State actors may want to install safety precautions such as physical means of preventing CBRN materials from being released unwillingly or of protecting themselves against exposure to such materials, in particular if they consider mass production. Such measures may attract attention in public locations. Non-State actors must thus make sure that they perform their preparations covertly to avoid detection and intervention, particularly considering that States are under an obligation to deny safe haven to those who support terrorism and to bring to justice those who engage in criminal activities.[64]

The lack of governmental control may make black spots ideal locations for the production of CBRN weapons. Aum Shinrikyo, for example, managed to operate a state-of-the-art, secret laboratory at the base of Mount Fuji,[65] and Al Qaeda reportedly maintained several biological and chemical weapons-related facilities in Afghanistan prior to the US invasion in 2001.[66] Allegedly, IS has also set up a special branch to develop chemical weapons for the group, using scientists from Iraq and Syria as well as other countries in the region".[67] However, "black spots" are not essential for developing a CBRN weapon as long as one flies under the radar. For example, in 2005, the British courts convicted an Algerian for "commit[ting] public nuisance by the use of poisons and/or explosives to cause disruption, fear or injury",[68] after police found equipment needed to produce ricin and recipes for ricin, cyanide and several other poisons in his flat in north London.[69]

As soon as personnel and facilities have been procured, preparations for the actual development phase may commence. Technical and knowledge-sharing innovations increasingly facilitate effective use of available information and technology, even by laymen. With a multiplicity of resources by which individuals, including non-State actors, can educate themselves on aspects of CBRN weapons, including college textbooks, academic journals and industry publications, such individuals may place themselves higher along the learning curve than lay actors from previous decades.[70] In addition to the increased diffusion of knowledge, technological advances are widely available.[71] For example, the same equipment and technical knowledge used for legitimate

64 UNSC Res. 1373, 28 September 2001, para. 2.
65 Christopher Szechenyi, "Inside the Village of Aum Shinrikyo", *Moscow Times*, 22 April 1995, available at: www.themoscowtimes.com/news/article/inside-the-village-of-aum-shinrikyo/340092.html.
66 Francis Marlo, "WMD Terrorism and US Intelligence Collection", *Terrorism and Political Violence*, Vol. 11, No. 3, 1999.
67 "'ISIS Branch' Seeking to Produce Chemical Weapons – Iraq and US Intel", *RT*, 19 November 2015, available at: www.rt.com/news/322726-ISIS-chemical-weapons-intel/.
68 Chris Summers, "Questions Over Ricin Conspiracy", *BBC News*, 13 April 2005, available at: http://news.bbc.co.uk/2/hi/uk_news/4433499.stm.
69 Edwin Bakker, "CBRN Terrorisme", in Erwin R. Muller, Uri Rosenthal and Rob de Wijk (eds.), *Terrorisme: Studies over terrorisme en terrorismebestrijding*, Kluwer, Deventer, 2008, p. 135; "The Ricin Case Timeline", *BBC News*, 13 April 2005, available at: http://news.bbc.co.uk/1/hi/uk/4433459.stm.
70 J. M. Bale and G. Ackerman, above note 10, p. 50.
71 Victor H. Asal, Gary A. Ackerman and R. Karl Rethemeyer, "Connections Can Be Toxic: Terrorist Organizational Factors and the Pursuit of CBRN Terrorism", *Studies in Conflict and Terrorism*, Vol. 35, No. 3, 2012, p. 6.

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research to save lives can also be used to manufacture deadly diseases.[72] For this reason it is ever more complicated to identify illegitimate laboratories – for example, those producing non-medical narcotics – that may at some point engage in producing CBRN agents.

Additionally, unscrupulous suppliers, including both State and non-State actors, have consistently flouted international restrictions on controlled dual-use items.[73] It is extremely difficult to shut down such supply lines considering that the necessary amount of dual-use equipment and materials is often far below the threshold for surveillance by any national or international non-proliferation entity and the actors involved sometimes cooperate with one another to undermine or avoid export controls. For example, even after a warning from the Ministry of Foreign Affairs that Iraq had used chemical weapons against Iran, a Dutch entrepreneur continued to supply large amounts of raw materials that, in addition to several legitimate applications, can be used as precursors for chemical weapons. Although the entrepreneur denied being aware of the use of his materials, the Dutch courts ruled that he was complicit in a violation of humanitarian law by those in power in Iraq, by supplying substantial amounts of raw materials for mustard gas, and he was sentenced to seventeen years' imprisonment.[74] In 2013 it was confirmed that European companies had exported a number of different dual-use chemicals to Syria, again demonstrating that there are inherent difficulties in controlling the international transfer of chemicals.[75] These difficulties apply not only to trade in chemicals, but also to the other fields of CBRN.[76]

Weaponization

If a non-State actor has been able to find sufficient financial support, assembled a network of dedicated and skilled individuals, and acquired the necessary knowledge, equipment and raw materials, it may attempt to build a CBRN weapon.

Chemical weapons

A number of steps are required to turn a chemical into a weapon. Most precursor chemicals are available in the chemical industry. The more basic the initial precursor chemicals that the non-State actor obtains, the more reaction steps will likely be required to produce the desired chemical agent and the longer and more

72 US Department of State, *Clinton in Geneva at Biological and Toxin Weapons Convention*, December 2011, available at: http://iipdigital.usembassy.gov/st/english/texttrans/2011/12/20111207104803su0.7202352.html?distid=ucs#axzz32iEEcrh1.

73 J. M. Bale and G. Ackerman, above note 10, p. 43.

74 Gerechtshof's-Gravenhage, *Strafzaak Van Anraat*, Case No. 2200050906-2, 9 May 2007, para. 8, available in Dutch at: http://deeplink.rechtspraak.nl/uitspraak?id=ECLI:NL:GHSGR:2007:BA4676.

75 Ian Anthony, "Exports of Dual-Use Chemicals to Syria: An Assessment of European Union Export Controls", Non-Proliferation Paper No. 35, January 2014.

76 For example, for information on illegal trade in nuclear components, see David Albright, Paul Brannan and Andrea Scheel Stricker, "Detecting and Disrupting Illicit Nuclear Trade after A. Q. Khan", *Washington Quarterly*, April 2010, pp. 85–106.

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complex the production process. Chemical weapon delivery systems may also vary in their technical sophistication and effectiveness. For example, it is extremely challenging to develop a warhead that will effectively disperse a chemical agent without destroying or degrading it. On the other hand, using garden sprayers poses fewer technical challenges, although it remains difficult to create an optimal aerosol for effective dispersal. The sarin used in the Tokyo subway attack in 1995 was carried in plastic bags and dispersed by puncturing the bags with the sharpened tip of an umbrella.[77]

The dual-use nature of many precursor chemicals and equipment puts at least simple toxic chemical agents within the reach of most, if not all, non-State actors. Although caution is warranted when handling chemical materials, a chemist with minimum gear such as a face mask and gloves might be able to manufacture chemical agents without great personal risk.[78]

The type of training needed to develop a chemical weapon depends on the materials at hand, the type of chemical agent and the sophistication of the desired weapon. For nerve agent production, advanced training, most likely at the graduate or doctoral level, would maximize the chances for safe and successful manufacture.[79] High-school-level training may be sufficient to make, for example, chlorine gas or hydrogen cyanide, but, as was witnessed during the First World War, these gases need to be produced and dispersed in large quantities to create a harmful attack. Mass production creates challenges such as ordering large amounts of raw materials and finding proper storage facilities, which will be difficult to conceal. Nevertheless, a smart, technical person with college-level education or less could be able to handle at least small production runs from direct precursors within a short period of time.[80] Some crude chemical weapons could even be made using household chemicals.

For this reason, future chemical attacks by non-State groups are more likely to be primitive than very sophisticated. For example, non-State groups could find chlorine attractive because it is readily available in large pressure tanks near urban environments.[81] This was the tactic behind the chlorine bombings in Iraq, which began as early as October 2006, when insurgents in the Al Anbar province used chlorine gas in conjunction with conventional vehicle-borne explosive devices.[82] Similarly, chemicals could be used as part of an improvised explosive device, which IS might be inclined to do, for example, using the materials it gained when it took control of the Al Muthanna facility.[83]

77 R. Pangi, above note 7.
78 Marc-Michael Blum, Andre Richardt and Kai Kehe, "Preparedness", in Andre Richardt, Birgit Hülseweh, Bernd Niemeyer and Frank Sabath (eds), *CBRN Protection: Managing the Threat of Chemical, Biological, Radioactive and Nuclear Weapons*, Wiley-VCH Verlag, Weinheim, 2013, p. 442.
79 C. D. Ferguson, above note 20, p. 28.
80 Richard A. Falkenrath, Robert D. Newman and Bradley A. Thayer, *America's Achilles Heel: Nuclear, Biological, and Chemical Terrorism and Covert Attack*, Belfer Center for Science and International Affairs, Cambridge, MA, 1998, pp. 102, 106, cited in J. M. Bale and G. Ackerman, above note 10, p. 52.
81 C. D. Ferguson, above note 20, p. 27.
82 J. Garamone, above note 48.
83 D. McElroy, above note 27.

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Biological weapons

Many of the attack methods or delivery mechanisms for chemical agents are similar for biological agents – that is, both can be disseminated by using commercial sprayers, industrial or military sprayers, crop dusters, munitions or missiles.[84] With biological agents, the possibility of contaminating food and water supplies and distribution through packages and letters have also been explored and used on several occasions by non-State actors. For example, a representative of the Bhagwan Shree Rajneesh sect stated that members had poisoned salad bars in The Dalles, Oregon, with *Salmonella typhimurium* bacteria as a test run for a plan to influence local elections in the sect's favour. Using a strain of salmonella ordered from a licensed commercial laboratory company, the sect infected about 12% of the community; the attack affected over 1,000 people, of which 751 cases of salmonellosis were confirmed.[85] The cult wanted to influence a local vote in Oregon by limiting the voter turnout and, as such, aimed to incapacitate people rather than kill them.[86]

Non-State groups could attempt to order building blocks of a deadly pathogen from biotech companies online, as these companies can be negligent in their security screening of requests.[87] Pathogens may also be harvested from the environment or directly from infected animals. However, non-State groups may confront significant hurdles to culturing the organism without losing any of its virulence or infectivity factors, and storing it safely and reliably until the following stage of weapon development.[88] Therefore, they may consider stealing material from disease cases in hospitals or veterinary clinics, or university or commercial laboratories. Another, less likely possibility is that materials may be retrieved from State-level biological defence programmes. The 2001 anthrax letters case in the United States shows that this is a possibility which cannot be ruled out.[89]

Many of the materials and equipment that can be used for biological weapons development are dual-use in nature and, therefore, may be rather easily available on the commercial or black market. The equipment needed for developing a biological weapon will depend on the scale of production and the organism being produced. Standard laboratory equipment can be sufficient for some agents and small-scale production, whereas more specialized equipment may be required to quickly create large amounts of agents or apply sophisticated processes such as genetic engineering.[90] Additionally, sophisticated methods for delivering biological agents, for example with weapons, are specialized and

84 C. D. Ferguson, above note 20, p. 29.
85 Jeffrey R. Ryan and Jan F. Glarum, *Biosecurity and Bioterrorism: Containing and Preventing Biological Threats*, Elsevier, Burlington, MA, 2008, pp. 140–142.
86 A. Vergely, above note 17.
87 See, e.g., the work of Raymond A. Zilinskas, *Biological Warfare: Modern Offense and Defense*, Lynne Rienner, Boulder, CO, 1998.
88 J. M. Bale and G. Ackerman, above note 10, p. 55.
89 See B. H. Stanislawski, above note 15; C. Leuprecht and K. Hall, above note 15.
90 J. M. Bale and G. Ackerman, above note 10, p. 54.

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usually classified, but a State sponsor or former biological weapons specialist could give technical help.[91] Although the importance of acquiring such practical hands-on experience through learning by example should not be overlooked, even without such assistance, technical barriers seem to be eroding as knowledge and expertise grow with the increase in biotechnology development and globalization.[92]

That said, weaponization of pathogens is technically challenging. Most pathogens are very delicate, which creates complications before, during and after weaponization, when materials are dispersed. Furthermore, a certain particle size is required to eventually bring the pathogens into the lungs. Nevertheless, some argue that a competent microbiologist (to produce a deadly pathogen) and an experimental physicist or mechanical engineer (to work on aerosol delivery) could together create a working biological weapon.[93] Others argue that it is increasingly likely that a crude but effective biological weapon could be made by using a small sample of any number of widely available pathogens, inexpensive equipment such as a field-expedient laboratory, and college-level knowledge of chemistry and biology.[94] Furthermore, there may come a time, relatively soon, when existing micro-organisms can be modified to increase infectivity and virulence, enhance stability in storage or in aerosol form, increase resistance to standard antibiotics and create bioengineered toxins.[95]

In particular, apocalyptic groups may be inclined to use biological weapons; an example is Aum Shinrikyo, which unsuccessfully used anthrax and botulinum toxin in attacks.[96] The Rajneesh cult showed that incapacitating people to achieve a short-term goal is also a possibility considered and executed by non-State groups.[97] Additionally, green anarchists may believe they can generate the rebirth of the earth through applying a deadly disease that only annihilates the human race.[98] Within the category of radical religious groups, differences of opinion on the use of biological weapons exist. For example, Al Qaeda considered biological weapons to be beyond the pale, but IS clearly has no such qualms as it does show an interest in acquiring biological capabilities.[99]

Radiological weapons

Radioactive materials include spent nuclear fuel from reactors, nuclear waste and radioactive sources used in applications such as medicine, food irradiation,

91 C. D. Ferguson, above note 20, pp. 31–32.
92 In the context of weaponization, tacit knowledge potentially plays an important role as a "barrier to optimising and creating effective bioweapons". The important sociotechnical aspects of biotechnology, including the role of tacit knowledge, are described in James Revill and Catherine Jefferson, "Tacit Knowledge and the Biological Weapons Regime", *Science and Public Policy*, Vol. 41, No. 5, 2014, p. 2, available at: http://sro.sussex.ac.uk/46723.
93 C. D. Ferguson, above note 20, p. 52.
94 US Department of State, above note 72.
95 C. D. Ferguson, above note 20, p. 32.
96 R. Danzig *et al.*, above note 29, pp. 14–26.
97 J. R. Ryan and J. F. Glarum, above note 85, pp. 140–142.
98 R. M. Frost, above note 33, p. 54.
99 D. McElroy, above note 27.

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research, industrial gauging and oil prospecting.[100] Spent nuclear fuel is often very highly radioactive, which can serve as a barrier for acquisition by non-State actors. There are disputes over the ease with which non-State actors can convert radioactive materials into a form that could be disseminated over a wide area. Some argue that radiological materials are commercially available in readily dispersible forms and that it would not be very difficult for a technically skilled individual or group to transform radioactive materials into such forms. Others assert that, since the creation of radiological weapons involves working with highly radioactive isotopes, shielding and containment is necessary, which greatly complicates working with these substances.[101] Indeed, depending on the source, anyone unshielded can absorb a lethal radiation dose within minutes without special handling gear.

Radiological sources are used widely throughout the world and a fraction of those sources represent inherently high security risks, in particular if they are portable, such as radiotherapeutic sources used in hospitals. Radioactive sources used in a variety of applications may cause considerable problems, as improper registrations and controls may lead to some of the materials being abandoned by the regulatory system; these are known as "orphan sources". For example, in 2013 alone, 153 incidents have been reported involving nuclear or other radioactive material that was out of regulatory control, meaning lost or stolen.[102] Of these, 92% involved non-nuclear, radioactive materials used in industrial and medical applications. In 2014 this number more than doubled, with a total of 325 incidents included in a database that registers nuclear or other radioactive material going out of regulatory control worldwide.[103] This is a serious problem, as these materials could potentially be used as raw materials for developing a dirty bomb. However, using such sources for creating a weapon that effectively disperses radioactive materials is not an easy undertaking.

To date, non-State groups have not made use of radiological weapons, but this does not mean that they are not able or willing to do so, as demonstrated by the caesium-137 device planted by Chechen rebels in 1995.[104] In fact, in 1998, the same Chechen separatist group was suspected to be involved in another incident in Argun, an area close to Grozny, Chechnya, when the Chechen Security Service discovered a container filled with radioactive materials attached to an explosive mine, hidden near a railway line.[105] One may wonder why the Chechen

100 C. D. Ferguson, above note 20, p. 33.

101 J. M. Bale and G. Ackerman, above note 10, pp. 57–58.

102 Jessica Varnum, "CNS Releases Annual Nuclear Trafficking Report, 153 Incidents in 2013 Reported", James Martin Center for Nonproliferation Studies, Middlebury Institute of International Studies at Monterey, 19 March 2014, available at: www.nonproliferation.org/cns-releases-annual-nuclear-trafficking-report-153-incidents-in-2013-reported/.

103 Benjamin Pack and Bryan Lee, *CNS Global Incidents and Trafficking Database: Tracking Publicly Reported Incidents Involving Nuclear and Radioactive Materials*, 2014 Annual Report, James Martin Center for Nonproliferation Studies, April 2015, available at: www.nti.org/media/pdfs/global_incidents_and_trafficking2015.pdf?_=1429915567.

104 John Pichtel, *Terrorism and WMDs: Awareness and Response*, CRC Press, Boca Raton, FL, 2011, p. 176.

105 Lexi Krock and Rebecca Deusser, "Chronology of Events", in *Nova: Dirty Bomb*, February 2003, available at: www.pbs.org/wgbh/nova/dirtybomb/chrono.html.

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separatists did not detonate their dirty bombs.[106] Since they had already conducted violent and high-profile attacks in the war for Chechen independence, it seems unlikely that they feared alienating their constituencies. One can only speculate; perhaps the explosives did not work properly, perhaps the separatists wanted to achieve more psychological/symbolic impact, or perhaps they wanted more visibility.

Nuclear weapons

Nuclear weapons are generally considered to be the most difficult weapons to acquire or manufacture. A non-State group could attempt to obtain an intact nuclear weapon from a State's arsenal or make its own improvised nuclear device, but it will confront significant barriers to doing so.

Nuclear-armed nations guard their weapons heavily, and even if non-State actors succeed in stealing, buying or being given one, several technical hurdles exist to detonating nuclear weapons, such as permissive action links and de-arming, arming, firing and fusing systems.[107] With regard to knowledge that is needed for the creation of crude nuclear weapons, it must be assumed that this is widespread and no longer limited to an exclusive club of scientists. The information is also available to non-State actors. The fear of proliferation of facilities, equipment and techniques required for the production of highly enriched uranium is increased by the uncovering of the Khan network,[108] in which Abdul Qadeer Khan reportedly sold weapon designs and centrifuge technology to a number of unpredictable regimes, including Iran, North Korea and Libya.[109] Even after uncovering the Khan network, control of dual-use goods remains challenging because proliferators will try to mislead suppliers into believing they are for a civilian, non-nuclear use.[110]

The main ingredient of an improvised nuclear device, and the hardest to acquire, is fissionable material. Highly enriched uranium and plutonium are the two traditional types of materials that have fuelled nuclear weapons. Non-State actors would likely have to acquire these materials from existing stockpiles because enriching uranium is an expensive and very technically demanding process, and plutonium exists only in trace amounts in nature and is thus produced or reprocessed in reactors.[111] Both uranium enrichment and plutonium production appear to be beyond the current capabilities of non-State actors. Furthermore, to design and build a bomb that would have a chance of working, technical challenges concerning the delivery system would also have to be

106 *Ibid.*
107 C. D. Ferguson, above note 20, p. 35. A permissive action link is a security device that prevents unauthorized detonation of the weapon.
108 E. Bakker, above note 69, p. 146.
109 David E. Sanger, "The Khan Network", Conference Paper, Conference of South Asia and the Future, Stanford University, 4–5 June 2004.
110 D. Albright, P. Brannan and A. Scheel Stricker, above note 76, pp. 85–106.
111 C. D. Ferguson, above note 20, p. 36.

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overcome.[112] Therefore, it is thought that without the assistance of a State sponsor, any slightly advanced design would be too challenging for non-State actors to build.

However, it is not unthinkable that non-State actors could produce or acquire such weapons in the future. Fissile materials are housed in numerous buildings in many countries, and security measures at these sites vary widely, from excellent to appalling.[113] As of yet, the non-State actor group that has come closest to developing a nuclear weapon is Aum Shinrikyo. Investigators discovered that the cult had tried to buy Russian nuclear warheads and had set up an advanced laboratory on a 500,000-acre ranch in Australia.[114] At the ranch, investigators found that the sect had been mining uranium, a main material for making atomic bombs. However, while the cult succeeded in creating and using chemical and biological weapons, it was never able to complete a nuclear weapon, even though it had, in the mid-1990s, more than $1 billion in assets and many scientists working for the group. It also failed to acquire State-arsenal nuclear weapons despite repeated attempts, including approaches to Russian officials.[115] Nevertheless, apocalyptic groups in general can be considered to pose the greatest threat when it comes to nuclear and biological terrorism, because some of them might want to bring about the apocalypse they foresee. By using nuclear weapons, the means becomes the end itself.

Execution of an attack

Although primitive CBRN weapons may be relatively easily developed, weaponization of CBRN materials into systems capable of inflicting massive physical impact is extremely challenging. CBRN agents certainly have the potential for toxic effects, but this potential can only be realized if the agent is actually delivered to the target. Apart from a nuclear device, the scope of the effect of a CBRN weapon is largely determined by the nature of the threat agent as well as the weapon system used, in particular the efficiency of its delivery. Chemical weapons, for instance, can dissipate before harming many people if the agent is not properly aerosolized or if meteorological conditions are unsuitable for dispersal.[116] The purity of the chemical agent and efficiency of the delivery can also have a large impact on the ultimate effects of an attack. In the sarin attack on the Tokyo subway system, for example, the full potential for catastrophic damage was not achieved as the sarin that was used was not pure and the dispersal technique was not well developed.[117]

112 For a more technical discussion, see Christophe Wirtz and Emmanuel Egger, "Use of Nuclear and Radiological Weapons by Terrorists?", *International Review of the Red Cross*, Vol. 8, No. 859, 2005, available at: www.icrc.org/eng/resources/documents/article/review/review-859-p497.

113 R. Kazi, above note 16, p. 4.

114 William J. Broad, "Seismic Mystery in Australia: Quake, Meteor or Nuclear Blast?", *New York Times*, 21 January 1997, available at: www.nytimes.com/1997/01/21/science/seismic-mystery-in-australia-quake-meteor-or-nuclear-blast.html.

115 C. D. Ferguson, above note 20, p. 40.

116 J. M. Bale and G. Ackerman, above note 10, pp. 10–11.

117 See R. Pangi, above note 7.

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Similarly to chemical agents, it may be relatively easy to produce batches of certain pathogenic organisms, but delivering these in a viable state so that they infect large numbers of people is far more technically challenging. The dispersal of biological agents presents a number of difficulties since sunlight, oxidation, air pollution, humidity and other environmental and meteorological phenomena can deactivate a large part of the agent before it has reached its targets.[118] To date, methods used by non-State actors to disperse CBRN agents have been primitive and inefficient,[119] although the 2001 anthrax letters could be seen as an exception. What seems likely in the future, although still not a simple endeavour, is the creation of a "dirty bomb", combining components that are accessible and not necessarily expensive with an improvised explosive device.

Even if a non-State actor succeeds in obtaining or creating a CBRN weapon, a further constraint may be the transportation and emplacement of the device. For executing an attack with a CBRN weapon or enabling the release of CBRN materials, a target needs to be selected. Via careful observation and surveillance, a non-State actor will have to acquire information on the surroundings of the trigger spot, the movements of targets and emplacement possibilities to ensure maximum damage. Once the target has been chosen, a more detailed plan will likely be made and confirmed, and rehearsals may be conducted. The weapon will be transported to the detonation spot and emplaced. Finally, a triggering/detonation mechanism, set off either by a triggerman on the spot or via a remote control system, would be necessary to ensure release of the CBRN materials. The non-State actor may lack control over the effects of CBRN agents after the release, particularly if the actor has developed a primitive CBRN device in which low-grade toxic materials are used or higher-grade materials are improperly disseminated.

Potential humanitarian consequences

As noted above, CBRN agents have the potential for massive toxic effects, but these can only be realized if the agent is properly delivered to the target. This raises the question of what the likely humanitarian consequences of CBRN use by non-State actors will be. Although in many cases it is extremely difficult, or not possible at all, to conduct a sound quantitative assessment to characterize the possible consequences of a CBRN attack, this section discusses the effects associated with such attacks and addresses both immediate effects, such as deaths and injuries, and long-term effects, such as contamination of affected environments, as well as third-order effects, such as economic damage and extreme legislation to prevent future attacks.

118 J. M. Bale and G. Ackerman, above note 10, p. 56.
119 *Ibid.*, p. 14.

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Immediate effects

During a CBRN attack, people and the environment are exposed to and may be contaminated by CBRN materials. After such attacks, the primary immediate need is to save lives and treat the injured. The severely injured require immediate life-saving medical care and need to be stabilized in preparation for evacuation and further treatment, including decontamination. First responders will attempt to provide the necessary aid as soon as possible, but certain areas may be out of reach owing to physical inaccessibility. This makes it difficult or impossible to quickly get to the victims. The same problem exists in the case of a conventional attack, but CBRN attacks pose some additional, particular challenges. For example, depending on the agent, its persistency and the actual levels of exposure and contamination, certain areas and the people in them may remain off-limits and inaccessible to responders for a longer period of time or may only be visited for very short durations. The specific risks to the health and security of personnel bringing assistance are a particular unique feature which differentiates CBRN events from conventional attacks.[120] Therefore, the equally important first reaction to an incident should be to contain the site and agent in order to limit spread and make sure no additional exposure and/or contamination will take place. On a more positive note, in contrast to an attack with conventional weapons, after which the impacts of explosions cannot be mitigated, prompt intervention may substantially reduce catastrophic effects. For example, proper decontamination and rapid medical treatment can save lives and prevent further spread of agents.

The latter will not likely apply to nuclear weapons. The use of even a single nuclear weapon with a relatively small destructive power in or near a populated area is likely to produce humanitarian needs that will be difficult or impossible to address. The significant destruction of infrastructure and radioactive contamination of large areas, posing serious risks to the health of anyone in or entering the area, would considerably complicate the delivery of humanitarian assistance.[121] Fortunately, nuclear weapons are generally considered to be the hardest of all weapons to acquire or manufacture and, as such, are unlikely to be within non-State actors' capabilities or reach. Future CBRN attacks will more likely take the form of relatively crude, low-level attacks with radiological or toxic materials.

Radioactive materials used in an attack could cause radiation sickness as well as long-term radiation effects, but the majority of death and injuries would most likely result from the blast. Subsequently, the effects would be widespread panic with subsequent economic disruption and other societal impacts. A radiological dispersal incident has the potential to disrupt life and business in a community through denial of access and service due to real or perceived environmental and facility contamination. Recovery from a radiological agent

120 Robin Coupland and Dominique Loye, "International assistance for victims of use of nuclear, radiological, biological and chemical weapons: time for a reality check?", *International Review of the Red Cross*, Vol. 91, No. 874, June 2009, p. 333.

121 *Ibid.*, p. 334.

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attack will challenge every level of government and the citizenry. Decontamination of even a small area would require vast resources and would be time-consuming.[122]

As regards chemical weapons, the symptoms of improvised devices may resemble those of classical chemical warfare agents – indeed, some toxic industrial chemicals, such as chlorine, have been used as warfare agents in the past. The nature of the injuries sustained when exposed to improvised chemical weapons will depend on the kind of agent; for example, the agent may attack the body's central nervous system, like nerve agents such as sarin or VX. Health facilities may be paralyzed by the arrival of people affected by chemical agents. In particular, hospital staff may fear secondary exposure (despite the fact that the dangers of secondary exposure are limited, especially in the case of non-persistent agents) and may thus be reluctant to treat patients without wearing protective equipment. Attacks with improvised weapons are less likely to cause a large number of deaths, but a society can nevertheless be gripped by panic once it is known that a chemical weapon has been used. This panic can also be a significant burden on the health-care system, in particular if many of the "worried well" flood hospitals. They may deprive actual victims of getting the medical attention they need.

The time from exposure to onset of symptoms is generally much longer for pathogens than for acute doses of chemical agents or toxins. Therefore, psychological effects, such as fear of not knowing whether or not one is contaminated, may largely dominate the immediate effects of a biological attack. Onset of clinical signs and symptoms may occur days, weeks or months after exposure to a pathogen depending on its incubation time. Exposed individuals may unknowingly incubate and further disperse the agent. As a result of extensive international air travel, a disease may spread extremely rapidly. Initially, many infectious agents tend to produce non-specific symptoms that mimic common illnesses – for example, flu-like symptoms – which complicates and delays diagnosis. As soon as it becomes clear that an outbreak has occurred, widespread panic may occur as people will want to know where and when agents have been released and if they are at risk of being infected – particularly after an intentional release, because it may happen again.

Long-term effects

From a first responder's point of view, the immediate effects of a CBRN attack last about a day, depending on the type of agent, scale of release, numbers affected and persistency of the agent in the environment. For some agents longer-term effects will occur, both resulting from the primary contact with a CBRN material or as a result of secondary contamination, physically or biologically. Treatment of outbreaks is an example of an immediate, medium- and long-term effect. Generally, relevant responder entities have experience in treating outbreaks, albeit from natural causes. Even if it is proven that an outbreak results from an intentional release, it

122 *Ibid.*

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may not significantly change the management of the epidemic from a health perspective, although it may change reactions in the political and media environments. Usually, measures to prevent diseases from spreading must be taken as soon as possible. A distinction should be made between contagious micro-organisms, like smallpox, plague or Ebola, and non-contagious micro-organisms, such as anthrax and tularaemia. The first category is capable of human-to-human transmission, in which prophylaxes may prevent further spread and protect people who have not been infected. Quarantine is of utmost importance. As for non-contagious agents, an outbreak may be contained by decontamination of contaminated sites. Incidentally, the difference between whether or not an agent is contagious may not necessarily be clear to the public. In both cases hospitals may be overwhelmed by the number of people worrying about being exposed and infected.

Long-term effects may be of an economical, societal or political nature. For example, as mentioned in the previous section in regard to radiological incidents, decontamination efforts may be time-consuming and extremely costly. As a result of the anthrax letters in 2001, the remediation of US Postal Service facilities alone, which were only some of the many contaminated facilities, cost more than $200 million.[123] Besides financial consequences, a difficult technical and political question regarding decontamination relates to the "safe" level of activity at which the population can return: how clean is clean? The extended periods for which significant portions of buildings and infrastructure are considered "contaminated", and the stigma that this causes, have a chilling effect on business. Furthermore, as long as sites may not be reoccupied, there may be many people who require assistance as a result of being displaced, homeless, in need of food, missing family members or friends or merely needing information.

Finally, considering the effects of CBRN attacks, it is not surprising that the international community has acted with great vigour to adopt international instruments and standards as well as multilateral alliances, treaties, agreements, regulations and voluntary controls in the aftermath of major CBRN incidents in order to prevent them recurring in the future. However, although measures taken to prevent or suppress terrorist offences should ensure respect for the rule of law, democratic values, human rights and fundamental freedoms as well as other provisions of international law, in practice this is not always the case. The 9/11 attacks, for example, have been used to justify "State terror"; soon after the attacks, it became clear that the United States intended to use all means possible against individuals implicated in terrorism, including torture and other cruel, inhuman or degrading punishments or treatment.[124]

123 National Resource Council, *Reopening Public Facilities after a Biological Attack: A Decision Making Framework*, National Academies Press, Washington, DC, 2005, p. 1.

124 J. Rehman, above note 58, p. 908. However, inducing "attacks" on innocent victims in an attempt to eradicate terrorists could lead to the reverse effect. Terrorism often thrives in environments in which human rights are violated. Non-State actors may exploit such violations to gain support for their cause and motivate new generations of militants to seek revenge. Thus, regimes may end up in a vicious circle in which terrorism is met with terrorism.

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Conclusions

This paper has explored and discussed the actual threat and consequences emanating from CBRN weapons pursuance by non-State actors. As for motivation and intent to use such weapons, in particular the fear that is spread by the threat of using CBRN materials alone makes them appealing for non-State actors. Nationalist, separatist or irredentist groups, radical religious fundamentalist groups, apocalyptic or millenarian "new religious movement" groups, single-issue groups, right-wing groups and social revolutionary or secular left-wing groups have been identified as potential CBRN weapons users. It is questionable whether these groups will actually use these indiscriminate weapons as they may target a too wide spectrum of victims, although religious fundamentalists and apocalyptic groups may be less restrained by such considerations.

Due to globalization, which facilitates the spread of knowledge, capabilities and materials, non-State actors may increasingly be able to acquire relevant CBRN weapons-related knowledge and skills. Due to their creative ways of generating funds, several existing groups may have the financial resources to be able to fund a CBRN programme. Fortunately, technical barriers still form a gap between the theoretical possibility and the operational reality. In particular, producing a sophisticated means of delivery seems too challenging for non-State actors at present.

It is generally agreed that it is most difficult for non-State actors to acquire fissile material and nuclear weapons capability, that biological seed stock and radiological materials fall somewhere in the middle, and that chemical weapons and their precursors are the most easily obtainable CBRN weapons. Most likely, crude, low-level attacks may take place in the future, including toxic or radiological materials. Depending on the means of delivery, for example via improvised explosive devices, the effects of such attacks may be limited in terms of physical damage and numbers of victims. Nevertheless, the fear that spreads among society may cause severe economic and societal damage.

The concern about potential use of CBRN weapons by non-State actors seems warranted. However, CBRN attacks that may be expected by non-State actors in the future will likely be more disruptive than destructive.

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