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Executive Summary

We are pleased to release Volume 7, Issue 12 (February 2016) of the Counter Terrorist Trends and Analysis (CTTA) at www.rsis.edu.sg/research/icpvtr/ctta (ISSN 2382-6444) by the International Centre for Political Violence and Terrorism Research at the S. Rajaratnam School of International Studies (RSIS), Nanyang Technological University (NTU), Singapore.

The possibility of terrorists acquiring and using chemical, biological, radiological and nuclear (CBRN) weapons has become a matter of serious concern, in light of reports that the Islamic State of Iraq and Greater Syria (ISIS) has used chemical weapons; that it could be in possession of radiological materials and could also be contemplating to buy a nuclear weapon as claimed in an article in ISIS' magazine Dabiq. This issue of CTTA examines the possibility of the acquisition or development of CBRN weapons by terrorists and what concerned agencies need to do to not only prevent the same, but to also manage the consequences in the event of an attack.

Shahzeb Ali Rathore discusses how ISIS might succeed in doing what Al Qaeda could not in terms of its ability to carry out a CBRN attack. He argues that ISIS might succeed in assembling a crude dirty bomb, i.e., a bomb which relies on conventional explosives combined with radiological material, by using dual-use material stolen from sensitive facilities.

Using prospect theory, **Kyler Ong** examines the probability of North Korea selling or supplying nuclear materials to terrorists especially to groups like ISIS.

Benjamin E. Martin's article highlights the deficiencies in the current regimes, especially the Nuclear non- proliferation Treaty (NPT), in preventing nuclear materials from falling into the hands of terrorists. The threat is further amplified by the physical and logistical vulnerability of nuclear stockpile facilities in a number of countries.

Devi Kalyan Mishra provides an overview of the threat of bioterrorism from a public health perspective, highlighting the need for promotive, preventive and curative intervention mechanisms to mitigate the consequences of a bio-terror attack. He further notes that the effectiveness of such a response is contingent upon the availability of resources and the existing public health infrastructure, including the presence of well-trained responders and effective coordination across the various concerned agencies.

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Counter Terrorist Trends and Analysis is a monthly journal of the International Centre for Political Violence and Terrorism Research (ICPVTR) of the S. Rajaratnam School of International Studies (RSIS) at the Nanyang Technological University (NTU), Singapore. The CTTA has a circulation of more than 11,000 subscribers.

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Counter Terrorist Trends and Analysis

Launched in 2009, Counter Terrorist Trends and Analysis (CTTA) is the journal of the International Centre for Political Violence and Terrorism Research (ICPVTR).

Each issue of the journal carries articles with in-depth analysis of topical issues on terrorism and counterterrorism, broadly structured around a common theme. CTTA brings perspectives from CT researchers and practitioners with a view to produce policy relevant analysis.

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Is the Threat of ISIS Using CBRN Real?

Shahzeb Ali Rathore

Over the years, numerous terrorist groups have attempted to develop Chemical, Biological, Radiological and Nuclear (CBRN) weapons, including Al Qaeda. While Al Qaeda failed, there is a possibility that the Islamic State of Iraq and Greater Syria (ISIS) will succeed. Given the technical and infrastructural requirements, it is almost impossible to develop a nuclear bomb. However, ISIS can still use a dirty bomb and crude chemical and bioweapons, which are relatively easy to make.

Introduction

Several terrorist groups throughout history have sought to carry out high-impact attacks with chemical, biological, radiological and nuclear weapons, also known as CBRN (Britannica 2014). CBRN weapons are known as Weapons of Mass Destruction (WMD) due to their large-scale impact on people, property and infrastructure compared to conventional weapons and bombs. Terrorist groups have displayed some degree of intent, given substantive evidence pointing to their experiments with CBRN materials, especially in the chemical weapons domain. These terrorist groups include the Japanese cult Aum Shinrikyo as well as Al Qaeda and its associates, including Egyptian Islamic Jihad and Jemaah Islamiya (Mowatt-Larssen 2010). In 1995, Aum Shinrikyo carried out a sarin gas attack in a Tokyo subway station, killing 13. More than 6,000 suffered effects of the nerve gas (Alfred 2015).

Failure of Al Qaeda

Since the mid-1990s Al Qaeda has made multiple attempts to acquire and weaponise CBRN materials (Salama and Hansell 2005, 618). For instance, Al Qaeda core leadership was engaged in the development of the lethal anthrax bacteria, a biological weapon. The programme was led by the then deputy and current *emir* (leader) of Al Qaeda, Ayman al Zawahiri (Mowatt-Larssen 2010). Al Qaeda's affiliate groups and individual cells even showed interest in crude chemicals and poison. For instance, Abu Musab al Zarqawi, the leader of Al Qaeda in Iraq, planned to utilise his network to carry out multiple ricin and cyanide attacks in London Underground from 2002 to 2003 (Mowatt -Larssen 2010). However, the Metropolitan Police Service of London thwarted these attempts.

In the sphere of nuclear capability, the development of the nuclear bomb by Al Qaeda has been greatly exaggerated. For instance, Al Zawahiri claimed that the Al Qaeda has acquired nuclear weapons from Former Soviet States (FSU), including Ukraine (Salama and Hansell 2005, 621). Clearly, such claims and reports were not true as Al Qaeda never had the bomb. Undeniably, Al Qaeda leadership showed consistent interest in developing nuclear capability, and Bin Laden even said in an interview that the acquisition of a nuclear weapon is a "religious duty" of Muslims (Van de Velde 2010, 684). However, despite Al Qaeda's desire to use CBRN against enemies, the threat never materialised.

There can be numerous reasons why Al Qaeda failed, including difficulties of acquiring the necessary materials and weaponising them. Also, Al Qaeda was looking for a functional nuclear bomb that was not easy to obtain or develop (Mowatt-Larssen 2010). Even the two Pakistani nuclear scientists who met Bin Laden told him that building a nuclear bomb was not possible with the materials and infrastructure that the group had at the time (Harnden 2001). Moreover, in its anthrax project, Al Qaeda learned that it was not easy to bottle and control the biological pathogen. As evident from Al Qaeda's case, it is not easy to develop an CBRN weapon and its effective delivery system. However, though Al Qaeda failed, there is a possibility that the Islamic State of Iraq and Greater Syria (ISIS) might succeed in creating a capability for such weapons.

According to Wolfgang Rudischhauser, director of the Weapons of Mass Destruction Non-Proliferation Centre of the NATO, ISIS has already acquired the knowledge and in some cases human expertise to use CBRN material (Boyle 2015). It might still be impossible for ISIS to develop a nuclear bomb, but employing a dirty bomb and using crude chemical and biological agents seem more conceivable.

The 'Dirty Bomb'

A dirty bomb otherwise known as a radiological dispersal device (RDD) combines conventional explosives, like dynamite, with radiological material (U.S.NRC 2014). The regular explosive helps in dispersing the radioactive material. A dirty bomb does not require much expertise to develop, and the radioactive material required for the bomb is easily available.

For example, different radioactive materials used in military, industrial and medical applications can also be used in a dirty bomb. Radium or cesium isotopes used in cancer treatments can also be used (CFR 2006). But a dirty bomb is not similar to a nuclear bomb. The latter creates an explosion that is a million times more powerful than a dirty bomb.

There may not be much destruction in terms of life and property but a dirty bomb can cause significant disruption in terms of mass fear and panic. A dirty bomb explosion can contaminate property, and the resultant radiation can disperse and affect large areas. Clean up of radiation can be highly costly and time-taking. Such a weapon, capable of creating alarm and terror, is quite attractive to ISIS that aims to do the same. A 7 October 2015 report by the Associated Press highlighted the threat of ISIS using a dirty bomb.

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Gangs with suspected Russian connections are looking to sell radiological material to Middle Eastern extremists, some even specifically seeking buyers from ISIS (Butler and Ghirda 2015). With annual revenue of $856 million coming from sales of oil, taxes and looting (Malm 2015), ISIS possesses the financial capacity to purchase radiological materials from the black market.

Risks of Access to Dual-Use Material to Manufacture a Dirty Bomb

Some radiological materials, like radium and cesium, have dual-use capabilities. It is plausible that these same materials can also be used for developing a dirty bomb. A report by the Australian intelligence claimed that ISIS had seized enough radioactive material from government facilities and hospitals in Iraq and Syria to build a dirty bomb (Withnall 2015).

In a study on the risks of dirty bomb attacks on the ports of Los Angeles and Long Beach, H. Rosoff and D. von Winterfeldt map out a high radioactivity scenario based on the explosion of a dirty bomb (Rosoff and Winterfeldt 2007). Though the study refuted concerns about the threat of the dirty bomb claiming that health risks and spread of radioactive material will be quite low, their findings confirm, quite irrefutably, the economic consequences of an attack, owing to a shutdown of the harbours and surrounding areas due to contamination.

According to Rosoff and Winterfeldt, a shutdown could result in significant losses amounting to tens of billions of dollars, including the decontamination costs and the indirect economic impacts from the closure of the harbours. In another study, Joe Cirincione and Geoff Wilson projected a scenario involving a dirty bomb explosion on a leading financial centre such as Wall Street, New York, which can cause considerable damage with economic consequences (Cirincione and Wilson 2015). For these reasons, the dirty bomb can have the desired psychological and long-term economic impacts, which can create great panic.

ISIS' Bioweapons and Chemical Weapons Interest

ISIS' ambitions of developing bioweapons first gained attention when a laptop was seized in 2014 from one of the group's hideouts in Syria. The laptop, owned by a Tunisian who had studied chemistry and physics at universities in Tunisia, revealed thousands of files pertaining to producing biological weaponry. There was one document that taught how to weaponise the bubonic plague from infected animals (Doornbos and Moussa 2014).

Similarly, a report by European Parliament, compiled after the November 2015 Paris attacks, reaffirms the fact that ISIS plans to recruit scientists do develop a biological weapon. To that end, as per the report, ISIS has recruited an army of experts in chemistry, physics, and biology and computer science and smuggled chemical and biological weapons into Europe (Elvey 2015).

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The European Parliament Report also claims that ISIS might also use CBRN materials for attacks in Europe (Boyle 2015). Moreover, it is believed that the scientists of the Islamic University of Mosul in Iraq allegedly recruited by ISIS could be used to develop bioweapons (Doornbos and Moussa 2014). ISIS' execution of the president of the department of Physics at the said university, when he refused to cooperate with the organisation in the development of bioweapons against the Iraqi government forces seems to suggest that the group has taken an active interest in developing bioweapons (Mamoun 2015).

However, it is very difficult to weaponise and contain biological agent, as evident by Al Qaeda failed anthrax project. Therefore, even a sophisticated bioweapon does not seem a plausible prospect. Nonetheless, ISIS can resort to much simpler methods that can also have far reaching impact on the populace.

According to Danny Shoham, a specialist in unconventional weapons from the Begin Sadat Center of Strategic Studies, this includes releasing a pathogen in the water system of a European city. According to this report, in response to these concerns Paris has increased security of its water systems (Amiga and Schuster 2015).

Chemical Weapons Attacks Carried out by ISIS

The group has recruited chemical experts from around the world and has set up branches responsible for pursuing chemical weapons. ISIS has even recruited Iraqi experts who had previously worked for Saddam Hussein (Berger 2015).

In June 2014, ISIS captured Muthanna in Iraq, which was Saddam Hussein's primary chemical weapons facility which, from a theoretical perspective, could have given the group plenty of resources to develop chemical weapons, both in terms of materials and expertise.

In fact, ISIS has already used chemical weapons in Iraq and Syria. So far, two types of chemical weapons have been used by the group. This includes the chlorine and sulphur mustard gas (Chivers 2015). International investigators have confirmed only one mustard gas attack by ISIS in August 2015 on the Kurds in Kobani, Iraq (Berger 2015).

Even more dangerous was the revelation by the Organisation for the Prohibition of Chemical Weapons (OPCW) chief who said that blood samples of victims in the said attack on the Kurds showed the use of sarin-like gas by ISIS (Wyke 2016). Nevertheless, a chemical agent is not easy to weaponise. However, according to the European Parliament report, ISIS can manufacture crude chemical weapons by placing chemical substances (which they already possess) into shells and firing those shells. Similarly, the group may even carry out a bomb attack on a chemical factory to cause the same affects as using a chemical weapon. This will not be too hard considering the terrorist attack on June 2015 on a chemical factory in Saint-Quentin-Fallavier, France (Al Jazeera 2015).

Conclusion

ISIS has asserted in Issue 9 of its propaganda magazine *Dabiq* that it can buy a nuclear bomb through its Wilayat in Pakistan, which has connections with corrupt officials of the country, and use it against the United States (Cantlie 2014).

" ISIS' execution of the president of the Physics department at the University of Mosul in Iraq when he refused to cooperate in the development of bioweapons against the Iraqi government forces seems to suggest that the group has taken an active interest in developing bioweapons. "

Such assertions, however, might not be more than just a part of their psychological war to spread fear. Moreover, while it is difficult to weaponise chemical and biological agents, the threat of a use of dirty bomb remains more plausible. ISIS has used chemical weapons to carry out attacks. ISIS can also exploit the lax security surrounding facilities in Iraq, Syria and Libya (RT 2015; Withnall 2015) holding CBRN materials and obtain chemical, radiological and biological materials. The fact that the illicit use of CBRN materials is not at all inconceivable is highlighted in the report of the European Parliament.

In order to counter the use of CBRN weapons by terrorists, governments need to increase security of facilities that hold dual-use materials. Given that the greatest threat may also come with the help of an insider there is also a need to keep a lookout for potential radicalisation of scientists and experts who work in sensitive areas involving contact with handling CBRN material. The commercial sale of such material also ought to be licensed, so as to prevent the widespread availability of dual-use materials in the open market.

In addition, governments need to introduce and/or strengthen radiation detection technology at sensitive facilities including financial centres and airports. Acquiring CBRN weapon materials and weaponising the same and managing the consequences of the same is extremely complex and has a potential for detection by government agencies. Nevertheless, governments must be more proactive in controlling and protecting the facilities that can be infiltrated by groups like ISIS.

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Nuclear Terrorism: Assessing the Threat from North Korea

Kyler Ong

Given the fact the Pyongyang has historically been a state sponsor of terrorism, this article explores the probability of the North Korean regime selling or supplying nuclear materials or even weapons to terrorist groups, especially to groups like Islamic State of Iraq and Greater Syria (ISIS).

Introduction

Successive regimes in Pyongyang have distinguished themselves not only for their political brinkmanship but also for their support to a number of terrorist groups across the globe. Between the 1960s and 1980s, the country operated at least 30 training camps specialising in terrorist and guerrilla warfare (Bechtol 2010). Among the recipients of such training were members of the Palestinian Liberation Organisation (PLO), the Irish Republican Army (IRA), the Japanese Red Army (JRA), and Hezbollah, to name a few (Rubin 2005; Bechtol 2010). North Korea was also the major source of arms and ammunitions including rocket launchers, artillery shells and mortars for the Sri Lankan Liberation Tigers of Tamil Elam (Davies 2001). In recent years, North Korea is believed to have supplied arm shipments including short-range missiles and artillery to Hezbollah and the Iranian Revolutionary Guard Corps which the U.S has designated as a sponsor of terrorism (Niksch 2008).

Appeal of the Nuclear Weapon

The appeal of committing a spectacular act of terror to inflict mass casualty has drawn terrorists to consider attacks with the use of chemical, biological, radiological and (CBRN) materials.

A number of groups and individuals have used one or other chemical and biological components to carry out attacks including the 1995 sarin attack in Japan by Aum Shinrikyo and anthrax attacks immediately following the attacks on September 11, 2001 (9/11) (Allison 2004). Others might have attempted to build chemical weapons without success, such as the seizure of tons of toxic chemicals from an Al Qaeda cell led by Abu Musab al-Zarqawi in Jordan (Vause, Schuster, and Ensor 2004). Clear intent to construct CBRN weapons by groups like Al Qaeda, Jemaah Islamiyah and others have also been documented (Allison 2004; Dolnik and Gunaratna 2008; Mowatt-Larssen 2010).

However, no terrorist group has ever been successful at carrying out an attack involving a radiological or nuclear material. Aum Shinrikyo represents one of the earliest attempts at recruiting Soviet physicists and engineers to gain black market access to nuclear warheads, before the group decided to settle on chemical and biological materials (sarin and anthrax) instead (Danzig et al., 2013).

Al Qaeda attempted to procure a nuclear or radiological device but without any success. These attempts include the near conclusion of a deal to buy a cache of weapons-usable uranium and the attempt to recruit two senior Pakistani nuclear scientists (Benjamin and Simon 2002; Allison 2004; Daly, Parachini, and Rosenau 2005). Exactly how close the group got to realising such a threat remains a speculation, but David Albright's warning in 2002 offers a chilling glimpse: "Al Qaeda was intensifying its long-term goal to acquire nuclear weapons and would have likely succeeded, if it had remained powerful in Afghanistan for several more years" (Albright 2002).

While the U.S. "War on Terror" severely undermined the capabilities of Al Qaeda subsequently, had the group retained its strong power base in Afghanistan, the reality of a nuclear-armed terrorist group might have materialised. The appeal of the nuclear bomb to these non-state actors is not to be taken too lightly.

Challenges in Constructing a Nuclear Weapon

Arguably, there were a number of occasions when security of nuclear materials had been compromised not only in the countries that were part of the former Soviet Union, but also in the U.S. (Allison 2004).

Internationally, the nuclear non-proliferation regime has also been put to test by the infamous A.Q. Khan network, led by Pakistani nuclear scientist, Abdul Qadeer Khan, that operated for over two decades until 2004 supplying nuclear technology, expertise and designs to Iran and North Korea (Allison 2004; Sanger 2004) – the countries most suspected to be state sponsors of terrorism.

Given the cost and technical hurdles of enriching or reprocessing the weapon-grade materials that would require state-level resources, it is likely that terrorists could opt to purchase the same in the black market. An October 2015 report, citing sources in the U.S. Federal Investigation Agency, (FBI) detailed at least four interrupted attempts by Moldovan criminal gangs to sell radioactive material – cesium – to Middle Eastern extremists, especially to ISIS (Butler and Ghirda 2015). In addition, an article in ISIS magazine, DABIQ, also mentioned the possibility of the group buying a nuclear weapon in Pakistan (Saul 2015).

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In the past, the North Korean regime has given ballistic missile technology to countries such as Iran, Pakistan, Saudi Arabia, Yemen and Iraq (Allison 2006), delivered slightly enriched uranium hexafluoride to Libya via the A.Q. Khan network (although it was contested whether the regime intended Libya to be a recipient) (Chestnut 207, 101).The North Korean regime has also allegedly helped Syria to design and build its plutonium-production reactor (Plant and Rhode 2013, 68). But in almost all cases, these were business transactions for monetary gains. There is a difference between trading with sovereign states and with terrorists though in case of North Korea it is difficult to underestimate the potential for the regime to ignore the consequences and sell or supply nuclear materials to terrorist groups like ISIS.

Prospect Theory

North Korea's nuclear weapons programme, as with others like Pakistan, is based on the classical concept of nuclear deterrence whereby an inferior power could deter a more powerful adversary by virtue of the threat of use of nuclear weapons (Waltz 2013).

How much the county values the success of its programme is bolstered by the fact that North Korea finds an appeal in the correlation that "[n]o nuclear weapon state has ever suffered a foreign invasion since the introduction of nuclear weapons…"(Mansourov 2014). However, this does not mean that a nuclear weapons power would be doing business with terrorist groups – selling and supplying the latter with nuclear materials. But does this logic apply in the case of North Korea?

Prospect theory postulates that agents make decisions based on their perception of whether they are in the domain of gains or losses. This theory, first introduced by Daniel Kahneman and Amos Tversky in 1979, has significant explanatory power in capturing and understanding the "cognitive decision-making processes under risky conditions," which may induce normative deviations from what may be deemed rational behaviours (Park 2010). A gambler, for instance, who perceives himself to be in a domain of gains, viz., having accumulated significant gains already, is expected to be more risk-averse to protect his current winnings (Mansourov 2014).

On the other hand, the agent in the domain of losses is expected to be more risk-acceptant as he feels that he has 'nothing to lose' by taking the risky route to recoup the money he has already lost. The agent may go a step further by weighing the probability of an outcome, known as the "certainty effect." Agents are likely to add more value to extremely low or high probabilities, and may tend to become more unpredictable when the probabilities are moderate or uncertain (Mansourov 2014).

Moreover, a gambler who believes that he is highly likely or unlikely to win a round of cards would be more swayed by the high or low probability to either play or sit out on that ground respectively. Contrarily, when the likelihood of him winning is half, it'd be harder to predict whether he would choose to play that round or not (Mansourov 2014).

In the case of North Korea, for example, a credible threat of U.S. pre-emptive strike will undermine Pyongyang's decision to 'sponsor' a terrorist group with nuclear weapons or materials when its calculation postulates that its provocation would prove enormously catastrophic to its own regime. Presumably, Pyongyang would have to decide which of the two options could ensure its regime survival. The country has repeatedly stressed the pivotal role of nuclear weapons as part of its deterrence and self-defence strategy (Mansourov 2014).

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At the same time, the country needs money to prop-up its sagging economy and one of the lucrative options could be selling nuclear weapons or related materials and technology to both state and non-state actors.

The first of the options would definitely trigger international condemnation and escalate tensions, while the latter could maintain status quo. The question to ask therefore, is whether an escalation strategy could be seen as a viable alternative that could produce a greater expected utility than the status quo?

There has been substantive evidence in the past of Pyongyang's gradually escalating nuclear threats during a crisis by testing nuclear weapons in 2006, 2009, 2013 and most recently, an alleged hydrogen bomb in 2016. Is it therefore, not reasonable to postulate that North Korea has been repeatedly emboldened by (1) the lack of more punitive measures (the high certainty effect of escalating tensions) in retaliation to its nuclear tests and (2) its perception that it now has an effective deterrent power, which would explain its risky choice of intensifying its game of brinkmanship?

One may speculate that if Pyongyang remains under the perception that its actions would only be met with nothing more than the reluctance to punish, it might continue its risk-taking tendency to reap the financial benefits of a nuclear deal even with terrorists (more so if it's in the domain of losses, for instance, when it perceives that it has 'nothing to lose' by being provocative).

Yet, such an assumption is susceptible to fallacy because it allows the outwardly aggressive stance portrayed by the regime to overshadow the country's repeated attempts to project itself as a responsible nuclear power that recognises the dangers of proliferation of weapons of mass destruction (WMD) (Mansourov 2014). This is despite North Korea's assertion that its behaviour will rest on "the improvement of relations with hostile [from Pyongyang's perspective] nuclear weapons states" (Mansourov 2014).

Conclusion

Will North Korea then consider supplying or selling terrorists nuclear materials or even a nuclear weapon as a viable alternative that could produce a greater utility than status quo?

Prospect theory however is not about calculating expected utility but about weighing the probability of an outcome. This is where the answer shifts from the realms of logic to speculation.

Despite the failure in terrorists' quest to procure nuclear weapons, their persistence present a salient warning not to underestimate the need for strengthening national and international efforts, regimes and frameworks to deal with threats originating from groups that also see the strategic appeal of the weapon.

Therefore, it is important for the international community to work together not only to prevent rogue, irrational and eccentric regimes like in North Korea from supplying or selling nuclear materials to terrorist groups but also to prevent other such regimes like Iran from getting that capability in the first place.

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Weapons of Mass Destruction: Nuclear Terrorism and Nuclear Proliferation

Benjamin E. Martin

The overarching goal of the nuclear proliferation treaty (NPT) is to ban all non-nuclear states from acquiring nuclear weapons and reduce nuclear weapons worldwide for the five recognised nuclear weapons states (NWS): U.S., China, Russia, France and the UK with a view to completely eliminate nuclear weapons. This paper attempts to identify the gaps in the current NPT and other policies and treaties that do not fully account for nuclear proliferation of non-nuclear states (NNS), non-state actors and terrorist organisations such as the Islamic State of Iraq and Greater Syria (ISIS).

One particular problem with the NPT is that the treaty has not changed or adapted over time along with the security concerns that exist in the current global arena. The steps envisaged in the NPT to address nuclear proliferation are ambiguous and not instructive. Two central themes in the NPT are; "the strengthening of trust between states; and ending production of any new nuclear weapons" (International Atomic Energy Agency 1970). Arguably, dialogue and diplomacy could potentially aid in state-to-state relations but only if states are willing to do the same in an atmosphere of trust. Historically, this has not been the case even as Russia and the U.S. have had a degree of unanimity concerning nuclear weapons and prevention of proliferation of nuclear weapons. Given the current geo-political situation, this is not likely to be the case in future.

In the meantime, countries like North Korea and Iran continue to pursue programmes for nuclear weapons capabilities. Given the nature of the regimes in the respective countries, the possibility of nuclear materials or even a nuclear weapon falling into the hands of terrorist groups cannot be easily discounted.

While the five signatory NWS are scaling down nuclear stockpiles and disposing of nuclear materials, North Korea has continued to refine uranium and plutonium in recent years. Since 2006, the intermittently active Pyongsan Uranium Plant been has been producing yellow cake for further refinement. Evidence regarding production can be seen in the unlined tailings pond at the Pyongsan Uranium Plant, where open source satellite imagery displays clear indications of steadily accumulating amounts of tailings. The latest 2016 imagery compared to the same in 2006 indicates that the amount of waste in the pond has tripled in size. North Korea seems to be mining more uranium to meet what may be increasing needs for fuel or bombs (Lewis 2015). It is difficult to determine if North Korea is producing uranium, either natural or enriched, for the purposes of much needed nuclear reactor fuel for their experimental light water reactor, or for current reactors that produce plutonium or for low grade weapons use.

Unfortunately, current non-nuclear proliferation regimes and the global community have had no restraining impact on North Korea's nuclear weapons ambitions since 2008, when North Korea withdrew from the NPT. The abstinence of members of the NPT from producing new nuclear weapons does help in preventing terrorists from acquiring such weapons and has proven to be effective so far. However, a persistent concern is that "North Korea may consider selling excess nuclear fuel or devises", and that legacy nuclear weapons remain particularly vulnerable to theft and pilferage (Snyder 2015).

The 2010 U.S. Nuclear Posture Review (NPR) states that "Sound Stockpile Management" for extending the life cycle of existing nuclear weapons will help ensure no new nuclear weapons are needed. However the measurement for such a program is classified in part and it does not address stockpile management for foreign NPT members. Furthermore, of substantial concern is the security of nuclear weapons sites (DOD 2010). In particular, "U.S. and Indian officials also have privately expressed worry about the security surrounding India's movement of sensitive nuclear materials and weaponry" and where "nuclear explosive material is actually produced; there were no visible external security systems" (Levy and Smith 2016).

A review of nuclear weapons storage sites worldwide reveals that there are significant security risks to nuclear weapons stockpiles which are susceptible to theft or seizures by terrorists. In recent years, the nuclear terrorism and nuclear proliferation by non-nuclear states (NNS) has been a matter of serious concern for the international community. In recent times, ISIS has repeatedly claimed that "financial fortunes are flourishing" and it is "in a position to obtain a nuclear bomb within the coming year" (Moftah 2015). ISIS has specifically mentioned Pakistan for such a purchase (Cantlie, 2015). Whether Pakistan will sell directly to terrorists or through a third party is yet to be determined, but the concern that terrorist groups like ISIS could one day buy their own nuclear weapon remains a real concern given that ISIS' net worth is estimated to be at about $2 billion (Cairo 2015).

NPT: Preventing Non-state Actors from Acquiring a Nuclear Capability

The NPT does not fully address terrorist organisations or non-state actors, but it does address NNS and the duty of the NWS of deterring them from acquiring prohibited nuclear materials. The NPT situates that NWS agree to provide nuclear materials that can only be used for peaceful means to NNS. In fact, the treaty underlines a sort of loose obligation to share technology to NNS. Sharing of such technology could pose particular concerns, especially in respect of NNS that have previously shown interest in nuclear weapons.

"A persistent concern is that "North Korea may consider selling excess nuclear fuel or devises," and that legacy nuclear weapons remain particularly vulnerable to theft and pilferage."

The NNS that have previously signed the NPT agreed not to conduct banned research and testing. However under extreme circumstances a NNS may choose to withdraw from the treaty. It is likely that NNS do not withdraw from the treaty because of international pressures or perhaps of the assurances the NWS have agreed to in order for NNS continuing to be nuclear weapons free. Terrorist organisations and non-state actors have no such assurances and so fall under no such agreements.

The measures identified to prevent nuclear terrorism and nuclear proliferation is defined in the NPR as a three part process. First is the reversal of North Korea's and Iran's ambitions in becoming a nuclear threat. In July 2015, part of this initiative was successful in the form of the Iran Nuclear Agreement and with the implementation of the specific and instructive Joint Comprehensive Plan of Action. This monumental agreement marked a positive step forward toward ensuring a country will use nuclear technology exclusively for peaceful means.

Due to the many years of U.S. and international sanctions, Iran is an economically struggling country with "more than $100 billion in frozen Iranian assets" (Garver 2015) and is poised to reclaim the amount once sanctions are lifted. Iran has held up its end of the bargain so far. However, a similar deal with North Korea does not promise any optimistic outcome as the issues are different. For North Korea, scarcity of food and the need for energy is a huge concern though the regime hides these issues under brinkmanship postures.

Despite bilateral or multilateral assistance however, it is unlikely that North Korea will discontinue its nuclear programme or its propensity to proliferate weaponry to state or non-state actors. For example, "Between 1995 and 2008, the United States provided North Korea with over $1.3 billion in assistance: slightly more than 50% for food aid and about 40% for energy assistance" (Manyin and Nikitin 2014). The U.S. tapered off any significant aid and ceased providing assistance in 2011 after North Korea conducted its second nuclear weapons test in 2009 following its abandonment of the NPT in 2008. The situation is made more complicated with Pyongyang's January 2016 claim that is has "successful carried out a hydrogen bomb test" (Roth, et al. 2016).

The second NPR measure to prevent nuclear terrorism and nuclear proliferation is the acceleration of efforts to "secure all vulnerable nuclear materials worldwide in four years" (NPR 2010). This initiative however fails specifically on addressing security issues at nuclear weapons storage sites in some countries. Over 40 countries have stockpiles of highly enriched uranium (HEU) and weapons grade plutonium. Many of these storage sites and locations continue to be a security risk, particularly Pakistan and in Iraq. The most recent documented theft happened in Iraq near Basra in November 2015. 10 grams of Iridium-192, a radioactive source material housed in a shielded laptop size container went missing and remains unaccounted for (Rasheed, Mohammed and Kalin 2016). The amount is hardly sufficient to be used in a dirty bomb (traditional explosive coupled with radioactive material).

Storage sites remain at risk of security breaches – funding and politics have prevented security upgrades at many storage sites. Until these factors are mitigated, storage sites will continue to remain potential targets for thefts or seizures. Moreover, increased physical security is unlikely to affect North Korea or other NNS but it may assist in prohibiting non-state actors and terrorists from stealing nuclear weapons and materials. Therefore, further international pressure may be needed in order to secure at risk nuclear weapon stockpiles – particularly those held by countries that do not feel threatened by terrorism.

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The third provision in the NPR is targeted at preventing nuclear terrorism and NNS from nuclear proliferation. This provision is supplemented by arms control measures such as the New Strategic Arms Reduction Treaty (New START), which is particular to Russia and the U.S.; the Comprehensive Nuclear Test Ban Treaty; and the Fissile Material Cutoff Treaty. New START is the only formal agreement with considerable weight and remains in effect. Since 1996, there has been no change to the Nuclear Test Ban Treaty which prohibits nuclear explosions in the atmosphere, underwater or in outer space. The treaty omits prohibiting testing underground, which is a North Korean preferred method of testing. An emerging but promising Fissile Material Cutoff Treaty is slowly gaining momentum though it has not yet been completely developed.

Preventing nuclear terrorism and NNS from nuclear proliferation based on the NPR's third step focused on treaties described above may one day be effective. However, since the Fissile Material Cutoff Treaty has not come into fruition and the Nuclear Test Ban Treaty still allows testing underground, it is likely that more stringent measures like banning all nuclear tests and sanctioning countries that continue to carry out controlled nuclear related detonations is the way ahead.

Limits of the NPT

To date, a total of 190 parties have signed NPT – more than any other arms limiting or disarmament agreement worldwide. Considering the possibility that if as many parties would sign into an agreement not to produce WMD, or Chemical, Biological, Radiological and Nuclear (CBRN) in general, the world today would have been much different and potentially much safer.

This however does not mean that rouge states such as North Korea, Iran and Syria could be dissuaded from experimenting with or using WMD. In 2013, the "Assad regime used chemical weapons to attack the rebel-held suburbs of Damascus, killing 1,400 persons, mostly civilians" (Deknatel 2015). Shortly after, and with pressure from Russia, the regime agreed to declare and turn over a chemical weapons arsenal of approximately 1,300 tones. Despite the Syrian government giving up nearly all of its chemical weapons, it later turned out that chemical weapons – specifically chlorine – are still being used in Syria.

Before it was weaponised, it was also used as a tool of punishment against populations in rebel held areas. The very chemical that was used to purify the drinking water, was withheld and in some instances shut off so that previously preventable diseases such as cholera, typhoid and polio could begin to infect and become widespread.

It can then be argued that by withholding certain basic necessities of life such as those that are essential for clean drinking water is an inadvertent use of weapon of mass destruction. The bottom line is that while the international community may pressure and seek to prevent states or organisations that are committing terrorism and human atrocities with the use of conventional CBRN materials, those actors may continue to find other ways to inflict mass atrocities and even mass causalities.

Conclusion

In summary, further initiatives, based on international consensus are needed to specifically deter nuclear terrorism, CBRN and WMD attacks. Existing treaties, protocols and agreements have generally not evolved to meet new and emerging security threats. The threat of nuclear terrorism will continue to exist, especially because there are still physical and logistical weaknesses regarding nuclear weapons stockpiles and storage.

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The threat of CBRN and WMD attack seems to be a reemerging phenomenon with groups like ISIS which seem credible given the intention and capability – in monetary terms – of such groups to acquire the capability and the vulnerability of storage locations. This explains the emerging discourse that a WMD or a dirty bomb may be the next likely tactic used by terrorists, particularly by groups like ISIS.

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The views expressed in this article are those of the author's and do not represent the views of the concerned organisations.

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Bioterrorism from a Public Health Perspective

Devi Kalyan Mishra

The possibility of terrorists using Chemical, Biological Radiological and Nuclear (CBRN) weapons has been much debated, especially after the 9/11 attacks. Much attention has also been given to the impact of an attack involving CBRN weapons and how to respond to restore normalcy and public confidence. This article focuses on bioterrorism from a public health perspective by exploring the role of health professionals and infrastructure in prevention, treatment and public education in the event of an attack with bio-terror weapon.

Why Bioterrorism?

Bioterrorism can be defined as the deliberate release of viruses, bacteria, toxins or other harmful agents used to cause illness or death in people, animals and plants (CDC, 2006). The aim is to generate greatest impact through fear, uncertainty and terror among the target population. While the actual biologic impact of a single act may be small, the degree of disruption caused by such an attack is enormous. The keys to the defense against an attack using biological agents are to have in place highly functioning public health surveillance and education systems and an appropriate healthcare infrastructure to mitigate the consequences in the event that an attack takes place.

Bioterrorism in History

Use of biological agents by adversaries in a combat situation is not new. In ancient Rome, Roman soldiers used to throw faeces to spread infection and to debilitate enemy combatants. In medieval times, rats infected with bubonic plague were released to infiltrate enemy cities.

During World War 1, German scientist Anton Digler used the cultures of Glanders (a micro-biological agent) to infect horses and mules bound for England. In 1942, U.S. President Franklin D. Roosevelt authorised a bio-weapons program under George W. Merck, who is considered as the biological warfare's Dr Robert Oppenheimer (the inventor of the atomic bomb) and founder of Merck Pharmaceuticals. The programme however, was terminated by President Nixon in 1969 (FAS October 1998).

In 1984, disciples of the Rajneesh Cult infected salad bars in Oregano (USA) with Salmonella typhimurium with a view to control the outcome of local election by preventing people from voting (Keyes 2014). The Japanese Cult Aum *Shinrikyo* which targeted the subway system in Tokyo in 1995 was trying to obtain Ebola virus as a potential biological weapon (Maron 2014). The 2001 Anthrax attacks in the U.S. in the immediate aftermath of the 9/11 attacks is still in public memory.

Key Features of Bioweapons

Bioweapons involve high morbidity and high mortality rates and potential for person to person spread. The threat is further magnified due to relative easy availability of pathogens and/or the production and stability of these agents in the environment. Importantly, low doses of toxins can be used to cause significant infection and damage (Lane and Fauci 2008). Besides, due to lack of capabilities to detect the infections, lack of universally available vaccines, antidotes and other essential medicines, bio-weapons have the potential to cause widespread and often disproportionate anxiety and panic among the general population.

Components of Bioterrorism

Microbial Terrorism

The U.S. Centers for Disease Control and Prevention (CDC) has categorised the threat potential of various microbial agents with potential terrorist use on the basis of how easily the agent disseminates or transmits from person-to-person; mortality rates; potential for major public health impact; Potential to cause public panic and social disruption; and requirements for special public health preparedness (CDC 2006).

Based on the above criteria, the CDC has divided microbial agents into three categories – A, B, and C, which is the standard that is being used worldwide. Among these, category A is of interest due the fact that terrorist groups have used, experimented with or most likely to use the many of the pathogens listed therein (CDC 2006) (See Annexure 1 for the categories). This classification however is based on severity rather than accessibility of the pathogens for terrorist use. For example, while anthrax has been used by a number of groups and individuals accessibility issues have prevented others to experiment with a number of other bio-agents.

Even though Aum Shinrikyo sent a team of medical practitioners to Democratic Republic of Congo in 1992 to collect Ebola virus, the attempt was a "flagrant failure" (Maron 2014). Al Qaeda, on the other hand was fairly successful in setting up a project for Anthrax in Afghanistan which was relocated to Pakistan after the U.S. attacks against its training camps following 9/11. Al Qaeda was able to rope in expert micro-biologists like Dr Abdur Rauf from Pakistan and Malaysian Yazid Sufaat, a U.S.-trained biochemist to procure pathogens and run the programme (National Infrastructure Protection Center 2003). In Southeast Asia, Jemaah Islamiyah (JI) also attempted a chemical-biological programme. However, most of the information in the JI chemical-biological manual that was recovered by law enforcement authorities were from the open source and were assessed to be quite rudimentary and unsustainable (Dolnik 2003).

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Anthrax

Given the interest of terrorist groups in Anthrax, it is worthwhile to examine this bio-agent in greater detail. The threat of its use by terrorist groups emerged centre stage in the immediate aftermath of 9/11 attacks due to the letters containing anthrax spores sent to some members of U.S. Congress. A total of seven letters were sent using the United States Postal Service (USPS) which resulted in 22 cases of infections out of which 11 were due to contact with skin (cutaneous) and others were due to inhalation. There were five deaths all of which were related to inhalation (Johnston 2005). However, investigations revealed that no terrorist group was responsible, the perpetrator being Bruce Edwards Ivins who worked at the bio-defense laboratory at Fort Detrick in the U.S. (Warrick, 2010).

Infection from Anthrax can manifest in different forms. It can be cutaneous - revealing as a painless skin lesion developing over two to six days from a papular (small raised lesion without any fluid) through a vesicular stage (raised lesion but containing some fluid) into a depressed black eschar with surrounding edema (swelling over the skin) fever, malaise and lymphadenopathy (swollen glands) may accompany the lesion (CDC, 2006).

Most dangerous Anthrax infection occurs through inhalation which is characterised by an acute illness, resembling a viral respiratory illness, followed by hypoxia (decrease in oxygen levels of blood), dyspnea (difficulty in breathing) or acute respiratory distress with resulting cyanosis (bluish discoloration of skin) and shock (CDC, 2006).

Another manifestation of Anthrax infection is in the gastrointestinal tract with severe abdominal pain and tenderness, nausea, vomiting, hematemesis (blood vomiting), bloody diarrhea, anorexia (decreased appetite), fever, abdominal swelling and septicemia (blood infection). The least severe is the type affecting the throat (Oropharyngeal Anthrax) with a painless mucosal lesion in the oral cavity or oropharynx (includes the mouth and throat), with cervical adenopathy (swollen glands in the neck), edema (swelling), fever, and possibly septicemia. In its most rare form, it affects the lining of brain and spinal cord with symptoms like acute fever, convulsions (shaking movements of body), coma (Meningeal Anthrax) which however is usually secondary to the other forms described above (CDC 2006).

Understanding of the symptoms is of vital importance not only from curative perspective but also to determine the cause and source of infection (See Annexure 2 for different types of exposures to Anthrax). Other category A agents with details of the incubation period, symptoms, diagnostic and treatment aspects are listed in Table 1.

Chemical Bioterrorism

The use of chemical warfare agents date back to World War 1. Most recently sulphur mustard and nerve agents were used by Iraq against Kurdish rebels in 1984-85 (Hurst and Newmark 2008). Sarin was used in Tokyo subway attacks in 1995. Table 2 catalogues various types of Chemical bio-terror agents and symptoms and Table 3 describes decontamination and treatment option for each category.

"In Southeast Asia, Jemaah Islamiyah (JI) also attempted a chemical-biological programme. However, most of the information in the JI chemical-biological manual that was recovered by law enforcement authorities were from the open source and were assessed to be quite rudimentary and unsustainable."

Table 1

Organism	Incubation period	Symptoms	Lab Diagnosis	Treatment Preventive	Treatment Curatve
VARIOLA MAJOR	7-17 days	Fever, malaise, headache, vomiting, maculopapular (skin lesions which are both flat and raised)	Culture, PCR (polymerase chain reaction of DNA)	vaccination	Supportive measures with cidofovir
Franscilla tularensis	1-14 days	Fever, chills, malaise, dyspnea (difficulty in breathing), pharyngitis, hilar adenopathy (swollen neck glands)	Gram staining and PCR	Doxycycline	Streptomycin
Viral haemorrhagic fever	2-21 days	Fever, myalgia (Muscle Pain), rash, encephalitis (inflammation of brain)	RT-PCR (real time polymerase chain r)	Not known	Supportive measures, Ribavarin
Botulinum toxin	12-72 hours	Dry mouth, blurry vision, ptosis (dropping of eyelids), weakness, dysarthria (unable to speak), respiratory failure	MOUSE BIOASSSAY, TOXIN IMMUNOASSAY	Antitoxin	Supportive
Yersinia Pestis	2-6 days	Affects the glands of groin, can cause respiratory symptoms and can cause shock	Wayson stain, RTPCR	Tetracycline	Gentamycin

Compiled based on information from the Center For Disease Control, "Bioterrorism Overview 2006," 28 February 2006.

Table 2

Type of Agents	Examples	Symptoms
Nerve Agents	Sarin, soman, tabun, vx	Miosis (constriction of pupil of eye), muscle twitching.
Asphyxiant (affecting respiration)/blood	Arsine, cyanides	Cherry red skin, cyanosis (blueness over the skin), frostbite.
Choking/lung damaging	Chlorine,Hcl,N0, phosgene	Eye and skin irritation, airway irritation, dyspnea (difficulty in respiration), chest tightness.
Blistering	Mustard gas, Lewsite	Severe irritation, redness and blistering, corneal damage mild respiratory distress. Death.
Incapacitating/behaviour altering	Agent 15/BZ	Dry mouth and skin, initial tachycardia (increased heart rate), altered consciousness, delusions, belligerence, ataxia (movement disorder), mydriasis (dilatation of pupil of the eye).

Hurst and Newmark 2008

Table 3

Type of Agent	Decontamination	Treatment	Complications
Nerve agent	Remove clothes, wash with soap and water	Atropine	Onset of symptoms may be delayed. Repeat dose may be required.
Asphyxiant	Remove clothes, wash with soap and water	Rapid treatment with oxygen, nitrite, sodium thiosulphate	Cyanogen may affect lungs.
Choking/lung damaging	Remove clothes, wash with soap and water	Fresh air, in semi-upright position. If respiratory distress use oxygen	May cause pulmonary edema (swelling of lungs).
Blistering/vesicant	Immediate decontamination, remove clothes, wash with soap and water	Flush eyes with normal saline for 10-15 mins. Oxygen in case of difficulty in breathing. There is no antidote for mustard	There is no antidote for mustard.
Incapacitating/ behaviour altering	Immediate decontamination, remove clothes, wash with soap and water	Evaluate mental status. Use restraints as needed. Monitor core body temperature	Hyperethermia (increased body temperature) and self-injury are largest risks. Possible serious arrthymias (heart rhythm disorder, physostigmine may be used.

Hurst and Newmark 2008

Radiation Bioterrorism

Radiation bioterrorism is coined by the medical profession to describe threats of terrorist attacks using "nuclear or radiation-related devices" (Tochner and Glatstein 2008). Though, there are many ways of using nuclear or radiation-related devices, the most likely scenario would be a dirty-bomb - the detonation of a single low-yield device with a cocktail of conventional explosives and radiological materials like cesium-137 which is easy to access due to medical use. Such an explosion can contaminate large areas with radioactive fallout and cause acute radiation sickness among the affected population leading to hematopoietic (affecting the blood and its cells), gastrointestinal disorders and neurovascular symptoms (affecting of nerves and vessels).

Treatment options depend on the extent of exposure to radiation and include hemostasis (maintaining all important body metabolic parameters). Aggressive treatment is given to every damaged system. It mainly includes transfusion of blood products and growth factors. Psychological support is also very important for the affected population (Tochner and Glatstein, 2008).

Conclusion

Given the rapidly evolving technology which has made terror weapons both accessible and affordable, the importance of a professional and well-equipped public health system can hardly be overestimated. The medical profession must maintain a high index of suspicion on unusual manifestation or clustering of the cases of rare diseases. When such diseases occur in a healthy population or diseases that are common in rural areas occur in urban areas, it is essential that medical care response team report these to appropriate authorities. In some countries, public health service is moving towards a larger, more highly trained, fully deployable task force to deal with the consequences of CBRN attacks including from bio-weapons. These include rapid access to quantities of pharmaceuticals, antidotes, vaccines and other supplies (CDC 2015). In some countries, law enforcement officials together with the members of the public health services conduct drills not only to educate their citizens about the possibility of bio-terror attacks but also to prepare both the public and responders in case an attack takes place (Ministry of Defence 2016).

However, most of the countries in the global south lack resources and public health infrastructure to deal with the aftermath of terrorist attacks using CBRN weapons including bio-weapons.

From an overall public health perspective, response in a bio-terror attack scenario involves promotive, preventive and curative intervention. Promotion involves information, education and communication activities implicating the responders and the public at large. Preventive measures include immunisation/vaccination and screening, among others. Curative measures involve diagnosis and treatment according to symptoms. All these require a high degree of professionalism as well as commitment to public service. Coordination with different agencies of the government, private sector and the civil society organisations is also of critical importance to effectively mitigate the medical consequences of terrorist attacks using CBRN weapons in general and bio-weapons in particular.

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The International Centre for Political Violence and Terrorism Research (ICPVTR) is a specialist research centre within the S. Rajaratnam School of International Studies (RSIS) at Nanyang Technological University, Singapore. ICPVTR conducts research and analysis, training and outreach programmes aimed at reducing the threat of politically motivated violence and mitigating its effects on the international system. The Centre seeks to integrate academic theory with field research, which is essential for a complete and comprehensive understanding of threats from politically-motivated groups. The Centre is staffed by academic specialists, counter-terrorism analysts and other research staff. The Centre is culturally and linguistically diverse, comprising of functional and regional analysts from Asia, the Middle East, Africa, Europe and North America as well as Islamic religious scholars. Please visit www.rsis.edu.sg/research/icpvtr/ for more information.

Launched in 2009, the Counter Terrorist Trends and Analysis (CTTA) is the journal of ICPVTR. It features articles with in-depth analysis of topical issues on terrorism and counter-terrorism, broadly structured around a common theme for each issue. Listed with EBSCO Information Services, CTTA was ranked among the top "Core Journals for Terrorism Research," with "significant importance for students, researchers, and professionals in the field of terrorism and counter-terrorism studies (2013)."

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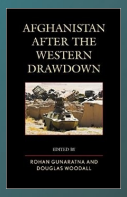

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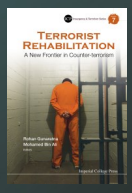

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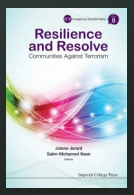

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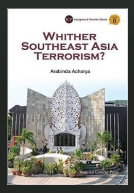

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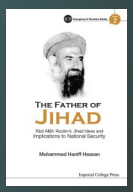

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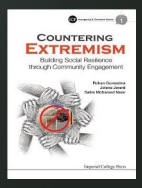

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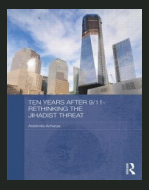

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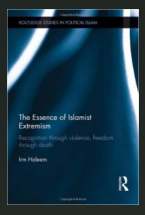

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Global Pathfinder is a one-stop repository for information on current and emerging terrorist threats from the major terrorism affected regions of the world. It is an integrated database containing comprehensive profiles of terrorist groups, terrorist personalities, terrorist and counter-terrorist incidents as well as terrorist training camps. This includes profiles from emerging hubs of global terrorism affecting the security of the world, as well as the deadliest threat groups in Asia, Africa, the Middle East and the Caucasus. The database also contains analyses of significant terrorist attacks in the form of terrorist attack profiles. For further inquiries regarding subscription and access to Global Pathfinder, please contact Ng Suat Peng at isngsp@ntu.edu.sg.

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