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„Assessing the risk of assassinations utilizing CBRN-  
materials - a conceptual approach“

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### III Table of abbreviations

BIO	Biological, incident involved with biological warfare agents, hazards or threats
CBRN	Chemical, biological, radiological and nuclear
CHEM	Chemical, incident involved with chemical warfare agents, hazards or threats
COMBINATION	Incident with more than one CBRN substance or threat involved
CWA	Chemical warfare agents
GTD	Global terrorism database
IED	Improvised Explosive Device
IS/ISIL/ISIS	Islamic state / in the Levante / in Syria
MWMDD	Monterey Weapons of mass destruction database
NA	Incident involved with CBRN materials but information not available which CBRN material type was present – no investigative CBRN capabilities deployed
RN	Radiological and nuclear, incident involved with radiological or nuclear materials, hazards or threats
SOP	Standing operating procedures
TTPs	Tactics, techniques and procedures
UAV	Unmanned aerial vehicle, drone
UNK	Incident involved with CBRN materials but unknown which CBRN material type was present
VX	Chemical warfare agent VX
WMD	Weapons of mass destruction



## 1. Introduction

### 1.1.CBRN-terrorism in general

CBRN warfare agents are a mixed blessing for terrorists. On the one hand, because they are characterized as weapons of mass destruction (WMD) and are difficult to detect. In most cases organoleptic detection of these substances is either too late or not possible at all. Because of that, they are especially useful to spread fear and terror as far as destabilization in the general population. On the other hand, using WMD and especially CBRN agents is hampered and something like a last resort. Overall, there is the risk to escalate the conflict and trigger massive (military) responses or loose supporters (MERARI 1999). Furthermore, acquiring such agents is risky and controlling the release can be very complex.

Since the terrorist attacks of the Aum-sect in Japan 1994 and 1995 using chemical warfare agents (CWA), the catastrophic effects of CBRN agents are widely known. Several acts of CBRN-terrorism have happened since then. These attacks can be specific, like focusing on single persons, or broad, trying to target as many people as possible or achieving maximum damage. Some examples are the assassination of Alexander Litvinenko with Po-210, the Anthrax-letters after 9/11, which lead to more than 400 missions of the Austrian Armed Forces or the Novichok attacks on Sergei Skripal in 2018. However, some of these attacks can be attributed to state actors rather than terrorism groups.

Different reasons have been reported, varying between nationalists/separatists, cults, fundamentalists or other groups (PALMER 2004). Recent research believes in a threat by white supremacy groups. For those groups CBRN-weapons seem to be especially alluring since nerve agents have been developed by Germany prior to the second world war. Those groups could be even more dangerous because they are known to undercut security services which could grant them access to additional information and knowledge. This could also include countering strategies of responders (FLEER 2020).

Three main factors are identified for CBRN-terrorism to happen: The availability of the relevant agents or precursor materials, the adequate knowledge to acquire, manufacture and release CBRN materials and the willingness to do so. The first two can be attributed to the term proliferation, whereas the last depends on the respective group's general situation, their agenda and available alternatives.

## 1.2. Development of CBRN-terrorism

In the past 40 years, some events/developments occurred which may have had an impact on CBRN/WMD-proliferation:

- The collapse of the Soviet Union and the end of the cold war
- The Tokyo Sarin Attacks
- The evolution of internet and darknet
- 9/11, the anthrax letters and the successive invasion of Iraq and Afghanistan
- The Arabic spring, especially focusing on Libya and Syria
- The recent broad availability of (mini)UAVs

During the cold war the use and development of CBRN/WMD was decelerated and hampered by the stand-off in nuclear capability (CORNISH 2007). Biological weapons were banned by the biological weapons convention (BWC) in 1975 (UNODA 2022) and the chemical weapons convention (CWC) was brought on the way with being ratified only in 1997 (OPCW 2022). After the end of the cold war, development in technologies deemed as dual-use increased. Dual-use in a CBRN/WMD context means technologies and materials which can be used in the civilian sector as well as in CBRN/WMD production. Due to international collaboration the risk for proliferation of technologies increased (CORNISH 2007).

The Tokyo sarin attacks in 1995 and the related releases of chemical and biological agents by the Aum sect were a game changer in CBRN-terrorism. For the first time a religious extremist group acquired enough funds, knowledge and means to produce and release chemical and biological warfare agents: namely sarin, anthrax spores and botulinum toxin. They remained undetected for years to build up their operation. The cult even tried to get their hands on the Ebola virus by traveling to Africa (OLSON 1999). It has been argued, that if journalistic investigations into the sect's actions had been taken more seriously by the intelligence and security community, the sarin attack could have been prevented (ACKERMAN 2005). The intention and planning capability as well as the means to deliver the agents in such a concerted manner have so far been unparalleled. It was fortunate, that the overall agent quality was low (Sarin concentration below 30 %) and the chosen release method was unsuitable resulting in only 12 casualties. The number of fatalities would have been drastically higher, if they used i.e. an atomizer for dispersal instead of sharp tools to spread liquid from plastic bags (LEE 2003).

By 1998, the internet became mainstream and centralized internet servers provided an easier way to share and distribute data. Furthermore, by realizing peer-to-peer networks, the threat of observation and/or recognition of all involved parties was reduced significantly, therefore enabling the spreading of dangerous and/or illegal content (BIDDLE et al. 2002). This so called dark web, dark net or deep web opens (CHEN 2011) up new possibilities for knowledge transfer on how to synthesize chemical and biological agents (NORRY 2018) as well as nuclear technologies (SHAHID 2019) especially between subversive actors like terrorist groups.

Additionally, with the emergence of cryptocurrencies the darknet became a relatively safe provider for raw materials, precursors or even CBRN-agents themselves (GIORGIDZE UND WITHER 2019).

With the terrorist attack on the world trade centre in New York in 2001 using airplanes to attack skyscrapers, terrorism was elevated to an unforeseen level. Al Qaida, the group responsible for the 9/11 attacks, reportedly has been trying to acquire WMD, probably inspired by the Tokyo sarin attacks (DASS UND ANANTHAN 2021, SAENZ 2013, MANCIULLI 2017). In the aftermath, letters were used to attack US officials and US offices containing white powder, spores of *bacillus anthracis*. Although, the overall death toll was very limited, a certain public awareness was triggered leading to hundreds of hoaxes and misinterpreted attacks affecting the whole CBRN responder community (WILLS et al. 2008). Due to the subsequent invasion of Iraq and Afghanistan in the context of war against terrorism and the paradigm of mitigating a WMD threat a regime change was initiated in both countries (SARASIN 2006).

Another major change was introduced with the Arabic spring movement, turning over the dictatorships/autocratic governments of countries like Tunis, Libya and Syria (DASS UND ANANTHAN 2021, SAENZ 2013). In this power vacuum another major terrorist organisation was born. The “Islamic state” (IS/ISIL/ISIS/Daesh) actually acquired territory spanning over four different countries and orchestrated large-scale drug operations and even oil trade to finance their operation. They also tried to get their hands on WMDs (RATHORE 2016, TØNNESSEN 2017, CHAPMAN 2017, MANCIULLI 2017) and used the dark web extensively to spread chaos, knowledge (e.g. bomb building schematics, IED plans) and their ideology (BERTI UND FRIEDMAN 2013, MARGOLIS 2012, VASILEVA 2019). The IS has been reportedly using chemical devices in attacks on their Iraqi and Syrian opposition. Beginning with chlorine IEDs and continuing with developing sulphur mustard devices, the IS’s chemical capabilities increased significantly. Also, the acquisition of nicotine toxin and thallium sulphate, both highly toxic substances has been reported (VASILEVA 2019).

Even tough UAVs have been investigated already by the Aum cult, especially in recent years their use in terroristic activities dramatically increased (TIN et al. 2021). Especially miniUAVs are available at low prices without any restrictions. They can be easily modified to carry explosives or even containers with CBRN substances (KALLENBORN UND BLEEK 2018). Defence systems, especially against miniUAVs are still lacking, thereby creating opportunities for terrorists and increasing risk for authorities (JENZEN-JONES 2020).

### 1.3.CBRN-terrorism featuring assassinations

CBRN-agents have been used also for assassinations events. Reports go back as far as 50 years. In 1978 the dissident Georgi Markov was killed by Bulgarian intelligence services using an umbrella, modified to release a pellet containing the toxin Ricin which could be injected during a walk-by in the streets (PAPALOUKAS et al. 2008).

More recent examples are the assassination of Kim Jong-Nam (NAKAGAWA UND TU 2018, TU 2020) and the attempts on Sergei Skripal (CHAI et al. 2018, VALE et al. 2018) and Alexei Navalny (BOLT UND HENGSTLER 2022). Kim Jong-Nam, the brother of the North Korean leader Kim Jong-Um was killed by VX at a public airport in 2017. The attempts on the Ex-Russian spy Skripal and the dissident Navalny were carried out using fourth generation chemical warfare agents of the novichok group (MASTERSON 2020). In both cases the agents were released in everyday situations without any indication of an attack happening or an event as potential target trigger.

Overall, the threat of CBRN-terrorism is real and trying to foresee future events seems to be challenging if not close to impossible but necessary to prevent loss of lives.

## 1.4.State-of-the-art research

A lot of scientific research work has been done in the field of predicting terrorism, including CBRN-terrorism. The Monterey weapons of mass destruction database has been used as foundation in several publications. The latest, published in 2022 focuses on the reasons why terror organizations want to acquire and use WMD (ASAL et al. 2022) and ten more publications in 2021. The global terrorism database has been exploited even more. Since 2021 more than 700 papers have been published referencing this dataset, but mostly addressing conventional terrorism.

Assassinations or assassination attempts with CBRN-agents have been investigated only a couple of times with very different focus areas. One recent work addresses the use of chemical warfare agents in assassinations and the role of state-actors as culprits (ZOLTÁN 2021). However, this research is not focusing on the risk of future occurrences. Other research has been done on crime-scene exploitation procedures (KOLENČIK 2021).

As far as literature was available to the author, the only work specifically focused on countering and preventing CBRN-attacks on VIPs or high value targets has been done by Daniel J. Kaszeta (KASZETA 2009, KASZETA 2014).

## 1.5.Aim of this work

Combining basics from risk assessment with findings and deductions from the development of CBRN-terrorism in the last 40 years, this work aims to support future risk analysis processes for assassinations utilizing CBRN-materials.

This work has two main goals. The first goal is to evaluate and compare published work on prognosing CBRN-terrorism incidents from the early 2000s to actually occurred and reported CBRN-incidents in the following years to estimate the possibilities of such forecasts. The available data will be interpreted and general information like year, location and number of affected people as well as CBRN-agent specific information like type or delivery method will be extracted for further evaluation. The recorded events are also investigated regarding the use of CBRN-agents in assassinations. Since published work on CBRN-assassinations is scarce, rather than analysing general CBRN-terrorism publications which have processed the databases and added their research input, the raw database datasets are investigated specifically focusing on this works aim.

The second goal is to use the findings to propose fundamentals and establishing coherent risk criteria for a CBRN-risk analysis for targeted assassinations based on open-source intelligence. With this assessment approach, a comprehensive and reproducible CBRN-risk estimate should be enabled.

## 2. Hypothesis and research questions

Three hypotheses have been devised to achieve the aim of this work. To further define the scope corresponding research questions were defined for each hypothesis.

### 2.1. Hypothesis 1

Predictions regarding CBRN-terrorism, published from 1997 to 2007 did not occur.

- Are there peer-reviewed open-source publications available from this period, which give an outlook regarding the possible future occurrence of CBRN-terrorism incidents?
- Did CBRN-terrorism incidents of the predicted type happen in the proposed timeframe and were reported?

### 2.2. Hypothesis 2

General conditions for CBRN-terror attacks are better now than before 2000.

- Did the number of reported CBRN-terrorism incidents between 2000 to 2019 increase compared to between 1980 to 2000?
- Did the complexity of reported CBRN-terrorism incidents between 2000 to 2019 increase compared to between 1980 to 2000?
  - How effectively were the CBRN-agents used, comparing the agent and the number of affected (killed or injured) people?

### 2.3. Hypothesis 3

Reported incidents using CBRN-agents for assassinations and attempted assassinations were orchestrated by state actors (unofficially) rather than terrorism groups.

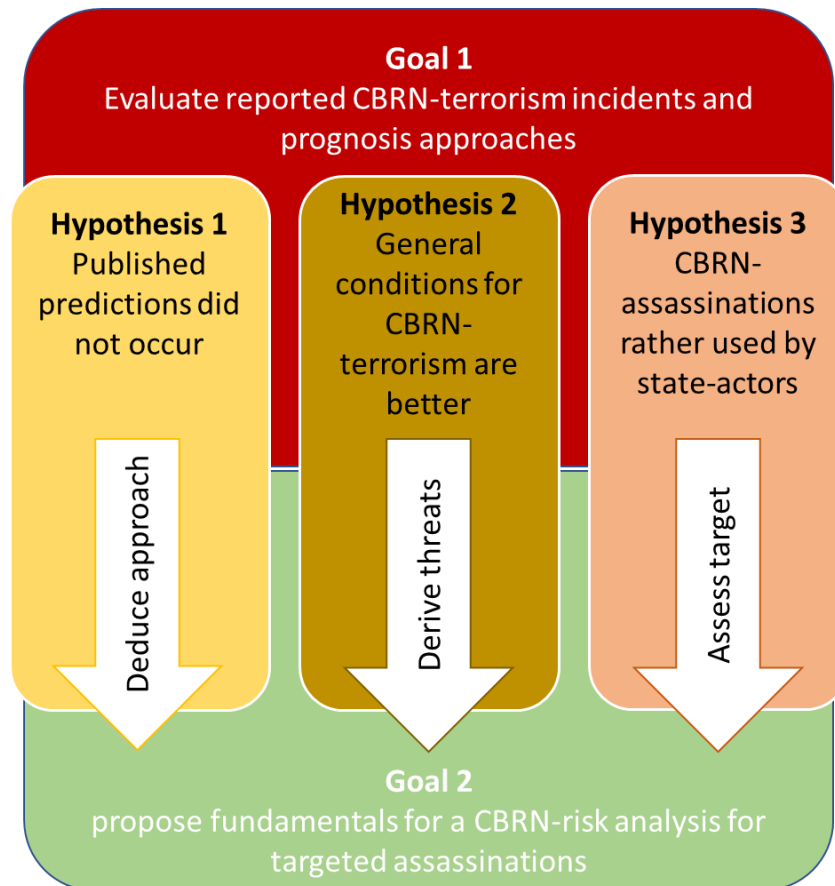
- How many assassinations/attempts with CBRN-agents after 2000 were reported?
- How many of these assassinations/attempts were claimed by or attributed to terrorism groups?
- Which materials were used in these assassinations/attempts and how were they delivered?





### 3. Methodical approach

To ensure comprehensive development of the goals, the following methodical approach, distinguishing for the three hypotheses is described. The framework relation between Goal 1 und 2 including the hypotheses and their contribution to the goals is visualized in Figure 1.



*Figure 1: relation between the thesis goals and the hypotheses*

As framework for the sampling process the concept as proposed by Taherdoost (compare TAHERDOOST 2016) was used. For each hypothesis the derived approach is described.

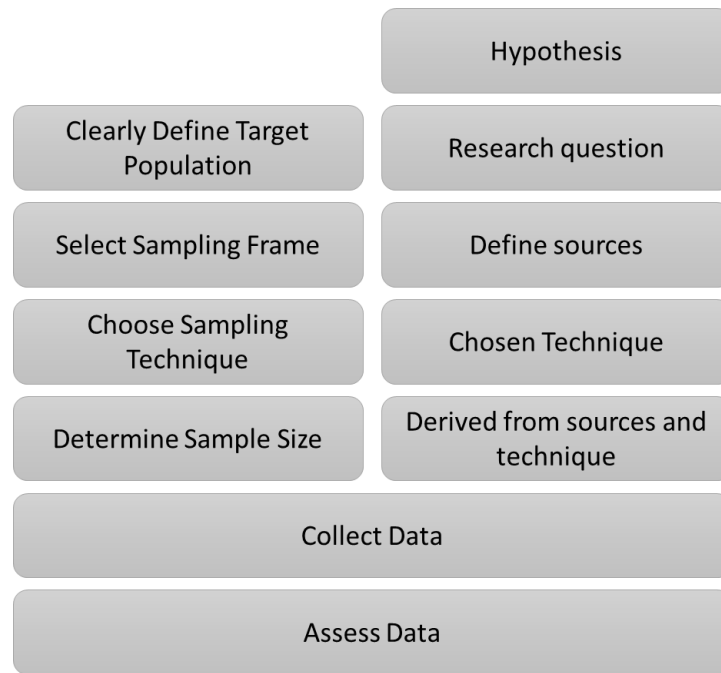


Figure 2: Conceptual sampling approach (compare TAHERDOOST 2016)

As basis for this work, only open-source data was used. During literature search two accessible databases were found: the “global terrorism database” (START-GTD 2021) and the “Monterey weapons of mass destruction database” (MONTEREY 2013). All other sources were acquired by keyword search using google scholar (<https://scholar.google.com>).

The global terrorism database (GTD) has been collecting data since 1970 and is still ongoing. It is mainly funded by the US government with contributions from German and UK governments. For an entry to be added to the database, there must be at least one independent source. The criteria for terrorism are threefold: Intent, a defined minimum level of violence or threat and a subnational actor, no state parties. The GTD includes 201.183 datasets (START-CODEBOOK 2021).

The Monterey weapons of mass destruction database (MWMDD) was maintained by the Center for Nonproliferation Studies Monterey University. This database covers all reported incidents by open sources involving CBRN materials as possible weapons with the first entry backdated to 1933. However, this database is not continued anymore and ended in 2012. The MWMDD includes 1.730 datasets focusing solely on CBRN/WMD (MONTEREY 2013).

### 3.1. Method to hypothesis 1

For the first hypothesis the two databases were used as well as peer-reviewed publications found by google scholar.

For the google scholar search the following keywords were used: “CBRN” or “WMD” + “prognosis”, “forecast” or “prediction” + “terrorism”. The publication date was limited from 1997 until 2007. This period was chosen because after the Tokyo sarin attacks in 1995, 9/11 and the anthrax letters a lot of scientific work regarding CBRN threats was published. Since the MWMDD dataset already ends in 2012, a minimum timeframe of five years is defined. A minimum limit of 10 publications was set.

From the MWMDD the columns “year”, “event”, “weapon type”, “country”, “agent”, “injuries” and “fatalities” were used. The entry “use of agent” in the event column was considered as actual CBRN release while all other entries were summarized as “threat/other”.

From the GTD the columns “year”, “weaptype1\_txt”, “weapdetail”, “region”, “success”, “nkill” and “nwound” were used. Since the GTD incorporates any type of terrorism incident, the weapon type was used to filter out CBRN incidents. For the weapon type all entries with either “biological”, “chemical” or “radiological” were considered. The column “success” was used to define an actual CBRN-release and were consistent with “nwound” and “nkill”. If the success value was “0” also no founded and fatalities were recorded in those columns.

The accessible publications were evaluated and predictions were extracted. Open-source publications don’t go as far as proposing actual numbers of possibly affected people or defining an agent type in more detail than “chemical”, “biological”, “radiological” or “nuclear. Still general forecasts could be derived and were compared to the database entries, thereby linking prognosis to actual reported incidents.

The comprehensive methodical approach is also portrayed in Figure 3.

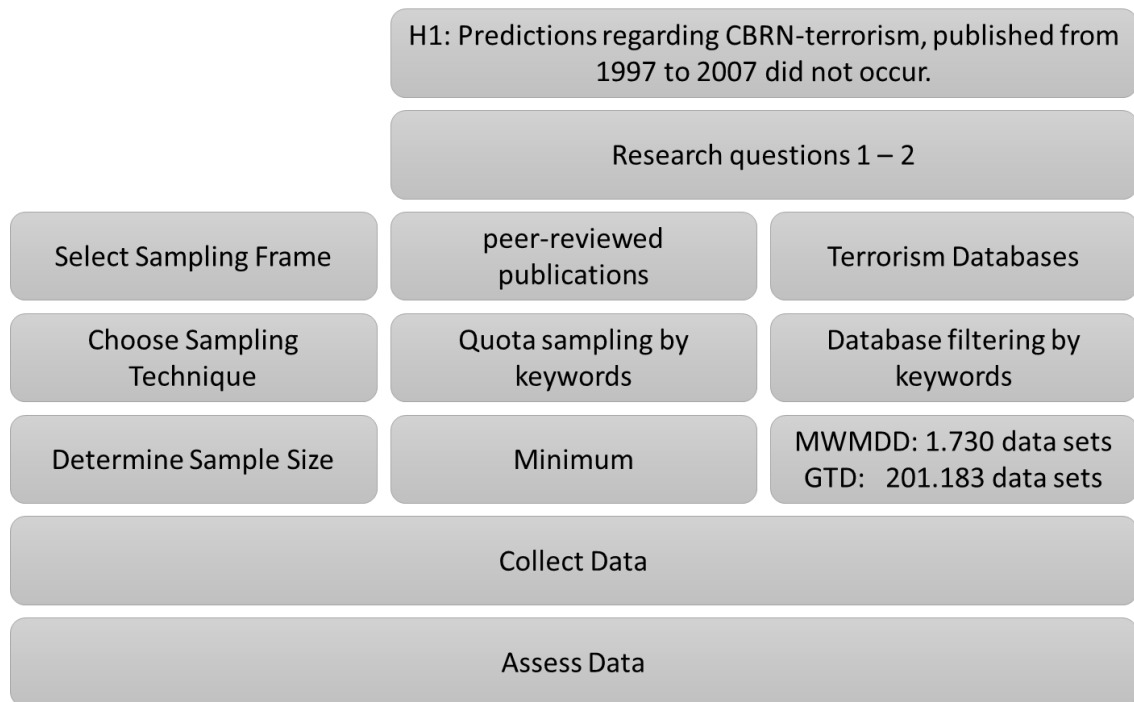


Figure 3: methodical approach for hypothesis 1 (compare TAHERDOOST 2016)

### 3.2. Method to hypothesis 2

For the second hypothesis only the two databases were used.

From the MWMDD the columns “year”, “event”, “weapon type”, “country”, “agent”, “injuries” and “fatalities” were used. The entry “use of agent” in the event column was considered as actual CBRN release while all other entries were summarized as unsuccessful.

From the GTD the columns “year”, “weaptype1\_txt”, “weaponsubtype1\_txt”, “weapdetail”, “region”, “success”, “nkill” and “nwound” were used. Since the GTD incorporates any type of terrorism incident, the weapon type was used to filter out CBRN incidents. For the weapon type all entries with either “biological”, “chemical” or “radiological” were considered.

The datasets were filtered in two periods: 1980-2000 and 2000-2019, compared and assessed. These timings were chosen to have time intervals of the same length. Since defining CBRN-terrorism events happened in both of them, the collapse of the Soviet Union and the Tokyo sarin attacks before 2000 and the other developments like the evolution of the internet, 9/11 and the Arab spring after 2000.

The comprehensive methodical approach is also portrayed in Figure 4

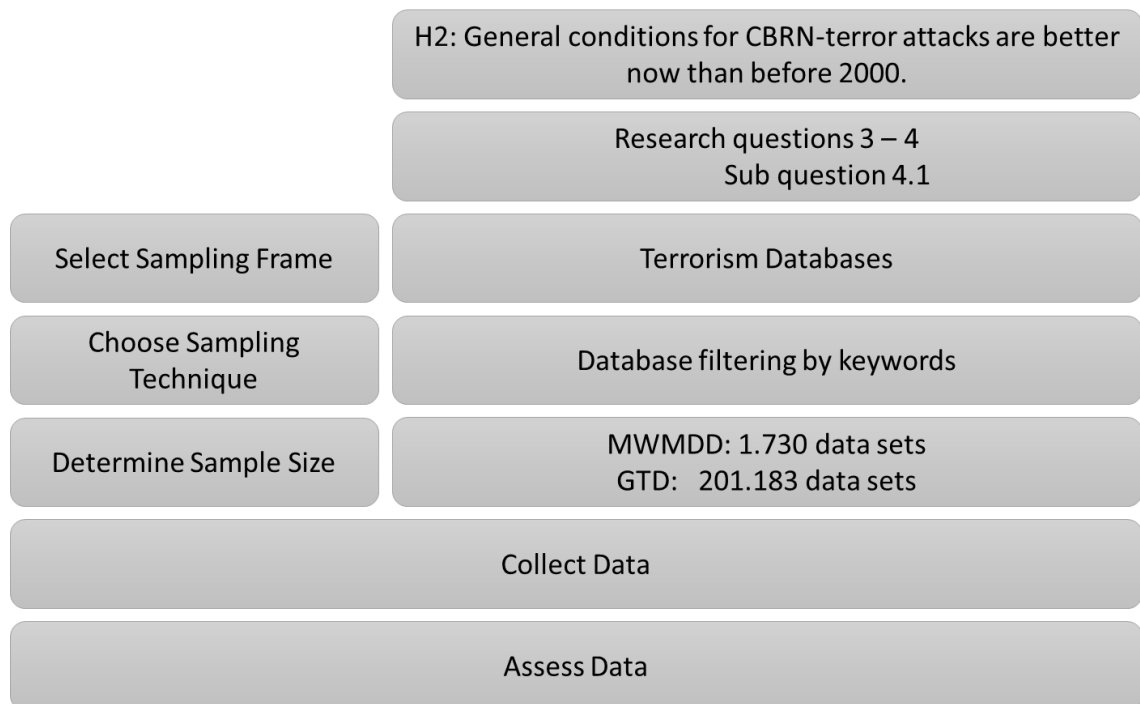


Figure 4: methodical approach for hypothesis 2 (compare TAHERDOOST 2016)

### 3.3. Method to hypothesis 3

For the third hypothesis the two databases were used as well as peer-reviewed publications found by google scholar and open-source search using google ([www.google.com/search](http://www.google.com/search)).

Since both databases only encompass data on terrorism which is defined as non-state acting, additional information regarding assassination incidents using CBRN materials was needed. Therefore, the following keywords were used in google as well as google scholar: “CBRN” or “WMD” + “assassination”.

There is no designated type “assassination” in the MWMDD, but in some cases in the “summary” column information involving an (attempted) assassination is provided. By using the Excel search function those events were singled out and analyzed accordingly.

From the GTD the columns “year”, “weaptype1\_txt”, “attacktype1\_txt” and “success” were used. Since the GTD incorporates any type of terrorism incident, the weapon type was used to filter out CBRN incidents. For the weapon type all entries with either “biological”, “chemical” or “radiological” were considered. With the column “attacktype1\_txt” offering a classification for “assassination”, that term was set as filter to extract the relevant GTD datasets.

The accessible publications and sources were evaluated and predictions regarding number, type and used CBRN-materials as well as delivery methods of incidents extracted. These numbers were then compared to the database analysis and assessed.

The comprehensive methodical approach is also portrayed in Figure 5.

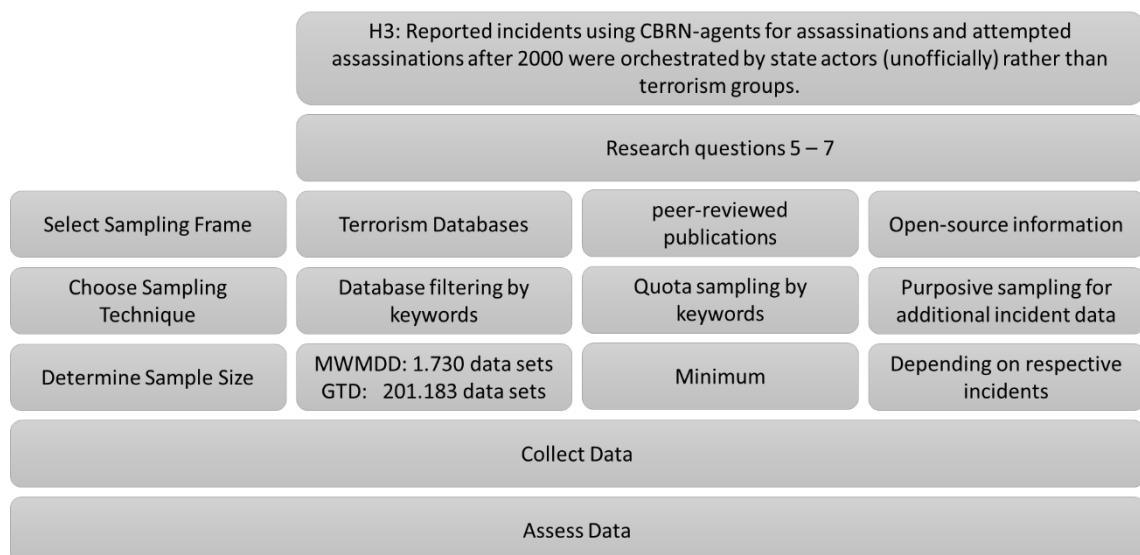


Figure 5: methodical approach for hypothesis 3 (compare TAHERDOOST 2016)

### 3.4. Method to propose fundamentals for a CBRN-risk analysis for assassination targets

To propose an approach for such a risk analysis the guidelines provided by ISO 31000:2018 (ISO 2018) were used as fundamentals. Based on the derived results from the postulated hypotheses, criteria are derived to categorize and compare specific information to support assessing the risk of an assassination threat using CBRN materials. A risk matrix is proposed which can be used to classify and compare targets/events at risk based on open-source information. Therefore, scenarios need to be established funnelling the probability assessment with data from inquests and research. The approach should be set up in a way, that required information can be provided by open-source intelligence.





## 4. Results

### 4.1. Hypothesis 1

As first hypothesis it is stated, that predictions regarding CBRN-terrorism, published from 1997 to 2007 did not occur. To validate this hypothesis, the following research questions are addressed:

*Are there peer-reviewed open-source publications available from this period, which give an outlook regarding the possible future occurrence of CBRN-terrorism incidents?*

*Did CBRN-terrorism incidents of the predicted type happen in the proposed timeframe and were reported?*

#### 4.1.1. Research Question 1

*Are there peer-reviewed open-source publications available from this period, which give an outlook regarding the possible future occurrence of CBRN-terrorism incidents?*

The search for relevant literature was done according to 3.1. Several publications were found, evaluated and the excerpted results are presented in Table 1.

There are no specific predictions for the occurrence of such incidents regarding type, quantity and location available in open-source literature. In most publications the threat is not quantified but set at a not negligible level with dramatic to catastrophic impact.

From a psychological aspect, the risk for WMD terrorism is believed to be increasing, when conventional attacks become routine. As long as “traditional” terrorism is perceived as threat by the people, there is no need to use complex WMD attacks (CAMERON 2000).

The challenge with predicting CBRN-terrorism is not only limited data, but also bias by experts and limits of understanding statistics (KOBLENTZ 2011). Some of these sources rely on surveys done with experts identified as such by the authors. Even though, they are all fundamentally skilled and experienced they may be prone to their own beliefs and limited in recognizing the big picture (LUGAR 2005, SMITHSON 2006). With keeping in mind that the Tokyo sarin attacks were so surprising to experts as well as intelligence services especially in complexity and magnitude, this particular event may have a decisive influence on all predictions and forecasts done in the observed period (CRELINSTEIN 1999).

Overall BIO is rated as more likely than any other CBRN type with NUC coming in second and a limited potential for CBRN-incidents is derived for the period from 2008 until 2013, further increasing between 2008 and 2018. These results are used for further investigation and comparison to the database entries in the next chapter.

Table 1: Open-source publications discovered according to 3.1, excerpted key info regarding predictions of CBRN-terrorism

CBRN-terrorism predictions		
Summary	Limitations	Reference
Low probability of WMD terrorism, but high impact recognized.		MERARI 1999
No effective employment of mass casualty attacks involving biological agents. Poisoning events (e.g. food poisoning) more likely than aerosolized distribution.	Focusing only on BIO	TUCKER 1999
CBRN terrorism cannot be predicted at this point and other assumptions are treated as fear based.	WMD deductions based mainly on Tokyo sarin attacks	CRELINSTEN 1999
Minimal risk for chemical and biological attacks, significantly lower than for conventional terror attacks.	Only for USA	CAMERON 2000
Technological proliferation as key for WMD terrorism. Complexity too high for most perpetrators.		JACKSON 2001
The risk for a WMD terrorism event before 2010 is substantial. The risk doubles until 2015. Chemical and biological attacks slightly more likely than nuclear ones.	Based on a survey	LUGAR 2005
The risk for a biological WMD terrorist attack is higher than a nuclear one.	Based on a survey	SMITHSON 2006
Risk estimation model for terrorist attacks. Minimal risk for the use of CBRN agents by Al Qaida (10 %) and negligible risk for other groups (0 %).	Only for 2004	WILLIS et al. 2006
Increasing casualty numbers resulting from conventional terrorism, not from CBRN/WMD terrorism. Proliferation of technology as main driver for future CBRN/WMD risk		LIA 2007
A WMD terrorism event somewhere in the world is more likely than not, before 2013. Biological agents pose greater threat than nuclear.	Focusing only on BIO and NUC	GRAHAM et al. 2008

#### 4.1.2. Research Question 2

*Did CBRN-terrorism incidents of the predicted type happen in the proposed timeframe and were reported?*

Derived from the findings of research question 1, there is a given risk for CBRN/WMD terrorism event between 2008 and 2018. The results from combing through both databases for the respective period are displayed in Table 2 and Table 3 as well as Figure 6 and Figure 7.

Even tough BIO events were ranked higher in all the reviewed literature not a single event with the actual use of biological hazardous materials has been entered in the MWMDD. In total 14 events were reported in the MWMDD, 13 chemical and one radiological. With overall 121 injured and no fatalities counted for the five years covered in the MWMDD, at least for that period, no large impact CBRN-terrorism is observed.

For the GTD covering the period from 2008-2019 only chemical incidents were reported factoring in success. In the same interval just six biological scenarios were entered in the GTD, none of them successful. Especially after 2011 the reported number of incidents as well as affected people, either wounded or killed, increased significantly.

These events can mainly be attributed to attacks in warzones (e.g. Syria) which don't directly affect any terroristic CBRN-threat for the US or Europe. However, for terrorism groups operating in such warzones the threshold to acquire knowledge and raw materials may be far lower than if such conflicts were already resolved and somewhat functioning states in place, heeding international laws. Proliferation policies like the BWC or the CWC can only function if they are implemented by the government and applied by the regulatory bodies and security services.

Furthermore, especially regimes hostile to western countries could act as supplier for both know-how and precursors to achieve their agenda. By international isolation, these countries may have to turn to other partners to be able to develop. Even tough nuclear proliferation in such cases is estimated as unlikely, this may not be true for CHEM and BIO (ICHIMASA et al. 2014, MARTIN 2016).

Based on the evaluated data, this research question can be answered quite simply with no. No incidents were of the prognosed type or scope have been reported. Due to the changing political landscape after the "Arab spring" CBRN-terrorism shifted to chemical attacks combined with explosives or artillery in countries with civil war or general instability.

*Table 2: Reported incidents with actual use or release of CBRN agents extracted from the MWMDD*

MWMDD						
Year	Total	Total Wounded	Total Killed	BIO	CHEM	RAD
2008	8	22	0	0	8	0
2009	2	2	0	0	1	1
2010	4	97	0	0	4	0
2011	0	0	0	0	0	0
2012	0	0	0	0	0	0

*Table 3: Reported incidents with actual use or release of CBRN agents extracted from the GTD*

GTD						
Year	Total	Total Wounded	Total Killed	BIO	CHEM	RAD
2008	5	83	5	0	5	0
2009	7	265	1	0	7	0
2010	7	155	0	0	7	0
2011	1	1	0	0	1	0
2012	13	1179	1	0	13	0
2013	12	718	27	0	12	0
2014	14	131	58	0	14	0
2015	21	617	11	0	21	0
2016	31	2164	41	0	31	0
2017	27	624	50	0	27	0
2018	10	397	1	0	10	0
2019	8	45	5	0	8	0

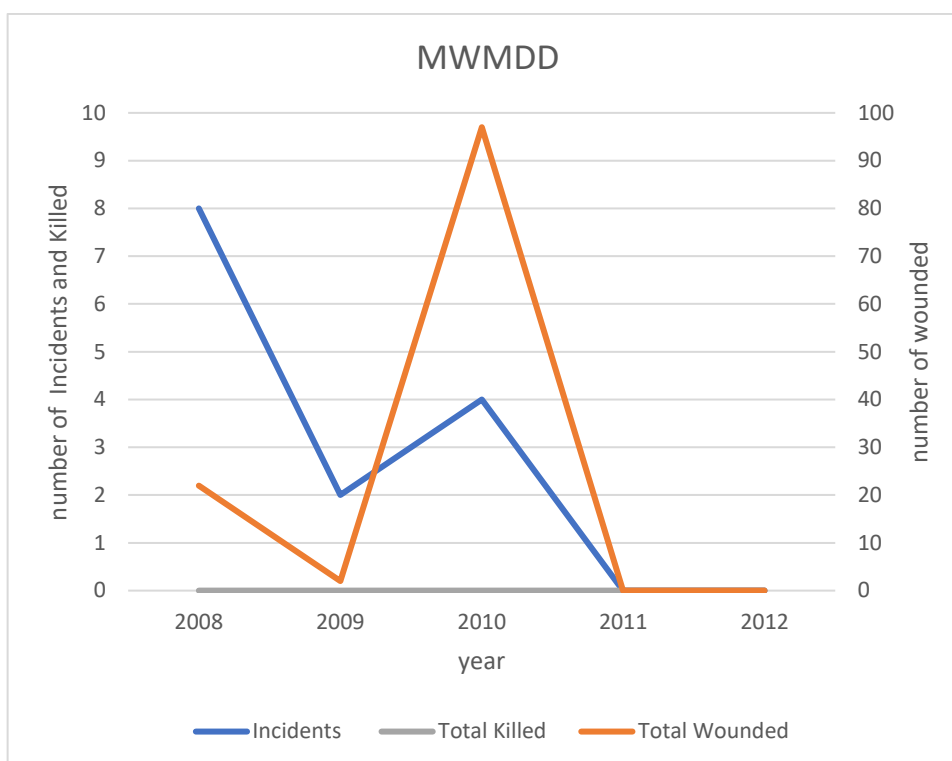


Figure 6: Reported incidents with actual use or release of CBRN agents extracted from the MWMDD

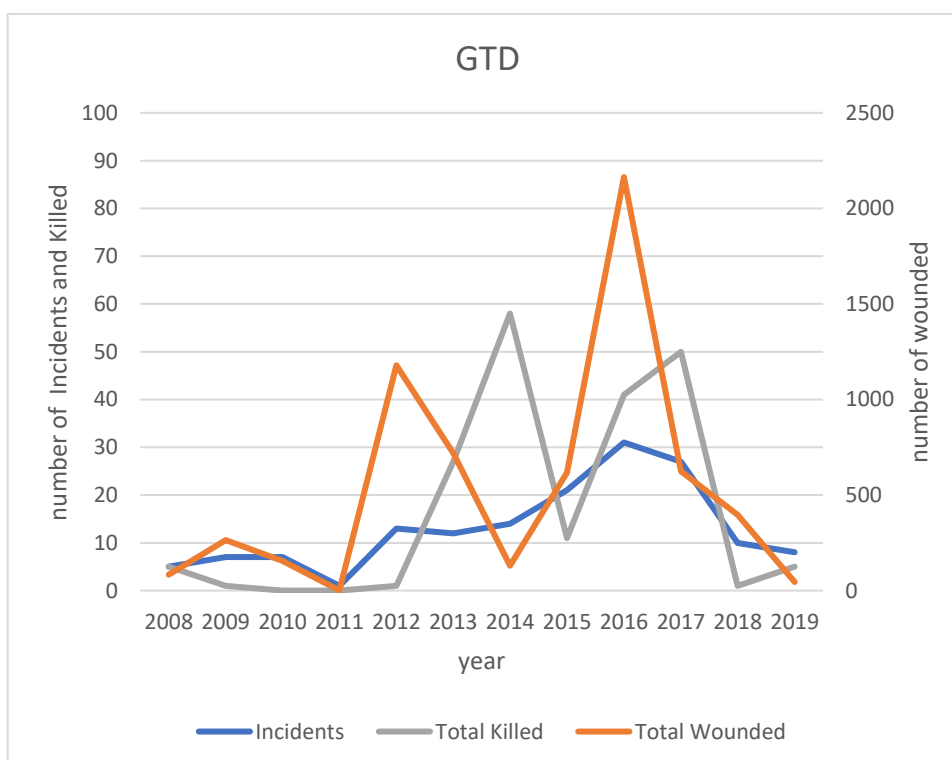


Figure 7: Reported incidents with actual use or release of CBRN agents extracted from the GTD

## 4.2. Hypothesis 2

As second hypothesis it is stated, that the general conditions for CBRN-terror attacks are better now than before 2000. To validate this hypothesis, the following two research questions, with one sub-question, are addressed:

*Did the number of reported CBRN-terrorism incidents between 2000 to 2019 increase compared to between 1980 to 2000?*

*Did the complexity of reported CBRN-terrorism incidents between 2000 to 2019 increase compared to between 1980 to 2000?*

*How effectively were the CBRN-agents used, comparing the agent and the number of affected (killed or injured) people?*

#### 4.2.1. Research Question 3

*Did the number of reported CBRN-terrorism incidents between 2000 to 2019 increase compared to between 1980 to 2000?*

To answer this research question, the GTD and MWMDD were both filtered and evaluated for the respective timeframe.

For the MWMDD 493 were reported prior 2000 and 1189 after compared to 90 and 268 for the GTD. This corresponds to an increase of +141 % and + 198 % respectively. The compiled numbers for total incidents and further breakdown in CBRN type are displayed in Table 4 and more detail in Figure 8 and for classification into actual use and threat in Table 5 and Figure 9.

The large difference in absolute numbers between the MWMDD and the GTD can be explained mainly by the limitation of the GTD to filter out threats and unknown incidents. Especially the Anthrax incidents after 9/11 in 2001 and 2002 which were mostly threats and hoaxes contributed to the MWMDD numbers (see Figure 8).

Breaking these numbers further down the only decrease was observed for incidents with actual used CBRN substances for the MWMDD. Compared to the GTD which shows an increase in 267 %, this can be explained by the shorter period of the MWMDD ending in 2012. Especially all Arabic spring related incidents (e.g. Syria) are therefore not part of the MWMDD.

So, the research question can be answered with yes. Derived from both databases, the incidents more than doubled to almost tripled after 2000.



*Table 4: Total number of CBRN incidents in the periods from 1980-1999 and 2000-2012/19 extracted from the MWMDD and the GTD, further distinguished in the type of CBRN material involved, with increase expressed in percentage*

	MWMDD			GTD		
	1980-1999	2000-2012	Increase [%]	1980-1999	2000-2019	Increase [%]
BIO	174	649	273	8	28	250
CHEM	254	266	5	81	230	184
COMBINATION	10	21	110			
RN	27	105	289	1	10	900
UNK/NA	28	148	429			
TOTAL	493	1189	141	90	268	198

*Table 5: Total number of CBRN incidents in the periods from 1980-1999 and 2000-2012/19 extracted from the MWMDD and the GTD, further distinguished in incidents where a CBRN substance was actually used (USE) or the only threatened to be used (THREAT), with increase expressed in percentage*

	MWMDD			GTD		
	1980-1999	2000-2012	Increase [%]	1980-1999	2000-2019	Increase [%]
USE	166	157	-5	54	198	267
THREAT	327	1032	216	36	70	94
TOTAL	493	1189	141	90	268	198

## Assessing the risk of assassinations utilizing CBRN-materials - a conceptual approach

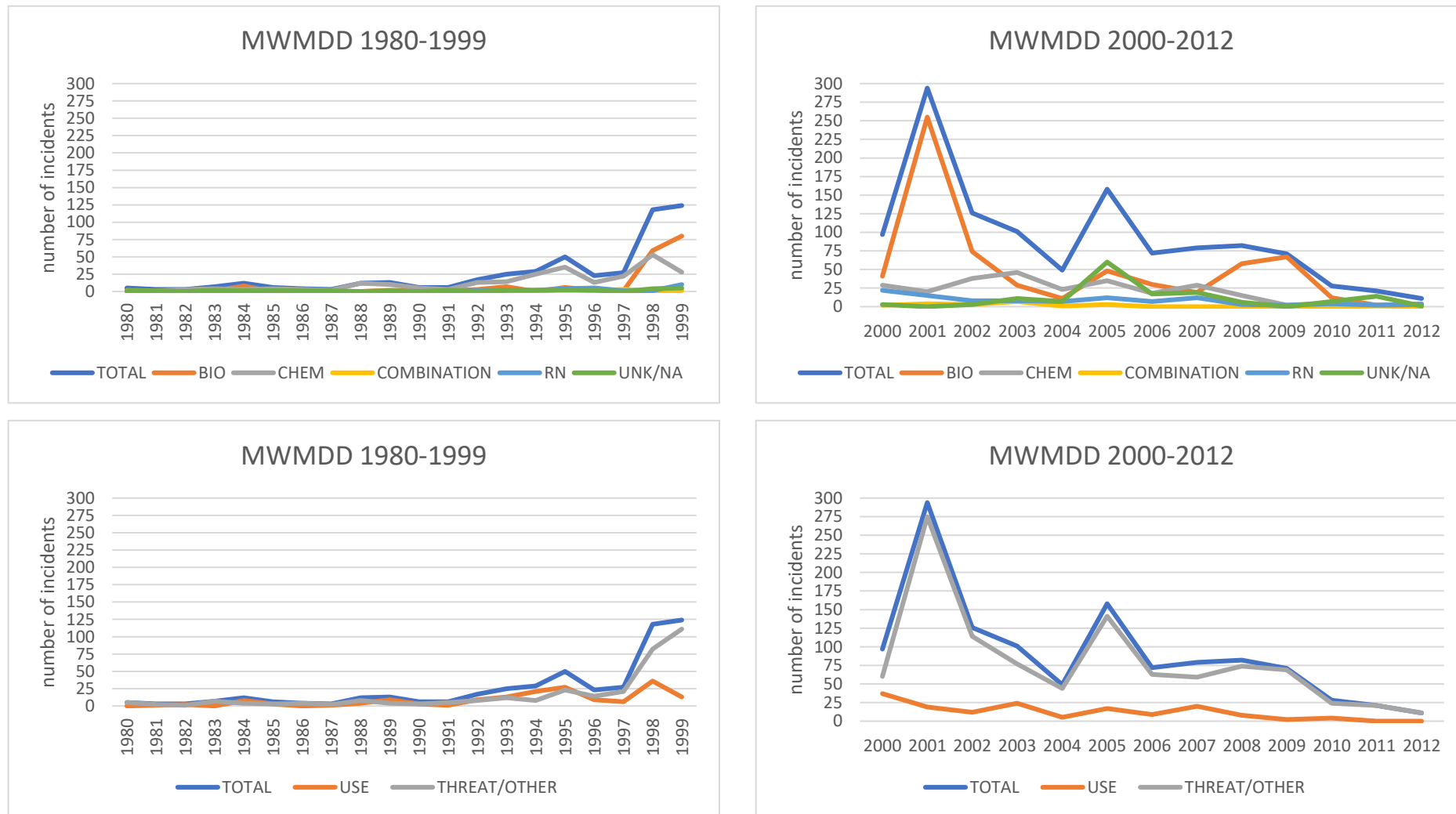


Figure 8: CBRN incidents in the periods from 1980-1999 and 2000-2012 extracted from the MWMDD, further distinguished in incidents where a CBRN substance was actually used (USE) or the only threatened to be used (THREAT)

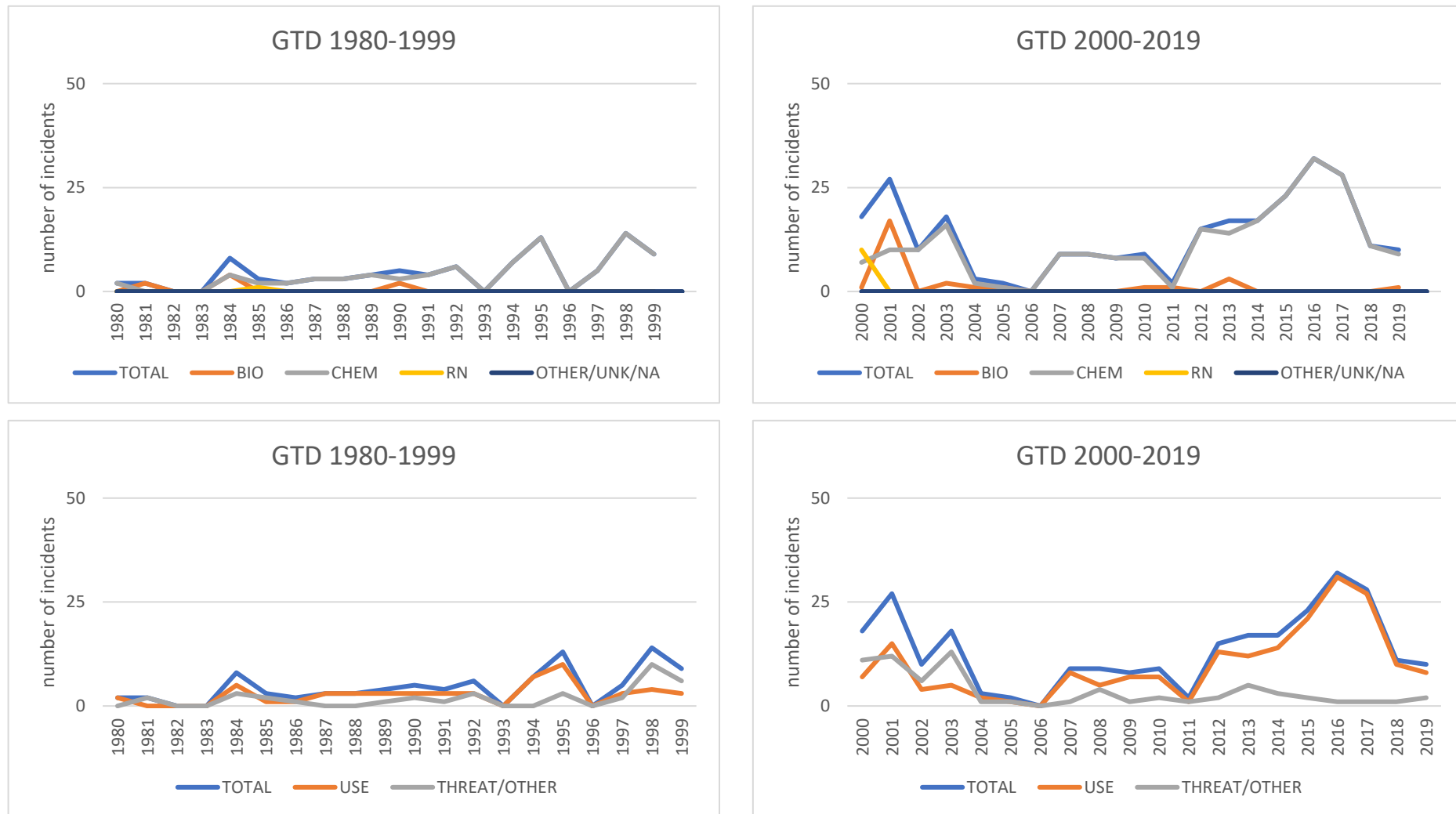


Figure 9: CBRN incidents in the periods from 1980-1999 and 2000-2019 extracted from the GTD, further distinguished in incidents where a CBRN substance was actually used (USE) or the only threatened to be used (THREAT)

#### 4.2.2. Research question 4

*Did the complexity of reported CBRN-terrorism incidents between 2000 to 2019 increase compared to between 1980 to 2000?*

This research question will be addressed by answering the following sub question.

*How effectively were the CBRN-agents used, comparing the agent and the number of affected (killed or injured) people?*

To answer this research question, the GTD and MWMDD were both filtered and evaluated for the respective timeframe.

The computed data is shown in Table 6. This clearly can be attributed to easier access to precursor materials and knowledge. As already discussed in the previous chapter the developments after the Arab spring are mainly responsible for this massive increase in chemical terrorism (Pita und Domingo 2014).

To further review these events the GTD was analyzed also in the column "region\_txt". The results are displayed in Table 7. More than 83 percent of all successful incidents recorded from 2011 on were happening Middle East, North Africa and South Asia. 75 percent of all killed persons as well as more than 91 percent of wounded persons are related to those regions as well. Most of the addressed incidents were involving poisonous or toxic gas combined with artillery or explosives.

Compared to that, except for the Sub-Saharan Africa region, no attacks involving gas attacks were reported in any other part of the world. However, the use of such gas attacks in South Asia and Sub-Saharan Africa in my opinion are already proof for ongoing proliferation of at least knowledge on CBRN-terrorism.

The comprehensive dataset for the MWMDD and the GTD are displayed in Table 8 and Table 9, respectively.

"Success rate", "Killed per incident", "Wounded per incident" and "Incidents involving explosives" have been calculated by dividing the respective numbers by the "Total number of incidents".

To assess the term "increased complexity" the following factors are considered:

- An increased success rate is a more effective use of CBRN-material
- A higher number of killed and wounded per incident is an indicator for better planning capabilities and access to knowledge about dissemination
- Delivering a CBRN-material with explosives is of higher complexity than simple release
- Use of actual chemical warfare agents is more complex than utilizing common chemical hazardous substances and requires either access to CWA or the capability for synthesis and access to respective precursor materials

Success rate is derived from the parameter “success” from the GTD and “event (use of agent)” from the MWMDD. Looking at the data from the GTD with a success rate of 57 % between 1980 and 1999 the effectiveness of CBRN terrorism acts has already been high. However, from 2000 until 2019 the success rate increased to 72 %. Using the dataset acquired from MWMDD with 36 % the observed success rate is considerably lower and decreased after 2000 to merely 12 %. This can be explained by the increased number of threats/hoaxes after 9/11 in consequence to the Anthrax letters. In 2011 and 2012 a significant increase can be observed (see Figure 1). Reasons may have been heightened public awareness to white powdered substances or subversive elements realizing how to keep responders busy with simple hoaxes.

The difference between GTD and MWMDD is due to the second main issue already addressed in 5.1.

Looking at the people killed by CBRN attacks the absolute number more than doubles for the GTD as well as MWMDD. However, normalizing the fatalities to the number of incidents a significant decrease is observed for the GTD with an almost even result for the MWMDD.

Comparing the number of wounded people, the decrease is massive for both databases. This is mainly due to the Tokyo sarin attack which contributes three quarters of the wounded for the earlier period in the GTD. For the MWMDD this attack only adds about one fifth to the numbers of wounded between 1980 and 1999. However, since the MWMDD stops recording data in 2012 the toll of injuries and fatalities from CBRN-attacks after the Arab spring is not documented.

When focusing on documented incidents where explosives are involved in concert with CBRN-agents, the MWMDD reports a decrease by 30 % whereas the GTD shows an increase of more than 800 %. Again, the limited observation time interval of only 12 years after 2000 for the MWMDD is deemed the reason for that.

For incidents where actual CWAs were used, the number of such attacks is increased by a factor of 2,5 and a factor of 3,5 for the GTD and MWMDD respectively. This clearly can be attributed to easier access to precursor materials and knowledge. As already discussed in the previous chapter the developments after the Arab spring are mainly responsible for this massive increase in chemical terrorism (PITA UND DOMINGO 2014).

Table 6: Parameters "total number of incidents", "success rate", killed per incident", "wounded per incident", "incidents involving explosives" and "incidents involving CWA" for CBRN incidents in the periods from 1980-1999 and 2000-2012/19 extracted from the MWMDD and the GTD

	MWMDD		GTD	
	1980-1999	2000-2012	1980-1999	2000-2019
Incidents	493	1189	90	268
"Successful" use of CBRN materials	176	157	51	193
Success [%]	36	13	57	72
Killed	496	1160	172	410
Killed [per incident]	1,01	0,98	1,91	1,53
Wounded	6417	2352	8093	6999
Wounded [per incident]	13	2	90	26
Incidents involving explosives	44	68	3	67
Incidents involving explosives [%]	9	6	3	25
Incidents involving CWA	22	74	4	10

Table 7: Regional distribution of reported successful CBRN incidents in the period from 2011-2019 extracted from the GTD (region classification according to the GTD)

Region	GTD			
	Incidents	Killed	Wounded	Main application
East Asia	1	0	2	spraying hazardous materials
Eastern Europe	3	1	2	spraying hazardous materials
Middle East & North Africa	57	133	2160	rockets/mortars with chemical gas
North America	7	0	48	spraying hazardous materials
South America	3	1	9	homemade bomb
South Asia	57	20	3233	poison/toxic gas
Southeast Asia	2	0	1	homemade bomb
Sub-Saharan Africa	6	49	419	poison/toxic gas
Western Europe	1	0	2	acid

## Assessing the risk of assassinations utilizing CBRN-materials - a conceptual approach

Table 8: CBRN incidents divided in substance subgroups in the periods from 1980-1999 and 2000-2012 extracted from the MWMDD, further distinguished in delivery method (assassination, bombing/explosives and other), success rate and number of killed and wounded people

Substance/ Group	MWMDD													
	1980-1999							2000-2012						
	Incidents	Assassinations	Bombing/ explosive	Other	Success rate	Killed	Wounded	Incidents	Assassinations	Bombing/ explosive	Other	Success rate	Killed	Wounded
Acid	40	0	1	39	37	4	56	18	0	6	12	13	1	26
Anthrax	143	3	5	135	5	0	0	610	0	16	594	10	5	22
CWA	22	2	1	19	8	20	1187	74	0	10	64	27	243	520
Cyanide	58	5	5	48	25	149	122	73	3	11	59	15	669	178
Gas	11	0	6	5	10	0	17	1	0	0	1	0	0	0
Other chemicals	17	7	3	7	16	25	1543	80	3	5	72		203	1116
Pesticides	11	0	0	11	10	21	140	6	0	1	5	4	7	11
Poisoning	29	1	2	26	12	7	63	9	0	0	9	6	14	285
Radiological	30	1	0	29	2	0	0	103	2	13	88	17	2	75
Riot Control Agents	1	0	0	1	0	65	0	5	0	0	5	4	0	36
Salmonella	5	0	0	5	1	0	776	4	0	0	4	2	2	60
Toxins	24	6	5	13	6	0	2	40	6	0	34	4	0	1
Unknown chemicals	102	5	16	81	37	205	2511	166	2	6	158	5	14	22
Total	493	30	44	419	169	496	6417	1189	16	68	1105	107	1160	2352

## Assessing the risk of assassinations utilizing CBRN-materials - a conceptual approach

*Table 9: CBRN incidents divided in substance subgroups in the periods from 1980-1999 and 2000-2019 extracted from the GTD, further distinguished in delivery method (assassination, bombing/explosives and other), success rate and number of killed and wounded people*

Substance/ Group	GTD													
	1980-1999							2000-2019						
	incidents	Assassinations	Bombing/ explosive	Other	Success rate	Killed	Wounded	incidents	Assassinations	Bombing/ explosive	Other	Success rate	Killed	Wounded
Acid	9	2	1	6	7	6	10	41	1	7	33	36	31	198
Anthrax	2	0	0	2	0	0	0	17	0	0	17	9	5	27
CWA	4	1	0	3	3	21	6000	10	0	10	0	10	28	1665
Cyanide	14	0	0	14	4	17	55	11	0	1	10	2	5	6
Gas	13	1	0	12	9	25	747	71	0	40	31	63	51	1715
Other chemicals	8	0	2	6	4	2	67	6	0	3	3	4	2	7
Pesticides	5	0	0	5	0	0	0	2	0	0	2	2	7	47
Poisoning	7	4	0	3	5	32	140	62	3	5	54	47	56	3152
Radiological	1	0	0	1	0	0	0	10	0	0	10	0	0	0
Riot Control Agents	16	0	0	16	15	69	146	16	1	0	15	9	0	62
Salmonella	4	0	0	4	3	0	778	1	0	0	1	1	2	0
Toxins	2	0	0	2	0	0	0	8	0	0	8	0	0	0
Unknown chemicals	5	0	0	5	1	0	150	13	0	1	12	10	223	120
Total	90	8	3	79	51	172	8093	268	5	67	196	193	410	6999



Three of the four considered criteria for complexity are explicitly pointing to more complex CBRN-attacks after the year 2000. Even though most successful reported incidents were happening in North Africa, the Middle East, the large number of incidents in South Asia and the emerging number of events in Sub-Saharan Africa, are examples for the distribution of knowledge in terror organizations.

With only the relative number of killed and wounded decreasing, but absolute counts rising this research question is answered with yes. The complexity of reported CBRN-terrorism incidents between 2000 to 2019 increased compared to between 1980 to 2000.

### 4.3.Hypothesis 3

As third hypothesis it is stated, that reported incidents using CBRN-agents for assassinations and attempted assassinations after 2000 were orchestrated by state actors (unofficially) rather than terrorism groups. To validate this hypothesis, the following research questions are addressed:

*How many assassinations/attempts with CBRN-agents after 2000 were reported?*

*How many of these assassinations/attempts were claimed by or attributed to terrorism groups?*

*Which materials were used in these assassinations/attempts and how were they delivered?*

To answer these research questions, the GTD and MWMDD were both filtered and evaluated for the information. Furthermore, open source recherche using google search engine was used to inquire about such incidents/attempts. Based on the google search results further information was gathered using google scholar with incident specific queries.

#### 4.3.1. Research question 5

*How many assassinations/attempts with CBRN-agents after 2000 were reported?*

Beginning from 1980, 19 assassinations or assassination attempts were reported in the MWMDD with eleven after 2000 and 13 in the GTD with only four after 2000.

From the 11 incidents reported in the MWMDD only two were actual use of agent resulting in the death of Alexander Litvinenko which was poisoned two times with Polonium-210. The other were either plots, threats or possession incidents.

The four incidents recorded in the GTD were all chemical attacks targeting one political leader, one relative of a former politician, one journalist and one informant. The attempt on the political leader was carried out using acid and lead to three wounded but no fatalities. The other three attacks were successful using poison and all resulting in the death of the target.

The compiled data is displayed in Table 10 for the MWMDD and Table 11 for the GTD.

However, in the last 20 years several incidents made the main stream media news and triggered journalistic as well as criminal and intelligence investigations and, in some cases, also political implications. These events are:

- The polonium-210 poisoning of Alexander Litvinenko in 2006 in London (HARRISON et al. 2017)
- The VX attack on Kim Jong-Nam in 2017 in Kuala Lumpur (NAKAGAWA UND TU 2018, TU 2020)
- The novichok attack on Sergei Skripal in 2018 in Salisbury (CHAI, HAYES, ERICKSON UND BOYER 2018, VALE, MARRS UND MAYNARD 2018)
- The novichok attack on Alexei Navalny in 2020 (BOLT UND HENGSTLER 2022, MASTERSON 2020)

Due to the limited timeframe of the MWMDD ending in 2012 only the Litvinenko incident can be and is indeed part of this database. The Litvinenko case as the other three attacks is not included in the GTD, whereas the Navalny incident also is out of frame of the GTD.

As to why this incident is added in the MWMDD but not in the GTD can be explained by the rumored involvement of national intelligence services. Mr. Litvinenko claimed that his death was ordered by Vladimir Putin's regime, however no official charges have been made and therefore the incidents remain non-state acting for the classifiers of the MWMDD but not the GTD.

Details on the three incidents, not included in the databases are summarized in Table 12.

## Assessing the risk of assassinations utilizing CBRN-materials - a conceptual approach

Table 10: Reported CBRN-assassination incidents, extracted from the MWMDD beginning with the year 2000, further subdivided in region, incident kind, target, attacking organization and success.

MWMDD					
Year	Region	Incident	Target	Attacker	Success
2000	North America	Toxin possession	Unknown	Unknown	No
2003	South Asia	Cyanide possession	Unknown	Jaish-e-Muhammad	No
2003	Middle East & North Africa	Plot, unknown	Nuclear facility	Al-Qaida	No
2004	Middle East & North Africa	Plot with Virus	Unknown	al-Aqsa Martyrs Brigades	No
2004	Middle East & North Africa	Threat with chemical	Intelligence services	Kata'ib al-Tawhid	No
2005	Russia	Threat with cyanide	Water reservoir	Amanat	No
2006	Europe	Polonium poisoning	Ex-FSB agent	Unknown	Yes
2006	Europe	Polonium poisoning	Ex-FSB agent	Unknown	Yes
2011	South Asia	Threat, unknown	Political defector	Unknown	No
2012	Europe	Attempted toxin acquisition	Unknown	Unknown	No
2012	North America	Toxin threat	Police/government	Unknown	No

Table 11: Reported CBRN-assassination incidents, extracted from the GTD beginning with the year 2000, further subdivided in region, incident kind, target, attacking organization and success.

GTD					
Year	Region	Incident	Target	Attacker	Success
2003	South Asia	Poisoning by injection	Possible police informer	Unknown	Yes
2003	South Asia	Poisoning by injection	Relative to politician	Unknown	Yes
2015	South Asia	Acid attack	Political leader	Unknown	No
2016	Middle East & North Africa	Poisoning	Journalist	Houthi extremists	Yes

Table 12: Reported CBRN-assassination incidents, not attributed to terrorism and therefore included neither in the MWMDD nor the GTD

Other sources						
Year	Region	Incident	Target	Attacker	Success	Source
2017	Europe	VX poisoning	Relative to political leader	Unknown	Yes	NAKAGAWA UND TU 2018, TU 2020
2018	Europe	Novichok poisoning	Double agent	Unknown	No	CHAI, HAYES, ERICKSON UND BOYER 2018, VALE, MARRS UND MAYNARD 2018
2020	Russia	Novichok poisoning	Dissident	unknown	No	BOLT UND HENGSTLER 2022, MASTERSON 2020

### 1.5.1. Research question 6

*How many of these assassinations/attempts were claimed by or attributed to terrorism groups?*

Of the four high-visibility CBRN (attempted) assassination events, three are clearly perceived as state funded rather than originating from terrorism. The assassination of Kim Jong-Nam was linked to the North Korean regime, the attempts on Mr. Skripal and Mr. Navalny to the Russian government. The perpetrators for the poisoning of Mr. Litvinenko have never been clearly linked to one or the other.

Information discussed in this chapter is displayed in Table 10 for the MWMDD and Table 11 for the GTD.

Of the events recorded in the MWMDD and the GTD most of the actors are unknown. Terror groups are as likely to be the culprits as intelligence organisations or regime-controlled kill squads.

The five events from the MWMDD which are linked to a terror organisation were all unsuccessful. Only the poisoning of a journalist in Yemen in 2017 was recorded as successful CBRN-assassination attempt and linked to Houthi-extremists.

Again, the complexity of CBRN-materials may be limiting its usefulness for CBRN-terrorism. With state/regime funded intelligence, access to equipment and sufficient preparation time, some successful assassinations reportedly have been carried out.

It is my belief, that CBRN-terrorism at this time is used more often for targeting large groups, mostly civilian to spread fear and panic. At the same time, at least two governments, Russia and North Korea, have been involved in three targeted (attempted) killings utilizing chemical warfare agents in the last 5 years. The use of agent has been verified for all these cases.

#### 4.3.2. Research question 7

*Which materials were used in these assassinations/attempts and how where they delivered?*

To answer this research question, the cases of Mr. Litvinenko, Kim Jong-Nam, Mr. Skripal and Mr. Navalny are reviewed.

*The polonium-210 poisoning of Alexander Litvinenko* (HARRISON, FELL, LEGGETT, LLOYD, PUNCHER UND YOUNGMAN 2017, MONTEREY 2013)

Alexander Litvinenko was a former officer of the Russian FSB. On November 1<sup>st</sup> 2006 he was admitted to a hospital because he felt ill. He was diagnosed to have suffered from radiation poisoning very quickly. Testing is Urine led to the conclusion that he was poisoned with the radioactive isotope Polonium-210 (Po-210). During his hospital admission Mr. Litvinenko repeatedly claimed, that the Russian government was responsible for his poisoning.

Since Po-210 is an alpha radiation emitter, it poses serious health risks only when ingested. Only the fraction of 1 gram of Po-210 is enough to induce fatal effects, like irreparable cell damage and DNA mutation. Investigations by international police forces found traces of Po-210 at 27 sites, including Mr. Litvinenko's personal car.

Initially it has been believed, that Mr. Litvinenko has been poisoned twice. However, in 2007 British prosecution named Andrei Lugovoy, a former FSB agent and Dmitry Kovtun, a former Soviet soldier as culprits even though other persons were investigated and tested positive for Po-210 exposure. Those two Russians met with Mr. Litvinenko for cocktails at the Millennium Hotel in London. The poisoning most likely occurred by dosing Mr. Litvinenko's drinks.

Unfortunately, the small amount of Po-210 was not enough to use trace forensic techniques to attribute the Po-210 to a specific source.

*The VX attack on Kim Jong-Nam* (NAKAGAWA UND TU 2018, TU 2020)

Kim Jong-Nam was the older brother of North Korean leader Kim Jong-Un. He suddenly died when staying at the airport in Kuala Lumpur during traveling on February 13<sup>th</sup> 2007. Two women, one Indonesian and one Vietnamese, were scratching/rubbing something in his face in a short interval only some seconds apart. Kim Jong-Nam died somewhat 20 minutes after the encounter with those women.

The substance used in this attack was later identified by the Malaysian security services as VX. The application was performed by using precursors for binary VX. This means, that at least one possible chemical synthesis path of VX is completed by only mixing two substances in the last step to generate VX. Both women applying the chemicals survived because either one of them was exposed to only one less toxic substance, with more severe symptoms for the second women because by applying she started the VX generation. Luckily VX is such a low volatility that no one else at the airport was hurt. By applying the liquid VX directly to his face, optimal uptake was achieved since the skin is highly transmissible for VX.

Both women were caught and charged, but they were only tasked to deliver the substance, not even knowing what they were actually doing.

Investigations concluded, that it was not the usual binary system known developed by the US but a different approach using different chemicals.

*The novichok attack on Sergei Skripal* (CHAI, HAYES, ERICKSON UND BOYER 2018, VALE, MARRS UND MAYNARD 2018)

Sergei Skripal was a former Russian military intelligence officer. On March 4<sup>th</sup> 2018, he collapsed in a park in Salisbury together with his daughter Yulia Skripal. They were admitted to a hospital and immediately treated for nerve agent poisoning. After a few days, the use of a chemical warfare agent of the novichok group was reported. The results were later on confirmed by the organization for the prohibition of chemical weapons (OPCW).

The Skripals both survived, with Yulia Skripal being able to appear in a television interview. Sergei Skripal lives but his physiological and psychological state remains unknown to the public. British defense scientists found novichok agent on the doorknob of Sergei Skripals house. When opening the door, he was exposed by direct contact (TALUKDER 2021). Some novichok substances are believed to be even more toxic than VX and the survival to of the Skripals remains unclear.

In my opinion Sergei Skripal opened the door thereby absorbing most of the agents himself, leaving only a lesser amount for his daughter to be exposed to. They may have been wearing gloves and/or washing hands after coming home, all measures to reduce the amount of agent directly in the skin.

Still, one victim has been reported connected to this incident. Dawn Sturgess died after spraying the contents of supposed perfume bottle on her wrists, her husband found discarded in Amesbury, a neighboring town to Salisbury. The vial, however, contained nerve agent, most likely from the attack on the Skripals (LOYOLA 2019). An innocent bystander with no relation to the targets at all became the only casualty.

This case has been the first ever documented case of using novichok. For a long time only theoretical knowledge on these agent groups, supposedly consisting of more than 100 different variants, has been published. Only a very distinguished intelligence crowd had access to the formula and means to orchestrate such an attack.



*The novichok attack on Alexei Navalny* (BOLT UND HENGSTLER 2022, MASTERSON 2020)

Alexei Navalny is a dissident and in direct political opposition to Russian president Vladimir Putin. He was poisoned on the 20<sup>th</sup> of August in 2020 and became symptomatic during a domestic flight in Russia. He was transferred to a hospital in Omsk, Russia after an emergency landing and treated for intoxication. Two days later he was transferred to the medical university hospital Charité in Berlin. The German government reported Novichok as the agent, which was confirmed later by the OPCW (STIGLER et al. 2022).

The details of how the poisoning occurred remain sketchy since the incident happened in Russia and the Russian government is believed to be responsible. One theory is that his drinking bottle was contaminated with novichok on the outside. Another belief is, that novichok was in a drinking bottle but modified to an extent, that the intoxication sets in only delayed. A third idea suggests that since Mr. Navalny was poisoned during swimming in the Tom river in Kaftanchikovo on the 19<sup>th</sup> of August. Some investigator favor viper poisoning whereas other theories consider novichok application to his underwear (HRI 2020).



## 5. Discussion

### 5.1. Database limitations

The GTD and the MWMDD are both dedicated to open source information on terrorism acts. However, subsequent discussion will show major discrepancies in absolute numbers and comparisons. This paragraph will address these issues and will be referenced in the following chapters accordingly.

One main difference is the period of data acquisition which is still ongoing for the GTD but has been stopped for the MWMDD in 2012. Therefore, especially for the period of 2000 until 2019 the MWMDD is providing only incomplete results. The version of the GTD available to the author at the time of finalizing this work ends at December 31st 2019.

The second main difference is the focus. The GTD involves all terroristic events also without any CBRN involvement whereas the MWMDD is only focused on CBRN-events. Consequently, the MWMDD has a lot of entries in the incident type sub categories “unknown” or “not available” which still relate to CBRN-incidents, because that’s the reason they are in the database at all. Comparable filters are not available for the GTD because such categorized incidents would predominantly involve non CBRN-related incidents and no structured way was found to overcome this limitation without introducing even more bias.

Looking at the codebooks of these databases the entry and description criteria are different which can lead to limited comparison options. Exemplary, the MWMDD gives information for the classification of assassination only in the summary section, whereas the GTD incorporates a dedicated code (attacktype1\_txt). Another example is the Tokyo Sarin attack from 1995 which documents 5500 injured people in the GTD and 1039 injured people in the MWMDD. The GTD’s codebook is available online (START-CODEBOOK 2021), whereas the MWMDDs is added to this work in annex 11.1.

## 5.2. Hypothesis 1

*Predictions regarding CBRN-terrorism, published from 1997 to 2007 did not occur.*

CBRN-terrorism developed differently than predicted. Although biological terrorism was favoured in most publications and expert opinions, especially after 2011 mainly chemical attacks were reported. These however occurred more often than other in war like situations.

Several aspects could be responsible for this development:

For one, the predictions could just be flawed. Founding the assessment on unverified models, biased expert opinions or trusting too much in statistics may be a reason for predictions not occurring. As already addressed in the corresponding results chapter the available hard data on CBRN-terrorism is somewhat fragmentary and non-exhaustive.

Another possibility could be, that the countermeasures implemented after the Tokyo sarin attacks and 9/11 may have been more effective than anticipated. The threshold level for terror organisations to get access to and deploy WMD is already quite high. With further strengthening security response, proliferation policies (KIBAROĞLU 2021) as well as information gathering and monitoring focused on CBRN it may have become even harder for state opposing forces to achieve CBRN/WMD means. To establish CBRN capabilities within first responders, one major lessons identified from the Tokyo sarin attacks, several programs were implemented to issue chemical, biological and radiological detection and decontamination equipment to civilian forces like police, fire fighters or emergency services all over the world (AYTAÇ UND KIBAROĞLU 2009, CARTER 2004, KATONA et al. 2006, LESSER et al. 1999, SIEGRIST UND GRAHAM 1999, STEINHAUSLER 2015).

Successfully predicting such events is next to impossible. The release of a chemical warfare agents in the subway of a capital city was not imaginable before the Tokyo attacks. Using planes to attack skyscrapers was unheard of before 9/11. When Kim Jong-Nam was killed using VX on a public airport and just one year later, the fabled Novichok agents were released in Salisbury, nobody was the wiser. For an organization, which can overcome the hurdles of acquiring CBRN-agents and the know-how to successfully release them, inventing new ways to deploy them seems reasonable. Even though some of these developments may have had been part of a risk analysis in intelligence services, they were deemed as highly unlikely.

As usual in risk management, not all risks can be mitigated because there simply is not enough money, time or personnel available. Risk with very low probability therefore tend to be ignored. Contrary, terror organizations, especially those capable of deploying CBRN-agents, may be prone to use that aspect to focus on new, unknown or unlikely ways to deliver such attacks.

Thereby, when trying to assess CBRN-threats, there is the need to always prepare for the unexpected.

Based on the extracted data and the discussed arguments, the first hypothesis is validated to be true: The predictions regarding CBRN-terrorism, published from 1997 to 2007 did not occur.

### 5.3. Hypothesis 2

*General conditions for CBRN-terror attacks are better now than before 2000.*

The number of CBRN-terrorism events increased significantly after 2000, compared to the 20 years before. By evaluating both databases, it could be shown, that the use of chemical warfare agents as well as their combination with more complex delivery methods is much higher in the comparison period.

There is no option to extract such information from the databases, but in my opinion, due to the Arab spring CBRN-materials as well as their precursors are more accessible than before. With failing regimes/governments in countries like Libya or Syria, which are believed to have had black ops chemical and biological weapons programs (BUNKER 2018, BUSCH UND PILAT 2013, TERRILL 1994) materiel and knowledge could be available to the highest bidder. Under such circumstances, technology, equipment and material could be sold on the Black market. Data and know-how could be distributed via the Dark net. Even experienced scientific personnel, employed in those regimes' programs, may be transferred. Thereby proliferation policies could be undercut and availability increased all over the world.

Therefore, the second hypothesis is validated to be true: The general conditions for CBRN-terror attacks are better now than before 2000.

### 5.4. Hypothesis 3

*Reported incidents using CBRN-agents for assassinations and attempted assassinations were orchestrated by state actors (unofficially) rather than terrorism groups.*

All four reviewed CBRN-assassination cases show, that complex chemical agents are not simply acquirable by a second-rate chemist in a basement. To apply such CWAs in this manner, a massive amount of planning, intelligence and observation capability is needed. The necessary level of preparation illustrated in chapter 4.3.2 shows, that targeting a high value individual with CBRN-agents is too complex without large organizational funding and support. Kim Jong-Nam was targeted at the airport, so the culprits knew that he would be there only for a couple of hours and were still able to get that information far enough ahead and to sufficient detail to develop and execute this plan.

The same goes for Mr. Navalny and Mr. Skripal. It is highly unlikely that covert agents just carry novichok around with them all the time, just following their targets and applying the substances whenever there is a chance. It is much more likely that large scale observations are set in place to precisely know the targets routines and effectively plan the attack.

Even though CBRN-terrorism increased considerably after 2011, reported (attempted) assassination incidents mainly have been linked to state actors.

Therefore, the third hypothesis is validated to be true: reported incidents using CBRN-agents for assassinations and attempted assassinations after 2000 were orchestrated by state actors (unofficially) rather than terrorism groups.





## 6. Risk analysis for assassinations utilizing CBRN-materials

Derived from the results found when working on the three hypotheses in the previous chapters, estimating the risk for terror attacks is at least difficult if not next to impossible especially if CBRN substances are involved. However, I believe some general criteria can be derived from the findings.

My approach for risk analysis is to propose risk criteria fitting in a risk matrix which are designed as questions, which could be answered with whatever level of intelligence is available.

The aim of this process is not to propose a general risk level for an assassination attempt to happen in a given country but to allow security services to establish risk for a specific target or a specific event where this target will be present. If this is done on a case by case basis a comprehensive risk assessment could be achieved.

After doing the probability assessment, based on the results likely scenarios must be derived to be able to consider impact. This will also be the base for considering options to reduce risk for the given scenario.

## 6.1. Risk matrix

The following risk matrix is composed by focusing on interchangeable parameters which could be applied based on specific targets. A six by six matrix was chosen to ensure sufficient differences when comparing results. With only limited information or intelligence with a four by four matrix, the outcome may always be too similar, thereby reducing the overall usefulness.

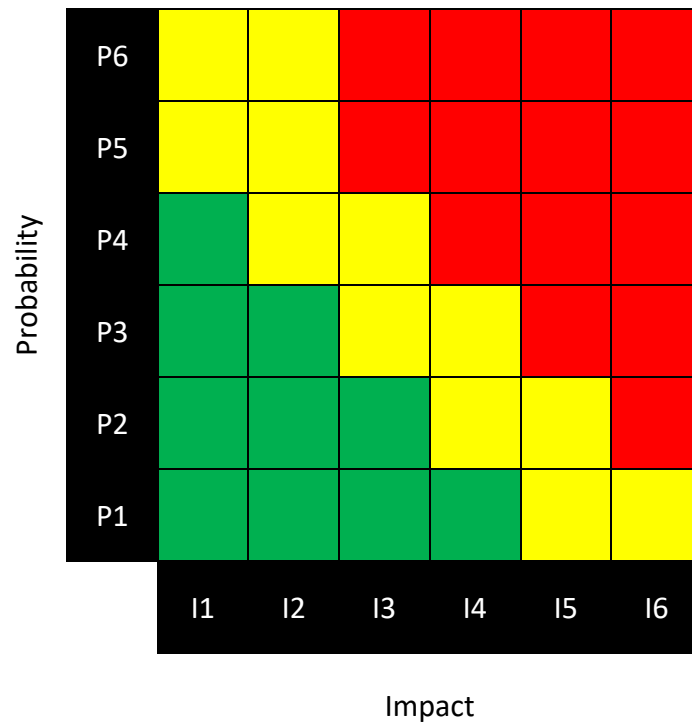


Figure 10: risk matrix, six by six, probability on the y-axis, impact on the x-axis, detailed descriptions for each category in chapters 6.1.1 and 6.1.2

### 6.1.1. Criteria for probability

As established in hypothesis three, state funded CBRN-assassinations are much more likely than others. Therefore, target analysis is a key parameter to assess probability. It is of major importance to know if the target is in opposition to a regime/group which has the means to use CBRN-material. Naturally, also journalists or investigators acquiring knowledge or distributing information on such opponents could be a target. The target-based criteria for probability are displayed in Table 13.

*Table 13: Target based probability criteria*

Class		Description
PT1	Rare	Target has no enemies
PT2	Remote	Target has only non-organized enemies
PT3	Unlikely	Target has organized enemies, which may have connections to CBRN-agents
PT4	Seldom	Target has organized enemies trying to acquire CBRN-agents
PT5	Occasional	Target is in opposition to states or groups known to be in possession of CBRN-agents
PT6	Likely	Target is in opposition to states or groups believed to have already used CBRN-agents in the past

The term “organized enemy” comprises of states, regimes or groups with a directly oppositional mindset to the target, whereas “non-organized enemy” refers to sporadic counterparts or lone wolves.

The term “target” exemplary encompasses politicians (of the same regime/state or of other regimes/states), regime critics (journalists, investigators, NGO employees) or dissidents (including Ex-intelligence personnel, of the same regime/state but operating from outside of the respective country).

However, probability also needs to be classified regarding the available information on the target. Is the persons address known? Does the person have certain habits which can be used to determine a place and a time where the person will be in the future? Is the person someone of public interest with foreseeable appointments and appearances? Depending on which information is recognizable in which detail by the enemy, is a crucial parameter.

A generic scenario is described to further clarify this point.

The president of the United states will be in Vienna for a meeting with the Austrian chancellor. The same night there is the final of the European Football league in the Vienna sports stadium. The president is known to be a huge football fan and wants to compare US football to

European football. He is asked to open the ceremony before the match starts. This information is available in mass media at least one week prior to the event.

So, for any opposition to make a move, they have seven days to plan and set up their attack. They now have detailed information of locations, positions and timings. The statement of the target will be only a few minutes and exact time is not known, however i.e. using a miniUAV, a CBRN-agent can be deployed as soon as the speech begins and can be on target in minutes or less. A miniUAV can be launched from outside the security premises and would be very difficult to counter.

Another possibility would be to place a remote or time activated device beforehand. Depending on the timeframe and the quality of information available defensive measures can be overcome.

The results from researching enemy capabilities (material types and delivery options) need to be used to consider impact in the next chapter.

The information-based criteria for probability are displayed in Table 14.

*Table 14: Information-based probability criteria*

Class		Description
PI1	Rare	No information is available on the target's timings and locations
PI2	Remote	Some information is available on the target, but only timing or location
PI3	Unlikely	Some information is available on the target, including location and unspecific timing
PI4	Seldom	Detailed information is available on one location and timing for less than seven days
PI5	Occasional	Detailed information is available on one location and timing for longer than seven days or several locations and timings for less than seven days
PI6	Likely	Detailed information is available on several locations and timings for longer than seven days

The seven days' time period is generically set up and can be adapted to fit the user's needs and specifications.

Another parameter would be to assess the vulnerability of the location to be assessed. Probability increased proportional with vulnerability. However, a detailed discussion of this criterion is out of the scope of this work.

### 6.1.2. Criteria for impact

The impact is a parameter which can be defined in several ways. In this approach no economic and sustainability consequences will be addressed.

The goal of an assassination is to kill the target or permanently hinder the target from a certain act (i.e. sharing information or making some decision). If that goal is not achieved, either by technical aspects of the attempt not working at all, the target not being there or security measures preventing the target from bearing the brunt of the attack, any other destruction may be inconsequential. For the assassin, the focus clearly lies on the effectiveness of the attack and the question: "Has the target been killed?". Depending on the overall situation collateral damage could be problematic also for the attacker. Operating in a foreign country there is little to none risk for the terror group to affect supporters by missing its target or using a broader approach not caring for unintended consequences. Assassination attempts can also happen in the origin or headquarter country of the respective terror organization. Thereby, general conditions to acquire, produce, transport and deploy may be more optimal than in any foreign country with working security services. On the contrary, the organization usually wants to be in favor of local minorities or suppressed people. In case of collateral damage, especially when their own followers are exposed, this may negatively affect support and interfere with future operations.

For the security detail, it's the imperative to protect their asset. General security services have a broader perspective and are tasked to protect the general public as well. Hence, besides safeguarding the asset, other loss of life must be minimized as much as possible. Even though the enemy's objective was not achieved, if people's opinion concerning the work of their security services and decision makers is negatively changed, that could have an even worse impact than the original enemy's intention. People's lives cannot be factored easily and the level of acceptable loss is set by the overall milieu where the assassination event is assessed to take place. Fatality numbers may be valued differently in South America's favelas or center districts of western capital cities.

Of course, impact is also dependent on the type and delivery of CBRN-material. Assassination attempts in the last 20 years however, have shown, that the targets were hit exclusively with only one documented innocent fatality. Thereby, possible material types and delivery methods need to be factored in when considering the enemy's capabilities during the probability assessment. Derived from those results, the application of CBRN-material will be used to estimate impact.

Table 15: Impact criteria

Class		Description
I1	Incidental	Target is not even in the vicinity Nobody is affected
I2	Minor	Target is in the area but not affected Less than 10 persons with minor injuries
I3	Moderate	Target is affected, but does not need any treatment Less than 25 persons with minor injuries, less than 3 people in critical condition
I4	Major	Target is wounded, but only minor injuries without chronic consequences Less than 50 persons with minor injuries, less than 10 people in critical condition
I5	Severe	Target is wounded and chronically injured More than 10 people in critical condition, less than three people dead
I6	Catastrophic	Target is killed or mortally wounded More than three people dead

The assumed numbers for affected people can again can be adapted to fit the users' needs and specifications.

## 6.2. User instructions

To work with this risk matrix, the first step is to assess the probability how likely a CBRN-assassination attempt is. For that evaluation the target-based (PT according to Table 13) categorization should be used. The next step should be performed only if PT is at 3 or higher.

In that case the assessment is continued by addressing the information-based probability (PI according to Table 14). The process is continued only for a PI of 4 or higher.

If the process is still ongoing the enemy capabilities must be estimated as basis for possible scenarios. These scenarios need to be described and analyzed to generate further information. To assess impact, they need to be evaluated regarding CBRN-material and method of release. From the type of material, possible effects can be derived. Number of affected people will differ if the CBRN-agent used is a toxic inhalation hazard, needs to be inhaled or can permeate through skin. The second matter is the amount compared to the toxicity. If only micrograms of a substance are needed to achieve fatal results, but several grams (or even more) are assessed to be possible, there is an increased risk of affecting more people than just the target. If an atomizer is used to disperse the agent, a lot more people could be receiving negative effects, compared to contaminating a pen used to sign something or some kind of clothing worn by the target.

By fitting the results into the criteria displayed in Table 15, the risk matrix can be finalized.

The process is also shown as flow chart in Figure 11 and a template to address scenario design is presented as annex in 11.2. The template is not exhaustive and needs to be adapted to the users experience and the available information.

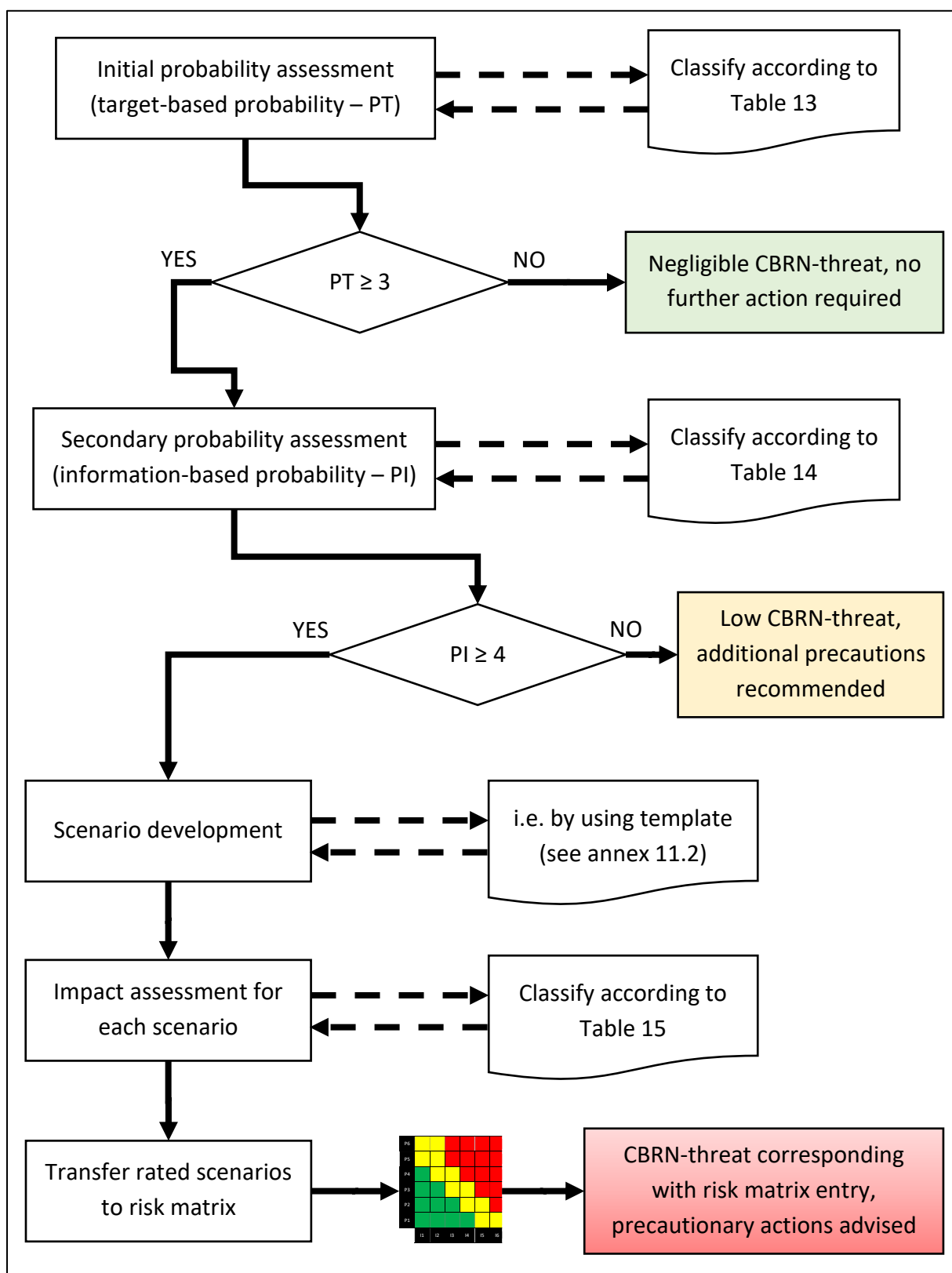


Figure 11: flow-chart for CBRN-risk assessment



## 7. Conclusion

The assessment of CBRN-terrorism is very complex. The predictions from the early 2000s did not occur and no data is yet available to verify current forecasts. The high-impact events which made people aware of CBRN-hazards combined with terrorism were not foreseen and probably won't be in the future. That makes preparing for and defending against such attacks very difficult, time consuming and expensive. A successful CBRN-attack may have large impact however, as long as the terror groups agenda can be carried out with classical attacks, there is no need to turn to CBRN-materials. Using knives or small arms fire on the streets or just driving trucks in large groups of people can be achieved a lot easier than involving CBRN-agents.

Still, the means to use CBRN-materials are out there. The OPCW and other organizations and policies try their best to prevent proliferation but the dark net and the general instability in North Africa and the Middle East cannot be easily compensated.

When looking at (attempted) assassinations with CBRN-materials, based on the available data, states/regime actors seem to be the main culprits, rather than terror organizations. Countering such opponents could be even more challenging. Intelligence, funding, manpower as well as abilities like being able to produce real legal documents or access to satellite networks are just some advantages of state actors.

The presented approach to assess the risk for the use of CBRN-agents to assassinate a specific target could be an initiator for security services to investigate the CBRN-threat. By utilizing the designed criteria CBRN-risks can be addressed and compared. The designed scenarios can be used to plan counter measures and implement actions to reduce risk up to mitigation. Rather than using general possibilities this assessment approach tries to focus on target-specific and event-based criteria. For this risk assessment procedure to work no classified intelligence is required. Most of the criteria can be addressed and ranked based on open-source knowledge. Especially when threats are received beforehand, this procedure should be implemented to get a grasp on the likeliness of a CBRN incident.

Countering and preventing CBRN-attacks are out of the scope of this work, however, based on the flow-chart (Figure 11) it is recommended to get in contact with specialized units for CBRN-defense if the result points to a more than negligible threat. For a low threat results at least, a coordinating effort with CBRN-specialized units should be implemented. For a high threat assessment such units or specialist should be implemented in the events safety and security planning and such units should be on stand-by before, during and after the event. The number, size and capabilities will depend on event specifics and should be derived from the scenarios established during the risk assessment.

Further research in event based CBRN-response has been done by Daniel J. Kaszeta (KASZETA 2009, KASZETA 2014).

I'd like to close this work with a soccer metaphor. Attackers/terrorists are like strikers, they can be lazy for 89 minutes of a 90-minute game as long as the score when they get the chance. Security services are like the keeper, they can do a premium job for 89 minutes, however, if they allow the striker to score, even though they could not have prevented it, they will be made responsible for the results. For CBRN-terrorism it is even more crucial to be ready anytime, because the impact in case of the release of such an agent could be far worse than any conventional attack.

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## 9. Kurzzusammenfassung

ABC-Kampfstoffe oder Massenvernichtungswaffen wurden in der Vergangenheit bereits für Terroranschläge benutzt. Besonders die Anschläge der Aum Sekte in Japan 1994 und 1995 mit chemischen Kampfstoffen, das Attentat auf Alexander Litwinenko mit Polonium-210, die Anthrax-Briefe nach den Anschlägen vom 11. September 2001 oder der Angriff mit Nowitschok auf Sergei Skripal 2018 zeigen, dass ABC-Terrorismus Realität ist und nicht nur als theoretisches Risiko abgetan werden kann. Die Häufigkeit ist gering, aber die Auswirkungen sind meistens katastrophal. Drei Faktoren werden als wesentliche Voraussetzung für ABC-Terrorismus identifiziert: Die entsprechenden Materialien oder Vorläuferstoffe müssen verfügbar sein, das Wissen sich solche Stoffe anzueignen, herzustellen und freizusetzen muss vorhanden sein und die entsprechende Gruppierung muss ABC-Stoffe auch tatsächlich einsetzen wollen. Neben Terrororganisation wurden auch ABC-Anschläge, besonders Attentate, durch staatliche Akteure nachgewiesen.

In dieser Arbeit werden Voraussagen für ABC-Bedrohungen von Anfang 2000 untersucht und mit Datenbankinformationen über terroristische ABC-Ereignisse verglichen. Daraus wurde abgeleitet, dass die Umfeldbedingungen für ABC-Terrorismus besser sind als noch vor 2000. Die Qualität von entsprechenden Voraussagen über ABC-Bedrohungen bleibt jedoch eingeschränkt.

Durch die Vorstellung von Risikokriterien für die Eintrittswahrscheinlichkeit und die Auswirkung sollen Grundlagen für eine Risikoanalyse für Attentate mit ABC-Gefahrstoffen geschaffen werden. Dadurch soll besonders ein strukturiertes, reproduzierbares Vorgehen ermöglicht werden.

## 10. Abstract

CBRN warfare agents or weapons of mass destruction have been used in the past in several terrorism incidents. Looking at the terrorist attacks of the Aum-sect in Japan 1994 and 1995 using chemical warfare agents (CWA), the assassination of Alexander Litvinenko with Polonium 210, the Anthrax-letters after 9/11 or the Novichok attacks on Sergei Skripal in 2018 CBRN-terrorism is a real threat and not just theory. Such events are happening infrequently but the risk is not negligible and the impact almost always were drastic. Three main factors can be identified as enablers for CBRN-terrorism: The availability of the relevant agents or precursor materials, the adequate knowledge to acquire, manufacture and release CBRN materials and the willingness to do so. Besides terror organisations, especially for assassination attempts, also state actors are known to use WMD.

In this work CBRN-threat predictions from the early 2000s are evaluated and compared to database information containing recorded CBRN-terrorism events. It could be validated, that the general conditions for CBRN-terrorism are more favorable, than before 2000. However, the possibility to forecast such attacks remain limited.

With introducing risk criteria for probability and impact, this work aims to support risk assessment for assassination events using CBRN-materials. The proposed risk matrix could be used as base for structured and reproducible risk analysis of such threats.



## 11. Annexes

### 11.1. MWMDD database codebook

#### LEGEND:

Bolded text represents column in datasheet

Red text represents categories provided by Monterey

- Event ID
  - (Assigned by Monterey based on order of entry into database, not chronological order)
- Date (Provided by Monterey only in YYYY-MM-DD format; no sub-categories)
  - YY-MM-DD
  - (For those events where precise date is not clear DD or MM are marked with 00)
  - Year (YYYY)
  - Month (MM)
  - Day (DD)
- Location (not broken down into sub-categories by Monterey)
  - Region
  - Country
  - Prov/State
  - City
  - Specific Location
- Event
  - Attempted Acquisition
  - False Case
  - Hoax/Prank
  - Plot Only
  - Possession Only
  - Threat Only
  - Threat with Possession
  - Unknown
  - Use of Agent
  - Type -- Type Text (Provided by Monterey as a single variable)
    - 1 -- Politically / Ideologically Motivated
    - 2 -- Criminally Motivated
    - False Case -- N/A
    - Unknown -- Unknown

- Weapon Type
  - Biological
  - Chemical
  - Combination
  - N/A
  - Nuclear
  - Radiological
  - Unknown
  - Agent
    - (Free text)
- Perpetrator
  - (Free text)
- Target
  - (Free text)
  - Target Type
    - Agricultural
    - Business
    - Educational
    - Government
    - Indiscriminate
    - Individual
    - Medical
    - N/A
    - Organization
    - Unknown
    - Categories I think were included by error:
      - (Blank)
- Injuries
  - (#)
- Fatalities
  - (#)
- Motive
  - False Case
  - To Act Because of an Ideology/Belief System
  - To Act on a Personal/Professional Grudge
  - To Fulfill Individualized Objective
  - To Protest Treatment of Animals
  - Unknown
  - To Support Other Single-Issue
  - To Establish Ethno-Nationalist Sovereignty
  - To Extort Money/Pure Financial Gain
  - To Express Abortion-Related Sentiment

- Categories I think were included by error:
    - Motivations Unclear
    - incite fear to increase financial gains
    - N/A
    - (Blank)
  - Sub-Motive
    - (Free text – additional detail on motive)
- Delivery
  - Aerosol/Spray
  - Casual/Personal/Direct Contac
  - Consumer Product Tampering
  - Explosive Device
  - Food/Drink
  - Injection/Projectile
  - Jug/Jar/Canister
  - Mail/Letter/Package
  - N/A
  - Reaction Device
  - Unknown
  - Ventilation System
  - Water Supply
- Related Cases
  - (No cases have been cross-referenced within this category in Monterey, although there are a number of clearly related cases with separate Event IDs)
- Sources
  - (Free text)
- Summary
  - (Free text)

## 11.2. Scenario template

Basic information	
Target/event	
Indoor/outdoor	
Weather conditions (average, best case, worst case)	
Enemy information	
CBRN capabilities	
Known TTPs	
Agent information	
Type of agent	
Amount of agent (minimum/maximum)	
Mechanism of agent exposure	
Average time between exposure and recognizable symptoms	
Method of delivery	
Personnel at risk	
Number of persons in close distance to target ( $< 10$ m)	
Number of persons present overall	
Countermeasures	
Security perimeter in place (yes/no, distances to target)	
Means to detect the agent (prior to event, during event)	
Responders available	