

# Chemical Warfare Agents in Terrorist Attacks

## *An Interregional Comparison, Tactical Response Implications, and the Emergence of Counterterrorism Medicine*

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### ABSTRACT

**Background:** Terrorist attacks are growing in frequency, increasing concerns about chemical warfare agents (CWAs). Asphyxiants (e.g., cyanide), opioids (e.g., carfentanyl), and nerve agents (e.g., ricin) represent some of the most lethal CWAs. Our aim was to define the epidemiology of CWA use in terrorism and detail specific agents used to allow for the development of training programs for responders. **Methods:** The open-source Global Terrorism Database (GTD) was searched for all chemical attacks from January 1, 1970, to December 31, 2018. Attacks were included when they fulfilled the terrorism-related criteria as set forth in the internal Codebook of the GTD. Events meeting only partial criteria were excluded. **Results:** A total of 347 terrorism-related chemical events occurred, with 921 fatalities and 13,361 nonfatal injuries (NFIs) recorded during the study period. South Asia accounted for nearly 30% (101 of 347) of CWA attacks, with 73 of 101 occurring in Afghanistan. The Taliban was implicated in 40 of 101 events utilizing a mixture of agents, including unknown chemical gases (likely representing trials of a number of different chemicals), contamination of water sources with pesticides, and the use of corrosive acid. The largest death toll from a single event (200 fatalities) was attributed to a cult-related mass murder in the Kasese District of Uganda in March 2000. East Asia sustained the highest NFI toll of 7,007 as a result of chemical attacks; 5,500 were attributed to the Tokyo subway sarin gas attack of 1995 by Aum Shinrikyo. **Conclusion:** The use of CWAs remains a concern given the rising rate of terrorist events. First responders and healthcare workers should be aware of potential chemical hazards that have been used regionally and globally and should train and prepare to respond appropriately.

**KEYWORDS:** *chemical warfare agents; terrorist attacks; counterterrorism medicine*

### Introduction

The Chemical Weapons Convention Implementation Act of 1997 prohibits the large-scale use, development, production, stockpiling, and transfer of chemical weapons. While limited production is permitted for research and medical or pharmaceutical purposes, member states have the additional obligation to destroy all current chemical weapons stockpiles under the supervision of the Organisation for the Prohibition of Chemical Weapons (OPCW).<sup>1</sup> To date, 193 states are signatories to the Chemical Weapons Convention treaty, with

only Egypt, North Korea, and South Sudan as non-signatory states.<sup>2</sup> It is estimated that 98.37% of the world's declared chemical weapons stockpiles have been destroyed.<sup>3</sup>

The threat of nonstate actors such as terrorist organizations using CWAs as weapons, however, remains a significant global challenge. A CWA is defined as a chemical substance whose toxic properties are used to kill, injure, or incapacitate human beings. The use of ammonium nitrate in the Oklahoma bombing of 1995, which killed 168 people, remains to date the deadliest act of domestic terrorism in the United States.<sup>4</sup>

Homegrown, right-wing extremist organizations as well as transnational terrorism are on the rise, with increasingly sophisticated attack methodologies being explored.<sup>5</sup> Healthcare vulnerabilities and education gaps in response to increasingly complex natural as well as manmade terrorist-related disasters have been at the forefront of discussions among disaster medicine specialists, leading to the establishment of counterterrorism medicine as a disaster medicine subspecialty.<sup>6-8</sup>

The aim of this study was to provide the historical epidemiology of global CWA use in terrorism, thereby allowing healthcare responders to be better informed about the unique toxidromes and injuries they may encounter. These data will also be useful in the development of training programs in counter-terrorism medicine.

### Methods

Data collection was performed using a database search through retrospective data from the GTD. This database is open access with a publicly available data collection methodology, including artificial intelligence identifying events daily from news media around the world, as well as human evaluation of the events by the National Consortium for the Study of Terrorism and Responses to Terrorism (START). The GTD was searched using the internal database search functions for all chemical attacks that occurred between January 1, 1970, and December 31, 2018. The GTD extends only as far back as 1970, and the years 2019 and 2020 were not yet available at the time of the study. Given the comprehensive methodology of the GTD database and its use in the determination of a number of other important measures of terrorism globally, the GTD was considered the appropriate database for this review, as opposed to a de novo search of lay news articles.

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Results were exported into an Excel spreadsheet for analysis. Attacks met inclusion criteria when they fulfilled the following three terrorism-related criteria as established by the GTD. Ambiguous events were excluded when there was uncertainty as to whether an incident met any of the criteria for inclusion as a GTD terrorist incident. Attacks that were attempted but not successfully carried out were included. These criteria are determined within the database, rather than by the authors.

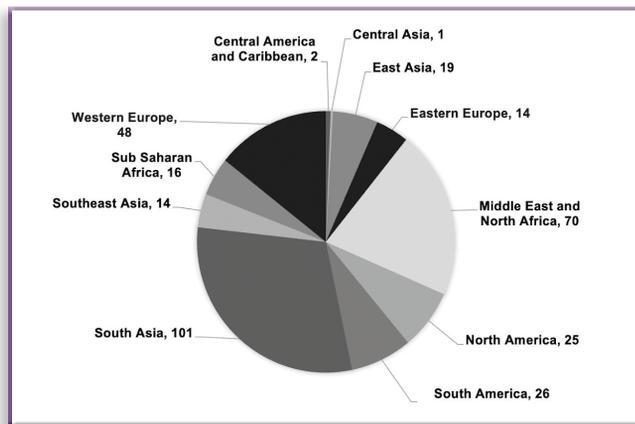
- Criterion I: The act must be aimed at attaining a political, economic, religious, or social goal.
- Criterion II: There must be evidence of an intention to coerce, intimidate, or convey some other message to a larger audience (or audiences) than the immediate victims.
- Criterion III: The action must be outside the context of legitimate warfare activities, that is, the act must be outside the parameters permitted by international humanitarian law, particularly the admonition against deliberately targeting civilians or noncombatants.

GTD-listed events of significance were cross-referenced with lay news reports and other grey literature to ensure there were no major discrepancies in reporting and to fill in any details not included in the GTD description of events.

## Results

South Asia accounted for nearly 30% of CWA attacks (101 of 347), with 73 of the 101 occurring in Afghanistan (Figure 1). The Taliban was implicated in 40 of the 101 events, utilizing a mixture of agents including unknown chemical gases (likely representing trials of a number of different chemicals), contaminating water sources with pesticides, and using corrosive acid. Although the exact chemical modality used in such attacks often remain unconfirmed, grey literature searches suggested possible use of white phosphorus.<sup>9</sup>

FIGURE 1 Chemical warfare agent events by region.



Cult-related chemical events accounted for both the highest death toll and highest NFI toll from an individual attack. The largest death toll from a single event was attributed to the mass murder of followers of the Movement for the Restoration of the Ten Commandments of God cult in the Kasese District of Uganda in March 2000, in which 200 people died.<sup>10</sup> The exact circumstances surrounding the event remain elusive. Followers of the religious cult movement died in an intentional church fire and a series of poisonings and killings. These were initially thought to be a group suicide, but it was later determined to

be a mass murder committed by the group's leaders after their predictions of the apocalypse failed to come about.<sup>11</sup> The use of sulfuric acid as a fire accelerant in a church inferno has been documented.<sup>12,13</sup> Multiple reports of poisoning are also mentioned in the grey literature, but no definitive determination of the chemical was provided.<sup>12,14</sup>

East Asia sustained the highest NFI toll of 7,007 as a result of chemical attacks (Table 1). A total of 12 deaths and 5,500 NFIs were attributed to the Tokyo subway sarin gas attack in 1995 by the Aum Shinrikyo cult.

TABLE 1 Terrorism-Related Chemical Weapon Attacks by Region, Fatalities, and Nonfatal Injuries

Region	Events	Fatalities	Nonfatal Injuries
Australia and Oceania	11	0	23
Central America and Caribbean	2	0	0
Central Asia	1	15	53
East Asia	19	21	7,007
Eastern Europe	14	6	36
Middle East and North Africa	70	184	2,293
North America	25	1	102
South America	26	108	80
South Asia	101	297	3,006
Southeast Asia	14	19	144
Sub-Saharan Africa	16	264	517
Western Europe	48	6	100
Global total	347	921	13,361

Chemical attacks predominantly targeted private citizens or buildings (49 of 70) in the Middle East, businesses (10 of 25) in North America, educational facilities (34 of 101) and police (32 of 101) in South Asia, and government (13 of 48) in Western Europe. Only 13 documented chemical attacks were targeted toward the military during the study period.

## Discussion

The use of CWAs in domestic terrorism has the potential to create high levels of complexity in the tactical prehospital response. Recent events, such as the Novichok attack in the United Kingdom, have seen first responders treating patients prior to toxidrome identification, resulting in contamination of responding staff.<sup>15</sup>

State-sponsored use of CWAs, such as the VX gas assassination of North Korean Kim Nam Jong or the Salisbury, United Kingdom, poisoning with Novichok, appears more likely to tend toward individual effect, with highly potent agents used. It is worth noting that the GTD database does not include acts of state terrorism. Nonstate actors without the same access to potent agents may target larger groups or more public areas for a more visible and destructive effect, but they may not have the same means to implement focused individual assassinations.

The 2017 terrorist plot to place an improvised explosive device on a commercial passenger jet flying out of Sydney, Australia, also uncovered a crude dispersal device created by the attackers using hydrogen sulphide. Use of toxic industrial chemicals can bypass the requirement for hard-to-produce CWAs and allow

potential terrorists easy access to chemicals with devastating effects. The ease of access to cyanide, chlorine, and other toxic industrial chemicals, potential difficulties in differentiating between an accidental hazardous material (HAZMAT) incident versus an intentional one, and delays in acquiring the appropriate specialized personal protection and decontamination equipment create a difficult response paradigm for medical providers and emergency services. These impediments to effective, early intervention by emergency services are exacerbated by the low frequency of CWA-response training for specialist providers, rather than training the general responders, who are likely to be first on the scene.<sup>16,17</sup>

The medical response to CWA has also in many cases been deficient for a variety of reasons. For example, the Tokyo sarin subway attack saw great numbers of contaminated self-presentations. This and the lack of early toxidrome identification led to large numbers of hospital staff being poisoned.<sup>18</sup> Rapid diagnostic algorithms in toxidrome recognition, antidote use, and clinical management of various CWA classes was until recently lacking, and there is likely a need for extensive refresher training among frontline medical responders in this domain.<sup>19</sup>

The Tokyo sarin gas attack remains one of the most discussed terrorism-related chemical-attack events in the world.<sup>20</sup> The use of VX gas, phosgene, sarin, and hydrogen cyanide by the Aum Shinrikyo cult in separate events is also documented in the grey literature, although the perpetrators never formally claimed responsibility.<sup>21</sup>

Highly complex medical systems with emergency medical services (EMS) should be wary of these types of events: EMS response could hamstring the local and regional medical response system due to symptomatic EMS personnel. The more recent Syrian attacks using chlorine and sarin demonstrated the concerns when these events occur in a less-sophisticated medical network already damaged by the ongoing civil war. The Syrian attacks showed what can occur with limited treatment ability, when the system was quickly overwhelmed and antidotes were depleted early during the response.<sup>18,22</sup>

Identifying more effective medical response systems for CWAs is critical, both to protect first responders and to save lives from preventable deaths. The Paris Fire Brigade

has produced a chemical, biological, radiological, and nuclear (CBRN)-focused tool based on the Chain of Survival initially used for cardiac arrest and subsequently adapted for high-threat, prehospital response by the Committee for Tactical Emergency Casualty Care (C-TECC).<sup>23,24</sup> The tool emphasises the use of spot decontamination initially, followed by early toxidrome recognition and early antidotes. After the initial stages of the CBRN chain, extensive decontamination is used to protect the healthcare system and, finally, transport to a hospital. This tool is designed to simplify and order the most effective steps from patient contact through definitive care, to reduce the complexity of response, and to reduce morbidity and mortality in CWA attacks.<sup>25</sup>

This epidemiological analysis of CWAs over the past 50 years can be used by responding agencies to determine their educational and operational needs for future CWA response. By understanding the types of weapons used, individual responders can be taught to recognize the toxidromes they are most likely

to encounter and can be equipped to respond appropriately. As response systems vary widely in available resources and methods of response, it will be up to local and regional decision-makers to use this information to create a local gap analysis of responder knowledge and resource allocation.

### Study Limitations

The GTD is a comprehensive record of global events. It is maintained by START and is the basis for other terrorism-related measures, such as the Global Terrorism Index. Reliance wholly on the GTD is partially mitigated by confirmation with other lay sources and searches for other online searches, but if there are incidents not reported in the GTD, this could limit the veracity of the findings. Furthermore, injuries and fatalities were cross-matched with news records rather than formal hospital or coroner reports, so this study relies on the completeness and accuracy of these sources.

### Conclusion

The use of CWA remains a concern given the rising rate of terrorist events. South Asia accounted for nearly 30% of documented historic terrorism-related CWAs, with the Taliban's operations in Afghanistan implicated in a large proportion of events. Cult-related chemical events accounted for both the highest death toll and highest NFI toll from an individual attack. First responders and healthcare workers should be aware of potential chemical hazards that have been used regionally and globally and train to identify, treat, and respond appropriately to CWAs using the multiple tools and algorithms developed in recent years.

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