

# Anatomizing Chemical and Biological Non-State Adversaries

## OVERVIEW

The possibility that violent non-state actors (VNSAs), including terrorists and criminals, might employ chemical or biological (CB) weapons has understandably attracted much attention in both policy and government circles. This is primarily a result of credible evidence of terrorist interest in these weapons and demonstrated terrorist willingness and capability, albeit thus far via conventional means, to inflict mass casualties. Much valuable research has been conducted in the areas of state possession of CB weapons, the vulnerability of industrial and commercial facilities to attack or infiltration, the technical capabilities required to construct CB weapons and preparations for dealing with the consequences of a large-scale chemical or biological attack. In contrast, the characteristics, decision-making and behaviors of the potential perpetrators themselves have thus far received far less attention.

## PROJECT BACKGROUND

The Anatomizing Chemical and Biological Non-State Adversaries Project sought to improve understanding of, and more effectively identify, perpetrators and potential perpetrators of attacks employing CB agents. The project's objectives included:

- 1) identifying indicators of VNSA's potentially changing CB predilections and capabilities;
- 2) improving our understanding of potential non-state attackers by identifying salient characteristics of past CB adversaries, including the linkage between their strategic concerns and their targets and tactics; and
- 3) embedding these findings into a Bayesian analytical tool that can assist policy makers preparing responses to this phenomenon.

The ultimate goal was to enhance the capability of defense practitioners to protect the United States by including more detailed specifications of the threat component in risk assessment calculations, in addition to the already well-developed vulnerability and consequence elements. Although the project's focus was on ideologically motivated violence, the research also provided some insight into criminal use of CB materials, which can also significantly impact public security.

## METHOD

The project's parameters required that the research team determine those specific organizations, or perpetrator archetypes, most likely to present a significant CB threat to the United States within the next decade. Significant CB threats in the context of the project were defined as the use by a non-state actor of any harmful chemical or biological materials, as well as attacks on facilities that involve the immediate release of CB materials, where the scale of intended harm was 50 or more casualties.

In order to fulfill the project's goals, the research team adopted a multi-disciplinary analytical approach featuring a combination of qualitative and quantitative approaches:

1. A qualitative analysis based on a combination of: the application of a series of literature- and theory-derived indicators to a set of extant VNSAs and examining past CB perpetrators, using data from the Chemical and Biological Non-State Adversaries Database (CABNSAD), which was assembled and coded as part of the research effort.
2. A quantitative analysis employing a set of statistical models to identify salient characteristics of past CB adversaries particularly with regard to the organizational determinants of their pursuit and effective use of CB weapons. Owing to the relative rarity of past CB events, methods used included logistic and rare-event logit regression models and event history methods.
3. An analysis using the results of a semi-structured and probabilistic elicitation of leading outside subject matter experts in the CB terrorism and related domains. This analysis employed a variety of ranking and other probabilistic risk assessment procedures.

The final task of the study was to compare the threat rankings that emerged from each research stream and synthesize them, although it was first necessary to establish which of the results should serve as the basis for comparison. For the qualitative rankings, the selection was simple – the final results that reflected a qualitative synthesis of the multiple systematic rankings and the research team's input. Of the elicitation results, the final (weighted) scores from the probabilistic elicitation were used,

since these reflected the most detailed input from the participants, aggregated and weighted by levels of expertise. For the quantitative analysis, the selection process was more difficult. Ideally, one would apply the best fitting model from the quantitative analysis to the most recent data to identify those organizations that most closely match the characteristics statistically associated with pursuing or using CB weapons. However, the quantitative data needed to accomplish this across all known terrorist organizations only existed up until 2007 and the variable values for many active terrorist groups have changed considerably since then. Moreover, multiple statistical approaches were utilized and it was not always clear which model(s) were superior. A number of heuristics were therefore employed to derive a viable ranking from the statistical results, such as replacing older organizational forms with their most current incarnation and privileging groups that are antipathetic towards the United States.

**Methodological note**

It is important, from a methodological standpoint, to understand the advantage of applying three methodologies more or less independently to the same problem space. This derives from the position that, especially with respect to prospective analyses with high levels of uncertainty, each methodological approach carries both strengths and weaknesses, as shown in the table below. Comparing the results of multiple methodological inquiries can thus lend greater credence to findings that are concordant across approaches, while singling out areas of divergence for closer examination.

**Summary of Analytical Approaches**

Qualitative Analysis	Statistical Modeling	Elicitation
<i>Based on review of literature, adversary profiles and analyst expertise.</i>	<i>Based on historical empirical data (BAAD2; POICN, etc.).</i>	<i>Combines the judgment of multiple domain experts.</i>
<p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>• Incorporates past, extant and future threats.</li> <li>• All non-state actors.</li> <li>• Combination of analysis by project researchers.</li> </ul> <p><b>Limitations</b></p> <ul style="list-style-type: none"> <li>• Not rigorously systematic.</li> <li>• Potential for analyst bias.</li> </ul>	<p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>• Allows for exploring variation in dependent variable.</li> <li>• Takes into account every actor in dataset (including null cases).</li> <li>• Statistical tests of significance and sensitivity possible.</li> <li>• Results / models are reproducible.</li> </ul> <p><b>Limitations</b></p> <ul style="list-style-type: none"> <li>• Limited time-scale of data (1998-2007).</li> <li>• Only includes terrorist/insurgent organizations (no criminal groups; lone actors, etc.).</li> <li>• Cannot make out-of-sample forecasts (i.e., limited to groups in dataset).</li> </ul>	<p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>• Specifically oriented towards future threats.</li> <li>• Heterogeneous expertise (operational; technical; policy; futurist).</li> <li>• All non-state actors.</li> </ul> <p><b>Limitations</b></p> <ul style="list-style-type: none"> <li>• Potential for expert bias</li> <li>• Relatively non-reproducible.</li> </ul>

**FINDINGS**

Comparing results from the research streams made it possible to make some broad observations about the VNSA CB threat to the United States in the medium term. First, given that all three analytical streams included particular terrorist organizations, it increases the confidence in the results that all three streams generated al-Qaida central and two of its most active affiliates, al-Qaida in the Islamic Maghreb (AQIM) and al-Qaida in the Arabian Peninsula (AQAP), as among the most highly ranked threats.

Indeed, a consistent finding across the three research streams was that the threat of non-state chemical or biological weapons pursuit and use lies heavily with jihadists of all stripes, with 7 out of the top 10 (11 of the top 20) spots in the qualitative analysis, 9 out of the top 10 (at least 14 out of the top 20<sup>1</sup>) in the quantitative analysis, and half of the top 10 (and top 20) in the elicitation, all occupied by jihadist actors.

**Lone Actors**

Aside from the threat posed by jihadist groups, the results also drew attention to lone disgruntled actors (especially insider technicians or scientists), as well as apocalyptic millenarian and domestic right-wing groups as potential threats capable of causing significant harm with CB agents. Although the results were generally consistent when broken down into separate

<sup>1</sup> This is less surprising than it looks when one considers that key organizational attributes that emerged as significant from the statistical modeling are the tendency to kill prolifically and maintenance of extensive networks with other violent organizations, two factors that are characteristic of jihadist groups.

chemical and biological streams, there were some differences, including a much higher prominence for disgruntled scientists as a biological threat.

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### Criminal Groups and Chemicals

One of the more surprising results overall was the appearance in the threat rankings of criminal groups as potential chemical weapons threats, in the '2<sup>nd</sup> tier' of both the qualitative and elicitation analyses, since this threat is hardly mentioned, if at all, in the literature. Criminal groups were not part of the quantitative dataset and so did not appear in these threat rankings. As an aggregated group, criminal actors (often, but not always, acting alone) were found to have caused considerable numbers of CB casualties over the course of the period studied. Although most criminal use of chemical agents resulted in small numbers of injuries or deaths, this was not always the case. It is noteworthy that where criminals did cause a significant number of casualties in a single incident this was often a result of ignorance of, or indifference to, the wider consequences of their planned actions directed at particular individuals or organizations.

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### Behavioral Profiles and Bayesian Net

These findings and products were incorporated and extended in the follow-on phases of the study. The primary output of the follow-on activities consisted of drawing on the threat rankings to select a set of perpetrators of interest and then to build on the initial theory and empirical data collection to create in-depth behavioral profiles (including likely tactical behaviors) of six different perpetrators.

The six detailed behavioral profiles were prepared to examine the motivations, capabilities, and likely operational choices of probable VNSA CB actors. As an example, the profile prepared for al-Qaida Central (the core group headed by Ayman al-Zawahiri and based in Pakistan) concluded that if the group were to mount a CB attack it would be more likely to attempt a large scale chemical attack requiring complex preparations over a significant period of time rather than a relatively simple small-scale chemical attack. A large scale biological attack was assessed to be unlikely. Although it is not certain that the organization would privilege producing chemical agents independently over seeking to acquire agents that have been prepared by others (such as agents produced and held by the Syrian government) this is the more likely scenario. There is also a possibility that its operatives might mount an attack on a facility storing significant quantities of chemicals with the intent of releasing these into the environment, but this would not fully conform with the organization's past methods. It is likely that an attack on the United States or its interests employing a CB weapon would be organized as a "martyrdom" operation (i.e., a suicide attack) given that this is normally the modus operandi for attacks that are planned and carried out by al-Qaida Central, and especially for its terrorist "spectaculars."

The second major follow-on was the encapsulation of the insights derived in this study into a Bayesian net that can be periodically updated with new data to reflect the latest threat information.

## RESEARCH APPLICATION

In addition to the overall analysis, behavioral profiles, and Bayesian net discussed above, the project also generated several standalone deliverables with a number of potential uses:

- A concise yet relatively comprehensive review of the literature related to non-state CB perpetrators that can be utilized as an introduction to the topic for training analysts
- The most comprehensive open-source database of CB perpetrators ever compiled (CABNSAD), which can continue to be mined for insights by researchers and analysts in a variety of applications, from social network analysis to machine learning.
- A range of quantitative elicitation and statistical data that can be incorporated into various computational risk assessment and modeling efforts.
- Operational products that can be used by intelligence and law enforcement agencies and security practitioners to proactively interdict the threat by:
  - Identifying a set of adversary threat rankings for the most likely non-state CB adversaries in the next ten years
  - Providing a list of high-priority intelligence targets among extant threats.
  - Supplying a set of differentially diagnostic indicators that can be applied to emerging actors to identify future CB perpetrators, determine the level of CB risk presented by known groups, detect shifts in CB threat potential, and to assist in the establishment of investigative priorities.

## FUTURE DIRECTIONS

This project represents one of the most comprehensive attempts to date to identify and characterize future CB adversaries. Overall it is intended to provide policy guidance for the strategic investment by government decision makers of resources to counter the threat of non-state CB use over the next ten years by highlighting the most likely threats. In addition, the results of this analysis can serve as the baseline for future research and analysis and can be revisited as new actors appear and current actors evolve. Therefore, this initial phase of the broader Anatomizing Chemical and Biological Non-state Adversaries study serves not only as the first stage in an ongoing research project, but also as a vital first step in the broader research endeavor to understand the future chemical and biological threats that the U.S. is likely to face within the near to medium term.

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