Missing: Legal Frameworks for Chemical Security

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Abstract

In recent years, state and non-state actors have broken the taboo against the use of chemical weapons. Yet evidence suggests that the national legal frameworks for chemical security, as required of all UN member states by United Nations Security Council Resolution 1540 (2004), remain persistently underdeveloped. Worse, the international community has yet to generate a widely accepted set of international standards for chemical security. To provide a baseline on national implementation of the chemical security obligations under Resolution 1540, the authors led a research team that first identified key practices for chemical security laws and regulations from a review of more than 30 national, regional, and industry codes of conduct and guidance. They then extracted more than 600 laws and regulations identified by the 1540 Committee for analysis. After comparing these measures against key practices derived from the codes and guidance, the authors generated a composite index score for each UN member state and created a choropleth map to provide new insights into the status of 1540 implementation, from geographic clusters to unexpected outliers. Finally, they offer several potential determinants for further research.

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In the aftermath of the widespread use of chemical weapons during the First World War, many countries committed to not use such weapons again in the 1925 Geneva Protocol.[1] In the following decades, despite their use by a few governments and non-state actors against domestic and foreign targets, a strong international norm against chemical weapons emerged.[2] With the end of the Cold War, the international community further formalized this norm into a robust regime against chemical weapons by establishing the 1993 Chemical Weapons Convention (CWC), which now has 193 state parties and created the Organisation for the Prohibition of Chemical Weapons (OPCW). More recently, however, state and non-state actors' use of chemical weapons threatens to under-

mine the chemical weapons nonproliferation regime at its foundation. The chemical weapons attacks during the Syrian civil war brought opportunities for international cooperation, resulting in Syria acceding to the CWC and destroying much of its chemical warfare agents. At the same time, the attacks brought moments of division, such as grappling with the Syrian government's role in continued attacks and a contested Security Council vote on the OCPW's responsibility to determine attribution.

Furthermore, perpetrators of chemical weapon attacks are employing new agents and tactics, from sophisticated chemical weapons for assassinations in Malaysia and the United Kingdom to attacks, virtual and physical, on chemical facilities.[3] The use of novel agents in these most recent attacks have even prompted CWC state parties to add new chemicals, the families of novichocks and carbamates, to the schedules of chemicals controlled under the CWC for the very first time.[4]

Unfortunately, these challenges to the nonproliferation regime and the norms that underpin it are not isolated or infrequent. Of the 517 events involving chemical, biological, radiological, or nuclear terrorism from 1990 to 2017 in the Profiles of Incidents Involving CBRN and Non-State Actors (POICN) database, more than 400 involve chemical terrorism occurring in at least 59 countries on six continents.[5] Thus, the international community has much more to do to secure and prevent the illicit use of these chemicals.

The global community knows little about how national systems are implemented and enforced, beyond evidence that illicit actors can and have exploited them.[6] However, with funding from Global Affairs Canada, the Henry L. Stimson Center began a project to explore the national legal frameworks for chemical security in all 193 UN member states with the intention to develop a compendium of laws, regulations, or their equivalent that include specific obligations to secure toxic chemicals of proliferation concern.[7] The project also sought to identify a set of emerging chemical security standards by reviewing open source literature and then evaluating national legal measures against key elements of those standards.

All UN member states are required to have effective legal measures and other controls in place for chemical security under legally binding obligations of United Nations Security Council Resolution (UNSCR) 1540 (2004). However, the OPCW has not yet developed an international code of conduct or guidance on chemical security. Without OPCW guidance, countries determine on their own how they should implement their chemical security obligations. In contrast, the International Atomic Energy Agency (IAEA) has produced a code of conduct and guidance for

nuclear and radiological security.[8] The lack of internationally accepted chemical security standards and practices has contributed to a global disarray of national systems to secure toxic chemicals, their precursors, and related facilities. This article first identifies key practices and standards of chemical security applicable to UNSCR 1540. It then generates a composite index score to evaluate each UN member state and provides insight into each state's implementation. Finally, the article recommends areas for more research into compliance with UNSCR 1540.

Chemical Security Practices and Standards: Is There Guidance?

Unlike the relatively clear and internationally accepted IAEA standards and recommendations regarding the security of nuclear and radiological sources, the security of chemical weapons–related material has no such guidance. The OPCW does not outline, much less detail, explicit international standards and best practices for securing chemical weapons–related materials, facilities, or equipment. As a body designed to implement the Chemical Weapons Convention (CWC), the OPCW had to focus initially on the dismantlement of declared chemical weapons programs and abandoned chemical weapons and the monitoring of production and movement of scheduled chemicals to prevent the re-emergence of state programs.[9] Only since 2017 has the ambit of its work shifted to include securing chemicals of proliferation concern.[10] This does not mean, however, that other (though less globally authoritative) bodies have not produced codes, guidance, or sets of effective practices for securing chemicals of proliferation concern. We identified and reviewed over 30 sources related to chemical security, varying greatly in purpose and scope.[11]

Our review of these resources identified five primary documents detailing how to address and implement a range of chemical security measures in chemical facilities and laboratories:

- US Department of Homeland Security's Chemical Facility Anti-Terrorism Standards (CFATS)
- US Department of Homeland Security's *Risk-Based Performance Standards* [RBPS] *Guidance: Chemical Facility Anti-Terrorism Standards*
- Responsible Care© Security Code of Management Practices (chemical industry initiative in the United States)

- European Responsible Care© Security Code Guidance and Best Practice for the Implementation of the Code (chemical industry initiative in Europe)
- National Research Council, *Promoting Chemical Laboratory Safety and Security in Developing Countries*

These sources are considered foundational to our research because of their level of specificity regarding essential elements of a strong security system for chemical weapons–related materials. For example, CFATS establishes 18 risk-based performance standards that identify which areas of a facility's security system are examined.[12] The RBPS guidance document accompanying CFATS offers detailed recommendations to assist high-risk chemical facilities in selecting and implementing appropriate protective measures and practices to meet the 18 performance standards outlined in CFATS.[13]

Both the US and European Responsible Care Security Codes add value because they are the primary chemical industry initiatives on securing high-risk chemical materials.[14] The purpose of these codes is to help "protect people, property, products, processes, information, and information systems by enhancing security, including security against a potential terrorist attack, throughout the chemical industry value chain."[15] Notably, the chemical industries in the United States and Europe established these security codes. Though supported by governments, these codes are solely implemented and monitored by countries' chemical industry.

Finally, the National Research Council's *Promoting Chemical Laboratory Safety and Security in Developing Countries* offers guidance for laboratories in the developing world to implement safe and secure practices in handling and storing hazardous chemicals. It includes information on how to develop administrative structures and support systems to delineate responsibility and accountability in a chemical laboratory. It also describes how to establish a safety and security management system and outlines the types of hazards and risks in chemical laboratories.[16] These sources and many others provide a strong understanding of chemical security common standards and best practices currently being discussed and implemented in facilities and laboratories around the world.

Emerging Chemical Security Standards and Effective Practices

Based on these five primary documents, we extracted the following 21 common effective practices for securing chemical weapons–related materials, facilities, and equipment:

- Training for relevant stakeholders
- Registration/inventory of chemical materials
- Registration/inventory of licenses
- List of controlled chemicals, technologies, and equipment of concern
- Awareness-raising for relevant stakeholders
- Physical security measures
- Access controls
- Inspector authority/system
- Registration system
- Background checks
- Supply chain verification practices
- Security guards
- Proliferation-resistant chemistry practices
- Defining criminal offences and violations
- Imprisonment as penalty provisions
- Fines as penalty provisions
- Other penalty provisions (e.g., search and seizure, suspension of license)
- Incident reporting
- Threat reporting
- Risk-based security approaches
- Authorization/licensing system

Nuanced Understandings of Chemical Security Standards and Effective Practices

It is important to note that many of these practices are understood differently throughout the literature. For instance, the most common chemical security standard is the provision of training. However, the type of training and intended stakeholder vary across sources. Many sources recommend training all personnel in contact with chemical materials and equipment, including facility employees, contractors, service providers, value chain partners, transport staff, scientists, and students.[17] Others also encourage training stakeholders who research and/or regulate chemical materials. During the Global Summit on Chemical Safety and Security in 2016, the deputy director of the OPCW noted that it had trained safety

officers, researchers, policy makers, and legal officers who addressed chemical safety and security concerns.[18]

Some references discuss training specific topics, such as security vulnerability assessments, security awareness, potential hazards, and standard operating laboratory procedures. For example, the *Code of Conduct for the Practice of Chemistry in the Middle East and North Africa* recommends a "program of effective, qualified, mandatory training that covers safety, security, and environmental responsibilities."[19] Other sources encourage training all chemical personnel to watch for suspicious activities or persons.[20]

Moreover, discussions on implementing an inspections system occur throughout the literature, but in two different ways. One way is to inspect personnel, vehicles, equipment, and materials as they enter a chemical facility's premises.[21] The second and more common way is for a chemical facility (public or private) or laboratory to have regular third-party or independent inspections to assess security vulnerabilities or overall compliance with company policies or national regulations. Both the American and European chemical industry initiatives embodied in the Responsible Care© Security Code and the European Responsible Care© Security Code encourage chemical companies to implement third-party verification and to use external auditors and inspectors to monitor security threats for evolving threats.[22] Similarly, from a laboratory perspective, sources agree that an effective compliance system should have a program for regular inspections of all science, engineering, safety, and security practices at facilities.[23]

Additionally, we found that reporting incidents and suspicious activities (e.g., theft, diversion, fraud, facility breach, material or equipment tampering, cyber sabotage) is considered an essential practice for a robust chemical security framework, along with reporting credible security threats.[24] For example, the US chemical industry's Responsible Care© Security Code differentiates between incident and threat reporting requirements. US chemical companies affiliated with the American Chemistry Council are required to evaluate, respond to, investigate, report, communicate, and take corrective action for security incidents. They are also required to relay security threats—specifically physical and cybersecurity threats—to law enforcement personnel as appropriate.[25]

Ultimately, the extensive literature on chemical security demonstrates that stakeholders everywhere are considering common elements for a strong chemical security system. We extracted these common 21 best practices for comparison against national legal framework requirements world-

wide. We sought to determine whether the current legislation reflects these emerging standards.

Comparing Legal and Practical Standards

The 1540 Committee has collected a trove of information on the measures taken by each UN member state to implement the resolution. Collated in a "1540 Matrix" for each member state, this data primarily includes a range of laws, regulations, decrees, and other legal measures on the nonproliferation of nuclear, chemical, and biological weapons and their means of delivery. The 1540 Committee's matrix has more than 300 data fields to characterize implementation by each member state. At least 10 of these fields address implementation efforts to secure chemicals and/or facilities of proliferation concern.[26] Information in each member state's matrix is derived primarily from information submitted by that member state directly to the 1540 Committee. However, the committee can supplement the national reports by using any official government source produced by that member state, such as an official legal gazette, ministerial websites, or submissions to international or regional organizations.

Using the 1540 matrices, we began our research on national implementation of nonproliferation, including efforts related to chemical security, by searching all the names of the legal measures identified in the 10 data fields in the 193 1540 matrices.[27] This search generated an initial list of 643 national legal measures related to chemical security across all UN member states. Next, the research team introduced context into the textual analysis to refine our findings, narrowing the number of relevant chemical security measures to 43 found in 32 UN member states. It is worth noting that there is a considerable discrepancy between the much larger number of measures listed in the 1540 Committee matrices—643—and the 43 measures we identified as having explicit textual requirements to secure chemical weapons–related materials and facilities. This difference likely emanates from several sources, including some error by the research team, the 1540 Committee, and certainly from the authors' stricter textual requirements. The number of states (32) we identified with chemical security measures in place, however, correlates more closely to the number of states (55) the 1540 Committee identifies with physical protection requirements.[28] We also understand that the 1540 Committee's current Group of Experts will soon issue revised matrices with considerably fewer relevant legal measures for chemical security than it previously identified.

We compared each chemical security law to the index of 21 chemical security practices to evaluate if and how each law or regulation complies.

A composite score could range from 0 to 21. Based on our analysis, all 43 measures' composite index scores range from 3 to 18, indicating the number of chemical security standards a single law/regulation incorporates. Similarly, at the state level, we developed a composite index of 22 chemical security practices ranging from 0 (for a state where the authors could not identify any relevant law/regulation) to 22. The state-level composite index range differs from the measures level due to the need to count whether a UN member state has a law that requires securing chemical weapons–related materials/facilities. All measures evaluated against the security elements had to have this requirement to be considered relevant. However, only 32 states had relevant laws. Therefore, when analyzing national implementation efforts across the globe, we included an additional (22nd) chemical security element related to if/whether the state has a law requiring chemical security. Using the state-level composite index, we mapped the low to high scores.[29]

Evaluating National Legal Measures

Only a few of the 21 common practices identified seemed to be represented in the 43 chemical security laws and regulations identified, either at the individual measures level or, therefore, at the state level (see figs. 1 and 2, respectively). For instance, of the 32 states with relevant chemical security legislative frameworks, less than half (15) incorporate a national registry of chemicals, only 11 have a physical security requirement, and just four include background checks (fig. 1).

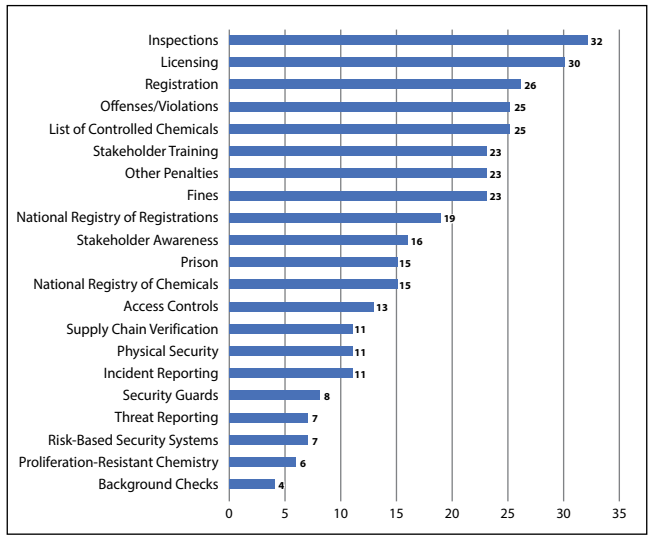

Figure 1. 21 Chemical security elements—individual measures

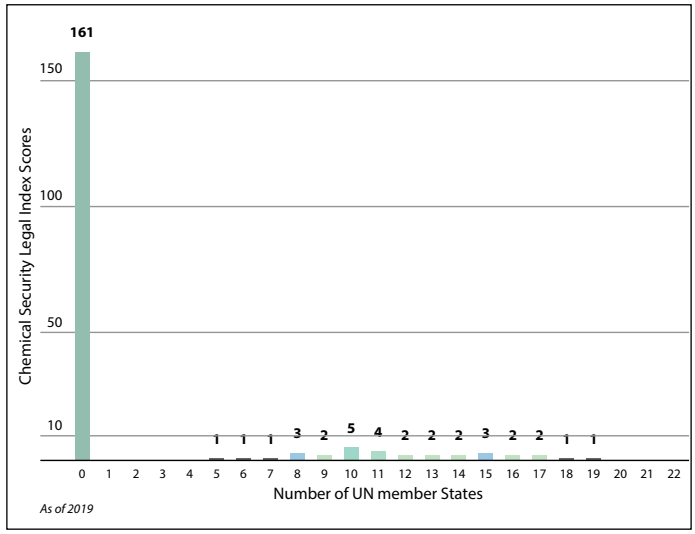

Figure 2. Chemical security elements within national legal frameworks

Among those 32 states with measures in place, the distribution of states ranges across the possible composite index scores in a near normal curve with an average composite index score of 11.8, with a low score of 5 and a high score of 19 (fig. 3). Ultimately, not one national legal framework includes every chemical security practice commonly discussed in the literature. Given the more than 4,000 declarable and inspectable facilities across 80 CWC state parties (which in itself may not reflect all facilities of concern as only 137 states have CWC-implementing legislation in place), the number of weak links in the worldwide chain of national legal chemical security frameworks is disturbingly high.[30]

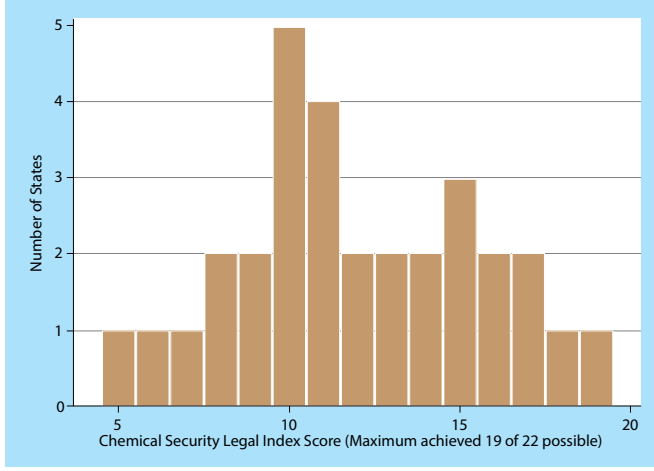

Figure 3. Chemical security elements in national legal framework

Nonetheless, the picture is not completely bleak. A simple test of the composite index scores of states with no CWC-declarable facilities and those with one or more declarable facilities suggests that states with declarable facilities under the CWC have a statistically higher composite index score than those states that have not declared such facilities.[31] In other words, our data analysis indicates that UN member states with CWC-declarable facilities tend to implement more chemical security practices in their national legal frameworks than states without such facilities. Perhaps the governing bodies of states with declarable facilities are more aware of the types of chemical facilities they have and the risks they pose. However, the relatively low mean index score for those states with relevant chemical facilities also indicates that almost all states, with or without these types of facilities, have considerable room for improvement.

The choropleth world map with state-level composite index scores exemplifies the usefulness of alternative data visualization (fig. 4).[32] The map clearly indicates that low levels of integration of effective chemical security practices in national legislation are not regionally determinant compared to, for example, UNSCR 1540 implementation. Variation exists even among European Union members, which one might not expect given the EU's legal harmonization. The choropleth map also shows that some relatively low-capacity states—such as Cuba, Indonesia, and Uganda—have more chemical security elements in their laws and regulations than do many high capacity states—such as Australia and Spain. The difference suggests that the international community will need a nuanced approach to understanding the determinants of chemical security legal frameworks. In many respects, the chemical security elements found most commonly in the 43 measures we identified seem closely linked to common elements for chemical safety, such as licensing and inspection of operators.

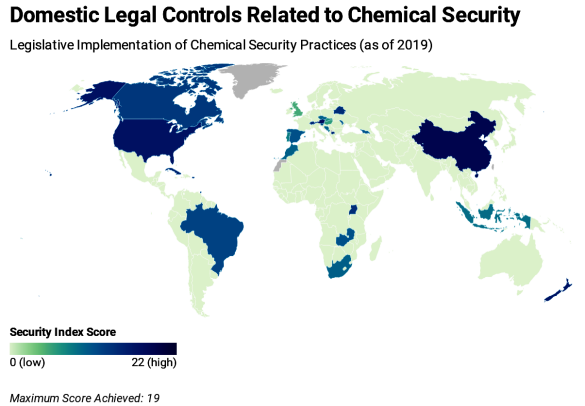

Figure 4. Composite chemical security index score

Given the limited correlation between the 21 chemical security practices identified in the literature and the 43 relevant chemical security laws and regulations, we sought to further verify if the chemical security practices are truly emerging standards. To better understand the context in which these chemical security standards were identified and used as variables to evaluate national legal frameworks, we compared the inauguration and amendment dates of laws with the lowest number of security measures against laws with the highest number of security measures. We also checked the publication dates of the chemical security literature we reviewed to determine if a relationship might exist between the number of security elements in legislation and when the legislation was established and/or updated. As multilateral discussions of chemical security have increased in recent years at the OPCW and other forums, one might expect that more recently adopted measures would align more closely with the emerging standards.[33]

As an exploratory effort, we selected laws based on each measure's low (3–6) or high (14–18) cumulative index score (again, most scores appear somewhere in the middle given the near normal distribution). We determined that some of the lowest-scoring chemical security measures in the dataset had been established with no new amendments in more than a decade—well before the increased use of chemical weapons or the rise in chemical security discussions. Legislation that exemplifies this trend include the following (table 1):

Table 1. Lowest-scoring measures and enactment/amendment dates

Country	Title of Legal Text	Year Enacted/ Amended	Composite Index Score
Hungary	Act LXXIV on the Management and Organization for the Prevention of Disasters and the Prevention of Major Accidents Involving Dangerous Substances of 1999	1999	5
Slovakia	Act No. 163/2001 Coll. of 5 April 2001 on Chemical Substances and Chemical Preparations, as amended in 2008	2001/2008	6
United Kingdom	Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2007	2007	4
United States	Public Law 109-294, an Act Making Appropriations for the Department of Homeland Security for the Fiscal Year Ending September 30, 2007, and for Other Purposes of 2006	2006	3

Meanwhile, some of the highest-scoring chemical security measures in the dataset were either adopted or amended in the last three years (table 2).

Table 2. Highest-scoring measures and enactment/amendment dates

Country	Title of Legal Text	Year Enacted/ Amended	Composite Index Score
Austria	Federal Law No. 145/1998 on the Transport of Dangerous Goods, as amended in 2018	1998/2018	14
Austria	Foreign Trade and Payments Act 2011, as amended in 2019	2011/2019	14
Liechtenstein & Switzerland	Federal Act on Protection Against Dangerous Substances and Preparations (Chemicals Act) of 15 December 2000, as amended in 2017	2000/2017	14
New Zealand	Hazardous Substances and New Organisms Act 1996, as amended in 2018	1996/2018	16
United States	Title 6, Chapter 1, Part 27 Chemical Facility Anti-Terrorism Standards of 2014, amended in 2019	2014/2019	14
United States	Department of Defense Instruction 5210.65, *Security Standards for Safeguarding Chemical Agents*, 19 January 2016	2016	15

Interestingly, after checking the publication dates of the resources on chemical security, we found that more than half were published within the last seven years (2012 to 2019). Given the trends between when laws are established/amended and how many security elements are included, we hypothesize that chemical security best practices are, in fact, *emerging*. They have been discussed regularly in literature for a few years, but their actual legislative implementation is still relatively new. It may be more likely that these types of standards will be found in newly written and recently updated laws. States that establish and amend chemical laws and regulations now appear to be thinking about security aspects more acutely and are determining more legislative measures to protect such high-risk materials from evolving threats.

Granted, outliers exist. China's State Council Order No. 591 on the Safety and Management of Hazardous Chemicals is the highest-scoring measure in the dataset with a cumulative index of 18 chemical security best practices, but it was last amended in 2011. Also, the United States' Title 33—Navigation and Navigable Waters, Part 105, is one of the lowest-scoring measures in the dataset with a cumulative index of four chemical security best practices, yet it was adopted in 2018. These outliers may exist due to the nature of the laws themselves. The Chinese State Council Order focuses on managing high-risk chemical materials, making it more likely

that significant consideration was given to incorporating security elements. Similarly, the Navigable Waters Act emphasizes securing maritime facilities, in which controls on toxic chemicals play only a small part.

Nonetheless, it appears that newer and updated legislation tends to include more chemical security elements than do older laws and regulations. This might prove a fruitful area for future research on how external shocks, such as chemical weapons use, and multilateral discussions, such as recent special meetings at the OPCW, affect developments in national implementation of international obligations and norms.

Essentially, our datasets show a limited relationship between chemical security best practices identified from the literature and their application in current chemical security laws and regulations worldwide, either at the national level or in individual measures. Despite this finding, we believe that these common practices may ultimately form emerging international standards for securing chemical weapons–related materials, facilities, and equipment. Based on the evidence when comparing the chemical security literature and the timing of those measures with the highest and lowest scores, these standards are relatively new and, thus, perhaps have not yet percolated into revisions of older laws and regulations.

Conclusions and Recommendations

It is essential to keep in mind that measuring a country's chemical security infrastructure in a field that lacks clearly determined international standards requires analyzing several variables, including chemical facility culture, physical protection equipment available, and national legal frameworks. Ultimately, legislation is an integral piece of a larger puzzle to begin the process of understanding global chemical security implementation practices.

Additionally, understanding why particular laws or regulations are adopted (or not) is itself a field of legal studies replete with its own controversies where determining intent is notoriously difficult.[34] Despite the very real threats from state and non-state actors (specifically, using chemical weapons, seeking chemical weapons–related materials, and targeting chemical facilities), the evidence suggests that a worryingly small number of UN member states have *any* legislation with an explicit requirement to secure chemical weapons–related materials and facilities. Determining why a state adopts a specific law or regulation for securing toxic chemicals—especially those of proliferation concern—would best be served by a series of in-depth case studies, as most are about current or recent public policy.[35] While a valuable avenue for future research, such projects go well beyond

our purpose here, that is, attempting to create a baseline of what legal measures all states now have or do not have as compared to emerging chemical security standards and best practices.

This study reveals that many states appear to have no chemical security measures in their national legal frameworks and suggests a greater determinant: the lack of authoritative international standards. Not only might states need more guidance on what to do before they act, but if they act now, their efforts may result in national systems out of alignment when global standards do eventually emerge. Although states may wish to—and likely should—update their existing frameworks to incorporate more of the chemical security elements already identified in the literature, they must do so in careful consideration of ongoing multilateral discussions on the topic.

Understanding precisely why states adopt or amend specific legislation related to chemical security is challenging and requires further study. Nonetheless, we can offer several potential vectors for future research. As noted earlier, states with more declarable facilities under the CWC have significantly higher scores statistically than states with no such facilities. However, a hypothesized relationship is not apparent, as states with more facilities might also face more domestic resistance to implementing costly security measures. One also might expect that states that have experienced terrorist incidents involving a weapon of mass destruction would be more likely to adopt chemical security measures than those that have not been subject to such attacks.

In the case of the United States, for example, the naming and timing of the adoption of the main regulation, the Chemical Facility Anti-Terrorisms Standards, emerged from an increased threat awareness. The US recognized that it faced a substantial threat from terrorists interested in causing mass casualties and mass disruption and that certain chemical facilities and their products were particularly vulnerable to terrorists.[36] Yet Japan, which suffered the atrocious chemical terrorism attacks by members of Aum Shinrikyo in 1995, does not thus far have a law or regulation with an explicit obligation to secure chemicals of proliferation concern.

The impact of international obligations might be another interesting avenue of exploration. Most of the measures in the dataset relate to dangerous or hazardous goods; however, only a few refer to international environmental or safety treaties or conventions, such as the Stockholm Convention on Persistent Organic Pollutants or the Convention concerning International Carriage by Rail. At least seven states that include chemical security obligations in their national legal measures specifically refer to the

CWC (Bosnia and Herzegovina, Cuba, Indonesia, Morocco, North Macedonia, Morocco, and Spain) even though the convention does not include obligations to secure chemicals of proliferation concern. Disturbingly, not one of the 43 measures refers directly to UNSCR 1540—unlike a range of nonproliferation measures in other risk areas, such as the European Union's export control regulations. As noted above, however, the absence of the resolution does not necessarily mean that it has not influenced a chemical security–related measure. India's Weapons of Mass Destruction Act of 2005, for example, does not mention resolution 1540 but was purposefully modeled on it. We suspect that the resolution has had more of an effect in policy areas where international standards exist, such as in the nuclear security field where states more clearly understand what they need to do to implement the obligations of UNSCR 1540.

Moreover, it is worth considering how UN member states incorporate chemical security into their national legal frameworks. Some states create completely new laws that emphasize managing chemical safety and security, such as China's State Council Order No. 591 on the Safety and Management of Hazardous Chemicals. Other states can build from existing and ancillary legislation, as demonstrated by the United States' Title 33—Navigation and Navigable Waters, Part 105. That China scored so high and the United States scored so low indicates that where there are standalone laws, they appear to be more comprehensive in their chemical security practices as opposed to ancillary legislation. Therefore, if national governments already have the political will (that can be sustained during the legislative process) to develop or enhance their chemical security legal infrastructures, then creating a comprehensive measure on chemical security would likely be the most effective approach. However, drafting and enacting new legislation takes extensive time and effort. Thus, if national governments are not in a position to augment their chemical security legislative infrastructures, then amending an existing (though ancillary) law may be an easier approach to start implementing some chemical security elements. Though amending existing legislation may not reap the most comprehensive chemical security benefits, it is a way to start a national conversation about chemical security.

Additionally, given the recent chemical attacks in Malaysia, the United Kingdom, and Syria, the risks and threats posed by controlled chemicals and nefarious actors may necessitate that national governments act sooner rather than later to implement security standards. Amending ancillary legislation could be an efficient path forward in the presence of many competing priorities in legislative bodies. Implementing chemical security

into national legal frameworks is critical, but how states do it will largely depend on their national realities.

Finally, from the small group of UN member states that have laws or regulations with an explicit chemical security requirement, a significant variation is also evident in how states approach chemical security laws and regulations. Unlike the standards outlined by the IAEA for nuclear and radiological security, the chemical security field lacks such internationally accepted and authoritative guidance. Given the few chemical security measures and laws in place that incorporate the emerging standards identified here, we believe there is an urgent need for action. The international community must determine what constitutes standards for securing chemical weapons–related materials and facilities (through the OPCW) and how to best incorporate them into national legal frameworks. Ultimately, we recommend that CWC state parties that have developed strong national legal frameworks for chemical security demonstrate leadership in this global security arena by beginning a sustained dialogue on what chemical security and its associated legal frameworks should look like. Once states parties signal their interest in and prioritize chemical security practices, the OPCW can take that as a cue to begin creating international standards in this space. The OPCW is the main international body that needs to develop internationally accepted standards for chemical security. Though doing so sounds like a lofty and contentious road to travel, CWC state parties have cooperated during fractious times and despite divisive issues—as demonstrated by the recent (June 2020) additions to the CWC Schedules, which were the first since their establishment in 1993.

The contributions of civil society, academia, and industry have fostered a more robust and frequent discussion of potential chemical security standards and effective practices in the OPCW and elsewhere. If the OPCW does develop widely accepted standards, a similarly diverse set of stakeholders should have an important role in (1) raising awareness of the new standards and practices; (2) helping states in their implementation; and (3) further tailoring the guidance to the specific circumstances—such as threat and risk profiles—of different national legal jurisdictions, industry sectors, and modes of scientific collaboration. Developing international chemical security standards can help countries better protect their societies, industry, and environment from chemical terrorism and chemical warfare. SSQ

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Notes

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11. Sources included international guidelines and recommendations, like the *Hague Ethical Guidelines* and the UN's *Recommendations on the Transport of Dangerous Goods*; regional and country-specific regulations and policy plans, such as the United States Chemical Facility Anti-Terrorism Standards (CFATS) and the Code of Conduct for the Practice of Chemistry in the Middle East and Northern Africa; chemical industry initiatives, like the Responsible Care Codes

for both the United States and European Union; and chemical laboratory management programs. (For the full list, see the bibliography at https://www.airuniversity.af.edu/.)

12. Chemical Facility Anti-Terrorism Standards (CFATS), 6 CFR Part 27, 1 January 2012, Cornell Law School, Legal Information Institute, https://www.law.cornell.edu/.

13. US Department of Homeland Security, *Risk-Based Performance Standards Guidance: Chemical Facility Anti-Terrorism Standards* (Washington, DC: Department of Homeland Security, May 2009), 7, https://www.dhs.gov/.

14. American Chemistry Council, "Responsible Care Security Code," 6, https://responsiblecare.americanchemistry.com/. See also Cefic, "European Responsible Care Security Code Guidance and Best Practice for the Implementation of the Code," Adopted in 2010 (Brussels: Cefic, 2013), 4, https://www.opcw.org/.

15. Cefic, "European Responsible Care Security Code Guidance," 4.

16. National Research Council, *Promoting Chemical Laboratory Safety and Security in Developing Countries,* (Washington, DC: The National Academies Press, 2010), chap. 3, https://www.nap.edu/read/.

17. Sources include US Department of Homeland Security, *Chemical Sector Security Awareness Guide: A Guide for Owners, Operators, and Chemical Supply-Chain Professionals* (Washington, DC: Department of Homeland Security, September 2012), https://www.dhs.gov/; Organisation for the Prohibition of Chemical Weapons, *The Hague Ethical Guidelines* (The Hague: Organisation for the Prohibition of Chemical Weapons, n.d.), https://www.opcw.org/; and Lisa Moran and Tina Masciangioli, eds., *Chemical Laboratory Safety and Security: A Guide to Prudent Chemical Management* (Washington, DC: The National Academies Press, 2010), http://dels.nas.edu/.

18. Deputy Director-General Hamid Ali Rao, OPCW (speech, Global Summit on Chemical Safety and Security, Kielce, Poland, 18 April 2016), 3, Organisation for the Prohibition of Chemical Weapons, https://www.opcw.org/.

19. Code of Conduct for the Practice of Chemistry in the Middle East and Northern Africa, in *Compilation of Codes of Ethics and Conduct: A Collection of Codes of Ethics and Conduct (and Related Guidelines) Compiled for the Workshops on Ethical Guidelines for the Practice of Chemistry under the Norms of the Chemical Weapons Convention*, ed. Organisation for the Prohibition of Chemical Weapons (The Hague: Organisation for the Prohibition of Chemical Weapons, September 2015), 30–33, https://www.opcw.org/.

20. Committee on Reducing the Threat of Improvised Explosive Device Attacks by Restricting Access to Chemical Explosive Precursors, *Reducing the Threat of Improvised Device Attacks by Restricting Access to Explosive Precursor Chemicals* (Washington, DC: The National Academies Press, 2018), chap. 4, https://www.nap.edu/. See also Cefic, "European Responsible Care Security Code," 4.

21. US Department of Homeland Security, *Risk-Based Performance Standards Guidance*, 41.

22. American Chemistry Council, "Responsible Care Security Code," 4; see also Cefic, "European Responsible Care Security Code Guidance," 4.

23. Moran and Masciangioli, *Chemical Laboratory Safety and Security; and* National Research Council, *Promoting Chemical Laboratory Safety,* chap. 3.

24. US Department of Homeland Security, *Risk-Based Performance Standards Guidance*, 109. See also Committee (report), *Reducing the Threat of Improvised Device Attacks,* 76, 92.

25. American Chemistry Council, "Responsible Care Security Code," 4.

26. These include the eight fields for securing chemical weapons–related materials in production, use, storage, and transport. Each topic has two data points, one for a legal measure and another for evidence of enforcement, usually in terms of a legal penalty provision. See 1540 Committee, "Approved 1540 Committee Matrix Template," 2018, https://www.un.org/.

27. A special thanks to Jessica Hartnett, Joshua Quinn, Ashley Fischer, and Adam Wilson from the University of Minnesota Humphrey School of Public Affairs and Doug Seals and Jacquelyn Harms, Spring 2019 interns at the Stimson Center.

28. UN Security Council, *Final Document on the 2016 Comprehensive Review of the Status of Implementation of Resolution 1540 (2004),* S/2016/1038, December 2016, 69, https://undocs.org/.

29. The authors are currently developing an online searchable database of the 43 chemical security measures that includes both our assessments of these laws against the 21 chemical security elements as well as a compendium of the full text of each law, regulation, or similar measure collected. We view the compendium and their assessments more as a dictionary of use with an aim to create a baseline for a discussion of standards rather than to suggest these 21 elements are standards.

30. Organisation for the Prohibition of Chemical Weapons, "OPCW by the Numbers," accessed October 2020, https://www.opcw.org/.

31. The group mean was 1.06 versus 3.31 and the t-score was -3.35 (with 187 degrees of freedom given the 189 state parties to the CWC).

32. A choropleth map is a thematic map that has shaded or patterned areas proportionate to a statistical variable that represents an aggregate summary of an area's geographic characteristics. In this case, the choropleth map is used to visualize countries' statistical implementation of up to 21 chemical security best practices in national legal measures.

33. For example, see Chemical Security Sub Working Group of the G7, Global Partnership against the Spread of Weapons of Mass Destruction, and the Global Chemical Congress at INTERPOL.

34. See, for example, Antonin Scalia and Bryan A. Garner, *Reading Law: The Interpretation of Legal Texts* (St. Paul: Thomson/West, 2012); Victoria Nourse, *Misreading Law, Misreading Democracy* (London: Harvard University Press, 2016); and Neil MacCormick and Robert S. Summers, *Interpreting Statutes: A Comparative Study* (Abingdon, UK: Routledge, 2016).

35. Robert K. Yin, *Case Study Research and Applications: Design and Methods* (Los Angeles: SAGE, 2018).

36. United States Government Accountability Office, *Chemical Terrorism: A Strategy and Implementation Plan Would Help DHS Better Manage Fragmented Chemical Defense Programs and Activities,* GAO-18-562 (Washington, DC: Government Accountability Office, August 2018), https://www.gao.gov.