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Editorial: Training on the mitigation of biological and chemical proliferation risks: insights into effective design, delivery, and implementation

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Chemical and biological security

International law prohibits chemical and biological weapons and their means of delivery establishing a framework of norms, standards, and rules to guarantee that under no circumstances these weapons are developed, produced, acquired, or used. The Biological Weapons Convention (BWC) and Chemical Weapons Convention (CWC) are important elements of this framework and share a common goal to counter the misuse of advances in life sciences, chemistry, and related fields. Both conventions rely on the general purpose criterion to ensure that biological agents, toxins, and chemicals are utilized solely for peaceful ends that benefit human, animal, and plant health, and the environment. The full and effective implementation of these conventions continues to face challenges. The re-emergence of chemical warfare tactics during armed conflict, as evidenced by the civil war in Syria and the ongoing war of Russia against Ukraine where the Russian armed forces have used riot control agents in violation

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of the CWC is an acute reminder that the international disarmament and non-proliferation architecture requires constant tending.[1] The deployment of chemical warfare agents as weapons for state-sponsored targeted assassinations tests the limits of the chemical prohibition regime and broadens the range of preconditions that need to be in place to ensure effective counter and defense against such threats. Recent attacks including the targeting of Sergei Skripal and his daughter, and the late Russian opposition leader, Alexei Navalny with "Novichok" and the poisoning of Kim-Jong Nam, a half-brother of North Korea's leader with VX highlight the complexity of investigating plots of this kind and the difficulties in holding their perpetrators accountable. And whilst the risk of chemical and biological terrorism might seem remote, the attempts of extremist groups to acquire poisonous substances, e.g. toxins and related manuals over the Darknet, and to attract followers and supporters with technical skills and knowledge that can be exploited for hostile purposes call for vigilance and proactive prevention.

To date, United Nations Security Council Resolution (UNSCR) 1540 remains the only international instrument addressing the risk of proliferation of chemical, biological, and nuclear weapons that is binding on all states. Adopted unanimously under Chapter VII of the UN Charter, this resolution contains provisions for the implementation of appropriate measures to guarantee the security of sensitive biological and chemical materials during storage, handling, transfer, transport, and use. UNSCR 1540 requires that states develop and enforce appropriate controls for the export and import of chemical and biological materials and related equipment to prevent their diversion for prohibited purposes. The resolution details what types of restrictive measures states need to adopt but it does not feature lists of materials and equipment that must be under control. Indicative control lists that cover dual-use biological and chemical materials and equipment, that is, materials and equipment which have legitimate application for peaceful purposes but can also be

[1] See, for example, First Report by the OPCW Investigation and Identification Team (IIT) on Ltamenah (Syrian Arab Republic) 24, 25, and 30 March 2017, S/1867/2020, 8 April 2020, https://www.opcw.org/iit/first-report-iit; Note by the Technical Secretariat: Second Report by the OPCW Investigation and Identification Team on Saraqib (Syrian Arab Republic) – 4 February 2018, S/1943/2021, 12 April 2021, https://www.opcw.org/iit/second-report-iit; Note by the Technical Secretariat: Third Report by the OPCW Investigation and Identification Team on Douma – 7 April 2018, S/2125/2023, 27 January 2023, https://www.opcw.org/iit/third-report-iit; Note by the Technical Secretariat: Fourth Report by the OPCW Investigation and Identification Team on Marea (Syrian Arab Republic) – 1 September 2015, S/2255/2024, 22 February 2024, https://www.opcw.org/iit/fourth-report-iit; Statement on Ukraine from the OPCW Spokesperson, 7 May 2024, https://www.opcw.org/media-centre/news/2024/05/statement-ukraine-opcw-spokesperson.

misused for biological and chemical weapon proliferation, have been agreed as part of voluntary international initiatives, such as the Australia Group (AG) and the Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies (WA).[2] The AG advances chemical and biological security by safeguarding trade and harmonizing the management of export control risks across countries. It sets up a comprehensive regime that comprises standardized licensing and screening requirements for the transfers of sensitive chemical and biological items. Items are categorized in Common Control Lists covering chemical weapons precursors, dual-use equipment, and related technology and software, and biological agents and toxins that affect human, animals, or plants. The scope of the WA is much broader covering munitions such as small arms and lights weapons, military armed vehicles, and aircraft, as well as multiple types of dual-use goods and technologies, including biological and chemical agents, and related equipment. With the exception of Russia and South Africa, all countries that participate in the Wassenaar Arrangement are also members of the AG.

The AG and WA criteria and requirements are incorporated in the EU regulation on the transfer of dual-use items which lays the foundations for the EU common export control system. To facilitate the in-depth implementation of the EU rules on export control and promote the adoption and internalization of security practices among stakeholders, the European Commission has recommended the development of internal compliance programs (ICPs) at industrial and academic entities that engage in export and transfer of dual-use items.[3] ICPs comprise an integrated set of institutional policies and procedures for due diligence to identify, assess, and mitigate risks related to the transfer of sensitive items. Training and awareness-raising are key elements of ICPs that enable practitioners to gain up-to-date knowledge of security risks and apply risk management principles and measures.

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[2] The Australia Group, https://www.dfat.gov.au/publications/minisite/theaustraliagroupnet/site/en/index.html; Wassenaar Arrangement, https://www.wassenaar.org/.

[3] Commission Recommendation (EU) 2021/1700 on internal compliance programs for controls of research involving dual-use items under Regulation (EU) 2021/821 of the European Parliament and of the Council setting up a Union regime for the control of exports, brokering, technical assistance, transit and transfer of dual-use items, 15 September 2021, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021H1700.

Training for chemical and biological security

The primary goal of chemical and biological security is to prevent the intentional misuse of materials, knowledge, and equipment in ways that can threaten the health of humans, animals, or plants, or infrastructure. Key focus areas in chemical and biological security include international prohibition and disarmament regimes; counter-terrorism; export controls; physical security of chemicals and biological agents and toxins, and related technology, information, and equipment; and governance of research with dual-use potential. Chemical and biological safety, that is, activities which aim to prevent the inadvertent release of toxic chemicals and biological agents and toxins are complementary to realizing the objectives of chemical and biological security. Efforts to enhance chemical and biological security are cross-sectorial involving multiple stakeholders in different domains such as law enforcement, criminal justice, intelligence, defense, and civil protection. Chemistry and life science stakeholders in public sector, academia, and industry play an important role in strengthening the prevention of misuse of chemicals and biological agents and toxins. It is critical that these stakeholders have access to training opportunities that allow them to develop and expand their skillset, so that they have sufficient understanding of current and emerging security concerns and practical knowledge of using relevant strategies and tools for risk management. It is also vital that available training is aligned with the job description of professionals, so that the acquired knowledge and skills can be put into practice on a regular basis.

Developing impactful and high-quality training for biological and chemical security requires attention both to the content of training programs and the methods used for their delivery. It is essential that the content and methods for delivery correspond to the needs of the specific target audiences; that they achieve concrete learning objectives; and that they produce effective learning outcomes. Biological and chemical security training should aim at fostering core competencies that enable professionals to identify, assess, and manage security risks both within research facilities and in their interactions with clients, funders, collaborators, contractors, suppliers, etc. Standards are key to harmonizing the sets of core competencies that different professionals should demonstrate, and ensuring the quality of training programs. Active learning methods and strategies that put trainees at the center of training activities facilitate situational awareness and the acquisition of hands-on knowledge and skills which professionals can more easily transfer to and internalize into their everyday work. Sharing good practices through cross-disciplinary exchange and international and regional cooperation makes it possible to identify impactful and effective training strategies and

support their wide and tailored application across institutions and communities.

Design, delivery, and implementation of biological and chemical security training: overview of the JOSTC Special Issue

This JOSTC Special Issue addresses the design, delivery, and implementation of training programs for biological and chemical security by bringing together scholars and practitioners' perspectives. The papers in the issue cover two overarching themes. The first theme relates to the application of active learning methods for inculcating professional responsibility and practice-based competence and the role of such methods in contributing to an enriched training experience that encourages reflection. The second theme relates to the process of institutionalization of training activities to promote greater access to specialized knowledge in the areas of biological and chemical security. Several papers in the issue use examples from the field of nuclear security education. They bring specific methods and strategies to the fore that have been implemented for training on security issues.

Active learning in training design and delivery

Instructional strategies that require learners to solve problems, discuss, and reflect instead of just memorizing new information are commonly referred to as active learning techniques. Such strategies enable learners to make connections between different fields of knowledge and develop transferrable skills.

There are two papers in this special issue that provide concrete examples of the practical implementation of active learning principles when developing training programs. As such, these two contributions offer insights that may help practitioners in chemical and biological security education become more comfortable with the application of active learning principles in their own courses.

Tzinieris & Homan (2024) discuss the use of case studies and its advantages and in the context of non-proliferation education.[4] They propound that case studies have a long tradition in conveying message to

[4] Sarah Tzinieris, Zenobia S. Homan, "The nun who broke America's nuclear sanctum: the use of case studies in CBRN nonproliferation training", *Journal of Strategic Trade Control*, Special Issue, Vol. 2, (September 2024).

others. The authors offer insights into case study design and how such tools can be embedded in a training context. Essentially, the authors suggest that case studies have to present realistic but not necessarily real learning situations because realistic stories facilitate reflection and role-playing among learners. Drawing upon their practical experience, they also highlight limitations related to the application of case studies, including the need for developing materials that are tailored to the local context where the training takes place.

Parotte et al. (2024) draw thought-provocative lessons from their experience with serious gaming and how this active learning can be applied to facilitate reflection and deliberation on complex issues of social significance.[5] Serious games allow for an interdisciplinary engagement and can be particularly useful in the field of chemical and biological security which cuts across several areas of scholarship and professional practice. The authors show how uncertainty can be introduced in games by elements of randomness, and how controversies can be introduced by creating hypothetical complex scenarios that lead to dilemmas and require trade-offs. Some of the lessons that they describe are transferable outside the gaming context, whereas others are more relevant to the specific serious gaming context. A first general takeaway relates to the use of jargon in a training program and how it can serve as conversation-starter between learners about the potential meaning of jargon. Second, the authors address the need to manage the timing of expert interventions carefully. In particular, they recommend that learners should try to work through controversies on their own first before consulting an expert.

Institutionalization of training activities

Whereas the first theme in this special issue focuses on the application of active learning principles, the next three contributions discuss the development of formal processes for training delivery. The establishment of university curricula, producing training resources, and fostering professional networks for community learning are relevant mechanisms that contribute to the institutionalization of chemical and biological security education.

Zanders (2024) describes the rationale, the context, the design, and implementation process of a CBRN master program developed within the

[5] Céline Parotte, Nathan Flore, Sacha Frenay, "Training to embrace uncertainties? The 'Pathway Evolution Process' serious game for assessing toxic waste program", *Journal of Strategic Trade Control,* Special Issue, Vol. 2, (September 2024).

EU- supported Targeted initiative.[6] The EU Targeted Initiative on dual-use export controls aims to engage the academic community in CBRN-related fields of knowledge with the management of risks relating to technology transfers. Introducing university curricula such as a master program can promote sustained attention to chemical and biological security risks at the community level. A master program allows creating a network of alumni and professionals and ensures that the message gets across.

Udum (2024) discusses the role of professional networks in promoting security education.[7] She shows that International Nuclear Security Education Network (INSEN) is an important piece in the nuclear security puzzle and shares her first-hand experience of being involved in INSEN activities. Supported by the International Atomic Energy Agency (IAEA), INSEN creates informal and friendly learning opportunities for professionals in the field of nuclear security education allowing members to interact and share knowledge and experience. INSEN members develop training materials, design and implement training courses and curricula, and engage in advocacy and outreach on the value of promoting nuclear security competence among relevant practitioners.

Shang et al. (2024) report on a development of a recent educational resource in the field of biological security in the form of an edited textbook with contributions from scholars, experts, and practitioners from around the world.[8] Building upon this experience, the authors discuss how the establishment of a professional network—International Biological Security Education Network (IBSEN), that draws on the INSEN model, can result in broadening the access to biological security education.

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[6] Jean Pascal Zanders, "Building a culture of responsibility: education for disarmament and non-proliferation", *Journal of Strategic Trade Control*, Special Issue, Vol. 2, (September 2024).

[7] Şebnem Udum, "The role of education in nuclear security compliance: the International Nuclear Security Education Network as a good practice", *Journal of Strategic Trade Control,* Special Issue, Vol. 2, (September 2024).

[8] Lijun Shang, Weiwen Zhang, and Malcolm Dando, "Addressing the biological security educational gap", *Journal of Strategic Trade Control*, Special Issue, Vol. 2, (September 2024).