

COMMENTARY

Addressing the biological security educational gap

Lijun Shang,^{*} Malcolm Dando,^{**} and Weiwen Zhang^{***}

Abstract

Addressing the gap in dual-use research within the framework of responsible research under the Biological and Toxin Weapons Convention (BTWC) and the Chemical Weapons Convention (CWC) presents a significant challenge for all stakeholders, particularly within life science communities. While biosecurity education has long been recognized as a key strategy to address this issue, its effective implementation remains crucial. In this contribution, the authors provide an overview of the recently edited volume *Essentials of Biological Security: A Global Perspective*, describing its potential as a pivotal tool in addressing this gap. The book begins by underscoring the importance of enhancing biological security, particularly in the post-pandemic era, and defines biological security as the prevention of natural, accidental, and deliberate disease in humans, animals, and plants. While stressing the interrelated and critical nature of these aspects, the book primarily focus on the prevention of deliberate disease within the life sciences. In this context, the authors underscore and address the crucial role of scientists and their institutions, as highlighted by the World Health Organisation (WHO)'s Global Guidance Framework for the Responsible Use of the Life Sciences. In addition to delineating the structure and content of the book, its timeliness, significance, overarching objectives, and scope, this commentary proposes that, in the longer term, an International Biological Security Education Network (IBSEN), akin to the successful model of the International Nuclear Security Education Network (INSEN) managed by the International Atomic Energy Agency (IAEA), would be essential in effectively improving biosecurity.

^{*} Lijun Shang, PhD, is Professor of Biomedical Sciences in the School of Human Sciences at London Metropolitan University, UK. He is the founding Director of the Biological Security Research Centre. His research focuses primarily on ion channels in the fields of health and disease.

^{**} Malcolm Dando, PhD, is a Fellow of the UK Royal Society of Biology. He is Emeritus Professor at the University of Bradford, UK and is the author of *Neuroscience and the Problem of Dual Use: Neuroethics in New Brain Projects*.

^{***} Weiwen Zhang, PhD, is Baiyang Chair Professor of Microbiology and Biochemical Engineering at Tianjin University of China, China. His recent research is focused on synthetic biology and governance of dual-use issues, and he currently serves as Chief Scientist of the National Key Research and Development Program of Synthetic Biology in China.

Commentary info

Commentary part of the JoSTC Special Issue, Vol. 2, September 2024, "Training programs to counter current and emerging biological and chemical proliferation risks: themes, practices, and lessons learnt". Guest editors: Tatyana Novossiolova, Tom De Schryver. JoSTC Editor-in-chief: Veronica Vella.

How to cite

Lijun Shang, Weiwen Zhang, and Malcolm Dando, "Addressing the biological security educational gap", *Journal of Strategic Trade Control*, Special Issue, Vol. 2, (September 2024). DOI: 10.25518/2952-7597.128

Publisher

European Studies Unit (ESU), University of Liège

Peer review

This article has been peer-reviewed through the journal's standard double-anonymous peer review, where both the reviewers and authors are anonymized during review.

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Open access

The Journal of Strategic Trade Control is a peer-reviewed open-access journal. Accessible at www.jostc.org

Keywords

Biosecurity Education, Dual Use, Biological and Toxin Weapons Convention (BTWC), International Biosecurity Education Network (IBSEN), International Nuclear Security Education Network (INSEN)

Introduction

In the aftermath of the COVID-19 pandemic, the oversight of dual-use research has attracted high-level international policy discussions. Benignly intended life science research raises concerns about dual-use potential when it might be applied for malign purposes in political, security, intelligence, or military fields.¹ Moreover, the problem of the deliberate use of biological agents is expected to escalate in the coming decades as advances in biotechnology place increasingly sophisticated capabilities for malign misuse into more hands. The World Health Organisation's (WHO) new Global Guidance Framework for the Responsible Use of the Life Sciences asserts that: "A chronic and fundamental challenge is a widespread lack of awareness that work in the area of life sciences"—which is predominantly undertaken to advance knowledge and tools to improve health, economies, and societies—"could be conducted or misused in ways that result in health and security risks to the public".² Also, incentives to identify and mitigate such risks are lacking. Therefore, addressing this gap presents a challenging question. At present, life scientists face difficulties in raising awareness and improving biosecurity education due to this widespread lack of awareness and knowledge in this area. Therefore, significant efforts will be required to support the life science community in dealing with this issue.

The States Parties to the Biological and Toxin Weapons Convention (BTWC), which have agreed "never in any circumstances to develop, produce, stockpile or otherwise acquire or retain" biological or toxin weapons, have taken serious steps to address this issue by, *inter alia*, organizing working group meetings leading up to 10th Review Conference in 2028. Similarly, the recent Chemical Weapons Convention (CWC) Science Advisory Board's Report for the CWC Review Conference has emphasized the importance of biotechnology and the role of scientists in this context.³ The Organisation for the Prohibition of Chemical Weapons (OPCW), especially in its recent medium-term plan, stresses the need for

¹ Lars Klüver, Tara Mahfoud, Nikolas Rose, eds., *Opinion on 'Responsible Dual Use'*, EU Human Brain Project, 2018, <https://www.humanbrainproject.eu/en/follow-hbp/news/opinion-on-responsible-dual-use-from-the-human-brain-project/>.

² *Global guidance framework for the responsible use of the life sciences: mitigating biorisks and governing dual-use research*, Geneva: World Health Organization, 2022, p. 28.

³ Report of the Fifth special session of the Conference of the States Parties to review the operation of the Chemical Weapons Convention (Fifth Review Conference), OPCW, June 7, 2023, <https://www.opcw.org/resources/documents/conference-states-parties/fifth-review-conference>.

education and the provision of detailed guidelines.⁴ Additionally, non-governmental organizations and other international organizations are undertaking various initiatives to address this issue.

The authors contend that what is required now is the development of content and methodology for biosecurity education for life scientists and the establishment of a network to connect people working on these issues around the world. Although the task will need long-term attention, it is achievable with sufficient effort and resources. For example, a new grant awarded by the Joseph Rowntree Charitable Trust to London Metropolitan University's Biological Security Research Centre aims to help build an International Biological Security Education Network (IBSEN).⁵ This initiative could lay the basis for a network focused on developing curricula and methodologies and connecting project initiatives in different countries and regions. The network could eventually be managed under the BTWC, similar to how the International Nuclear Security Education Network (INSEN) is managed by the International Atomic Energy Agency (IAEA) and the OPCW's Advisory Board on Education and Outreach (ABEO) focusing on outreach and education under the CWC. With its current interest in biosecurity education following the production of the new Global Guidance Framework, the WHO is also fully engaged in biosecurity education.

While there is a considerable amount of literature available that could be useful in such a dedicated biosecurity educational process for life scientists, this material is dispersed across various sources and rarely consolidated into formats that could easily be utilized by practicing life scientists in educational programs. In 2022, the authors initiated a project aimed at producing a series of books to summarize such material and create new content that can be used worldwide in biological security educational courses at schools, and universities, and for continuing professional education in the coming decades. The broad themes selected for the books series include all issues related to biosafety and biosecurity. This comprehensive approach will not only provide thorough coverage of the subject but will also appeal to a wide range of readers.

⁴ Report of the Credentials Committee on the credentials of representatives to the Fifth Special Session of the Conference of the States Parties to review the operation of the Chemical Weapons Convention, OPCW, May 18, 2023, <https://www.opcw.org/resources/documents/conference-states-parties/fifth-review-conference>.

⁵ "Biological Security Research Centre at London Met awarded charity funds", July 28, 2023, <https://www.londonmet.ac.uk/news/articles/biological-security-research-centre/>. International Biological Security Education Network, <https://ibsen.org.uk/2024/06/26/book-launch-essentials-of-biological-security-a-global-perspective/>.

The book series began with an edited volume titled *Essentials of Biological Security: A Global Perspective*, offering an overview of the entire landscape related to biosecurity, with contributions from over twenty international experts.⁶ This will be followed by a second book that reviews practical examples of biological security education carried out in pioneering projects in recent years. Subsequent books will address specific issues related to the elements of the Tianjin Guidelines, which have recently been developed to assist in creating codes of conduct for the life science community in relation to the BTWC.⁷

In this contribution, the authors aim to present an overview of the first volume, explain its timeliness and importance, its aims and scope, and future perspectives. The authors have the ambition and hope the book will serve as a solid starting stone to address the aforementioned gap and the first practical step for building up IBSEN.

Scope and objective of the book

For the purpose of the book, biological security is defined broadly to encompass the prevention of natural, accidental, and deliberately caused diseases in humans, animals, and plants. The authors adopt a comprehensive approach that integrates both natural sciences and social science perspectives, with a particular focus on the potential for deliberate disease in future biological security. Specifically, the authors explore the role that scientists can play in preventing the hostile misuse of their benignly intended work.

Perceptions of deliberate biological threats have evolved rapidly in recent years, beginning at the start of this century with increasing concerns that novel biotechnologies could be used by terrorists to create biological weapons. More recently concerns have focused on potential state-level threats as the international system has become more unstable. Particularly after the pandemic showed once again how devastating disease outbreaks can be to human populations, the prevention of natural, accidental, and deliberate biological threats has received increased attention. Addressing this expanded range of threats in a coherent manner requires integrated actions in terms of both biosecurity and biosafety. One of the major difficulties anticipated for the future in assuring biosecurity lies in the extremely rapid pace of advances in the

⁶ Lijun Shang, Weiwen Zhang/Malcolm Dando, eds., *Essentials of Biological Security: A Global Perspective*, (Wiley, 2024).

⁷ *Tianjin Biosecurity Guidelines for Codes of Conduct for Scientists*, Johns Hopkins Bloomberg Center of Public Health Center for Health Security, Tianjin University Center for Biosafety Research and Strategy SHPIP, Tianjin: Tianjin University, 2021.

life sciences and related fields. While the specific topics of concern may vary according to the backgrounds and interests of different groups of stakeholders, this overarching theme of a rapidly growing threat emerges consistently in the attempts to assess the risks of future developments over the coming decades. However, the clear recognition of scientists and their institutions as key players in ensuring future biological security, along with the identified gap in their relevant knowledge and culture, poses a significant challenge, as highlighted again in the WHO's Global Guidance Framework. Therefore, the authors' objective in producing the book was to provide a "one-stop-shop" where any interested scientist or stakeholder could swiftly grasp the main issues involved in addressing the dual-use problem and ensuring biological security more broadly. Additionally, they aim for it to be easily used by educators to add material on biological security into their teaching of life and associated science courses according to different educational levels.

The challenges associated with integrating biological security into the education and culture of life sciences and related scientists should not be underestimated, given the vast numbers of such scientists worldwide, the disparate nature of the fields in which they work, and the rapid pace of advances being made in many of these research areas. A further factor that needs to be taken into account is that there is a growing demand for scientists to take part in discussions with governments to provide advice about how dual-use dangers are to be regulated.

Overview of book structure and chapters

In order to fulfil the objective of providing a comprehensive yet user-friendly source of information on biological security post-pandemic, the subjects covered in the book have been divided into twenty chapters organized into five sections: Introduction and Overview (one chapter); The Threat (seven chapters); The International Response (four chapters); The Role of Scientists (six chapters); The Future (two chapters). References have been kept to a limited number but selected to offer a swift route into more detailed literature for those requiring additional information or interested in further exploration of the discussed issues. Nonetheless, some chapters contain a larger numbers of references, as the authors deemed the topics they covered to be less familiar to readers compared to the rest of the book. For instance, the main sections of the WHO Global Guidance Framework document contain one hundred and fifty-four references, with additional references in the report's annexes.

The first requirement in raising awareness and improving biosecurity education entails ensuring that life and associated scientists have a better understanding of why biosecurity must be enhanced. Therefore,

following the overview and introduction of Section 1, Section 2 provides an extensive account of the history and current status of the threat. This section begins with Chapter 2 by Jean-Pascal Zanders, delving into the evolution of our understanding of poisons and infections over the past two centuries as chemistry and biology emerged as sciences, and of how the international community has attempted to prevent the hostile use of these new sciences. Following this, Chapter 3 by Gemma Bowsher examines past attempts to use biological weapons by various actors with different motives, as well as how the potential use of such weapons is now being exploited in disinformation campaigns and infodemics. Brett Edwards then explores the influence of scientific knowledge and context on the potential use of biological weapons from antiquity to 1946 in Chapter 4, while Chapter 5 by Brian Balmer reviews the offensive biological weapons programs of states during the latter half of the 20th century, including details of effective biological and toxin weapons produced during this period. In Chapter 6, Kathryn Nixdorff investigates the developing concerns about dual-use arising from experiments conducted in the early 21st century, followed by Xinyu Song and Weiwen Zang's description of cutting-edge technologies of concern today, focusing particularly on synthetic biology and genome editing in Chapter 7. The section on the threat concludes with Chapter 8 by Ralf Trapp, which discusses the increased concern about dual-use applications resulting from the convergence of technologies, such as artificial intelligence and machine learning with biotechnology.

Section 3 of the book then examines how the international community has endeavored to deal with this threat. It begins with Chapter 9, where Tatyana Novosiolova provides an account of the origin and development of the concept of the web of prevention. This is followed by Jeremy Littlewood's review of the structure and functions of the 1925 Geneva Protocol and the BTWC in Chapter 10, and Michael Crowley's examination of other relevant international agreements such as the CWC in Chapter 11. The section concludes with Chapter 12 by Louison Mazeaud, James Reville, Jaroslav Krasny, and Vivienne Zhang, which reviews the role of relevant international organizations such as the WHO and the International Committee of the Red Cross. This section contextualizes how informed and educated life and associated scientists can contribute to preventing the malignant misuse of their benignly intended work.

Within that broader context of national and international regulations, Section 4 of the book shifts focus to the key role that life and associated scientists can play in improving biosecurity. It begins with Chapter 13 by Mayra Ameneiros, which reviews the elements of biorisk management, followed by Chapter 14 by Dana Perkins and Lela Bakanidze, which describes two national regulatory systems, one in the United States and the other in Georgia. Nariyoshi Shinomiya then investigates the lessons

derived from recent experiences with enhanced Potential Pandemic Pathogen (ePPP) research and the COVID-19 pandemic in Chapter 15. The subsequent chapters address the development and effective implementation of biosecurity codes of conduct. Yang Xue reviews the Hague Ethical Guidelines developed under the CWC and the Tianjin Biosecurity Guidelines for the BTWC in Chapter 16, followed by Yahan Bao and Alonso Flores's discussion of engaging scientists in biorisk management in Chapter 17. This section culminates in Chapter 18 by Leifan Wang, which examines the challenging issue of involving scientists in social science fields such as appropriate ethics and its application. The book concludes with Chapters 19 and 20 in Section 5, which focus on the future. Nancy Connell and Gigi Gronwall analyze the multi-layered system of different components involved in efforts to prevent the misuse of life and associated sciences effectively in Chapter 19. Finally, Kathryn Millett and Lijun Shang stress the urgent need to establish an International Biosecurity Education Network to support the effective biosecurity education of life and associate scientists in support of the Tianjin Biosecurity Guidelines in Chapter 20.

Final thoughts and future directions

In conclusion, it becomes evident that the comprehensive structure of the book, coupled with its user-friendly approach, aims to fill a crucial gap in the availability of resource materials for teaching biosecurity. By dividing the subjects into 20 chapters organized into five sections, the authors have endeavored to provide a thorough yet accessible resource for lecturers and teachers in universities and colleges. The author's hope is that this book will not only assist lecturers and teachers in incorporate biosecurity elements into their courses but also contribute significantly to raising awareness and enhancing education in this vital field. Additionally, the authors plan to translate the book into major languages, in line with their broader objective of fostering global engagement and collaboration, particularly in the development of IBSEN. Through these concerted efforts, the authors aim to facilitate a more informed and proactive approach to addressing the challenges of biological security in the post-pandemic era.