Strengthening Biological Security after COVID-19: Using cartoons for engaging life science stakeholders with the Biological and Toxin Weapons Convention (BTWC)

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Abstract

The devastating effects of the COVID-19 pandemic have acutely shown the need for maintaining robust international and national systems for biological security and ensuring that life sciences are used only for peaceful purposes. Life science stakeholders can play an important role in safeguarding scientific and technological advances in biology and related fields against accidental or deliberate misuse, not least because they are on the frontlines of driving innovation. This paper argues that enhancing awareness and understanding of the risk of deliberate disease is essential for effective biological security. The paper first discusses the issue of 'dual-use' in science and technology as it relates to WMD disarmament and non-proliferation. Second, it reviews how scientist engagement with dual-use risks has been addressed in the context of the Biological and Toxin Weapons Convention (BTWC). And third, the paper reports on the development of an innovative awareness-raising tool – a cartoon series – that can be used for engaging life science stakeholders with BTWC issues. The conclusion outlines a set of practical considerations for promoting sustainable life science engagement with the BTWC.

Key Words

Cartoons, life sciences, biological security, Biological and Toxin Weapons Convention, awareness, engagement

1. Introduction

The rapid progress of the life sciences over the past few decades offers tremendous prospects for health, socio-economic development, and prosperity. At the same time, this progress could profoundly redefine the international security landscape by enabling novel misuse capabilities and multiplying the range of actors with access to such capabilities (Meselson, 2000; Wheelis, Rozsa and Dando, 2006). When addressing the Security Council regarding the implications of COVID-19 on the maintenance of international peace and security, the UN Secretary-General has noted that "the pandemic also highlights the risks of bioterrorist attacks, and has already shown some of the ways in which preparedness might fall short if a disease were to be deliberately manipulated to be more virulent, or intentionally released in multiple places at once" (United Nations Secretary-General, 2020). The Secretary-General has further pointed out that improving the response to future disease threats requires serious attention to preventing the deliberate use of diseases as weapons (United Nations Secretary-General, 2020). Life scientists can play an important role in addressing the dual-use potential of modern life science and related technologies, not least because they are on the frontlines of driving innovation that seeks to benefit humanity. This paper argues that enhancing awareness and understanding of the risk of deliberate disease is essential for effective biological security. The paper first discusses the issue of 'dual-use' in science and technology as it relates to WMD disarmament and non-proliferation. Second, it reviews how scientist engagement with dual-use risks has been addressed in the context of the Biological and Toxin Weapons Convention (BTWC). And third, the paper reports on the development of an innovative awareness-raising tool – a cartoon series – that can be used for engaging life science stakeholders with BTWC issues. The conclusion outlines a set of practical considerations for promoting sustainable life science engagement with the BTWC.

2. Biological Security and the Question of Dual Use in the Life Sciences

Dual-use life science research is benignly intended life science research that has the potential to provide knowledge, information, products or technologies that could be directly misapplied to create a significant threat with potential consequences to public health and safety, agricultural species and other plants, animals, and the environment. (WHO, 2020). This includes development of biological weapons and the risk of bioterrorism. International efforts to prohibit biological weapons reflect a shared commitment among States to ensure that advances in biology and related fields are used only for peaceful ends and for the benefit of humanity. The 1975 Biological and Toxin Weapons Convention (BTWC), the first international agreement to outlaw an entire class of weapons of mass destruction (WMD) is indicative in this regard. The prohibition of biological and toxin weapons is a responsibility incumbent upon all those engaged in the life sciences, whether in government, industry, or academia. States Parties to the BTWC have recognised the importance of engaging life science stakeholders as a way of promoting the in-depth implementation of the Convention. For example, when considering the national implementation of the Convention, the Second Review Conference noted the importance of:

- "Legislation regarding the physical protection of laboratories and facilities to prevent unauthorised access to and removal of pathogenic or toxic material;
- Inclusion in textbooks and in medical, scientific and military educational programmes of information dealing with the prohibition of bacteriological (biological) and toxin weapons and the provisions of the Geneva Protocol." (Second Review Conference, 1986).

Similar language has been agreed by subsequent Review Conferences of the BTWC. The Sixth Review Conference of the Convention held in 2006 "encourage[d] States Parties to take

necessary measures to promote awareness amongst relevant professionals of the need to report activities […] that could constitute a violation of the Convention or related national criminal law. In this context, the Conference recognise[d] the importance of codes of conduct and self-regulatory mechanisms in raising awareness, and call[ed] upon States Parties to support and encourage their development, promulgation and adoption" (Sixth Review Conference, 2006).

The Seventh and Eighth Review Conferences of the BTWC held in 2011 and 2016, respectively reiterated the value of scientist engagement with the Convention:

> "The Conference notes the value of national implementation measures, as appropriate, in accordance with the constitutional process of each State Party, to:
>
> (b) encourage the consideration of development of appropriate arrangements to promote awareness among relevant professionals in the private and public sectors and throughout relevant scientific and administrative activities;
>
> (c) promote amongst those working in the biological sciences awareness of the obligations of States Parties under the Convention, as well as relevant national legislation and guidelines;
>
> (d) promote the development of training and education programmes for those granted access to biological agents and toxins relevant to the Convention and for those with the knowledge or capacity to modify such agents and toxins;
>
> (e) encourage the promotion of a culture of responsibility amongst relevant national professionals and the voluntary development, adoption and promulgation of codes of conduct" (Seventh Review Conference, 2012; Eighth Review Conference, 2017).

Efforts to enhance engagement among science stakeholders with security issues are observed in other areas of non-proliferation and disarmament. For example, the scope of the Nuclear Security Programme of the International Atomic Energy Agency (IAEA) is to "contribute to

global efforts to achieve effective nuclear security, by establishing comprehensive nuclear security guidance and, upon request, promoting its use through peer reviews and advisory services and capacity building, including education and training" (IAEA-BG, 2017). Since 2010, the International Nuclear Security Education Network (INSEN) has been functioning as a partnership through which the IAEA, educational and research institutions, as well as other stakeholders cooperate to promote sustainable nuclear security education (International Atomic Energy Agency, 2022a). To this end, INSEN utilises a comprehensive approach comprising activities on the development, implementation, and evaluation of nuclear security education programmes (International Atomic Energy Agency, 2020a). The IAEA also cooperates with States on the establishment of national Nuclear Security Support Centres (NSSCs), in order to strengthen the sustainability of nuclear security (International Atomic Energy Agency, 2022b). NSSCs are intended to serve as national coordination hubs for promoting nuclear security culture through a multiple stakeholder engagement underpinned by human resource development, technical support services, and scientific support services (International Atomic Energy Agency, 2022b; Technical Meeting, 2014).

Likewise, States Parties to the Chemical Weapons Convention (CWC) have acknowledged the value of broad stakeholder engagement in the area of chemical security stressing their:

- "**Determination** to maintain the Convention's role as a bulwark against chemical weapons; to that end to promote, *inter alia*, outreach, capacity building, education and public diplomacy;
- **Desire** to improve interaction with chemical industry, the scientific community, academia, and civil society organisations engaged in issues relevant to the Convention, and cooperate as appropriate with other relevant international and regional

> organisations, in promoting the goals of the Convention" [original emphasis]. (OPCW-CSP, 2013)

The Scientific Advisory Board (SAB) of the OPCW reviews and assesses developments in scientific and technological fields that are relevant to the Convention and provides advice on technical matters related to its implementation (Organisation for the Prohibition of Chemical Weapons, 2022a). The work of the SAB is critical for ensuring that the CWC keeps pace with rapidly advancing and converging science and technology.

The Hague Ethical Guidelines – a set of guiding ethical principles for responsible conduct in chemistry – were developed by a group of independent international experts and established under the OPCW in 2015 (Organisation for the Prohibition of Chemical Weapons, 2022b). The Hague Ethical Guidelines apply to all stakeholders in chemistry and related fields and aim to support the development of a science professional culture that helps prevent the re-emergence of chemical weapons.

Established in 2015, the Advisory Board on Education and Outreach (ABEO) of the OPCW is a multidisciplinary body comprising 15 independent experts (OPCW-CSP, 2015; Organisation for the Prohibition of Chemical Weapons, 2022c). Its primary function is to provide advice on the development of education and outreach strategies, key messages, and partnerships that support the implementation of the Convention (Advisory Board on Education and Outreach, 2018).

3. Scientist Engagement with the Biological and Toxin Weapons Convention (BTWC)

During the 2005 BTWC Meeting of States Parties, Russia tabled a Working Paper titled "Basic Principles (Core Elements) of the Codes of Conduct of Scientists Majoring in Biosciences" which defined professional duties and responsibilities for biologists with regard to the BTWC:

"Scientists should:

i. Be well informed of, and apply in their practice, international and national regulatory legal instruments on the prohibition of biological and toxin weapons;

ii. Be involved in raising biologists' awareness of international and national obligations related to the prohibition of biological weapons, including criminal liability for their violation;

iii. Assist in improving and strengthening international legally binding arrangements banning biological weapons and their proliferation;

iv. Participate, within their competence, in the development of national regulatory legal acts aimed at using scientific and practical results of biological research solely for peaceful purposes;

v. Contribute to the reduction of new risks and threats which may affect the enforcement of the BTWC;

vi. Avoid referring to the results of the work, which may be used in violation of the BTWC provisions, in their scientific papers and statements to the mass media;

vii. Take measures to ensure that transfers of biological agents, toxins, equipment and technologies to any natural or legal person are performed in compliance with the BTWC requirements and national legislation enforcing such measures." (Russian Federation 2005).

Codes of conduct are sets of principles that denote acceptable modes of behaviour within a given social group. Codes of conduct also determine the ways in which the members of a particular group relate to their broader social environment. In this sense, codes of conduct shape professional responsibility and assign corresponding duties (Novossiolova and Martellini, 2019). Codes of conduct and codes of ethics for life scientists are common but few explicitly

address the issue of dual-use research (BWC Implementation Support Unit, 2008; Virtual Biosecurity Center, 2019; Green, Taub, Morin, and Higginson, 2006).

A well-known example of a professional ethical code is the Hippocratic Oath that specifies the main principles of medical profession that physicians should abide by in their everyday practice. The World Medical Association (WMA) – a professional standard-setting body in the area of medicine – has adopted a set of key documents which specifically examine the question of medical involvement in the development of chemical and biological weapons (Crowley and Nathanson, 2018). The *WMA Declaration of Washington on Biological Weapons* which was adopted in 2002 and last reaffirmed in 2012 draws attention to the special responsibilities of all those concerned with health care and biomedical research as regards "the growing threat that biological weapons might be used to cause devastating epidemics" (Box 1) (World Medical Association, 2002).

Box 1: World Medical Association Declaration of Washington on Biological Weapons*

- ✓ "[…] The release of organisms causing smallpox, plague, anthrax or other diseases could prove catastrophic in terms of the resulting illnesses and deaths compounded by the panic such outbreaks would generate. At the same time, there is a **growing potential** for production of **new microbial agents**, as expertise in biotechnology grows and methods for genetic manipulation of organisms become simpler. These developments are of **special concern to medical and public health professionals** because it is they who best know the potential human suffering caused by epidemic disease and it is they who will bear primary responsibility for dealing with the victims of biological weapons. Thus, the World Medical Association believes that medical associations and all who are concerned with health care bear a **special responsibility** to lead in **educating the public and policy makers** about the implications of biological weapons and to mobilise universal support for condemning research, development, or use of such weapons as morally and ethically unacceptable.

- ✓ […] **Nonproliferation** and **arms control** measures can **diminish** but **cannot** completely **eliminate** the threat of biological weapons. Thus, there is a need for the creation of and adherence to a **globally accepted ethos** that **rejects** the development and use of **biological weapons**.

- ✓ **All** who participate in **biomedical research** have a **moral** and **ethical obligation** to consider the **implications** of possible **malicious use** of their findings. Through **deliberate** or **inadvertent means**, genetic modification of microorganisms could create organisms that are more virulent, are antibiotic-resistant, or have greater stability in the environment.

- ✓ **Research** specifically for the **purposes of creating biological weapons** is to be **condemned**. As scientists and humanitarians, physicians have a **societal responsibility** to decry scientific research for the development and use of biological weapons and to **express abhorrence** for the use of biotechnology and information technologies for potentially harmful purposes.

- ✓ **Physicians** and **medical organisations** have important **societal roles** in demanding a **global prohibition on biological weapons** and stigmatising their use, guarding against **unethical and illicit research**, and mitigating civilian harm from use of biological weapons."

* Source: World Medical Association, 2002; emphases added.

In 2005, the Inter-Academy Partnership, an organisation that brings together more than 140 national, regional, and global science academies, published a *Statement on Biosecurity* which underscores "scientists' special responsibility regarding problems of 'dual use' and the misuse of science and technology" (Inter-Academy Partnership, 2005). The Statement contains core guiding principles that are intended to inform the development of codes of conduct that address the dual-use potential of life sciences (Box 2). It was issued ahead of the 2005 BTWC Meeting of States Parties and endorsed by over 60 national science academies (Inter-Academy Partnership, 2005).

Box 2: IAP Statement on Biosecurity – Guiding Principles*

1. ***Awareness***. Scientists should always bear in mind the potential consequences – possibly harmful – of their research and refuse to undertake research that has only harmful consequences for humankind.

2. ***Safety and Security***. Scientists have a responsibility to use good, safe and secure laboratory procedures, whether codified by law or common practice.

3. ***Education and Information***. Scientists should be aware of, disseminate information about and teach national and international laws and regulations, as well as policies and principles aimed at preventing the misuse of biological research.

4. ***Accountability***. Scientists who become aware of activities that violate the Biological and Toxin Weapons Convention or international customary law should raise their concerns with appropriate people, authorities and agencies.

5. ***Oversight***. Scientists with responsibility for oversight of research or for evaluation of projects or publications should promote adherence to these principles by those under their control, supervision or evaluation and act as role models in this regard.

*****Source: Inter-Academy Partnership 2005

Low level of awareness of the BTWC and dual-use issues among life scientists has been recognised as a challenge to the development and adoption of relevant codes of conduct (Rappert, Chevrier, and Dando 2006; Rappert, 2010; Stearns, 2017; Whitby, Tang, Shang, and Dando, 2020). Two Working Papers submitted to the 2008 BTWC Meeting of Experts by China and Japan, respectively, and a Working Paper submitted to the 2008 Meeting of States Parties by Pakistan highlighted the need to consider codes of conduct and biological security education as mutually-reinforcing sets of measures for promoting responsible life science practice (China, 2008; Japan, 2008; Pakistan, 2008).

In 2018, China and Pakistan tabled a joint proposal for the development of a model code of conduct for biological scientists under the BTWC. This proposal builds upon an earlier Working Paper that China submitted in 2015 ahead of the Eighth Review Conference of the BTWC. The proposed model code comprises ten elements including:

> 8. "(Education and training) Scientific community and professional associations should play an active role in education and training. Increase public awareness of the Convention, and establish a safety education and training system for all parties involved in biotechnology research. Biological scientists should be encouraged to engage in

dialogue and cooperation with social scientists, philosophers and anthropologists, so as to have a better understanding of the possible ethical and social implication of relevant biological research and its outcome.

9. (Awareness and engagement) Biological scientists should be fully aware of the potential threats of dual-use research to human society, ecological environment and economic security. It is advocated to promote the peaceful application of biological research achievements, to prevent the abuse and misuse of biological products, scientific knowledge, technology and equipment, and to consciously resist any unethical scientific conducts that are harmful to human society." (China and Pakistan, 2018).

At the same BTWC Meeting of Experts, the delegation of France delivered a technical presentation on the development of a national code of conduct (charter) to promote good practice and govern dual-use research in biology and biotechnology (France, 2018). The national code is being developed by the National Consultative Council for Biosecurity and features education of dual-use issues for life scientists as a key element.

In 2019, the USA tabled a Working Paper, *Approaches to Risk and Benefit Assessment for Advances in Life Scientists* which recognised the value of biological security awareness-raising in preventing the misuse of life sciences:

19. "In the coming years, it is certain that there will be remarkable biotechnology research advances with dual-use potential. Science-based assessment and evaluation tools can help to assess potential risks and benefits and to direct oversight attention and resources towards the most likely or concerning threats. When combined with additional tools like biorisk management and **social awareness**, these risk assessment

and evaluation tools can help reduce the risk of misuse of biology" (USA, 2019; emphasis added).

Another Working Paper tabled in 2019 by the UK points out the need for promoting awareness of biological security issues and interaction among all relevant life science sectors and communities, in order to ensure effective biological risk assessment and management (UK, 2019).

The Tianjin Biosecurity Guidelines developed in 2021 set out ten elements for strengthening responsible conduct in the life sciences and safeguarding research and technologies against hostile misuse (Johns Hopkins Center for Health Security and Tianjin University, 2021). One of the elements of the Tianjin Biosecurity Guidelines specifically focuses on the role of education and training in the process of ensuring that the life sciences are used only for peaceful purposes:

> "Scientists, along with their professional associations in industry and academia, should work to maintain a well-educated, fully trained scientific community that is well versed in relevant laws, regulations, international obligations and norms. Education and training of staff at all levels should consider the input of experts from multiple fields, including social and human sciences, to provide a more robust understanding of the implications of biological research. Scientists should receive ethical training on a regular basis" (Johns Hopkins Center for Health Security and Tianjin University, 2021).

4. Using Cartoons for Engaging Life Science Stakeholders with the BTWC

It is important that biosecurity principles – such as those contained in the Tianjin Biosecurity Guidelines – are internalised in life science professional practice. This process requires a concerted effort from multiple stakeholders, such as researchers, life science funders, publishers, policy-makers, and end-users (Whitby and Dando, 2010; Novossiolova et al. 2021).

This section reports on the development of an innovative awareness-raising tool for engaging life science stakeholders with biological security issues. The tool comprises a cartoon series available in 13 different languages. Earlier research in the area of biological security education and outreach has revealed some of the challenges to fostering awareness of dual-use issues, as well as the utility of active learning methods for promoting reflection on such issues in a more engaging and easily assimilated form (Rappert 2010; NASEM 2018a and 2018b; NRC 2011; NRC 2000).

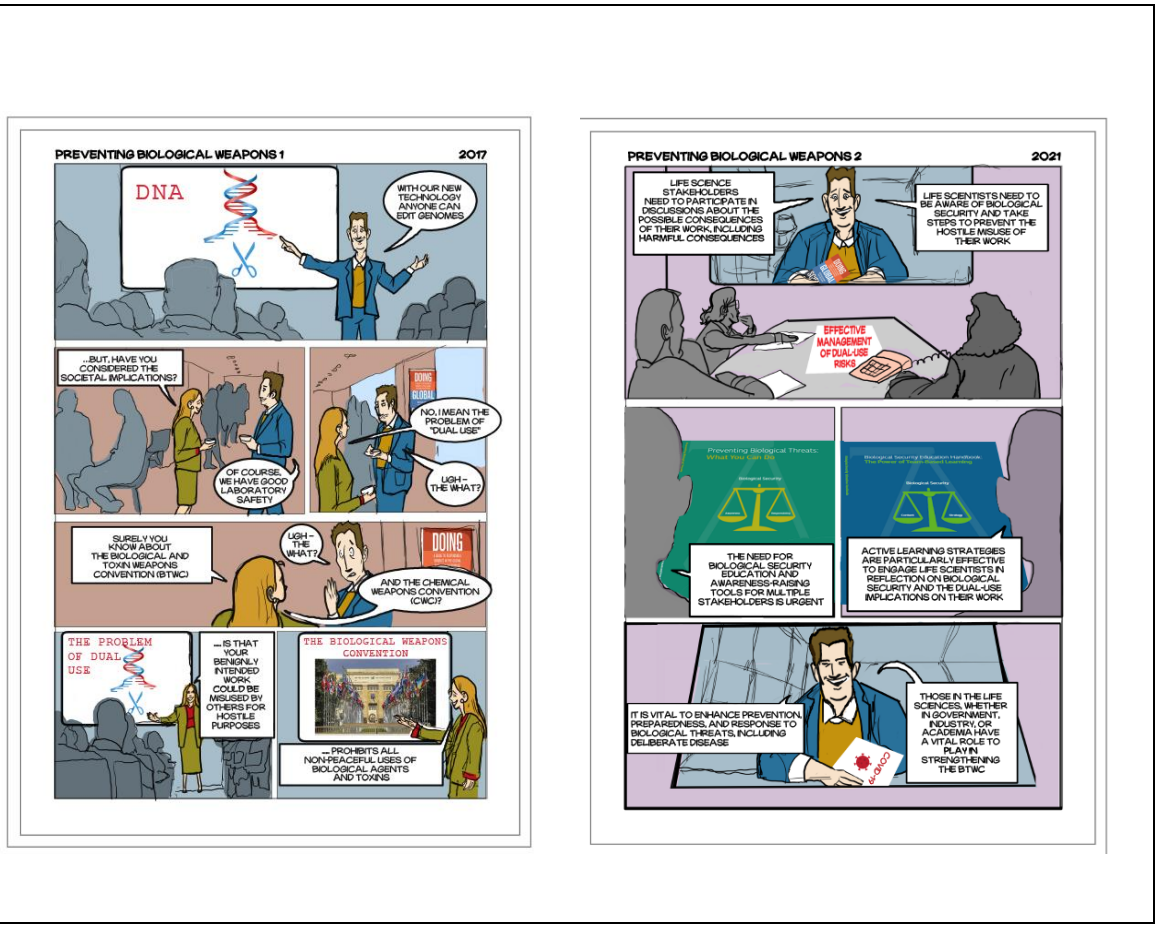
The choice of using cartoons has been informed by several considerations. The use of illustrative material – graphs, histograms, pie charts, and even diagrammatic abstracts – is widespread in scientific settings. The cartoon format also finds application in presenting complex processes and concepts in a simplified way (Office of Science and Technology, 2022). In addition, cartoons have been used for educational purposes, including for promoting awareness of biological security issues (Bickford, 2010; RSC 2022; Japan 2018).

The cartoon series titled *Strengthening the Web of Prevention against Chemical and Biological Weapons* features five two-page cartoons each focusing on a specific concept of relevance to biological security (LMU, 2021a). Cartoon 1 examines the issue of dual-use research and biological weapons prevention. Cartoon 2 examines the issue of codes of conduct. Cartoon 3 examines the issue of education and awareness-raising. Cartoon 4 examines the process of fostering a biological security culture. And Cartoon 5 examines the concept of 'one health' security. The cartoon series is envisaged as an integrated five-part story, whereby some of the characters appear in several cartoons. Each cartoon can be used separately, as well.

The cartoons are set in ways that make it possible for life scientists to relate to the scenario presented. For example, the first page of Cartoon 1 focuses on a dialogue between life scientists during a conference. The second page of this cartoon looks into the role that life scientists

could play in raising awareness of biological security issues (Figure 1). Cartoon 1 further aims to highlight existing resources that could be used for biological security education and training, such as the IAP's guide *Doing Global Science*, the training guide *Preventing Biological Threats: What You Can Do*, and the active learning manual, *Biological Security Education Handbook: The Power of Team-Based Learning* (IAP 2016; Whitby et al. 2015; Novossiolova 2016).

Figure 1: Cartoon 1 – Preventing Biological Weapons



*Source: LMU 2021a

To facilitate the dissemination of the cartoons, an animated video has been developed that focuses on the different situations that are depicted on the cartoon (LMU, 2021b). In addition, the cartoon series has been translated into 12 different languages, including the six official UN languages: Arabic, Armenian, Chinese, French, German, Greek, Italian, Japanese, Russian,

Spanish, Ukrainian, and Urdu. The cartoons have been presented at several international events and used as part of biological security awareness-raising efforts (Novossiolova et al. 2021). The translations were carried out by biological security education practitioners from around the world.

5. Conclusion

Enhancing life scientist engagement with the BTWC, including through codes of conduct and education requires both nationally and internationally coordinated effort. At the time of writing of this paper, the World Health Organisation is coordinating the development of a framework document – *Global Guidance Framework for the Responsible Use of Life Sciences. Mitigating Biorisks Governing Dual-Use Research* – which seeks to consolidate and integrate existing good practices and lessons learned for responsible conduct of science (WHO, 2022a; WHO, 2022b). Life science civil society can play a crucial role in promoting a shared recognition of the need to internalise relevant modes of behaviour and reasoning in the everyday practice of life scientists. There are at least five areas of action to which the life science civil society can actively contribute, in order to enhance understanding of the risk of deliberate disease and strengthen dual-use risk management. These include:

- Design and implementation of biological security education and training programmes.
- Standardisation of biological security competence, practice, and relevant infrastructure.
- Promulgation of biological security practices, including through the development of codes of conduct.
- Development of methodologies, tools, and instruments for science and technology assessment, including cost and benefit analysis.
- Promoting biosecurity capacity building, including through scientific cooperation, dialogue, and exchange of lessons learned, good practices, and experience.

These five areas of action are intertwined and cross-cutting and should be implemented in an integrated manner. Considerations related to the risk of deliberate disease should be built-in at every stage of the life science research process to ensure a comprehensive risk assessment and management.

At international level, the interaction between the BTWC and other disarmament agreements and ethics-related initiatives which underscore the important role of human resource development for maintaining science integrity should be deepened. These could include, for example, the International Nuclear Security Education Network, the International Nuclear Security Training and Support Centres (NSSCs Network), and the Advisory Board on Education and Outreach of the OPCW. In addition, the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) could be consulted and the experience and expertise of the OPCW in industry engagement with safety and security issues could be leveraged, in order to identify viable mechanisms for promoting engagement with the BTWC within the life sciences.

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