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The Biological and Toxin Weapons Convention

Implications of advances in science and technology

In preparation for the 8th Review Conference a meeting was convened in Warsaw in September 2015 to identify and discuss *Trends in Science and Technology Relevant to the Biological and Toxin Weapons Convention*. The conference noted many issues of relevance to the Review Conference and reached several overarching conclusions.

The meeting concluded that:

- Technological barriers to acquiring and using a biological weapon have been significantly eroded since the Seventh Review Conference. There had been no further developments that could enable novel activities inconsistent with the aims and objectives of the BWC.
- Likewise, there were no developments that would not be covered by the treaty or additional supplementary understandings, but
- The speed at which the life sciences and technology are advancing, and the rate of convergence of disciplines, is still accelerating. This increases the likelihood of such developments in the foreseeable future.
- Such potential problems, as well as any appropriate responses could be discussed prior to the 9th Review Conference.
- Biotechnology is increasingly important around the world as a manufacturing technology and has therefore become a potential target for biological weapons itself.
- It should be explored whether there are any risks not already captured by existing treaties and laws of weapons that cause damage to equipment, supplies, or material associated with the bio-economy.
- There was an increased need for education and outreach to promote the aims and objectives of the BWC amongst the scientific community.

The biosciences are developing at an unprecedented rate

The rate and scale of progress in the life sciences and biotechnology continues to grow rapidly. There is an increasing diffusion of knowledge around the world and more interconnection between knowledge hubs, many of them 'virtual'. Laboratories operate in more diverse geographic locations and across different sectors of our societies.

The character of life sciences and biotechnology is evolving with greater focus on rational design, biological engineering, and more flexible production. Moving from 'concept' to 'application' is becoming ever simpler, unlocking further potential for progress. All these factors have both positive and negative implications for the BWC.

The BWC should continue to monitor these developments

For this reason, the BWC should continue to ensure that such developments are not used in prohibited activities, whilst facilitating their use for peaceful purposes. It could achieve this by devising an effective, on-going, and suitably resourced mechanism to:

- Develop specific questions that can be answered through an on-going review of developments in science and technology;
- Identify current scientific and technical capabilities applicable to these questions;
- Consider the implications of those developments in the context of the BWC; and
- Formulating informed decisions about any further actions that may be required.

An approach for systematically assessing the risk of new scientific developments to the BWC would greatly assist in this process.

The global ability to detect and treat disease has been enhanced

One positive outcome of developments since the Seventh Review Conference is that our collective capacity to combat disease has markedly improved, regardless of whether the outbreak is naturally occurring or the result of a malevolent act. Whilst remaining logistic, economic and technical barriers are to be surmounted, the conference noted that it should now be possible to assemble patchwork capabilities into a diffuse but integrated system for countering global or local outbreaks.

Such a system could scale from local needs through to international responses. A structure that enabled data, such as pathogen sequences, to be shared more effectively and efficiently would facilitate a rapid and effective response. As expertise and 'know-how' matures, opportunities for technological leapfrogging appear, as was the case with mobile communication systems. Developing countries can then access opportunities and capabilities in the field that match, if not surpass, those found in developed countries.

Increasing 'digitization' of pathogen data enables the identification and characterisation of the infectious agent by centralised facilities, facilitating the development of countermeasures and the use of 'distributed diagnostics' at the site of the outbreak. This concept has already been partially implemented in both developed and developing countries. The conference noted a pressing need for more comprehensive sets of baseline and reference pathogen data. 'Microbial forensics' can be used to help establish attribution if a malevolent deployment is suspected.

Vaccines and drugs can now be developed more rapidly than ever before. Lead times can be reduced through rapid detection and characterisation of outbreaks. The design, testing and optimisation of vaccines and drugs have been streamlined using better computational technologies, modelling tools and platform technologies although provision of bioinformatics capabilities remains challenging.

Outsourcing of key production steps has reduced the need for dedicated vaccine production infrastructure, and the distance a product has to travel to its point of use. It is increasingly simpler, faster and cheaper to industrialize production processes. Single-use equipment and modular production technologies shorten turn-around times. However, regulatory and liability issues associated with diagnostics, drugs and vaccines in health emergencies continue to limit potential for progress and this is an issue that should be addressed.

Recent advances have also facilitated the development of biological weapons

Recent advances could also facilitate almost every step of a biological weapons programme, and technological barriers to acquiring and using a biological weapon have been conspicuously eroded since the Seventh Review Conference.

Both novel and traditional approaches continue to offer opportunities for acquiring an agent from nature. The sometimes-formidable challenges associated with the synthesis of existing agents and the development of novel agents have been overcome in some cases by using gene transfer and other biosynthetic engineering approaches.

Modification of biological agents enables them to be more easily optimized for specific purposes, a capability that could be applied for use in developing a biological weapon. Developments in scale-up and production technologies have changed production signatures. Less space and time are needed, narrowing windows for interdiction.

Although these trends diminish the need for stockpiling, the proliferation of (e.g.) freeze-drying capacity has actually reduced the space required to store biological weapons. It is also now easier to deliver a biological agent given advances in areas such as nanoparticles and sophisticated modelling of dispersal patterns using the techniques of aerobiology.

Many of these advances are at the leading edge of current capabilities. They are expensive and complicated to acquire and to deploy successfully. Making use of them for prohibited purposes would probably currently require the resources of a state but this situation may change in the future, reinforcing the need for on-going efforts to review relevant developments in science and technology.

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