

Strengthening the Biological Weapons Convention

Review Conference Paper No 26

Effective Implementation of the BTWC: The Key Role of Awareness Raising and Education

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EFFECTIVE IMPLEMENTATION OF THE BTWC: THE KEY ROLE OF AWARENESS RAISING AND EDUCATION

by Simon Whitby[†] and Malcolm R. Dando^{*}

Introduction

1. The 1975 Biological and Toxin Weapons Convention (BTWC) adds to the ban on use of biological weapons embodied in the 1925 Geneva Protocol by what is known as the *General Purpose Criterion* of Article 1. This states¹ that:

Each State Party to this Convention undertakes never in any circumstances to develop, produce, stockpile or otherwise acquire or retain:

1. Microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes...

Thus whilst the peaceful uses of the life sciences are fully protected, there is a comprehensive prohibition of non-peaceful development, production, stockpiling, acquisition or retention of microbial or other biological agents or toxins – and toxins are understood to cover all mid-spectrum agents such as bioregulators.

2. As early as the Second Review Conference of the BTWC in 1986, the States Parties recognised the importance of the awareness and education of life scientists in regard to the Convention. In the *Final Declaration* of that Review Conference, the States Parties noted², in relation to Article 1V on National Implementation measures, that:

The Conference notes the importance of:

– inclusion in text books and in medical, scientific and military educational programmes of information dealing with the prohibition of microbial or other biological agents or toxins and the provisions of the Geneva Protocol.

Similar statements were agreed by the States Parties at subsequent Review Conferences.

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¹ The Biological and Toxin Weapons Convention. Available at [http://www.unog.ch/80256EDD006B8954/\(httpAssets\)/C4048678A93B6934C1257188004848D0/\\$file/BWC-text-English.pdf](http://www.unog.ch/80256EDD006B8954/(httpAssets)/C4048678A93B6934C1257188004848D0/$file/BWC-text-English.pdf) and at <http://www.opbw.org>

² United Nations, Second Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Geneva, 8 – 26 September 1986, *Final Document*, BWC/CONF. 11/13/11, Geneva 1986. Available at <http://www.opbw.org>

3. At the Sixth Review Conference some 20 years later, in 2006, the States Parties agreed³, again in relation to Article IV, that:

14. The Conference urges the inclusion in medical, scientific and military educational materials and programmes of information on the Convention and the 1925 Geneva Protocol. The Conference urges States Parties to 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, in order to raise awareness of the risks, as well as of the obligations of States Parties under the Convention.

15. The Conference encourages States Parties to take necessary measures to promote awareness amongst relevant professionals of the need to report activities conducted within their territory or under their jurisdiction or under their control that could constitute a violation of the Convention or related national criminal law. In this context, the Conference recognises the importance of codes of conduct and self-regulatory mechanisms in raising awareness, and calls upon States Parties to support and encourage their development, promulgation and adoption.

4. During the Intersessional Process between the Fifth and Sixth Review Conferences in 2001/2002 and 2006 respectively, Australia reported⁴ at the Meeting of Experts in 2005 that:

1. Amongst the Australian scientific community, there is a low level of awareness of the risk of the misuse of the biological sciences to assist in the development of biological or chemical weapons. Many scientists working in 'dual-use' areas simply do not consider the possibility that their work could inadvertently assist in a biological or chemical weapons programme.

5. At the same meeting in 2005 we reported work carried out with Brian Rappert of the University of Exeter in which we held interactive seminars to determine what the views were amongst those engaged in carrying out *practical* work in the life sciences regarding the 'dual use' potential of their work, particularly in regard to the results and techniques generated through experimental work. In total, 25 seminars were held as follows: 12 in England (excluding Greater London), 6 in Greater London, 3 in Scotland, 2 in Wales, 1 in Northern Ireland and 1 in Germany. Analysis of these seminars led us to conclude⁵ that:

*There is **little evidence** from our seminars that participants:*

- a. regarded bioterrorism or bioweapons as a substantial threat;*
- b. considered that developments in life sciences research contributed to bio-threats;*

³ United Nations, Sixth Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Geneva, 20 November – 8 December 2006, *Final Document*, BWC/CONF. VI/6, Geneva 2006. Available at <http://www.opbw.org>

⁴ Australia, *Raising Awareness: Approaches and Opportunities for Outreach*. BWC/MSP/2005/MX/WP.29. 21 June 2005. Available at www.opbw.org.

⁵ Dando, M.R. and Rappert, B. *Codes of Conduct for the Life Sciences: Some Thoughts from UK Academia*. Briefing Paper No 16 (Second Series), University of Bradford, May 2005. Available at www.brad.ac.uk/acad/sbtwc.

- c. were aware of the current debates and concerns about dual-use research;
- or
- d. were familiar with the BTWC.

6. In the next year, 2006, we reported to the Sixth Review Conference on further seminars in the UK and in Finland, Germany, Netherlands, South Africa and the United States. We found⁶ that despite the recent international attention given to the problem of the potential misuse of the life sciences, our initial findings reported at the Meeting of Experts in 2005 were essentially replicated in our later seminars in the UK, and in the other countries (Finland, Germany, Netherlands, South Africa and the US) we visited. We said that a *fundamental conclusion from this study therefore is that in depth implementation of the BTWC within States Parties requires a significant effort on education and outreach for such implementation to be effective. To achieve this, a simple declaration as at previous Review Conferences about the importance of education will be insufficient and States Parties will need to take concerted action to ensure increased educational provision and outreach.*

7. Our subsequent experience of carrying out seminars in 10 different countries (Argentina, Australia, India, Israel, Japan, Kenya, Sweden, Switzerland, Uganda, Ukraine) with three thousand life scientists in over 90 different departments has confirmed and consolidated these findings^{7,8}. Indeed, in our later work, we have used the seminars more as an awareness raising mechanism rather than a means of investigative research. It is thus evident that awareness raising and education have a key role in achieving the effective implementation of the Convention.

8. In this Review Conference Paper, we examine the education gap and consider how best this may be filled – and thereby improve the implementation of the Convention.

The Education Gap

9. These findings showing the lack of biosecurity awareness of those engaged in the life sciences requires explanation. Physicists have long been aware of the dangers of the misuse of their science and have played important roles, for example, in the Pugwash Conferences on Science and World Affairs which have since 1957 brought together influential policy officials, scientists and public figures to seek ways of eliminating nuclear weapons and reducing the threat of war. Chemists were also influential in helping to bring the negotiations in the 1980s of the Chemical Weapons Convention (CWC) to a successful conclusion, and the International Union of Pure and Applied Chemistry (IUPAC) has contributed major reviews of relevant science and technology to the first two Review Conferences of the CWC.

10. It is consequently not unreasonable to ask why practicing life scientists are so unaware of

⁶ Rappert, B., Chevrier, M.I. and Dando, M.R. *In-depth Implementation of the BTWC: Education and Outreach*. Review Conference Paper No. 18, University Of Bradford, November 2006. Available at <http://www.brad.ac.uk/acad/sbtwc>.

⁷ Rappert, B. and Chandre Gould (eds), *Biosecurity: Origins, Transformations and Practices*, New Security Challenges, 2009, Palgrave, Basingstoke.

⁸ Giulio Mancini and James Revill, *Fostering the Biosecurity Norm: Biosecurity Education for the Next Generation of Life Scientists*, Landau Network-Centro Volta, Como, Italy, November 2008. Available at: <http://www.centrovolta.it/landau/2008/11/20/FosteringTheBiosecurityNormBiosecurityEducationForTheNextGenerationOfLifeScientists.aspx>

the BTWC and the problem of dual-use despite the increasing attention being given to these issues, for example, by the U.S. National Academies? One possible explanation is that life scientists are unaware of biosecurity issues because it does not feature in their university education. In order to investigate this we carried out⁹, in co-operation with the Landau Network-Centro Volta in Italy, an internet survey on the extent of biosecurity education in life science degree courses in Europe. Using a sample of 142 courses from 57 universities in 29 countries speaking 25 different languages, we looked for evidence of biosecurity modules, bioethics modules and biosafety modules as well as for references to biosecurity, the BTWC, biological weapons and/or arms control, dual use and codes of conduct.

11. The results were quite startling:

This research suggested that only 3 out of 57 Universities identified in the survey currently offered some form of specific biosecurity module and in all cases this was optional for students.

On the other hand:

There is evidence of a considerable number of bioethics modules and nearly half of the degree programmes surveyed evidenced some form of bioethical focussed module. In terms of biosafety modules...roughly one fifth of life science degrees in the sample contained a specific dedicated biosafety module although several of these specific modules were optional.¹⁰

So we found a reasonable number of biosafety modules, a large, and we suspect, increasing number of bioethics modules, and virtually no biosecurity modules.

12. We attempted to investigate in more detail by looking for any kind of reference to biosecurity issues in the course material. Again the picture was bleak:

Exactly what constitutes a reference varies; however, based on the quantitative data from the investigation, we found a total of 37 life science degree courses out of our sample of 142 where there was clear evidence of a reference to biosecurity. Only a minority of the degree courses in the study - a total of 22 out of 142 - made a reference to the BTWC, BW and/ or arms control and a similar number, 29 degree courses, exhibited some reference to the dual -use issue.¹¹

⁹ Giulio Mancini and James Revill, *Fostering the Biosecurity Norm: Biosecurity Education for the Next Generation of Life Scientists*, Landau Network-Centro Volta, Como, Italy, November 2008. Available at: <http://www.centrovolta.it/landau/2008/11/20/FosteringTheBiosecurityNormBiosecurityEducationForTheNextGenerationOfLifeScientists.aspx>

¹⁰ Giulio Mancini and James Revill, *Fostering the Biosecurity Norm: Biosecurity Education for the Next Generation of Life Scientists*, Landau Network-Centro Volta, Como, Italy, November 2008. Available at: <http://www.centrovolta.it/landau/2008/11/20/FosteringTheBiosecurityNormBiosecurityEducationForTheNextGenerationOfLifeScientists.aspx>

¹¹ Giulio Mancini and James Revill, *Fostering the Biosecurity Norm: Biosecurity Education for the Next Generation of Life Scientists*, Landau Network-Centro Volta, Como, Italy, November 2008. Available at: <http://www.centrovolta.it/landau/2008/11/20/FosteringTheBiosecurityNormBiosecurityEducationForTheNextGenerationOfLifeScientists.aspx>

13. When we carried out a similar survey in Japan of 197 life science degree courses in 62 Universities we found¹² a similar picture with only 3 specific biosecurity modules. In Japan we took the investigation a stage further by sending out a questionnaire to lecturers asking why biosecurity and dual-use was not being taught. Clearly some lecturers did not see these subjects as relevant to their courses, but others certainly did. Where people thought the topics relevant but did not teach them the reasons cited were a lack of expertise and access to necessary resources and a lack of space on a very crowded timetable in the modern life sciences. Similar results were found in surveys in Israel (in a comprehensive survey of 35 courses in 6 research universities), and in the Asia-Pacific Region (Australia, China, India, Indonesia, Malaysia, New Zealand, Philippines, South Korea, Singapore, Thailand and Taiwan).

Correcting the Deficiency

14. It is evident that it will be a massive task to correct this deficiency in the education and awareness levels of life scientists and that this is one requiring action by States Parties at the Seventh Review Conference. In the meantime there is a potential role for civil society in providing models of what might be done to close the gap in the most effective way in a short time frame. The University of Bradford has over the past few years been developing a Dual-Use Biosecurity Educational Module resource [BEM]. A report¹³ by the US National Science Advisory Board for Biosecurity (NSABB) on a *Strategic Plan for Outreach and Education on Dual Use Research Issues* has considered what needs to be done in some detail. In their view, developing such a strategic plan requires:

First and foremost, the target audience must be identified and assessed as to their level of understanding of the issues since this will guide educational strategies.

It goes on to add that:

Messages should be tailored to specific target audiences. Key points must be identified and specifically crafted to effectively convey the nature and importance of the information while simultaneously addressing the unique concerns of different stakeholder groups.

And because there are so many different possible methods of communication:

it is important to select those methods that will most effectively reach the intended audiences.

15. When we applied a similar method of analysis to our work, it was evident that our intended target audience – university-level lecturers and students – did not have a high level of awareness of biosecurity and dual-use issues. Furthermore, given the prevalence of the use of the internet in universities, it was clear providing information on the web was by far the

¹² M. Minehata & Shinomiya. M, *Biosecurity Education: Enhancing Ethics, Securing Life and Promoting Science: Dual-Use Education in Life-Science Degree Courses at Universities in Japan*, Survey Report, 2009.

¹³ *Fostering the Biosecurity Norm: Biosecurity Education for the Next Generation of Life Scientists. Strategic Plan for Outreach and Education On Dual Use Research Issues*, Report of the National Science Advisory Board for Biosecurity (NSABB) 10 December 2008, Report of the National Science Advisory Board for Biosecurity (NSABB).

most efficient and effective way forward. However, given the different pressures on the timetable in different universities, we decided not to design a one-size-fits-all module and decided to design a Biosecurity Educational Module resource¹⁴ that could be used by individual lecturers around the world to draw upon so as to fit relevant parts into their own courses.

16. Our thinking was also much influenced by the developing consensus about education of life scientists that developed at the 2008 Meeting of the States Parties¹⁵ which considered:

(iv) Oversight, education, awareness raising and adoption and/or development of codes of conduct with the aim of preventing misuse in the context of advances in bio-science and bio-technology research with the potential of use for purposes prohibited by the Convention;

17. The report¹⁶ of this Meeting of States Parties stated that :

26. States Parties recognised the importance of ensuring that those working in the biological sciences are aware of their obligations under the Convention and relevant national legislation and guidelines, have a clear understanding of the content, purpose and foreseeable social, environmental, health and security consequences of their activities, and are encouraged to take an active role in addressing the threats posed by potential misuse of biological agents and toxins as weapons, including bioterrorism.

This paragraph then continued by saying, significantly, that:

States Parties noted that formal requirements for seminars, modules or courses, including possible mandatory components, in relevant scientific and engineering training programmes and continuing professional education could assist in raising awareness and in implementing the Convention.

18. In the next paragraph *the States Parties agreed on the value of education and awareness programmes* that would address the following:

- (i) Explaining the risks associated with the potential misuse of the biological sciences and biotechnology;*
- (ii) Covering the moral and ethical obligations incumbent on those using the biological sciences;*
- (iii) Providing guidance on the types of activities which could be contrary to the aims of the Convention and relevant national laws and regulations and international law;*

¹⁴ English and other language versions of the Biosecurity Education Module are available at <http://www.brad.ac.uk/bioethics/EducationalModuleResource/>

¹⁵ Meeting of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, *Report of the Meeting of States Parties*, BWC/MSP/2008/5, 12 December 2008.

¹⁶ Meeting of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, *Report of the Meeting of States Parties*, BWC/MSP/2008/5, 12 December 2008.

- (iv) *Being supported by accessible teaching materials, train-the-trainer programmes, seminars, workshop, publications, and audio-visual materials;*
- (v) *Addressing leading scientists and those with responsibility for oversight of research or for evaluation of projects or publications at a senior level, as well as future generations of scientists, with the aim of building a culture of responsibility;*
- (vi) *Being integrated into existing efforts at the international, regional and national levels.*

19. Our idea for the Biosecurity Education Module is to address as many of these ideas as possible based on the concept of having a web of integrated prevention policies¹⁷ that together would persuade anyone thinking of breaking the BTWC prohibition that the costs would far outweigh the benefits. However, in work carried out under British Council Funding with colleagues at Japan's National Defence Medical College on designing and testing the Biosecurity Education Module it became clear that any such module needed to start with material that could be readily understood by life scientists.

20. Thus the Biosecurity Education Module consists of 21 lectures, each consisting of 20 Powerpoint slides and notes for the lecturer, and with direct internet links to the references used. Each lecture also includes some suggested essay questions and the Biosecurity Education Module has an introduction to all the material for lecturers and a small number of Briefing Papers cover material that would be less familiar to life scientists. Several lectures are also duplicated with material in the second set being more scientifically orientated.

Biosecurity Education Module

21. Our Biosecurity Education Module resource¹⁸ has been designed in five parts:

A	Introduction and Overview	Lecture 1
B	The Threat of Biological Warfare and Biological Terrorism and the International Prohibition Regime	Lectures 2-10
C	The Dual-Use Dilemma and the Responsibilities of Scientists	Lectures 11-18
D	National Implementation of the BTWC	Lectures 19-20
E	Building an Effective Web of Prevention	Lecture 21

Part A gives a brief overview of the whole of the module resource in order to orientate the user. Part B then sets out the misuse of modern biology after the discovery of the causes of infectious diseases in the late 19th Century by scientists such as Pasteur and Koch. This history is largely unknown amongst life scientists and forms a basis for the consideration of the possible misuse of future advances. This part ends by briefly reviewing how the international community has dealt with the threat of the proliferation of biological weapons through the 1925 Geneva Protocol, the 1975 BTWC and the 1997 Chemical Weapons Convention, given that there is an overlap between the BTWC and CWC in the area of mid-

¹⁷ Pearson, Graham S. (1998). The Vital Importance of the Web of Deterrence, Background Paper, Division of Peace Studies, University of Bradford, UK. Available at: <http://www.brad.ac.uk/acad/sbtwc/other/bw-info.htm>

¹⁸ English and other language versions of the Biosecurity Education Module are available at <http://www.brad.ac.uk/bioethics/EducationalModuleResource/>

spectrum agents such as toxins and bioregulators.. In this part we have also introduced modern accounts of the traditional agents such as anthrax, smallpox and botulinum toxin in order to better engage scientists interest in the issue of biosecurity.

22. Lectures 2 – 10 in Part B are as follows:

2. Biological weapons from Antiquity to World War 1
3. Biological weapons from WW1 to WW11
4. Biological weapons during the Cold War
5. The impact of biological weapons agents
6. Assimilation of biological weapons in State Programmes
7. International legal agreements
8. Strengthening the BTWC 1980-2008
9. The 2003-2005 Inter- Sessional Process
10. The 2007-2010 Inter-Sessional Process.

These lectures begin with a consideration of the history of biological warfare and end with the BTWC recent annual meetings in which scientists have become increasingly involved-at least at the level of national academics and industrial leaders.

23. This then sets the scene for Part C in which lectures 11 to 18 address:

11. Bioethics methodology
12. Obligations derived from the BTWC
13. The growth of dual-use bioethics
14. Dual-Use: The US National Academy of Sciences Fink Report
15. Dual-Use examples
16. The US National Academy of Sciences Lemon-Relman Report
17. Weapons targeted at the nervous system
18. Regulation of the life sciences.

24. Although our studies strongly indicate that there is little biosecurity or dual-use content in university life science bioethics courses today, it is our belief that this is probably the best place to focus on these issues. Life scientists are becoming familiar with the ethical problems that new research brings up, and teaching of bioethics is growing in universities. Our view is that biosecurity and dual-use issues are best presented to life scientists in this context of the moral and ethical implications of research – a point that was made in the report of the 2008 Meeting of States Parties: see item (ii) reproduced in paragraph 17 above. Consequently, Part C of the module starts with a review of standard bioethical analyses that students are likely to have encountered before introducing the growing literature on dual-use bioethics. The section then leads on to a consideration of the key US National Academics Fink Report and the subsequent Lemon-Relman Report, which began the closer examination of the dual-use problem from within the scientific community. Lecture 15 examines classic dual-use experiments such as the mousepox experiment and Lecture 17 examines concerns over the misuse of advances in neuroscience so as to illustrate the contention by Lemon-Relman that the dual-use problem is far wider than just microbiology. Lecture 18 concludes Part C by

reviewing the various papers that have recently discussed the regulation of the security implications of the life sciences.

25. Parts D and E of the module continue this theme on national and international regulation:

Part D

- 19. International Regulation of Biotechnology
- 20. National Implementing Legislation

Part E

- 21. The Web of Prevention.

26. When the specific points agreed by the States Parties in paragraph 27 of the report on the 2008 Meeting of States Parties are considered:

27. States Parties agreed on the value of education and awareness programmes:

- (i) Explaining the risks associated with the potential misuse of the biological sciences and biotechnology;*
- (ii) Covering the moral and ethical obligations incumbent on those using the biological sciences;*
- (iii) Providing guidance on the types of activities which could be contrary to the aims of the Convention and relevant national laws and regulations and international law;*
- (iv) Being supported by accessible teaching materials, train-the-trainer programmes, seminars, workshops, publications, and audio-visual materials;*
- (v) Addressing leading scientists and those with responsibility for oversight of research or for evaluation of projects or publications at a senior level, as well as future generations of scientists, with the aim of building a culture of responsibility;*
- (vi) Being integrated into existing efforts at the international, regional and national levels.¹⁹*

it is evident that the Biosecurity Education Module has covered many of these.

27. The BEM was launched at the 2009 Meeting of States Parties.²⁰ The Module is currently available in English, Japanese, French, Russian (courtesy of the Government of Canada who facilitated its translation), and Polish, Romanian, Spanish, and Urdu versions are currently in preparation. The next sections set out further steps that should be taken. However, clearly much more needs to be done.

¹⁹ Meeting of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, *Report of the Meeting of States Parties*, BWC/MSP/2008/5, 12 December 2008.

²⁰ Adil Ayub and Simon Whitby, *Building Capacity in Dual-Use Bioethics*, *Peace Studies News*, Issue 48, Summer 2010, p. 2-4.

Increasing Efficiency through Networks

28. One way in which to build on the work that has been described here is to carry out further surveys of education provision in the university sector in different countries. These surveys, particularly if carefully followed up by questionnaire, telephone and e-mail inevitably provides a list of contacts of life science lecturers who are interested in bringing issues of biosecurity and the dual-use dilemma into their courses. By assisting the development of country and regional networks on the basis of these contacts it should be possible to generate a much faster development and uptake of material suitable for different countries and regions. Such an approach would also contribute to the agreement by States Parties on education and awareness programmes *being integrated into existing international, regional and national activities.*

29. A recent report²¹ from the US National Academies on *Ethics Education and Scientific and Engineering Research: What's Been Learned? What Should Be Done?* showed clearly how dual-use bioethics developments can be fitted into efforts to develop ethics education more broadly. It is, however, evident that whilst there are advances in understanding about how to proceed best in engaging students, an adequate means of evaluating the impact of such teaching on later ethical behaviour has yet to be found. The report points out that:

Attempts to evaluate and improve ethics education for scientific and engineering research and practice are just beginning. However, they do show that even though immediate results of some programmes are positive, circumstances and pressures can overwhelm graduate students, postdoctoral fellows, and junior-faculty end researchers and undermine results.

In the longer term, it is clear that attention to evaluation of the impact of dual-use bioethics education will be central to ensuring that the prohibition embodied in the BTWC is effectively implemented.

30. The next opportunity to address the education and awareness of all engaged in the life sciences will arise at the Seventh Review Conference in 2011. It is to be noted that the report of the Meeting of States Parties in 2008 included the following:

*31. States Parties are encouraged to inform the Seventh Review Conference of, inter alia, any actions, measures or other steps that they may have taken on the basis of the discussions at the 2008 Meeting of Experts and the outcome of the 2008 Meeting of States Parties, in order to facilitate the Seventh Review Conference's consideration of the work and outcome of these meetings and its decision on any further action, in accordance with the decision of the Sixth Review Conference (BWC/CONF.VI/6, Part III, paragraph 7 (e)).*²²

²¹ US National Academies, *Ethics Education and Scientific and Engineering Research: What's Been Learned? What Should Be Done? Summary of a Workshop*, 2009. Available at: http://www.nap.edu/catalog.php?record_id=12695

²² Meeting of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, *Report of the Meeting of States Parties*, BWC/MSP/2008/5, 12 December 2008.

Consequently, if networks of life scientists concerned with implementing dual-use bioethics education can be set up in different countries and regions, and if they think about evaluation of their efforts, then the results could be applied rapidly in other places to help close the education gap.

31. Even if all of what has been discussed in this paper was to be achieved it would still leave much needing to be done. Two specific points in the report of the 2008 Meeting of States Parties appear particularly important to us: train-the-trainer programmes and addressing leading scientists with the aim of building a worldwide culture of responsibility amongst life scientists. In addition, we would argue that there is a need for the identification and articulation of biosecurity competency standards and the creation of a network and register of biosecurity-aware practitioners. In regard to both these, we believe rapid progress can be made through the use of modern technology.

Train-the-Trainer

32. One of the most efficient and effective ways in which to build a worldwide sustainable capability in dual-use biosecurity is through the development of train-the-trainer programmes²³. Such courses can be delivered online using interactive virtual learning e-platforms where course participants can explore in real-time face-to-face lectures issues of relevance to dual-use, biosecurity and address concerns and dilemmas that result from activities in the life sciences.

33. With the aid of such technologies, life scientists can usefully be engaged in discussions about the concept of biosecurity and in discussion regarding the way in which this term relates to but differs from the concept of laboratory biosecurity and the management of biosecurity risk which has arisen to ensure that dangerous materials are kept secure from those with malign intent. Engagement on the issue of 'biosecurity' can facilitate the development of a broader informed appreciation of the phrase being used to relate to a threat spectrum that ranges from natural outbreaks of disease and accidental outbreaks of disease, through to deliberate outbreaks of disease. It can be pointed out that natural outbreaks of disease is addressed by public-health measures, and accidental outbreaks of disease by 'biosafety' – in other words by addressing seriously issues around good laboratory practice.

34. Thus biosafety and laboratory biosecurity can be viewed by life scientists as a component part of biosecurity, whilst at the same time the point can be made that the term has a much wider meaning related to the concept of a web of preventative policies centred on the prohibition of the misuse of the life sciences embodied in the General Purpose Criterion of the BTWC. Thus biosecurity can be addressed as being the objective of the whole range of policies, including those that relate to issues such as *inter alia* biosafety, laboratory biosecurity, bio-defence, export controls, regulation of biotechnology, and national implementation of the Biological Weapons Convention, all of which make a vital contribution to minimising the possibility that the life sciences might be used for hostile purposes. Within that range of policies there is a clear role for practising life scientists in being aware that the materials, technologies and knowledge they produce may be misused;

²³ See the University of Bradford's Applied Dual-Use Biosecurity Education Masters Level 20 Credit teaching modules at: <http://www.brad.ac.uk/peace/courses/>

and a role for practicing life scientists in contributing their expertise to the development and maintenance of preventative policies.

35. Such online learning courses can be designed to include the following learning outcomes in that they can:

- Introduce participants to the wider concept of 'biosecurity';
- Introduce participants to the concept of 'bioethics' and its relationship to the broader issue of biosecurity;
- Develop awareness and understanding of a range of dual-use ethical dilemmas that arise due to the impact of science and technology on society;
- Develop knowledge of ethical approaches which provide a defence for ethical decisions or recommendations regarding dual-use technologies; and
- Facilitate further ethical research into 'dual-use' issues and develop policies and practices that will prevent the misuse of knowledge generated through biomedical research.

Participants can be encouraged to bring their own personal ideas and experiences to such courses, and share ideas with their fellow participants in order to contextualise knowledge and understanding in ways that will help meet the ethical challenges thrown up by dual-use. Participants on such courses can participate in online lectures, seminars, and discussion groups and interaction on course-work-related topics can take place between tutors, moderators and students and participants can benefit from a supportive and interactive on-line web-based learning community toward the completion of coursework assignment and the completion of online group work scenarios based on real-world dual-use life science scenarios.

36. Lectures can be designed to address the themes identified as being of central importance to the development of an informed appreciation of biosecurity so as to cover a range of issues of relevance including²⁴ an understanding of: the threat (offensive biological warfare programmes and bioterrorism); the prohibition regimes (the Geneva Protocol, the BTWC, the CWC, Security Council Resolution 1540); dual-use dilemmas (including paradigm cases such as Mousepox, Spanish Influenza, and Synthetic Polio); responsible conduct of research (on being a scientist); the importance of national implementation of the BTWC; and, the wider web of preventative policies that together minimise the risk of the hostile misuse.

37. A case study approach applied in seminar scenarios can usefully allow life scientists to develop an informed appreciation of the range of dual-use dilemmas and knowledge and learning can be enhanced in this respect from inviting direct personal experience of dual-use dilemmas that participants may have been confronted with in the educational settings or in the workplace. Advanced-level group work seminar scenarios can be designed with practical application in mind, for example, by setting an assignment that invites participants to show how they might utilise the information in the Biosecurity Education Module through its incorporation and assimilation in the teaching of others across a range of educational and professional settings.

²⁴ English and other language versions of the Biosecurity Education Module are available at <http://www.brad.ac.uk/bioethics/EducationalModuleResource/>

38. Reaching the required standard – can be measured against the learning outcomes set by appropriate course module descriptors and can include the following:

1. Knowledge & Understanding.

On successful completion of this module participants will be able to:

- Review and appraise the key concept of biosecurity
- Review and appraise ethical theories and methods relevant to dual-use
- Recognise and discuss ways in which the application of ethics methodologies resolves or leaves unresolved ethical questions relating to dual-use issues

2. Discipline Skills

On successful completion of this module participants will be able to:

- Organise and synthesise ideas and questions relevant to assessing ethical dilemmas in specific dual-use issues affecting humans, animals and plants
- Integrate dual-use biosecurity issues and concerns into the training of others.

3. Personal Transferable Skills

On successful completion of this module participants will be able to:

- Evaluate and integrate data from a variety of sources and express these ideas clearly both verbally and in writing
- Communicate effectively in an online environment with your colleagues and students using a range of media
- Collaborate effectively with colleagues on group tasks and assessments
- Support the learning of colleagues through peer reviews and assessments
- Make effective use of communication and information technologies

Biosecurity Competency Standards

39. A further development that could also facilitate the building of a sustainable capability in dual-use biosecurity is through the establishment of a common competency standard in biosecurity. We see a potentially significant role for the rapid establishment of networks in different countries and regions in helping to close the education gap. Through the development and support for an expanding network of practitioners, and with novel means of dissemination, the latter will facilitate the further dissemination of research on dual-use bioethics and biosecurity and contribute to achieving a much needed cultural change in life science education and practice. Such a competency standard in biosecurity can be used to increase momentum in bringing about this much needed change in life science culture and practice through the identification, articulation and formalisation of Bioethics and Biosecurity Professional Competency Standards; and through the creation, development and ongoing support for a Bioethics and Biosecurity Professional Competency Standards Register and Network.

40. A pertinent example of how this might assist in the object of building capacity in this area is in the establishment of online Train-the-Trainer courses of the kind that have been established at the University of Bradford. Such courses in Applied Dual-Use Bioethics and

Biosecurity Education are currently being delivered by the Bradford Disarmament Research Centre (BDRC). This is a 20 credit module and a 6-week short course in Applied Dual-Use Bioethics and Biosecurity Education. There is a wide range of participants including some from the Middle East – Egypt, Jordan, Libya, Morocco, Qatar, Saudi Arabia, United Arab Emirates; from South Asia - Pakistan, Afghanistan; from East Asia - Philippines, Indonesia; and from Africa - Kenya, Nigeria, Uganda. There is thus an opportunity to create and subsequently develop of a network of participants with Professional Competency Standards in Bioethics and Biosecurity. The competency standard would be moderated and accredited by University of Bradford and the criteria would be to pass the module.

Conclusions

41. It is evident from our seminars in 16 different countries (UK, Finland, Germany, Netherlands, South Africa and the United States and then in Argentina, Australia, India, Israel, Japan, Kenya, Sweden, Switzerland, Uganda, Ukraine) with several thousand life scientists in over 90 different departments that there is little awareness amongst the life scientists in academia of the obligations arising from the Biological and Toxin Weapons Convention and that there is little understanding of the potential dual-use nature of the life sciences. Whilst our work has been primarily in academia, there is little to suggest that the situation is any different in industry or government. Consequently, it is evident that for effective national implementation of the BTWC, education and awareness programmes need to be an integral part.

42. As we noted prior to the Sixth Review Conference in 2006:

A fundamental conclusion ... is that in depth implementation of the BTWC within States Parties requires a significant effort on education and outreach for such implementation to be effective. To achieve this, a simple declaration as at previous Review Conferences about the importance of education will be insufficient and States Parties will need to take concerted action to ensure increased educational provision and outreach.

Our subsequent work reinforces this conclusion and it is evident that one of the most effective steps that could be agreed by the Seventh Review Conference would be an agreement that each States Party in implementing Article IV of the Convention shall carry out an extensive education and outreach programme amongst all those engaged in the life sciences, whether in academia, industry or government. We would urge the adoption of a National Implementation Action Plan at the Seventh Review Conference that includes as an essential integral element the requirement to carry out such an education and awareness programme.