Chapter 5

Responsible Governance of Biosecurity in Armenia

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Abstract This chapter analyses a case study of responsible governance of dual use life sciences and biosecurity in Armenia. It is based on materials presented during a Responsible Research and Innovation Course in Armenia, held on 17–19 May 2019. The course was organised as part of the ISTC Targeted Initiative (TI) on CBRN Export Control and Dual Use in Central Asia. The focus of the case study is on ethical aspects and how collective responsibility for biosecurity can be organised, in order to prevent innovation from undermining international law prohibiting hostile uses of life sciences.

5.1 Introduction

For the purpose of this chapter, dual use technology is defined as civil technology with military or criminal misuse potential. Dual use sciences and technologies are problematic, because banning them is impossible since this would inhibit the development of beneficial peaceful applications such as new medicine or novel food. In addition, the current legal framework is insufficient to govern emerging new technologies. Innovation in dual use technologies calls for additional voluntary self-governance of the scientific and industrial communities concerned.

In general, innovation impacts laws through the following mechanism. Laws governing technologies are formal instruments, adopted by legislative authorities, which regulate the market access and permitted properties and uses of known technological products, processes and systems. Future technological innovation can be addressed to some extent during the formulation of laws, e.g. through “general purpose criteria” in the Chemical and Biological Weapons Conventions prohibiting any kind of chemical, biological or toxin substance for hostile purposes, implicitly covering also substances which did not exist at the time of adopting the convention.

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However, innovation tends to create uncertain and unforeseen impacts, which often go beyond the imagination of lawmakers (Trump et al. 2020a). This unpredictability of emerging technologies calls for regular updating of existing laws or even adoption of new laws. E.g. the increasing popularity of innovative drones among hobbyists (e.g. airborne cameras) and commercial service providers (e.g. delivery drones) has led to discussion on the adoption of new laws regulating unmanned aerial vehicles (c.f. Finger et al. 2015). Nevertheless, the laws update process is difficult and takes time to catch up with technological innovation, because of that, in many cases, when the new law is out, it is already outdated.

The formulation of legal texts related to science and innovation are based on sound scientific evidence, the collection of which is time consuming, and on consultations with the relevant stakeholders, often with conflicting interests and diverging views. In these circumstances, soft law (e.g. EU or UNESCO Recommendations) or voluntary codes of conduct are often used as complementary instruments to fill the formal legislative deficit.

After presenting the current legal framework governing dual use life sciences and biosecurity, we will discuss some ethical concepts and instruments that could be used to govern this domain. How these ethical instruments can work out in practice, and which stakeholders should be involved is illustrated in the subsequent case study of dual use life sciences in Armenia. The chapter ends with some conclusions and recommendations.

5.2 Capacity Building in Dual Use Export Control in TI Partner Countries

The International Science and Technology Center (ISTC) and the Science and Technology Center in Ukraine (STCU) are intergovernmental organizations established in 1992 and 1993, respectively as unique multilateral mechanisms to prevent proliferation of ex-Soviet scientific know-how related to weapons of mass destruction (WMD). By sponsoring and facilitating scientific cooperation, the two Centers seek to integrate these scientists into the international community and redirect their talents into peaceful, sustainable, civilian work. Between them, the ISTC and STCU Recipient membership include most of the former Soviet Independent States. Both Centers have the legal status of intergovernmental organizations with diplomatic privileges in the member countries where they work.

In the last two decades, the threat that non-state actors may acquire chemical, biological, radioactive or nuclear (CBRN) weapons has become an increasing concern for the international community. Taking into consideration the fast pace of scientific and technological change that is taking place in the ISTC/STCU countries, both Centers have developed new delivery mechanisms for science & technology projects over the past 10 years described as Targeted Initiatives (TI's). One of

them is a Targeted Initiative on CBRN Export Control on Dual-Use Materials and Technologies funded by the European Commission.

The partner countries (PC) of the TI are Afghanistan, Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Mongolia, Pakistan, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.

The Targeted Initiative focuses on mitigating the risks of misuse of the investigations and know-how related to CBRN weapons programs; the raising of awareness among both the academic and industrial community of these risks, as well as facilitating the collaboration between state and non-state actors of Export Control systems in PC's.

The Targeted Initiative includes the following activities:

- Development of a network of scientists and activities related to responsible science and ethics;
- Development of a master course and other customized courses on export control;
- Grants for PhD students from the Partner countries; and
- Outreach to Industry, including handbooks development and commodity identification courses.

Since the start of the activities under the TI, the Centers have carried out several regional seminars to raise awareness among researchers, academics, industry, and government representatives.

In September 2019, in conjunction with Taras Shevchenko National University of Kyiv, Ukraine, a master program on Economic security of Entrepreneurship including modules on export control was launched.

Furthermore, within the TI activities, local experts from Kyrgyzstan, Georgia, Moldova, Ukraine and Azerbaijan developed handbooks on export control. These handbooks will be available free of charge to the public with an intention to facilitate the access to the information and improve the control of dual-use goods.

In Kazakhstan, a group of experts is working on an Internal Compliance Program (ICP) model to be used by industries, which will then be made available to all partner countries.

In August 2019, the Centers held a meeting in Ypres, Belgium, for young scientists, in order to raise awareness of the potential misuse of their research and the importance of ethics in education. The outcome was very impressive with many of the scientists developing projects on ethics and education to be run in their own countries, for young students.

5.3 Legal Framework Governing Dual Use Life Sciences and Biosecurity

There are several legal instruments governing dual use life sciences, each of them with different characteristics and imposing different obligations to signatories and partner countries.

5.3.1 *Protocol for the Prohibition of the Use of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare – Geneva Protocol of 17 June 1925¹*

The Geneva Protocol was drawn up and signed at a conference which was held in Geneva under the auspices of the League of Nations from 4 May to 17 June 1925, and it entered into force on 8 February 1928.

The 1925 Geneva Protocol prohibits the use of chemical and biological weapons in war: “asphyxiating, poisonous, or other gases, and of bacteriological methods of warfare.” It recognizes the significance of bringing together controls on chemical and biological weapons. It prohibits the **use** of such weapons. A number of countries submitted reservations when becoming parties to the Geneva Protocol, declaring that they only regarded the non-use obligations as applying to other parties and that these obligations would cease to apply if the prohibited weapons were used against them. The main elements of the protocol are now considered by many to be part of customary international law.

Armenia signed the Protocol on 13 March 2018.

5.3.2 *The Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction²*

The Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, commonly known as the Biological Weapons Convention (BWC) or Biological and Toxin Weapons Convention (BTWC) is a legally binding multilateral treaty that outlaws biological arms banning an entire category of weapons. The BTWC opened

¹ https://unoda-web.s3-accelerate.amazonaws.com/wp-content/uploads/assets/WMD/Bio/pdf/Status_Protocol.pdf

² <http://disarmament.un.org/treaties/t/bwc/text>

for signature in 1972 and entered into force in 1975. It currently has 183 states-parties, including Palestine, and four signatories (Egypt, Haiti, Somalia and Syria). Ten states have neither signed nor ratified the BTWC (Chad, Comoros, Djibouti, Eritrea, Israel, Kiribati, Micronesia, Namibia, South Sudan and Tuvalu).

The BTWC bans the development, production, acquisition, transfer, retention, stockpiling and use of

- Biological agents and toxins “of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes;”
- Weapons, equipment, and delivery vehicles “designed to use such agents or toxins for hostile purposes or in armed conflict.”

The convention further requires states-parties to destroy or divert to peaceful purposes the “agents, toxins, weapons, equipment, and means of delivery” described above within nine months of the convention’s entry into force. Accordingly, many States Parties have adopted national legislation and regulations to implement the prohibitions of the Convention. The BTWC does not ban the use of biological and toxin weapons but reaffirms the 1925 Geneva Protocol, which prohibits such use. It also does not ban biodefense programs.

In contrast to the Chemical Weapons Convention, the BTWC has no verification mechanism to monitor compliance, and negotiations on the creation of such a mechanism have stalled to date. The treaty regime mandates that states-parties solve compliance concerns consulting each other and also allows states-parties to lodge a complaint with the UN Security Council who can investigate compliance issues; but this power has never been invoked.

At the Sixth Review Conference (2006), the States parties adopted by consensus a detailed plan for promoting universal adherence and decided to update and streamline the procedures for submission and distribution of the Confidence-Building Measures (CBMs). They also adopted a comprehensive intersessional programme spanning from 2007 to 2010 that included activities related to the implementation of the obligations that arise from different articles of the treaty. In a significant development, the Conference agreed to establish an Implementation Support Unit (ISU) to assist States parties in implementing the Convention. The ISU -a 3 persons team- has been established for the BTWC within the Geneva Branch of the United Nations Office for Disarmament Affairs, which is also tasked with outreach activities. But in practice, education, outreach and awareness-raising activities take place in scientific, professional and academic associations, bodies and institutions within States Parties.

Recently, and in particular in the wake of the evolution of more sophisticated/complex terrorism threats and actions, a renewed interest in ensuring greater global participation and implementation of the BTWC has rapidly emerged. So, States Parties agreed to promote the effective implementation of the Convention nationally, including integration into education; outreach; and raising awareness.

In 1994, Armenia joined the Biological and Toxin Weapons Convention (BWC).

5.3.3 *United Nation Security Council Resolution No. 1540 (UNSCR 1540)*³

United Nations Security Council Resolution (UNSCR) 1540 places an international obligation on all Members of the UN to take action against the proliferation of WMD. UNSCR 1540 is a legally binding international instrument with the objective to prevent non-state actors from acquiring and using WMD, which has been widely used as a common legal basis for states to use when drafting and promoting strategic trade control legislation. The resolution also encourages international cooperation to achieve its goals and raise awareness among the national stakeholders to have a sound implementation of the Resolution.

The control lists agreed in the multilateral regimes (Nuclear Suppliers Group, Australia Group, Missile Technology Control Regime and Wassenaar Arrangement) have become an informal part of international law, since they are (vaguely) referred to in UNSCR 1540. In a footnote, UNSCR 1540 defines related materials as ‘materials, equipment and technology covered by relevant multilateral treaties and arrangements, or included on national control lists, which could be used for the design, development, production or use of nuclear, chemical and biological weapons and their means of delivery’.

Armenia sent information to the 1540 Committee on the following dates: 9 November 2004, 21 December 2005, 12 December 2007, 4 March 2014 and 22 August 2016.

The country matrix was approved on 23 December 2015. It contains all the relevant provisions related to the implementation of the UNSCR 1540 on the nuclear, chemical and biological fields included in the Constitution, Criminal Code and other legal instruments.

The 1540 Committee uses the matrices as a reference tool for facilitating technical assistance and to enable the Committee to continue to enhance its dialogue with States on their implementation of Security Council resolution 1540 (2004). The matrices are not a tool for measuring compliance of States in their non-proliferation obligations but for facilitating the implementation of Security Council Resolutions 1540 (2004), 1673 (2006), 1810 (2008), 1977 (2011) and 2325 (2016).⁴

5.3.4 *National Laws and Law Enforcement*

Internally, each country must fulfil the obligations assumed at the time they become part of the international instruments above-mentioned. According with their legal system, they will issue the laws that are required to comply with the treaties.

³[https://undocs.org/S/RES/1540\(2004\)](https://undocs.org/S/RES/1540(2004))

⁴<https://www.un.org/en/sc/1540/national-implementation/1540-matrices.shtml>

When it comes to the enforcement there are many nuances related to both the extent of the dual use related sector in the country (not only the industry but the universities and academia), the commitment of the state with WMD non-proliferation, the risk perception analysis on the topic and the availability of resources (human and financial) to do the task.

Because of the disparity between countries, many international programs are in place to help them to have a sound implementation of their international obligations.

Our TI on Export Control is linked to the countries' obligations under the UNSC 1540 as well as the BTWC.

In 2010 Armenia adopted a Law on control over the circulation of goods and technologies of dual use which substituted an analogous law adopted in 2003. For the implementation of the law, the Government of Armenia adopted a Decree No 1785 of 15.12.2011, which confirmed the control list of dual-use goods. The list follows the European list of controlled dual-use goods and technologies and it is frequently updated according to the changes of the European lists.

The violations of the obligation of the international treaties regarding biological weapons is included in the Armenian Criminal Code, mainly in articles 284–286 and 386–387.⁵

5.4 Ethics of Dual Use Life Sciences

The legal framework described above constitutes a solid foundation for governing dual use life sciences. As mentioned in the introduction, this legal basis should be complemented by respect for fundamental ethical principles. From an ethical perspective, four concepts are relevant for governance of dual use life sciences: human rights, justice, war and peace, and responsibility.

Human rights are fundamental and inalienable, meaning that the rights of any human being should always be respected, even if they would not be formally written down in a positive legal text. Human rights are universal, meaning that everyone is entitled to the rights. International law includes positive formulations of human rights, distinguishing civil and political liberties, and socio-economic rights.⁶ This formalisation is a continuing process leading to the recognition of new rights under the influence of social as well as technological innovations. Some current discussions address the recognition of rights for human embryos, animals and cyborgs (cybernetic organisms, e.g. combining robotic and human body-parts). Several technologies can impact human rights in different ways. For example, innovation in biomedical technologies can affect the right to life, human dignity, informed consent and other health-related rights. Emerging Information and Communication

⁵ https://www.unodc.org/res/cld/document/armenia_criminal_code_html/Armenia_Criminal_Code_of_the_Republic_of_Armenia_2009.pdf

⁶ C.f. UN Treaty collection: <https://treaties.un.org/>

Technologies (ICT) influence the way privacy, personal data protection, civil and political rights and the right to decent working conditions can be protected. Novel agricultural or food technologies can affect socio-economic rights of farmers and consumers. Human rights are not absolute: trade-offs between different rights must be found in a continuing balancing act, e.g. between academic freedom for life scientists and biosecurity for society at large.⁷

Justice is a concept which intrinsically calls for balancing the rights of different individuals and social communities. New technology tends to impact this balance in different ways. For example, the right to ownership presupposes a delicate balance between protection of intellectual property for inventors and companies versus the universal right to reap the fruits of progress in science for the common good. As new technologies emerge, this balance may shift. For example, the European Group on Ethics highlighted potential ethical issues related to protection of intellectual property raised by innovation in nanomedicine: “According to the current regulatory system for patenting, some exemptions are allowed with regard to the patentability of therapeutic and surgical procedures. The exemptions in the present patent system are based on a balance of interests whereby diagnosis, therapy and research should be available to patients without patents being a hindrance. This is likely to be blurred because the new nanomaterials may logically fall within more than one category. To protect the ethical position that has led to these exemptions it is important to ensure that patents in these new areas do not alter the current balance. There are risks of overly broad patents being granted that may hinder their therapeutic availability. This is also the case for nanomedicine.” (EGE 2007). In addition, fairness may be affected if technology gives rise to a changing gap between haves and have-nots. New surveillance technologies can facilitate shifting the balance between liberty and security towards securitization by “big brothers” (governments monitoring the movements of citizens without a reasonable ground) and “little sisters” (private companies and citizens spying on each other).⁸

Dual use technologies sit squarely at the crossroads between war and peace, which are the focus of several philosophical ethical theories including pacifism⁹ and the Just War Theory.¹⁰ The former prohibits the use of violence to solve conflicts between states, while the latter imposes threshold for political decisions to go to war (Jus ad Bellum) and humanitarian rules for conduct of armed forces during a war (Jus in Bello). International Humanitarian Law¹¹ can be considered a positive formulation of Just War Theory. Some conventions including the Geneva Conventions and arms control treaties including the Biological and Chemical Weapons Conventions extend their scope to military and dual use research and innovation.

⁷Read more about the philosophical concept “Human Rights” here: <https://plato.stanford.edu/entries/rights-human/>

⁸Read more about the philosophical concept “Justice” here: <https://plato.stanford.edu/entries/justice/>

⁹C.f. <https://plato.stanford.edu/entries/pacifism/>

¹⁰C.f. <https://plato.stanford.edu/entries/war/>

¹¹C.f. https://www.icrc.org/en/doc/assets/files/other/what_is_ihl.pdf

Notably, Article 36 of the First Protocol of the Geneva Convention (8 June 1977) reads: “In the study, development, acquisition or adoption of a new weapon, means or method of warfare, a High Contracting Party is under an obligation to determine whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any other rule of international law applicable to the High Contracting Party.”

Dual use life sciences are simultaneously subject to human rights including the right to academic freedom and ownership of intellectual property, and to international humanitarian rights, including the ban on use of life science knowledge and technologies for hostile purposes. Malsch (2013) includes a suggestion for balancing these rights, by extending the scope of some Just War principles to military and civil security research and balancing these with academic ethical principles governing peaceful uses. In the early stages of dual use research, from basic research (Technology Readiness Level, TRL 1)¹² until TRL 5 (technology validated in relevant environment) as well as commercial dual use research from TRL 6 (technology demonstrated in relevant environment) until TRL9 (actual system proven in operational environment), care should be taken to balance freedom and security, and dual use risk and technology assessment should be performed in parallel to the R&D. Advance civil security research (TRL 6–9), such as the development of sensor technologies for controlling access to life science laboratories, should in addition address the Just War principles of Just Intent and Proportionality. Advanced legitimate military research (TRL 6–9) such as biodefence is subject only to Just War principles Just Intent, Legitimate Authority and Proportionality.

The principle of collective responsibility for progress in science and technology was formulated by the philosopher Hans Jonas (1979). In short, he asserted that science and technology can potentially contribute to catastrophic risks, e.g. by large scale use of biological, chemical, or nuclear weapons. To prevent the extinction of humankind he foresaw, all people must contribute to a collective responsibility. In his view, worst case scenarios must be developed as the basis for strict regulation of science and technology. Since then, the interdisciplinary field of technology assessment has emerged (c.f. Banta 2009), and several methodologies have been developed for risk management and risk governance. Currently, most experts seek to strike a balance between potential benefits and risks. A related trend is the shift from government to governance. Government implies that national authorities in a State have the sole responsibility to protect their citizens, environment, and national interests. Governance implies that governments share a collective responsibility with non-state actors, including companies, the research community, non-governmental organisations (NGOs) and citizens. However, responsible governance of innovation is not straightforward, because of “many hands” (c.f. Poel et al. 2015) or “wicked problems”¹³: in the current system with a globalised economy, national legal

¹²Read more on Technology Readiness Levels: https://en.wikipedia.org/wiki/Technology_readiness_level

¹³C.f.: https://en.wikipedia.org/wiki/Wicked_problem

sovereignty and international governmental organisations, too many parties take responsibility for their own part of the problem, nobody has the capacity to take responsible for the common good, and unforeseen negative consequences are not addressed (Trump et al. 2020a, b). The need for institutional reform is often stressed by UN institutions, Multinational companies (World Economic Forum), International NGOs and the Scientific community (c.f. Malsch 2018).

5.5 Case Study Life Sciences and Biosecurity in Armenia

On 17–19 May 2019, we organised a Responsible Research and Innovation Course for young researchers in Armenia, together with Kai Ilchmann and Hrayr Azizbekyan in the framework of the ISTC TI on export control. An interdisciplinary group of 15 young researchers participated. One of the key case studies demonstrated how innovation can undermine law focused on biosecurity issues. The present chapter discusses the responsible governance of dual use life sciences and biosecurity in Armenia, based on the course materials.

Biology, biomedical sciences, agriculture and other life sciences are double edged swords. The same knowledge, materials and technologies are needed to cure or feed people but can also be misused to kill people or to destroy livestock or food crops (biological weapons). Bio risk management is needed, consisting of two distinct approaches. Biosafety aims to “protect people from bad bugs” (natural or accidental infectious disease outbreaks), while biosecurity aims to “protect bugs from bad people” (human-made epidemics). Biosecurity can be protected through legal, social, and technological means. In the legal dimension, biological weapons are prohibited through the abovementioned international agreements and national laws, but also through professional codes of conduct for researchers and companies, including the Statement on Biosecurity published by the Inter-Academies Partnership (IAP) in 2005.¹⁴ The code includes these principles: Awareness, Safety and Security, Education and Information, Accountability and Oversight. The National Academy of Sciences of Armenia is among the 70 national academies which endorsed this code.

Technological biosecurity measures include infrastructure and equipment in laboratories at increasingly stringent biosafety levels (1–4).¹⁵ In addition to technological means for protecting the Occupational Health and Safety of laboratory staff, safer-by-design methods are under development, which can limit the feasibility of misusing life sciences for hostile purposes. Social biosecurity measures include peer review of laboratory risk management including site visits. Researcher training, security screening of employees and dialogue with stakeholders and citizens

¹⁴<https://www.interacademies.org/17806/Biosecurity> and <http://www.interacademies.org/10878/13912.aspx>

¹⁵https://en.wikipedia.org/wiki/Biosafety_level

about biosecurity measures are also useful social means to raise awareness of biosecurity issues.

5.6 Dual Use Life Sciences in Armenia

Life science research is performed in Yerevan State University, Armenian State Agrarian University, and several institutes of the National Academy of Sciences: the institutes of Zoology, Hydroponics, Botany, Molecular Biology, Organic Chemistry and the centre of microbiology and deposition of microorganisms. The Scientific Centres of Agrobiotechnology and of Vegetable-Melons and Industrial Crops of the ministry of agriculture and the Scientific Research Institute of Biotechnology of the Ministry of Economy are also involved (Hovhannisyan and Yesayan 2010). In addition to the biological research in universities, nature is also a possible source of biosafety and biosecurity risks. Some infectious diseases are endemic in the territory of Armenia, including plague (in 80% of the country), tularaemia, anthrax, yersiniosis, leptospirosis, and erysipeloid (Hovhannisyan and Yesayan 2010).

As mentioned in the section on the regulatory framework, Armenia has adopted the BWC already in 1994. The capacity for bio risk management has been built up in international projects since then. Recent international cooperation projects include the following. In 2013–15, UNICRI¹⁶ funded several biosecurity projects in Armenia, focusing on food safety risk assessment, and the work of ministries for emergencies, agriculture, public health, and livestock disease surveillance. The USA and EU have also invested in infrastructural laboratory safety and building human capacity to comply with biosafety protocols including the WHO biosafety manual. Armenian researchers including Avetisyan et al. (2017) surveyed the status quo in medical laboratories and recommended introducing biosafety manuals and training for the personnel. Likewise, Danielyan and Mnatsakanyan (2017) recommended setting up training, working groups and investment in biosafety and biosecurity measures. Indeed, such training and capacity building has continued since then. For example, in 2018, the International Science and Technology Centre (ISTC) organised seven workshops in Armenia to strengthen laboratory biosafety, training 75 participants from 38 laboratories, with EU funding. In addition, ISTC organised a seminar on dual use export control in Yerevan.¹⁷

¹⁶<http://www.unicri.it/index.php>

¹⁷C.f. www.istc.int

5.7 Discussing Ethical Dilemmas

While most of the capacity building on dual use export control focused on transferring knowledge on national and international legal requirements and on technological and infrastructural safeguards for implementing biosecurity and biosafety, in the Responsible Research and Innovation Course, we raised some ethical dilemmas connected to dual use life sciences and biosecurity issues. The first addressed what would be an appropriate balance between openness and confidentiality in academic dual use research. The second addressed balancing public and private responsibilities in governing biosecurity. The third addressed the acceptability of do-it-yourself biology with dual use potential. All three cases were based on ethical issues which had been discussed in other countries, where private biotechnology companies and do-it-yourself biology laboratories were more common than in Armenia. For example, some participating young researchers had not heard about do-it-yourself biology and were concerned about the implications of allowing this outside of the institutional oversight in universities.

As most of the dual use life sciences research in Armenia is academic at Technology Readiness Levels 1–5, Malsch (2013) would recommend dialogue to reach agreement on the appropriate balance between fostering academic freedom and protection biosafety and biosecurity. The capacity building activities including training staff in biosafety and biosecurity measures are suitable ways to foster such dialogue. In addition, the research performed in the facilities should be accompanied by dual use risk and technology assessment, to monitor emerging biosafety and biosecurity risks.

During the RRI Course, we pointed out the limitations of legal instruments for governing dual use life sciences and called for collective responsibility for dual use research in a “web of prevention” perspective (Dando 2000; Rappert and McLeish 2007). In this case, regulation is not enough, because lifesaving and economically useful research is inherently dual use. In addition, rapid progress in science and technology undermines existing legislation. Collective responsibility for frontier research implies distinct role responsibilities for the involved actors. Governments should perform oversight, improve regulation, and organise public and stakeholder dialogue. Scientists should contribute their expertise in science for policy, train students, develop and abide by codes of conduct, conduct confidence building peer review, participate in academic and public dialogue, and apply their knowledge in safer-by-design research. Companies handling dual use biological materials including pharmaceutical and food producing industry should take their corporate social responsibility, develop and abide by biosafety and biosecurity codes of conduct, inform policy makers about innovations which could influence the current legal framework governing biosecurity, host site visits as part of confidence building measures, and participate in public and stakeholder dialogue. NGOs should contribute to raising public awareness of biosecurity issues, campaign for governmental oversight of dual use life sciences activities, and participate in public dialogue. Citizens should also participate in public dialogue.

5.8 Conclusions and Recommendations

Besides knowledge transfer, the course programme featured lively discussions about the role of scientists in the contemporary Armenian society. Several participants were keen on developing skills in science communication. Inspired by existing codes of conduct including the IAP Statement on Biosecurity, the participants expressed the intention to develop an “Apaga Declaration” including common ethical principles governing their research. The development of such a new contextualised declaration is more important than simply endorsing an existing code because the underlying rationale is to raise awareness about ethical issues and to stimulate scientists to reflect on the decisions they take in their daily practice. In addition to investing in infrastructural and institutional conditions ensuring biosafety and biosecurity, it is important to continuously train young generations of scientists in laboratory safety practices. In addition, these young generations will need to acquire skills in two-way science communication, to be able to participate in public debate around responsible science and ethics topics. Civil Society Organisations and communities are becoming more critical of the role of science in society, and it is important that scientists are not only persuasive in transmitting their enthusiasm for science, but also aware of genuine concerns about potential risks and ethical issues related to their research.

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