

over a tissue macerator toward the exhaust vent near the door. This macerator, which was not hermetically sealed, was used before tissue and carcass were discharged into the sewage system. Operators frequently opened it while maceration was ongoing in order to add additional tissue, and the waste sometimes backed up into the operating room sink.

The rat operating and postmortem room was associated with a laboratory that had six additional staff members. One worker, who was allergic to fur and never entered the animal facility, also seroconverted to Hantavirus; she homogenized solid tumors in the laboratory. The other laboratory workers did not homogenize solid tumors and did not seroconvert.

A critical follow-up study indicated that the virus could be isolated from tumor samples stored at 70°C for

2 to 10 years. Sera obtained from infected rats also transmitted the virus. The authors point out that frozen antibody and tumor samples were a previously undetected reservoir of Hantavirus that had accumulated at this institute in the 10-year period following the importation of the Louvain rat model (Lloyd & Jones, 1986). Screening the animal colony for evidence of Hantavirus infection became standard practice in the institution's animal program following this outbreak.

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# A Code of Conduct for Biological Scientists: An Important Topic for Action

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## Introduction

Biosafety professionals, in conjunction with scientists conducting biological research and members of other professional organizations, should form a representative working group to facilitate the development of a Code of Conduct for biological scientists. The need for a Code of Conduct for all biological scientists is under discussion at the United Nations (UN) and in individual countries and professional associations as demonstrated by recent publications (Somerville & Atlas, 2005). In addition to developing their own Code of Conduct, biological scientists should, at a bare minimum, immediately begin to raise awareness of the importance of the underlying principles that would be included in this Code of Conduct. Other scientific, professional, and commercial organizations that have established Codes of Conduct include, among others, the American Society for Biochemistry and Molecular Biology ([www.asbmb.org/asbmb/site.nsf/Sub/CodeofEthics](http://www.asbmb.org/asbmb/site.nsf/Sub/CodeofEthics)), Murdoch University in Australia ([www.murdoch.edu.au/vco/secretariat/admin/codes/ethics.html](http://www.murdoch.edu.au/vco/secretariat/admin/codes/ethics.html)), and a number of pharmaceutical companies like Johnson & Johnson that have established ethics statements ([www.jnj.com/our\\_company/our\\_credos/index.htm](http://www.jnj.com/our_company/our_credos/index.htm)). Many organizations understand the importance of scientific integrity, biosafety, and biosecurity and that adherence to these principles and practices depends on the integrity and reliability of the people in the organization (Johnson, 2003). As members of the scientific community, biosafety professionals should actively participate in the development of a scientific Code of Conduct for biological sciences. This is a timely endeavor for ABSA and optimally the International Biological Safety Working Group.

[www.murdoch.edu.au/vco/secretariat/admin/codes/ethics.html](http://www.murdoch.edu.au/vco/secretariat/admin/codes/ethics.html)), and a number of pharmaceutical companies like Johnson & Johnson that have established ethics statements ([www.jnj.com/our\\_company/our\\_credos/index.htm](http://www.jnj.com/our_company/our_credos/index.htm)). Many organizations understand the importance of scientific integrity, biosafety, and biosecurity and that adherence to these principles and practices depends on the integrity and reliability of the people in the organization (Johnson, 2003). As members of the scientific community, biosafety professionals should actively participate in the development of a scientific Code of Conduct for biological sciences. This is a timely endeavor for ABSA and optimally the International Biological Safety Working Group.

## Background on Codes of Conduct

In October 2001, the UN Policy Working Group on UN and Terrorism recommended that UN offices produce proposals to reinforce ethical norms and specifically

to create codes of conduct for scientists. At the request of the UN Under-Secretary-General for Disarmament, the International Center for Genetic Engineering and Biotechnology (ICGEB) in Cuba, a member of the UN family, initiated consultations with numerous internationally based National Academies of Science to develop a draft code of conduct. The draft, entitled "Code of Conduct for Scientists in Relation to Safe and Ethical Use of Biological Sciences," was presented at the UN Meeting of States Parties in December 2004 and has been used to form the underlying principles of evolving codes. This code and other information on this topic can be found at [www.opbw.org/new\\_process/mx2005.htm](http://www.opbw.org/new_process/mx2005.htm).

The draft code from ICGEB presented in 2004 identifies that:

- ...There are extraordinary opportunities derived from knowledge and technologies recently developed or foreseeable in the near future....
- ...There is a possible dual-use potential for these technologies for both peaceful use and prophylaxis and/or hostile intent in the development, production, stockpiling, or use of biological weapons or toxins....
- ...Ethical implications of working in the life sciences include a duty to society and humankind to ensure that activities are used to advance knowledge and benefit humankind and the environment....
- ...Personal benign intent does not absolve the responsibility to understand possible abuse or hostile use of technology....
- ...It is the moral duty of scientists, especially those working with dangerous materials, to adopt best practices and maintain the highest standards of professionalism, safety, and security to minimize the risk of intentional and unintentional damage....
- ...Scientists should raise to the appropriate level any concerns about suspicions of hostile intent and/or misuse of research....
- ...It is important to develop a holistic view of the scientific process and an awareness that experiments performed prior to or after a project could be oriented in a way different from that intended (i.e., for hostile purposes)....
- ...Oversight of research and the evaluation of projects and publications form an integral part of educational curricula and institutional regulations...and it is an individual as well as a collective duty to be familiar with these processes....
- ...Self-governance by scientists should ensure preventing the hostile or unethical use of biosciences and should take precedence over obligations derived from other commitments such as professional or military duties....
- ...Scientists must know and teach prohibitions about biological weapons (BW) with regard to international legislation, regulations, and guidelines prohibiting the development, production, acquisition, transfer, stockpiling, and use of BW....

- ...Scientists must act to raise public awareness of the universal prohibitions against BW and hostile intent or use...and the need for universal prohibition incorporating proscription, prosecution, and punishment.

During the same timeframe, the UN Secretariat examined Codes of Conduct from other professional areas including engineering, pharmacology, the nuclear industry, and others to distill general principles and obligations. The background paper prepared by the Secretariat in April 2005 grouped principles and obligations into the following elements:

- The global public good
- Respect of governance measures
- Scientific integrity
- Scientific stewardship
- Scientific obligations

The elements paraphrased below are synergistic and complementary to the draft proposed by ICGEB in that they echo the duty owed (obligation) to society to protect the welfare of humankind and the environment. To fulfill this obligation, codes should:

- Recognize that many rules and regulations exist and must be acknowledged so no one code operates in a governance vacuum.
- Promote individuals working to further the goals of their sciences, collectively ensure the highest degrees of professionalism, uphold safety and security norms, and recognize that successful implementation of a code would include mechanisms to deal with breaches in the code, sanctions for noncompliance, and a means to protect those who work within the code but may be vulnerable to those who are noncompliant.

Codes of Conduct for scientists were discussed at length by over 40 States Parties and Non-Government Organizations and professional organizations in June 2005. Topics of discussion included, but were not limited to, the potential benefits derived from Codes of Conduct, approaches to developing a code, and the type of information contained in the language of the code. The topics discussed were substantial and encompass the thoughts, perspectives, and recommendations from many similar as well as varied viewpoints. A sample of the perceived benefits of Codes of Conduct includes:

- Increasing public trust in science
- Balancing scientific progress while better preventing or managing risk
- Decreasing security risks and releases which could harm humans
- Assisting in Biological Weapons and Toxins Convention compliance
- Establishing norms and raising awareness
- Protecting ethical scientists
- Fostering a culture of responsibility and ethical dimension in science
- Fostering a professional community, not imposing it
- Evolving and changing with any new developments

in bioscience

- Fostering and addressing concerns about biosafety and biosecurity

In exploring approaches to developing a code, participants in the June 2005 meeting focused on a higher-level goal, rather than defining specific requirements. This approach fostered the desire to harmonize global requirements and create a permissive and interactive scientific community. Some recommendations include:

- Defining core values, scope, and goals of the code
- Focusing on feasibility and consensus
- Involving scientists, academicians, pharmaceutical representatives, NGOs, international organizations, and other stakeholders
- Understanding that a Universal Code need not be a “single code”
- Establishing that the code should be short, easily understood, and acceptable across cultures. Additionally, it should be relevant, endorsed internationally by scientific professional organizations, and taught.

In discussions of what topics would be included in the code, many felt the need to address contentious research, note that human life is sacred, increase awareness of the dual-use potential in biological sciences, and provide for the protection and dignity of persons during inquiries.

As part of trying to address the many topics raised, a number of higher-level points were proposed for what a Code of Conduct should contain. These include:

- Guiding principles and governance mechanisms
- Awareness of safety, security, education, accountability within cultures, and research oversight
- Ensure research merit and integrity, do no harm, ethics, and the obligation to report wrongdoing and administer justice

## The Future

Biosafety and biosecurity are inextricably linked and play a vital role in today's and tomorrow's national and global biomedical and biotechnical programs. Optimally, programs will encourage collaboration and enhance safety and security for all entities conducting work in the biosciences and the people and environment potentially impacted by these research activities. To further promulgate enhanced biosafety and biosecurity, a Code of Conduct for scientists in the biosciences should be developed, to the greatest extent possible by international consensus. This does not preclude the independent development of Codes of Conduct in the interim, and these codes may well provide guiding components for the development of an overarching global code.

But Codes of Conduct and biosafety and biosecurity programs are ineffective if the information is not properly instilled in the target audience—the researcher, collaborator, laboratorian, and very importantly the future generation who are currently in school and training. These ele-

ments of laboratory training should not only be a prerequisite for graduation and entering the workforce; rather, they should become part of the high school and undergraduate class curriculum.

It is never too soon to take even a modest amount of time to educate and instill the existing workforce and the next generation of scientists and leaders with the importance of scientific integrity, humanity, and ethics. Instilling a sense of laboratory responsibility, including safety, security, ethics, and societal responsibility, is essential in developing a future workforce that is reliable, trustworthy, honest, and well-trained to meet global future needs. Levels of training and discussion will differ based on the target audience, but science must become more a part of everyday life to gain acceptance and receive constructive feedback from the major consumer and benefactor of its fruitful progress—humankind.

There is a need to reach all people, not only those destined for careers in science but also those in peripheral contact with science and the often overlooked general public. As “big government” works nationally and internationally to develop and codify a Code of Conduct, the question we face is, “How can professional and educational organizations work today to communicate this important message to the administrators of high schools and colleges?” Optimally, the administrators would approve allocating some time in the curricula to this topic, which will be an important factor in shaping the coming generations of students who become our scientists and laboratorians. We should keep in mind that we as a scientific community must also be prepared to assist academicians, if asked, with the development of course material. After all, it is at our behest and recommendation as scientific professionals that Codes of Conduct be introduced into the curriculum.

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