



A Survey of Attitudes and Actions on Dual Use Research in the Life Sciences: A Collaborative Effort of the National Research Council and the American Association for the Advancement of Science

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Committee on Assessing Fundamental Attitudes of Life Scientists as a Basis for Biosecurity Education, National Research Council

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Summary

Over the past 50 years, rapidly expanding knowledge in the biological sciences has brought great benefits to society. But the same technologies that fuel scientific advances also pose potential risks—that the knowledge, tools, and techniques gained through legitimate biotechnology research could be misused to create biological weapons or for bioterrorism. This is often called the dual use dilemma of the life sciences. The fear is that some research—dual use research of concern—could be used by those with malicious intent to do great harm. Yet even research with the greatest potential for misuse may offer significant benefits as well. Determining how to constrain the danger without harming essential scientific research is critical for national security as well as prosperity and well-being.

Growing concerns about the potential risks of dual use research of concern have led to calls for raising awareness within the scientific community about dual use issues. Several reports from the National Research Council, including *Biotechnology Research in an Age of Terrorism* (NRC 2004a, herein called the Fink report), *Seeking Security: Pathogens, Open Access, and Genome Databases* (NRC 2004b), and *Globalization, Biosecurity, and the Future of the Life Sciences* (NRC 2006a) share a common message: The scientific community should take preemptive steps to protect the integrity of science and to minimize the risk of misuse of dual use research of concern. These reports also contain recommendations for enhanced education and outreach programs to raise awareness of the potential unintended harm from dual use research. They recommended that scientific societies and professional associations undertake programs to educate

scientists about dual use issues and their responsibilities to help mitigate the risks of misuse.

In addition to proposed efforts by professional and scientific societies, the National Science Advisory Board for Biosecurity (NSABB), created in 2004 in response to the Fink report (NRC 2004a), has an explicit mandate to “provide recommendations on the development of mandatory training programs for education and training in biosecurity issues for all scientists and laboratory workers at federally funded institutions.” A few universities, nongovernmental organizations, and professional societies have undertaken or are planning education efforts even before there is any government mandate to do so. For example, though certainly not exhaustive, in the United States the Federation of American Scientists, the Southeast Regional Center of Excellence for Emerging Infections and Biodefense, and the Center for Arms Control and Nonproliferation all have online materials or programs available.

THE AAAS-NRC SURVEY PROJECT

In September 2005, NRC and the American Association for the Advancement of Science (AAAS) Center for Science, Technology, and Security Policy (CSTSP) hosted a meeting, “Education and Raising Awareness: Challenges for Responsible Stewardship of Dual Use Research in the Life Sciences,” that brought together over 50 participants to share information and explore ways to engage and educate the research community most effectively. The discussions underscored how little data exist about levels of awareness and attitudes about biosecurity issues in the life sciences community and highlighted the critical need to move beyond anecdotes to empirical evidence.

Building on the results of their 2005 planning meeting, CSTSP and NRC developed a plan to survey a sample of AAAS members in the life sciences about their knowledge of dual use issues and attitudes about their responsibilities to help mitigate the risks of misuse of their research. In addition to providing essential baseline data, it was hoped that the results of the survey would generate more attention to the continuing challenges of dual use issues and foster additional debate among life scientists about their personal and professional responsibilities. The project used consultations with experts and practicing scientists as well as four focus groups in 2007 to design and refine a Web-based survey questionnaire that could be e-mailed to AAAS members in the life sciences.

The focus of the survey was on practicing scientists in the biological, health, and agricultural sciences working in the United States. AAAS is the largest general scientific society in the world and has more than 64,000 life scientists among its members. Since the membership is largely American

(about 84 percent) and primarily composed of scientists with advanced degrees (e.g., Ph.D.s or M.D.s), there was ample opportunity to attempt to survey the attitudes of American researchers across the full range of life science subfields. Because the survey was conducted via e-mail the study was restricted to 24,194 members who had validated e-mail addresses out of 64,787 life scientists who belong to AAAS. A random sample of 10,000 from these 24,194 AAAS members was selected to be contacted.

The survey was fielded from early August to early October 2007 by the AAAS Office of Member Services, with several follow-up e-mails to encourage a higher response rate. Among those sent the survey, 2,713 individuals viewed the survey (i.e., clicked on the link to the questionnaire provided in an e-mail); 1,954 individuals completed part of the survey; and 1,570 completed the entire survey. This leads to a response rate of about 16 percent for completed surveys and 20 percent including partial responses.

Almost all of the respondents had conducted or managed life sciences research (and three-quarters of them are currently doing so), were employed, had a postgraduate degree, and were U.S. citizens. In addition, a substantial majority of the scientists were academics and most were mid-career.

Given the low response rate, the lack of information by which the characteristics of the nonrespondents could be compared to those of the respondents, and the fact that the sampling frame included only those AAAS members whose e-mail addresses were known to AAAS, the survey results should not be generalized to the general population of U.S. life scientists. The methodological difficulties encountered in this project with regard to obtaining a representative sample and a high enough response rate to make generalized conclusions provide valuable lessons for future surveys on this as well as other topics of interest to the scientific community. Although it is necessary, because of these issues, to confine the report to the respondents and not to generalize beyond them, the committee believes that the survey results (including respondents' anecdotal comments) provide interesting indications of how the U.S. life sciences community may view dual use research that merit further investigation.

SURVEY RESULTS

The results of the survey provide some of the first empirical data about the perceptions of a sample of U.S. life scientists across a variety of disciplines about the potential risks of misuse of legitimate scientific research for malicious purposes. The survey data provide evidence about how the respondents perceive the sources of risk related to dual use research, the actions that some of these scientists are taking to reduce the risk of misuse

of science, and the prospects for acceptance of various policy proposals aimed at reducing the risks of misuse of legitimate life science research, although, as indicated earlier, the results of the survey must be viewed with caution because of the low response rate and possible response bias. Scientists who may be involved in biodefense research or who use select agents, for example, may be more aware of the dual use dilemma and thus more likely to have responded to the survey. In addition, a few of the questions could have been interpreted in multiple ways so that, for example, all “Yes” or “No” responses may not be comparable. Despite these potential problems, the committee believes the data obtained in this study offer valuable insights and new information.

Overall, the survey findings suggest that there may be considerable support for models of oversight that rely on the responsible conduct of research and self-governance by the scientific community. The responses also suggest, however, that there is a critical need to clarify the scope of research activities of high concern and to determine the appropriate actions that members of the life sciences community can take to reduce the risk of misuse of science for biological weapons development and bioterrorism.

Perceptions of Risk

The findings suggest that, on average, the scientists who responded to the survey perceive a potential, but not overwhelming, risk of bioterrorism and that the risk is greater outside the United States. On average, the respondents believed that there is a 51 percent chance that there will be an act of bioterrorism somewhere in the world in the next 5 years and a 35 percent chance that there will be an act of bioterrorism in the United States in the next 5 years. Three-quarters of the respondents believe that a preference for other means of attack is the primary reason why there have been only a few acts of bioterrorism to date; overwhelmingly, 87 percent of respondents said that they believe that terrorists are not deterred by the threat of being caught and punished. Fewer scientists considered a lack of knowledge (46 percent) or access to equipment (51 percent) or agents (36 percent) to be significant barriers. It may be that one’s perceived risk of such an attack is related to one’s support for taking measures to reduce the risks that life sciences research might be misused.

With regard to the chance that the knowledge, tools, or techniques from dual use research will facilitate bioterrorism, the respondents perceive a 28 percent chance, on average, of such a bioterror attack within the next 5 years. Half of the respondents thought that if someone wanted to create a harmful biological agent, the Internet would be the most likely place to provide sufficient information for life scientists with college-

level training. Other sources of information—articles in scientific journals (40 percent), personal communications (38 percent), and presentations at professional meetings (18 percent)—were considered relatively less likely sources, although on average 45 percent of respondents answered “Don’t Know” to these questions.

Actions Taken by Life Scientists in Response to Dual Use Concerns

Although the responses to the survey indicate that bioterrorism probably is not perceived to present a serious immediate risk to U.S. or global security, the survey results also indicate that there is already concern about dual use issues among some of the life scientists who responded. Fifteen percent of the respondents (260 individuals out of 1,744) indicated that they are so concerned about dual use research that they have taken actions, even in the absence of guidelines or mandatory regulations from the U.S. government. Some respondents reported that they had broken collaborations, not conducted some research projects, or not communicated research results. The results indicate that more scientists have modified their research activities than some members of the committee expected on the basis of previous reports of manuscripts that have been modified or not published because of dual use concerns.

Interestingly, many of the actions that the respondents reported taking to mitigate concerns occurred before the publication stage; much of the behavior change occurred during the research design, collaboration, and early communication stages. Of particular interest and concern to the committee, a few respondents commented on their concerns about foreigners as potential security risks, which may be reflected in the reported avoidance of some collaborations.

The survey results suggest that: (1) some life scientists in the United States may be willing to consider self-governance aimed at the responsible scientific conduct for dual use research, and (2) some life scientists in the United States are already acting, even in the absence of government regulations and guidance, to protect against the perceived risk of misuse of dual use research.

Oversight Mechanisms

With a proposed oversight framework for dual use research of concern proposed by NSABB in June 2007 now under consideration within the U.S. government, the survey was an opportunity to assess scientists’ attitudes toward specific policy options. Many of the respondents indicated that they believe that personal responsibility, including measures such as codes of conduct, could foster a positive culture within the scientific com-

munity to evaluate the potential consequences of their research for public safety and national security. They also indicated that they believe that individual researchers, professional scientific societies, institutions, and scientific journals should be responsible for evaluating dual use potential of research and/or fostering the culture of scientific responsibility.

A majority of those who responded to the survey favored self-governance mechanisms for dealing with dual use research of concern, such as those proposed by the Fink report (NRC 2004a), rather than additional mandatory government regulations. In addition to the low level of support for greater federal oversight (26 percent), the individual comments indicated a belief that increased government oversight of dual use research would be counterproductive by inhibiting the research needed to combat emerging infectious diseases and bioterrorism as well as being potentially harmful to the scientific enterprise more generally.

The survey suggests that most of the respondents (82 percent) favor their professional societies' prescribing a code of responsible conduct to help prevent misuse of life sciences research. However, many respondents (66 percent) did not know whether the societies to which they belonged already had codes that address dual use issues, and some of the societies most frequently cited do not in fact have a code. There was substantially less support (38 percent agree or strongly agree) for a Hippocratic-style oath.

The results also indicate potential support for journals having biosecurity policies. Yet, most of the respondents did not know if any of the journals in which they have published or to which they have submitted manuscripts have those policies. Moreover, more than half of those who responded to the survey strongly disagreed or disagreed with restrictions on personal communication, altering or removing methods or findings from scientific publications, or limiting publication itself.

The survey points to a likely preference for self-governance measures to provide oversight of dual use research. There was substantially less support for mandatory measures that might be imposed by regulation, although the results varied for different policy measures. The results indicate that there may be greater support for restrictions on access to biological agents (just under 50 percent of the respondents said they agree or strongly agree) and certifications of researchers (just over 40 percent of the respondents said they agree or strongly agree) than for any control of scientific knowledge generated from the research or through information exchange (only 20 to 30 percent of respondents supported these measures). Table S-1 provides a list of the level of support for the various measures addressed in the survey.

TABLE S-1 Summary of Results Regarding Support for Measures of Personal and Institutional Responsibility

Measures of Personal or Institutional Responsibility	Strongly Agree or Agree (or Respond Yes*) (%)
Principal investigators should be responsible for the initial evaluation of the dual use potential of their life sciences research.	87
Principal investigators should be responsible for training lab staff, students, and visiting scientists about dual use research.	86
Should professional science societies have codes for the responsible conduct of dual use life sciences research?	82*
University and college students should receive educational lectures and materials on dual use life sciences research.	68
Scientists should provide formal assurance to their institution that they are assessing their work for dual use potential.	67
Funding agencies should require grantees to attest on grant applications that they have considered dual use implications of their proposed research.	60
Should scientific journals have policies regarding publication of dual use research?	57*
Institutions should provide mandatory training for scientists regarding dual use life sciences research.	55
Greater restrictions should be placed on access to specific biological agents or toxins.	47
Researchers conducting dual use research should be certified.	42
All grant proposals for life sciences research with dual use potential should be reviewed by a researcher's institution prior to submission for funding.	41
Scientists conducting or managing research should take an oath.	38
Research findings should be classified based on their dual use potential.	28
Dual use research needs greater federal oversight.	26
Certain experimental methods or findings should be altered or removed prior to publication or presentation.	22
Certain biological equipment that is commonly used in life science research should be licensed.	21
There should be restrictions on disclosure of details about the research or its findings through personal communication.	21
There should be restrictions on publication of findings based on their dual use potential.	21

SOURCE: NRC/AAAS Survey of Life Scientists; data analysis by staff.

The survey results suggest there is *support* for:

1. Greater oversight that is not federally mandated,
2. Self-governance mechanisms as an approach for preventing misuse of life science research and knowledge,
3. Professional and scientific societies adopting codes of conduct that include dual use research as suggested in the Fink report (NRC 2004a),
4. Establishing and implementing policies for authors and reviewers to consider the dual use potential of research manuscripts submitted to journals.

The survey results suggest there is *opposition* to:

1. Mandatory government regulations to govern the conduct of dual use research and the communication of knowledge from that research;
2. Other mandatory oversight actions, such as oaths or licensing of scientists.

Based on the survey results and its own analysis, the committee believes that a basis of support exists within the U.S. scientific community for measures that, taken together, could lead to the development of a system of self-governance for the oversight of key aspects of dual use research.

Education and Outreach

A major reason for conducting the survey was to inform efforts for education and awareness-raising about dual use research by providing empirical data on the attitudes of a sample of the life sciences community. In general, the respondents to this survey would likely support educational and outreach activities aimed at raising awareness of the dual use dilemma. The respondents indicated that they supported educational materials and lectures on dual use research for students. They also supported mandatory training by institutions for practicing life scientists regarding dual use research of concern.

The survey results also highlight the need to better define the scope of dual use research of concern. Fewer than half of the respondents who indicated that they were carrying out dual use research activities felt that their research fell into one of the seven categories of research of concern specified by the NSABB. The dual use experiments of concern as listed in the Fink report (NRC 2004a) and by the NSABB are all based on microbial research, but other relevant research, such as theoretical research, scenario development, or applied research (e.g., pharmaceutical formulations or

neuroscience research) can be of dual use concern. In their individual comments, a number of respondents stressed the difficulties of defining dual use, as did participants in the focus groups used to develop the survey. Clearly a better understanding of the scope of dual use research of real concern would help any educational or outreach activities aimed at raising the awareness of life scientists so that appropriate actions can be taken.

Based on the survey results and its own analysis, the committee believes that there is support for mandatory education and training about dual use issues, most likely as part of ethics and responsible conduct of research training.

RECOMMENDATIONS

The committee believes that the survey raises several hypotheses that merit further research about the views of life scientists about oversight policies and education and outreach efforts to address concerns about dual use issues in the life sciences. In particular, based on the survey results and its own deliberations, the committee offers the following recommendations:

Oversight, Education, and Outreach

1. Explore how to continue and to expand the dialogue within the life sciences community about dual use research of concern.
2. Explore ways to provide guidance to the life sciences community about appropriate actions that can be taken to protect against the misuse of dual use research.
3. Seek to better define the scope of knowledge in the life sciences that may be at greatest risk for misuse and to provide the life sciences community with criteria for recognizing dual use research of concern.
4. Encourage journals that have biosecurity policies or plan to adopt them in the future and the professional and scientific societies that have or plan to develop codes of conduct to communicate those policies more effectively.

Further Research

1. Examine the effectiveness of existing educational programs and how they can be enhanced and focused.
2. Seek to extend educational and awareness-raising efforts being conducted in the United States to the broad international scientific community.

3. Examine how education and outreach activities can be developed to guide the life science community's response to concerns about dual use research so as to ensure that actions taken by the community are appropriate and contribute to advancing scientific knowledge while protecting national security.

4. Conduct additional surveys, interviews, or focus groups of U.S. life scientists that better represent the full community, with higher response rates than the current study was able to achieve, and the ability to assess potential bias, in order to gain

- a better understanding of the awareness of a broader range of U.S. life scientists about dual use research of concern and the measure that they would support to reduce the threat that research in the life sciences could be subverted to do harm;

- a better understanding of the types of behavioral changes being made in response to dual use concerns to determine if actions by life scientists are contributing to national security or harming scientific research; such research is critical given the actions that the current survey suggests are being taken;

- more detailed information about the types of changes scientists are making or scientists' thoughts about dual use issues, experiments of concern, and select agents;

- a better understanding of scientists' experiences with education on this topic and their views about the content and delivery of educational and training materials.

5. Conduct additional surveys of life scientists outside the United States that would enable comparisons of attitudes toward dual use research of concern and inform educational and outreach programs so that they can be effective on a global scale. Such knowledge could also facilitate international discussions of potential measures to address dual use concerns.

A SURVEY OF ATTITUDES AND ACTIONS ON DUAL USE RESEARCH IN THE LIFE SCIENCES

A Collaborative Effort of the National Research Council and the
American Association for the Advancement of Science

Committee on Assessing Fundamental Attitudes of Life Scientists
as a Basis for Biosecurity Education

Development, Security and Cooperation
Policy and Global Affairs

Board on Life Sciences
Division on Earth and Life Studies

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COMMITTEE ON ASSESSING FUNDAMENTAL ATTITUDES OF LIFE SCIENTISTS AS A BASIS FOR BIOSECURITY EDUCATION

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Preface and Acknowledgments

To begin to assess the attitudes of members of the life sciences community and to learn what actions life scientists in the United States would support to reduce the risk of misuse of the results of scientific research, the National Research Council (NRC) of the National Academies and the American Association for the Advancement of Science (AAAS) conducted a survey of life scientist members of AAAS to assess their *awareness* of the dual use dilemma, including their perceived risks of bioterrorism, and their *attitudes* toward their responsibilities to help reduce the risks that their research could be misused.

NRC appointed a committee to provide oversight for the Academies' participation in the project. The committee was not formally appointed until after the stages of the project that developed the survey instrument and survey design and decided whom to survey. The committee did provide oversight for the analysis of the survey results and the preparation of the final report. The committee is fully responsible for the interpretation of the data.

Funding for the project came from several sources. A generous grant from the Alfred P. Sloan Foundation provided the primary source of funding. In addition, the initial development of the project was supported by a planning grant from The Carnegie Corporation of New York, while the Presidents Circle Communications Initiative of the National Academies supported the focus groups. Fielding of the survey was supported by the AAAS Center for Science, Technology and Security Policy and funds from the John D. and Catherine T. MacArthur Foundation.

The results of the survey provide some of the first empirical data about the awareness and attitudes of a sample of U.S. life scientists toward biosecurity and the potential misuse of legitimate scientific research for malicious purposes, that is, their awareness of and attitudes toward the so-called dual use dilemma. Unfortunately, a low response rate and uncertainties about whether the respondents are representative of the broader U.S. life sciences community limit the ability to generalize from the responses that were obtained from the survey. Nevertheless, the findings are valuable in generating hypotheses that can be tested in future efforts. There appears to be support among life scientists for self-regulatory approaches to reducing the risk of misuse of scientific knowledge. In fact the survey results suggest that concerns about dual use research have led some scientists to change their research activities. This may be an indication that the life sciences community is responsibly responding to reduce the risk of misuse of science. But it is also possible that some scientists are overreacting to the perceived threat, for example, by breaking collaborations and excluding foreigners from their laboratories. The committee feels that it is important to investigate further what changes are being made in the conduct of research by U.S. researchers in response to dual use concerns and how this may be impacting the conduct of research in the life sciences.

As recognized in previous NRC reports, notably *Biotechnology Research in an Age of Terrorism*, the committee feels that it is important for all involved to recognize that protection of the life sciences against misuse requires a global effort. This survey was a first step to learn about the level of awareness of dual use research within the life science community in the United States and the policy measures that would be supported by that community. Future efforts will need to assess the prospect of the international life science community accepting various policy proposals aimed at reducing the risks of misuse of legitimate life science research. The committee hopes that its work will help further the essential dialogue and empower the voices of the life sciences community to be heard.

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Academies' Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the process.

We wish to thank the following individuals for their review of this report: Gerald Epstein, Center for Strategic and International Studies;

Rachel Levinson, Arizona State University; Filippa Lentzos, London School of Economics; Nancy Mathiowetz, University of Wisconsin; Henry Metzger, National Institute of Arthritis and Musculoskeletal and Skin Diseases; Stephen Morse, Columbia University; Victoria Sutton, Texas Tech University; and Judy Tanur, The State University of New York.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Edward Perrin, University of Washington, and Mary Clutter (Retired), National Science Foundation. Appointed by the National Academies, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

The committee wants to thank the members of the NRC and AAAS staff who provided extensive input during the project. The design and development of the project was a group effort among the staff from several parts of the NRC and AAAS. John Sislin served as study director, provided the data and statistical analyses that were the core of this study, as well as drafting the methods and findings chapters. Jo Husbands and Kavita Berger also made substantial contributions to the many drafts of the report. Fran Sharples and Kerry Brenner provided insightful comments that helped guide the committee in its work. We also want to extend our thanks to Connie Citro and Michael Cohen from the NRC Committee on National Statistics for providing additional statistical advice. Finally, the committee wishes to acknowledge the work of the staff at AAAS who were involved in fielding the survey that provided the data for the committee to analyze.

The committee is especially grateful to those who participated in the focus groups that helped formulate the survey questionnaire and the many scientists who took the time to complete the survey. Although filling out surveys is tedious and often unrewarding, the committee hopes that the completion of this report will be valuable to the life sciences community and policy makers who are trying to advance the responsible conduct of science and ensure that knowledge in the life sciences is not misused to do harm.

Ronald M. Atlas, *Chair*

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