

National Security, Terrorism & the Control of Life Science Research

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***Abstract.** This paper assesses ongoing attempts to balance security and openness in the conduct of civilian bioscience and biomedical research. More specifically it examines the state of current policy discussions regarding the security threats posed by life science research results and techniques. Concern about their ‘dual use’ potential has intensified tremendously since 9/11 and the anthrax attacks in the US. Despite the considerable attention to this issue today, this paper argues that current discussions are unclear and arguably problematic in relation to vital questions regarding the problem posed by life science research, the ultimate goals of controls, and the desirability of the circulation of dual use knowledge. It seeks to challenge the state of discussion by asking how the current security presentations of the threats posed by emerging bioscience developments are themselves formed in relation to definitions of scientific practice. On the basis of this analysis, consideration is given to the potential and pitfalls associated with current international efforts to devise a ‘code of conduct’ for bioscientists.*

Introduction

Today in many countries, renewed attention is being given to the potential for the biological and medical sciences to facilitate the development of biological weapons.^[1] Questions are being asked whether some research is too ‘contentious’ to pursue and what systems should be in place to evaluate and possibly restrict laboratory activities. With this has come a questioning of whether the scrutiny and controls being undertaken are damaging the science base. Debates about what, if any, controls might be prudent often turn on how classifications and distinctions are made in relation to questions such as: What counts as ‘dangerous’ research? In what ways is the understanding of life processes now being generated opening up new ways of interfering with the functioning of humans, animals, and plants? What research findings constitute a novel contribution to a discipline? To what extent are the security issues associated with the life sciences similar or different to those associated with other WMD areas of concern such as nuclear physics?

This paper considers what is at stake in the way such questions are being posed and answered today. It does so by questioning how ‘the problem’ with bioresearch is defined. In particular it asks how current depictions of the threats posed by emerging bioscience developments are themselves formed in relation to understandings of scientific practice. It aims to identify key issues hitherto not given sufficient attention, the knots and binds associated with trying to assess the dual-use capacity of research, and problems for future consideration. Following from an

analysis of these issues, the pros and cons associated with attempts to develop an international code of conduct for bioscientists are discussed.

This paper itself employs several distinctions to set the boundaries of analysis. The first is between research controls intended to prevent the unauthorized acquisition of biological agents or their accidental release with those controls intended to prevent the knowledge and techniques generated from being misused. While the first refers to the fairly well trodden ground of biosecurity/biosafety, the second raises much less familiar matters for the life sciences. It is the latter which is the focus here. In addition, this chapter is concerned with the implications of controls for *non-military agency* funded academic^[2] (and to a lesser extent) industrial R&D. Finally, much of the argument centres on recent activities in the US, the country which is on the forefront of debating and adopting research controls. At the time of writing while European countries had made various regulatory biosecurity/biosafety reforms, discussions are only beginning about ‘dangerous knowledge’. As the site of a considerable percentage of the world’s life science research and because of its ongoing interest in internationalizing any controls adopted in the US, this concentration is prudent.

1. The Life Sciences & Biological Weapons

Discussions about the dual use potential – that is their potential for civilian and military applications – of biological and medical research today include concerns that such activities may facilitate state and non-state actors making bacteria more resistant to antibiotics, modifying agents’ virulence and pathogenicity, synthesizing viruses, devising novel bioweapons, and reducing the effectiveness of the body’s defence system.^[3] While renewed attention is being paid to the proliferation of nuclear and chemical expertise and equipment, there is little doubt that much of current public policy attention regarding the security implications of sciences centres on the life sciences.

The impetus behind and character of this focus derives from a series of distinctions made between life science research as other ‘dual use’ areas of concern such as nuclear science and cryptography. In recently assessing the threat posed by biological weapons used by terrorists, for instance, the US National Research Council (NRC)^[4] concluded that the dual-use potential of life science research is much more of a potential problem than that posed by nuclear physics because of comparative differences in the steps and resources required between fundamental science and the production of weapon, this including: the accessibility of the materials required, the ease of distinguishing civilian from military relevant activities, the size and global dispersion of the communities, and the extent of the incorporation of security issues within the existing culture of research.^[5] In brief, the NRC argued that the resources and knowledge required for the production of biological weapons is more thoroughly and troublingly ‘dual use’ than that necessary for nuclear weapons.^[6] Much the same overall conclusion was said to apply to cryptography. As another consideration, the diffuse nature of the materials and expertise in the life sciences were said to limit the viability of research controls.

The import of these distinctions for security responses depends on the nature of the would-be user of the weapons envisioned. While much attention has been given to terrorist threats in recent years, this did not figure as a prominent topic in the past.^[7] The aforementioned differences in the dual use potential of research though would suggest the materials and expertise necessary for attacks with biological weapons are far more readily accessible than those required for devising nuclear weapons. For some though, the concentration on terrorism today misplaces the most likely developers of bioweapons: that being states in offensive programs. Among the demands often cited for producing a viable bioweapon include obtaining a virulent strain of an agent,

culturing it in sufficient quantities, weaponising the agent (e.g., through aerosolisation techniques) and then securing the means of dispersing it. Many security analysts have taken the limited employment of biological weapons around the world despite the historical interest in such capacities as an indication of the difficulty of effectively employing them.^[8] In sum, there is much debate today about the characteristics of life science research and the likelihood of the threats posed.

1.1 Policy Responses

Much of the initial policy response post 9/11 and the anthrax attacks in the US has been directed towards strengthening the physical containment of pathogens. For instance, the 2001 US *Patriot Act*, the US *Public Health Security and Bioterrorism Preparedness and Response Act of 2002* and the 2001 UK *Anti-terrorism, Crime and Security Act* brought in enhanced controls on who could access traditional dangerous pathogens and toxins (mainly so-called ‘select agents’ by US Center for Disease Control classification).

However, in the US at least, the debate has expanded significantly beyond issues associated with personnel and materials to consider how the knowledge and techniques generated from research might pose security concerns. The often said relatively ease of moving from the science to the production of biological weapons as well as the pace of scientific developments has led to questioning about the advisability of pursuing some lines of research. Post 9-11, experiments such as the insertion of the interleukin-4 gene into the mousepox virus, the comparison of *variola major* and *vaccinia* viruses and the artificial chemical synthesis of the poliovirus have routinely figured as examples of how non-applied research might facilitate the development of biological weapons.^[9] With the passage of the Homeland Security Act in the US, renewed attention has been given to the possibility of introducing a ‘sensitive but unclassified’ security categorization for certain research findings.^[10] In early 2003, a group of 32 largely American based scientific journals met to agree guidelines for reviewing, modifying, and perhaps even rejecting research articles where ‘the potential harm of publication outweighs the potential societal benefits.’^[11] In 2004, the NRC’s report *Biotechnology Research in an Age of Terrorism* made significant new recommendations for the review and oversight of potentially dangerous research proposals. While it found existing legislation and regulation for protection of materials and the vetting of personnel adequate, it concluded that additional procedures should be in place to screen so-called ‘Experiments of Concern’.^[12] Currently this category includes activities such as increasing the transmissibility of pathogens, enhancing virulence of agents, and rendering vaccines ineffective; though the Council has stated the classification might have to expand in the future. The National Research Council suggested this category of experiments be reviewed through expanding the remit and expertise of existing local Institutional Biosafety Committees (IBCs) in the first instance, with the second stage referral of problematic dual-use cases to an expanded Recombinant DNA Advisory Committee. The US NASBB was set up in 2004, in large part to take forward the recommendations in *Biotechnology Research in an Age of Terrorism*. While most of the initiatives involving controls on dual-use finding have taken place in the US, there is active attention to how these might be internationalized.

2. Issues for the Control of ‘Dual-use’ Knowledge

Thus, in addition to a tightening on the procedures for recording and approving who works with what materials in which labs, questions are being asked about the advisability of conducting and communicating what (in another security environment) might be regarded as unremarkable research. Arguably, the situation today is characterized as one of unprecedented attention in the life sciences on how to integrate security and openness. The long held assumption in relation to civilian scientific research vis-à-vis biological weapons – that national security is best served by

the beneficial and protective innovations deriving from unfettered research – is increasing being questioned as the biosciences are told to ‘lose their innocence’.^[13] Despite the significant amount of attention to these issues today, this paper argues the discussion to date has been characterized by ambiguity regarding its central premises and objectives. In the following section, it will identify some of the problematic issues associated with the ‘silencing of science’^[14] as currently proposed.

2.1 *What is the goal?*

Although some members of the bioscience community have criticized the proposed oversight measures as imposing unnecessary and counter productive burdens,^[15] it is not clear how or even if the system being discussed in the US today will curtail avenues of investigations. While the 2004 NRC report calls for existing IBCs to factor into their decision-making processes security concerns, it was decidedly vague about just what reviewers should be looking for in this process. The NRC calls for ‘carefully weighing the potential benefits versus the potential danger’ of research proposals (pg. 91) without any further detail as to how experiments should be assessed. What such a general call should mean in practice is far from clear though. A similar lack of specifics has characterized other oversight proposals. The Center for International and Security Studies at Maryland, for instance, put forward a ‘Biological Research Security System’ in which local approval committees were simply tasked with considering ‘the scientific merit of the proposal, the experience of the principal investigator, and the potential risks’^[16], steps which are already taken to assess the biosafety of experiments. Given the complexities of the issues at stake in evaluating the dual use potential of research, the task of specifying rules for assessment is a daunting one. The US NSABB has been charged with developing guidelines, though at the time of writing this process is just beginning. As well, major criticisms have been made of the frequency, rigor, and transparency of US IBCs.^[17]

Despite the present uncertainty about just what the review process will entail, there is good reason for believing that any system which takes as its basic decision logic the weighing of risks versus benefits is unlikely to impose many or nearly any restrictions. A major reason for this is the importance attributed to staying ahead of security threats through the rapid innovation of detection, prevention and treatment measures. Following this line of thinking, in order to prepare for bioattacks by terrorists or others, deliberate steps have to be taken to understand the nature of the threats faced. Each of the three contentious experiments mentioned above (artificial polio virus, IL-4 and mousepox, and the comparison of *variola major* and *vaccinia* viruses) were strongly defended by the scientists involved and others as providing much needed information about disease mechanisms that could (if acted upon with yet further R&D) alleviate or prevent the consequences of attacks.^[18] If in general terms what is helpful for terrorists can also be so for counter-terrorists, then in practice when it comes to making determinations of who can make the best use of research, it is almost certainly going to be decided that this rests with the counter-terrorists because we have disproportional expertise, resources, and abilities to call on. So even in the case of publishing research on how to make *bacillus anthracis* ciproflaxin^[19]- resistant, the editor of the *Proceedings of the National Academy of Science* has suggested that such work may well be important to publish because of what it could reveal about the characteristics of resistant strains.^[20] Moreover, the lack of readily available research findings has been said to not to be a bar those intent on undertaking nefarious activities.

The importance attributed to what might be characterized as the ‘run faster’ strategy is amply illustrated by considering the recent US emphasis on biodefense R&D. While in FY2001 the US civilian biodefense funding totaled \$414 million, in FY2005 it is budgeted at over \$7.5 billion.^[21] Research on infectious disease is a major strand of the biodefense response. The National Institute of Allergy and Infectious Diseases at the National Institutes of Health is leading much of

this work. Its budget has gone from \$53 million in FY2001 to \$1.7 billion in FY2005. This represents the largest ever increase in funding for a single initiative in the National Institutes of Health. The research is focused on ‘Category A’ traditional agents (e.g., anthrax, smallpox, tularemia, and plague) and broken down into research about therapeutics, diagnostics, host response, vaccines, basic biological mechanisms and building expertise resources. Although some have suggested this increase in funding constitutes a disproportionate response given the unlikelihood of terrorists on their own being able to successfully deploy bioweapons,^[22] it has been deemed far too limited by others who suggest the ‘revolution in the life sciences’ will mean the future threat faced is far more varied than traditional agents and thus the response needs to be more comprehensive as well (see next sub-section).^[23] In addition, other military and non-military agencies are funding their own work. The National Biodefense Analysis and Counter Measures Center under the Department of Homeland Security has been tasked to function as a “hub and spoke” agency for devising countermeasures. It is current planning to conduct threat assessments that include analyzing the storage and dispersion of biological agents as well as providing high-fidelity modelling and simulating disease transmission.^[24] Even leaving aside the questionable permissibility of such threat assessment activities under the BTWC, they signal an active interest in exploring varied threats from biological attack.

While this massive increase in biodefense funding is consistent with the basic underlying logic of running faster, it is rather at odds with the assumption that the forthcoming oversight system will limit lines of research. Given the extensive activities underway and the overall legitimacy (indeed urgency) accorded to biodefense measures, it is far from clear in the future that IBCs will be asked to screen out research that might directly raise dual-use issues. Examining such topics is a central aim of extensive new streams of funding in the US.^[25] Moreover, with the emphasis placed on the importance of innovation and ‘staying ahead’ of possible threats, where the dual use concerns are most acute, the calls for unfretted research are likely to be most pronounced.

2.2 *Where is the problem?*

Many of the existing or proposed controls for dual-use research rest on the ability to distinguish between problematic/unproblematic, acceptable/unacceptable, potentially dangerous/benign knowledge. Those bits of information identified as particularly troubling are then to receive a further level of scrutiny and possibly restriction. While this approach has a certain straightforward logic, it is not clear that it adequately captures the issues at stake.

One problem is the difficulty of identifying contentious research against the backdrop of other work taking place. While in the abstract it is often commented that nearly any research poses dual-use concerns, efforts to identify actual significant instances of dual use knowledge have proved more elusive. Although journals such as the *Proceeding of the National Academy of Sciences* and the eleven journals of the American Society for Microbiology have had procedures in place providing additional scrutiny for dual-use manuscripts since 2002, relatively few have been deemed as requiring close scrutiny. Of the 22,486 manuscripts received by ASM journal between January 2002- July 2003, 575 select agents ones were chosen for special screening, of which 2 were sent to the full ASM publication board (its second tier of scrutiny) for possible modification.^[26] In a two month period during late 2002, the *PNAS* identified 1% of its manuscripts as requiring special attention by its Board, though no changes were made to any of these submissions.^[27]

Even if the three controversial publications mentioned above had gone through the procedures agreed in 2003, it seems unlikely that they would have had any modifications imposed. Part of the reason for this relates to the points noted in the last sub-section about how risks and benefits are likely to be assessed, another reason though relates to the manner in which individual

publications are likely to be evaluated against others.^[28] For instance, when the former editor of the *Journal of Virology* was asked to justify the publication of the IL-4 mousepox article, he argued that its findings should not be seen in isolation from what was already ‘out there’ in the literature.^[29] Rather, it had to be seen against prior work into IL-4 and pox viruses and an understanding of what someone skilled might be able to ascertain from the literature. When approached in this fashion, it became quite difficult to draw a line demarcating the ‘acceptable’ from the ‘unacceptable’. Halting the mousepox publication would have been ineffective because the experiment discussed in it built on previous work in the field and its results could have been guessed by those knowledgeable about the issues at hand. Yet, the further one moves away from the particular contentious results in question, the more one would have to restrict whole areas of research, in this case investigations into the basic mechanisms of immunology. Strikingly similar lines of reasoning, I would contend, have been offered for other controversial cases. As such, it becomes quite problematic to justify isolating bits of research that are somehow in-and-of-themselves problematic. Questions can always be asked (and often with good reason) about what is already foreseeable and derivable.

One solution proposed by the former editor of the *Journal of Virology* was to focus on those areas of research that throw up unexpected findings. Yet, this suggestion is problematic because what counts as a continuity or discontinuity can be and has been a matter of disagreement. In the case of the mousepox experiments, despite suggestions after the fact that the researchers should have been able to predict the results of their experiments,^[30] the Australian researchers are reported to have said the results were a surprise.^[31] What one ‘skilled in the art’ might ‘reasonably’ be able to ascertain from the cumulative findings in the literature is not straightforward. Research in the field of Science and Technology Studies on claims to scientific novelty and replication would suggest that much interpretative work goes into determining what experimental results counts a continuity or discontinuity.^[32]

Perhaps a more fundamental problem associated with seeking to identify particularly troubling instances of dual use research is the manner in which this fails to address the totality of developments in the life sciences. While many of the existing research controls have been geared towards select agents, for some commentators, traditional agents (or even traditional agents with modified virulence, antibiotic resistance or transmissibility profiles through recombinant DNA technology), represent only a fraction of possible future threats from biological weapons. As contended, the major problem for the medium term lies with the ability to cripple individuals’ immune systems, develop ‘stealth’ viral vectors with gene therapy technology, produce highly specific toxins with transgenic plants, fashion novel agents, and target the neurological system; all options soon to be afforded by the ‘revolution’ or ‘paradigm shift’ in the life sciences. Each stage of the use of bioweapons – their production, weaponisation and delivery – will be eased through future research in the life sciences as well as a host of related fields.^[33] With the proliferation of skills and the simplification of biotechnology techniques comes the possibility that a wider range of individuals (e.g., terrorists, sociopaths) will have the ability to cause mass disruption if not death.^[34]

Thinking in terms of such large scale and systematic changes though requires moving well beyond a focus on particular experiments and traditional select agents. The major source of concern is not the odd experiment; rather it is with the cumulative ‘advance’ of academic and industrial R&D and what this means for the development of enabling technologies and the rapid diffusion of capabilities. If the next generation threats being discussed today are realistic options for skilled terrorists within a medium time frame, then seeking to identify (an already quite limited range of) ‘contentious’ experiments that might be suggestive of dual use possibilities is deeply limited and missing the point.

2.3 How should dual-use concerns be communicated?

Following on from the points made in the last two sections – the intense efforts underway in biodefense and the potentially widespread concerns associated with life science research – questions can be raised about how the implications of research should be communicated to both specialized expert audiences and the public in general.

For those critical of attempts to impose ‘non-proliferation-type’ controls and in favor of the ‘run faster’ response, limitations on performing or publishing research because of dual use fears will be ultimately prove counterproductive. As suggested above, the extensive biodefense programs emerging in the US are predicated on the wisdom of attempting to stay ahead of potential threats through rapid scientific and technological advancement. With the breadth of activities budgeted for – from fundamental research on the functioning of cells to highly applied research on threat assessments about the aerosolisation of agents – in the next few years many significant ‘dual use’ findings are likely to be produced. Yet, just how those should be communicated remains a topic of uncertainty and contention. If significant elements of US biodefense activities are kept secret (particularly those close to weaponisation) then this is likely to arouse suspicion in other countries regarding the ultimate aims of the US programs. In the past, heated claims and counterclaims about the legitimacy and purpose of ‘biodefense’ programs have figured as part of international disagreements about whether countries are adhering to the BTWC. Without some level of transparency the sheer scale of activities now taking place in the US will almost certainly cause suspicion in other countries and give them reason to reconsider whether their biodefense measures are adequate or even too transparent. Yet, if the results of threat assessments or other such studies directly related to the functioning of biological weapons are made more widely available to encourage the development of responsive measures (as it would be consistent with the ‘run faster’ approach) then such information could be quite valuable to would-be bioweapons engineers in both developing devices and refining them to evade detection or treatment measures.

On a more subtle level, the question is not just whether research should be published or not, but whether as part of that process possible dual use implications should be elaborated. So, while nearly all of the fundamental research conducted by the NIH is likely to be published (and following from Section 2.2 likely without modification), just whether possible dual use implications of the experiments and studies conducted should be actively discussed is another matter. Such a practice, though consistent with the goal of raising general awareness in the life sciences and with the importance of community wide responses, would almost certainly lead to widespread public concern about the direction and merit of life science research. Experiments where some level of accessible speculation has taken place regarding the implications of the findings, such as the experiments with artificial polio virus, IL-4 in mousepox, and the comparison of *variola major* and *vaccinia* viruses have already generated calls by politicians and others for controls deemed draconian and ill-advised by some of those in the scientific community.^[35] Yet, should bioscientists routinely hypothesize about the possible malign utility of their work, (unwanted) critical public and political attention will surely increase. For instance, the artificial polio virus publication in 2002 has been highly criticized as an opportunistic PR stunt because it was said to have been known for years if not decades that this sort of synthesis was possible.^[36] Whatever the merits of such denunciations, arguably few outside of life science research knew of such capabilities or considered their implications. Should concerted efforts be made by scientists in forthcoming years to elaborate possible dual use implications of their work (even if the research in question is not ‘new’), then a considerable reaction is likely.

2.4 *Who decides?*

Throughout the discussion above, questions have been raised regarding who should make decisions about how to balance research and national security. Despite frequent complaints about governments imposing controls on research, when it comes to matters involving restrictions on knowledge, even in the US, government agencies have been reluctant to compel bioscientists to implement security controls, let alone stop lines of investigation. There are few, if any, bright lines indicating what research is proscribed. Instead, the scientific communities have been asked to formulate ideas for what needs doing. As suggested above though, the issues at stake are not simply technical matters that can be resolved through the application of expert knowledge. Differences exist in what one 'skilled in the art' might reasonably know, what counts as a realistic future weapons possibility, and what research should be permissible. So while scientific expertise is obviously essential in evaluating threats and considering policy options, questions can be raised whether it is sufficient. The National Research Council recommendations now being taken forward in the US conceive of oversight decision as the prerogative of scientists. In contrast, the Center for International and Security Studies at Maryland's 'Biological Research Security System' calls for 'a mix of scientists and public representatives who are not directly involved in the research in question'.^[37]

3. What Prospect for 'Codes of Conduct'?

Against the backdrop given above, this section examines the prospects associated with developing a 'code of conduct' for bioscientists and others associated with the life sciences. While the idea of formulating a professional ethical code has been mooted for decades,^[38] since 2001 various statements by governments, NGOs and professional societies have given renewed impetus to this idea (for information about BW codes see <http://www.ex.ac.uk/codesofconduct/>). The adoption of some sort of code has become incorporated into the formal agenda of key institutions in and outside the US. In 2005, as part of the talks being held under the Biological and Toxin Weapons Convention, the topic for discussion will be 'The content, promulgation, and adoption of codes of conduct for scientists'. The UK will chair these meetings, and as such professional organisations and others here have taken a particular interest in codes.³⁹ In 2002 the UN General Assembly and the Security Council endorsed establishing codes of conduct across areas of research relevant to the development of weapons of mass destruction, a suggestion for the BW area that is now being taken up by the InterAcademy Panel and the International Centre for Genetic Engineering & Biotechnology.^[40] The Policy Working Group on the UN and Terrorism had suggested that codes of conduct should:

Aim to prevent the involvement of defence scientists or technical experts in terrorist activities and restrict public access to knowledge and expertise on the development, production, stockpiling and use of weapons of mass destruction or related activities.^[41]

As well, the US NSABB has been tasked with developing 'Professional codes of conduct for scientists and laboratory workers that can be adopted by professional organizations and institutions engaged in life science research'.^[42]

Despite the widespread attention to developing a code or codes, at this stage it is not clear what they would entail in terms of their aims and audiences. Overall, professional scientific codes (whether they be called 'code of conduct', 'practice' or 'ethics') vary greatly in terms their content and purposes; from statements that lay out aspirational goals in the desire to raise awareness of issues or set ideal standards; to more advisory or educational guidelines that provide suggestions for action; to enforceable rules that specify do's and don'ts with enforcement mechanisms attached (e.g., steps regarding the physical control of lab materials).^{[43][44]} Initial statements by governments and others about the need for 'code of conduct' include reference to this range of types.

Certainly the effectiveness of codes in general (not specific to bioweapon concerns) has been questioned by social scientists and ethicists: they are often open to numerous interpretations; codes are rather inert forms of knowledge that are limited in their ability to deal with complex issues; they can be PR exercises that stave off other forms of regulation; and codes require enforcement mechanisms, but to the extent they are binding then the issue for evaluation is the merits of regulation in question.^{[45] [46] [47] [48]} More positive analyses of codes in professional life have maintained that they can heighten awareness of issues, help individuals re-interpret the situations facing them, set expectations, clarify individual versus collective forms of responsibility, and influence behaviour for areas where standards have not formed.^{[49] [50] [51] [52]}

With the relatively widespread emphasis on codes today, the matter of just what should they be deserves considered attention. If the primary threat from bioweapons is conceived of in terms of terrorist attacks, then at first glance ethical codes would seem an incredibly ill-suited policy option. At yet, given the concern with the dual use potential of wide ranging areas of life science research undertaken by professionals in universities and industry, codes may have varied roles to play even with respect to this concern. While it is highly doubtful any would-be terrorists would be put off by the formation of codes, they could go some way towards forming a workable collective agreement or (minimally) encouraging the presentation of alternative points regarding how to address the problems, dilemmas, issues mentioned in Section 2.

Several traits are likely to characterize useful code-related activities. First, while much of the existing policy discussion speaks to the desired content of codes (read: outputs), in keeping with the conclusions of studies of other professional codes, the *process* of devising and adopting a code needs concerted attention. Certainly outside of the US, substantial policy dialogue about the wisdom of research controls on knowledge and techniques is in its initial phase. Arguably beyond those areas of research working with select agents, attention to dual use issues in the past has been minimal. Properly handled discussions on whether or what kind of codes would be appropriate can be one way of facilitating structured discussion. This should not be limited to practicing bioscientists (as it has often been framed in policy documents to date), rather it should include those that fund, represent, administer, commercialize, and regulate research in order to facilitate the sort of systematic and synergistic thinking required. Through this, the extent of the dual use ‘problem’ within the life science could be explored and debated.

Second, codes can do much more than merely keeping the conversation going about bioweapons. The adoption of codes could go beyond simply reiterating the existing provisions of national and international regulations and conventions (though this might prove useful in and of itself) by seeking to elaborate their meaning. There is much ambiguity in the interpretation of many provisions, much of it a product of the consensual character of international negotiations. Professionals in the life sciences can contribute to reaching a working agreement of their meaning. So just what the provisions of the BTWC mean in relation to the development of so-called non-lethal incapacitating agents or what counts as permissible biodefense activities are matters of disagreement today, ones where those outside of traditional security networks can and should contribute to current debates.^[53] That might be in specifying do’s and don’ts or establishing expectations about the communication and transparency of such activities necessary to build international confidence in their legitimacy. Another clarifying function that code-related processes could do is to comment on who counts as the relevant community for make decisions about controls. Part of that might entail asking in what ways the ‘prevention against biowarfare and bioterrorism [is] too important to leave to the scientists and politicians’.⁵⁴

Third, in whatever they call for, codes should attempt to build on existing practices/controls in some way. To take the debate forward, codes could seek to make issues about biological weapons relevant to a wide range of activities currently not affected by biosecurity regulations so as to make the issues of dual use more prevalent in the day-to-day practices of the life sciences. This need not require adopting burdensome forms of regulation, but instead building concerns about dual use issues within the routines of research practice.^[55]

Approached in the general manner outlined above and with sufficient effort, while codes are unlikely to resolve debates about what needs doing and what is problematic about research, the process of adopting codes *could* play a role in fostering long term and focused discussion across the life sciences about many of the difficult issues raised in Section 2.

4. Conclusion

Today wide ranging concerns are being expressed about the dual use applications of the life sciences. The potential for a terrorist attack with advanced bioweapons capacities is a topic of much political and public concern. However low probability on regards such an attack, it would likely be highly consequential. In a manner that is perhaps unprecedented, the life sciences in industrialized nations are being scrutinized for their ability to further nefarious ends. This paper has sought to challenge the aims and direction of many of the current controls being pursued for results and techniques. With regard to this issue, it has been argued that current discussions are unclear and arguably problematic in relation to vital questions regarding the problem posed by life science research, the ultimate goals of controls, the desirability of the circulation of dual use knowledge, and the matter of who should decide what constitutes dangerous research. This conclusion challenges simple notions both that nothing and too much is happening. Rather the picture presented is one where much uncertainty and disagreement exists regarding the way forward. Consideration has been given to the potential and pitfalls associated with current international efforts to devise a 'code of conduct' for bioscientists. The paper has forwarded the basic outline of the desirable characteristic of the adaptation of codes to address many of the policy questions being discussed today.

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[²] For consideration of this topic see Brickley P. 'US universities resisting government attempts to control fundamental research' *The Scientist* 7 January 2003.

[³] E.g., Nixdorff K & Bender W. 'Ethics of University Research, Biotechnology and Potential Military Spin-Off.' *Minerva* 2002; 40: 15-35.

[⁴] National Research Council. *Biotechnology Research in an Age of Terrorism* Committee on Research Standards and Practice to Prevent the Destructive Application of Biotechnology Washington, DC: National Academies Press; 2004: 112.

[⁵] See as well Tucker J. 'Preventing the Misuse of Pathogens' *Arms Control Today* 2003; June.

[⁶] Block S. 'Facing the Growing Threat of Biological Weapons' 42nd Annual Meeting of the American Society for Cell Biology 14 December 2002.

[⁷] Though see publications such as *Biosecurity and Bioterrorism* Istituto Diplomatico Mario Toscano, Villa Madama, Roma, September 18-19, 2000

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