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*Ethical and Philosophical Consideration of the  
Dual-Use Dilemma in the Biological Sciences*

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# EXECUTIVE SUMMARY

## ***What is the Dual-Use Dilemma?***

The so-called “dual-use dilemma” arises in the context of research in the biological and other sciences as a consequence of the fact that one and the same piece of scientific research sometimes has the potential to be used for evil as well as for good.

A dual-use dilemma is an *ethical* dilemma, and an ethical dilemma for the *researcher* (and for those who have the power or authority to assist or impede the researcher’s work, eg. governments). It is an *ethical* dilemma since it is about promoting good in the context of the potential for also causing harm, e.g. the promotion of health in the context of providing the wherewithal for the killing of innocents. It is an ethical dilemma *for the researcher* not because he or she is aiming at anything other than a good outcome; typically, the researcher intends no harm, but only good. Rather, the dilemma arises for the researcher because of the potential actions of *others*.

Malevolent non-researchers might steal dangerous biological agents produced by the researcher; alternatively, *other* researchers – or at least their governments or leadership – might use the results of the original researcher’s work for malevolent purposes. The malevolent purposes in question include bio-terrorism, bio-warfare and blackmail for financial gain.

In the aftermath of the 11<sup>th</sup> September 2001 attacks and the subsequent anthrax letters episode in the US, bio-terrorism is widely considered to be a real threat, especially to populations in western countries. Moreover, it is seen as a more likely threat from non-state terrorist groups than, say, nuclear WMDs, given the availability of the technical knowledge necessary to produce the relevant biological agents and the feasibility of weaponisation. (In this report we assume terrorist acts could be performed by state actors as well as non-state actors. This is consistent with the definition given in the Commonwealth of Australia Criminal Code 1995.)

## ***Aims and Scope of this Research Project***

In general terms, the aims and scope of this project are to provide a reasonably comprehensive array of (possibly competing) answers to the following questions:

### (A) Morally Impermissible Research

- What, if any, research in the biological sciences that does *not* give rise to a dual-use dilemma is morally impermissible, eg. research undertaken for purely offensive military purposes?
- What is the dual-use dilemma in the biological sciences, and in what categories of research does it arise, eg. experimental research undertaken to assist in the combating of mice plagues that might in fact result in the development of a more virulent form of smallpox?
- What are the moral and other considerations in play in these various categories of research that give rise to dual-use dilemmas, eg. potential to save human life versus potential to destroy human life?
- In the light of these considerations what, if any, research in the biological sciences that gives rise to a dual-use dilemma is morally impermissible?

- Who is to decide what research, if any, in the biological sciences is morally impermissible, eg. biosecurity committees?

(B) Physical and Regulatory Conditions under which (Permissible) Experiments of Concern ought to be undertaken.

- In relation to the various categories of *prima facie* permissible research that, nevertheless, give rise to dual-use dilemmas, what are the safety and security – and associated regulatory – conditions under which this research ought to be undertaken, eg. background checks and security clearance for research personnel?

(C) Dissemination

- What are the moral and other considerations in play in relation to the ownership rights (intellectual property) of permissible, safe and secure research in the biological sciences that, nevertheless, gives rise to dual-use dilemmas?
- What are the moral and other considerations in play in relation to the dissemination of findings from permissible, safe and secure research in the biological sciences that, nevertheless, gives rise to dual-use dilemmas?
- In relation to permissible, safe and secure research in the biological sciences that, nevertheless, gives rise to dual-use dilemmas what, if any, restrictions ought to be placed on its dissemination?
- In relation to permissible, safe and secure research in the biological sciences that, nevertheless, gives rise to dual-use dilemmas who ought to decide what, if any, research findings ought not to be disseminated or ought to have restrictions placed on their dissemination?

## **Experiments of Concern**

Our approach is to map the range of the dual-use dilemmas by identifying and taxonomising a set of salient “experiments of concern”.<sup>1</sup> We accept this approach in the context of our attempt to isolate the morally permissible from the morally impermissible in relation to dual-use research in the biological sciences.

“Experiments of concern” are those that would:

1. demonstrate how to render a vaccine ineffective;
2. confer resistance to therapeutically useful antibiotics or antiviral agents;
3. enhance the virulence of a pathogen or render a non-pathogen virulent;
4. increase the transmissibility of a pathogen;
5. alter the host range of a pathogen;
6. enable the evasion of diagnosis and/or detection by established methods;
7. enable the weaponization of a biological agent or toxin;
8. Genetic sequencing of pathogens;
9. Synthesis of pathogenic micro-organisms;
10. Any experiment with *variola* virus (smallpox); or
11. Attempts to recover/revive past pathogens.

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<sup>1</sup> National Research Council, (2004) *Biotechnology Research in an Age of Terrorism*, Washington DC: National Academies of Sciences, 5.

## ***Ethical Analysis of Dual-use Research***

Fine-grained ethical analyses of dual-use research in the biological sciences would seek to *quantify* actual and potential benefits and burdens, and actual and potential recipients/bearers of these benefits and burdens. These analyses would also identify a range of salient policy options. Each option would embody a set of trade-offs between present and future benefits and burdens, and recipients and bearers thereof. The construction of these options and the process of selection between them would consist in large part in the application of various ethical principles, including human rights principles – eg. right to life, freedom of inquiry, and free speech – and principles of utility and of justice.

We are not in a position to provide any such fine-grained ethical analysis, but will rather focus (somewhat simplistically) on a single ethical consideration, namely, human health (including human life) that gives rise to the dilemma; and do so without exploring questions of which human populations or how many individual humans have benefited/been burdened or are likely to benefit/be burdened, and so on. Viewed from this perspective the dual-use dilemma concerns human health (as a simple, unquantified human good), and the dilemma consists in the fact that research undertaken to promote human health might instead be used to destroy human health. As such, the dilemma gives rise to questions of security; what are reasonable and ethically justified forms and degrees of security in this context?

The above mode of analysis of the dual-use dilemma consisting of the quantification of harms and benefits, the identification of salient options, and the selection of an option on the basis of ethical principles is reasonable as far as it goes. However, a more dynamic, indeed creative, mode of analysis is called for.

In the first place, options are not static because well-intentioned scientists, malevolent actors and security personnel are *responsive* to the problems that they confront, including the problems provided by other actors. The response of scientists to a pathogen with enhanced virulence might be the development of a new vaccine. The response of security personnel to a new bioterrorist threat might be an enhanced regulatory system. Accordingly, the mode of analysis of the dual-use dilemma must be dynamic in character.

In the second place, ethical dilemmas are not necessarily – or even typically – to be resolved by careful calibration of the differential ethical weight that attaches to the options provided for in the dilemma. Rather the dilemma must, if possible, be resolved by *designing* a new third or fourth option, i.e. by bypassing the dilemma. Consider the question of whether to disseminate dual-use research findings or not disseminate them: academic freedom versus security. Perhaps the solution is to find a third option, such as to disseminate them in a manner that will not enable the experiments in question to be replicated. This mode of analysis is *creative*. It lets us have our cake and eat it; it squares the ethical circle. Let us refer to this kind of ethical analysis as *designing-in ethics*.

In relation to the issue of the moral permissibility of dual-use research, there appear to be three separable ethical questions. Firstly, the ethical question as to whether or not a putative biological agent to be researched ought in fact to be eliminated (or, if already

eliminated, not retrieved). Here the *possibility* of research is removed; no possibility of research because no biological agent to be researched. We have in mind the case of smallpox and the arguments in favour or against the elimination of all samples of smallpox. (We note that in the context of the recent possibility of genome mappings of biological agents, it may not matter so much whether the organism actually exists; since it can be recreated from the sequence alone.) Secondly, the ethical question (or questions) arising from dual-use research in relation to a biological agent whose present and/or future existence is taken as a given; there is no intention to eliminate or not retrieve or not bring into existence the biological agent in question. For example, research to determine whether or not avian influenza could trigger a human pandemic might lead to the creation of dangerous new strains that could be used by terrorists. Such research might include work intentionally undertaken to create novel pathogens or synthesising existing ones, albeit work whose ultimate purpose was to develop, say, a vaccine against these pathogens. Thirdly, the ethical question of whether to undertake dual-use research for the purpose of protection against weaponised pathogens, e.g. research into the aerosolisation of pathogens.

The smallpox debate is essentially about balancing the desirability of retaining the virus for prospective research purposes against the uncertain risks associated with not destroying it.

In relation to the second question there is a complex mix of scientific, security and public health questions, as well as ethical ones. Moreover, because the actors involved in dual-use dilemmas are responsive to problems and to one another's actions, probability judgments regarding risks need to take this into account. One way to do so is to analyse, for example, a security risk from bioterrorists in part in terms of a complex set of variables including the ability, opportunity and motivation of the bioterrorists, the likely intelligence possessed by, and the likely assessment made by, the terrorists, the capacity to respond to specific forms of bioterrorist attack, the likely movements of innocent third parties at risk from specific security responses, the relevant moral principles, the rights and duties of the various actors involved, and so on.

However, what might be crucial here is the capacity to generate a creative response to the security problem thus analysed. Perhaps a focus on reducing the opportunities available to bioterrorists by establishing a licensing system for laboratories using dual-use technologies is a case in point.

In relation to the third question, the issue resolves itself into whether or not in practice the weaponisation of pathogens for protective purposes can be distinguished from the weaponisation of pathogens for offensive purposes.

Presumably, if these two conceptually distinct activities are to be distinguished in practice then this is because there are *verifiable* differences in respect of: (i) intention or purpose; and (ii) physical properties of the weaponised pathogen.

## ***Options for the Regulation of Dual-use Experiments and Information***

In what follows we provide a set of options regarding the imposition of limits on dual-use experiments and the dissemination of potentially dangerous information resulting from dual-use discoveries. The five options presented range from the least intrusive/restrictive to the most intrusive/restrictive, and the advantages and disadvantages of each option are discussed in turn. Each option is complex in that it consists of six sub-options each of which pertains to one of the following six categories of decision:

### (1) Permissible or Impermissible Research

Who is to be the decision-maker in relation to determining whether or not an instance of one of the eleven identified types of experiment of concern is permissible or impermissible? The candidates for decision-maker are: the individual researcher; the specific institution hosting the research project in question, i.e. a university, corporation or government research centre; an independent authority; the government. In the case of the university, the decision-maker would presumably be a collegial body comprised of relevant scientists (at least).

Freedom of inquiry is a human right that finds institutional expression in universities in the form of academic freedom. In the context of a liberal democracy there is a presumption against governmental restriction of human rights, including in the name of protecting other human rights. Moreover, arguably progress in science is importantly dependent on academic freedom. The question of whether research is morally permissible or impermissible is an extremely difficult issue, and it is by no means obvious who the ultimate decision-maker ought to be.

### (2) Mandatory Physical Safety and Security Regulation

Should there be regulations providing for mandatory physical safety and security of the storage, transport and physical access to samples of pathogens, equipment, laboratories etc. The answer is presumably in the affirmative.

In theory, the specific content of these regulations might be determined either by a government agency, an independent authority, a professional association of scientists or the specific institution hosting the research programs in question. However, governments bear the ultimate institutional and moral responsibility for the safety and security of their citizens, including the researchers themselves, in so far as that safety and security is a matter of the physical conditions under which potentially harmful (albeit permissible) research is to be undertaken and the physical elements thereof stored, transported etc. Accordingly, the government would at least need to be able to satisfy itself that the regulatory system, including the regulations and their enforcement mechanisms, governing the physical safety and security of dual-use experimentation are adequate.

The application of many of these regulations could be undertaken by, for example, biosafety committees operating at the institutional level, e.g. a university-based biosafety committee. However, these committees would need in turn to be accountable to government (perhaps via an independent authority).

### (3) Licensing of Dual-Use Technologies/Techniques

Should there be mandatory licensing of dual-use technologies/techniques/pathogen samples. Only certain laboratories in the public sector and the private sector might be licensed to engage in research involving the use of certain dual-use technologies. For example, laboratories that undertake genetic engineering of pox viruses would have the means to make recombinant smallpox viruses. Similarly, researchers studying influenza virus and using reverse genetics could easily construct a 1918 flu virus with available information.

The establishment of a licensing authority to conduct such a licensing process would be a significant addition to the mechanisms available to contain the dangers associated with the dual-use dilemma. However, it raises a number of important questions. One set of question concerns the criteria that the licensing authority would deploy in its licensing process. Is there a presumption in favour of granting a licence; the criteria having been framed for the sole purpose of eliminating licence applicants that are manifestly unable to provide a safe and secure research environment? Are the criteria to be used to determine the issuing of licences objective and publicly available? Another set of questions pertains to the status and make-up of the licensing authority; is it, for example, independent of government in the sense that its decisions are binding and not able to be overridden by government?

These questions are important in the context of the concerns one might have in relation to government interference with freedom of intellectual inquiry (who decides what is permissible research?) and freedom of speech/dissemination of research findings (who decides what research findings can be disseminated and to whom?). The point is that a licensing authority could be given, at least in principle, powers that would in effect override human rights to freedom of intellectual inquiry and freedom of dissemination (and associated rights to academic freedom) by licensing, say, only government research centres.

### (4) Mandatory Education and Training

Given the potential harms arising from the eleven identified types of experiments of concern it is clear that some process of education and/or training for relevant researchers and other personnel is called for. There is a question as to the precise content of such education and training. However, at the very least those working in laboratories would need to have received safety and security training in relation to the physical safety and security of the storage, transport and physical access to samples of pathogens, equipment, laboratories etc. In addition, there is a need to ensure that editors and others responsible for the dissemination of potentially harmful information are aware of the issues in relation to dual-use research findings. In short, some forms of mandatory education and/or training are justified. What the precise content of such education/training programs ought to be, and who ought to be responsible for their provision, remain open questions. However, it is an institutional and moral responsibility of government to ensure that minimal training/education programs in relation to potentially harmful dual-use research and dissemination of dual-use research findings are being provided (even if not by government itself).

### (5) Mandatory Personnel Security Regulation

Physical safety and security of a research environment, including access by non-authorised persons, e.g. potential thieves, is one thing; however, personnel security in

relation to researchers, e.g. background checks, screening of researchers in relation to any history of mental illness, political affiliations with extremist groups etc., is quite another. Doubtless it is prudent, indeed it is a moral requirement, that access to virulent pathogens be disallowed to a researcher diagnosed as a psychopath or to a known member of a terrorist organisation. On the other hand, other things being equal, government officials prying into the lives of university students enrolled in degrees in the biological sciences is an unwarranted intrusion of civil liberties. Here, as elsewhere, the devil is in the detail, and there is a need for specific policies to be framed in the light of a range of human rights, academic and scientific considerations as well as security concerns.

One way forward here might be to develop a system of security checks for personnel working in licensed laboratories but (absent special considerations) not for other research personnel.

#### (6) Censorship/Constraint of Dissemination

As we have seen above, the question of whether research findings ought to be freely disseminated, censored or their dissemination in some lesser way restricted is an extremely difficult issue and it is by no means obvious who the ultimate decision-maker ought to be. Freedom of speech and freedom of dissemination of knowledge are human rights that find institutional expression in universities in the form of academic freedom. In the context of a liberal democracy there is a presumption against governmental restriction of human rights, including in the name of protecting other human rights. Moreover, arguably progress in science is importantly dependent on academic freedom.

A relevant important distinction here is that made above between 1<sup>st</sup> tier and 2<sup>nd</sup> tier dual-use research. For example, 1<sup>st</sup> tier research findings might need to be disseminated in such a way that anyone being informed of these findings would not be able to replicate the experiments that enabled the results reported in the findings.

The five broad options and their sub-options can be represented in the form of a matrix, as follows.

## DECISION-MAKING RE DUAL-USE DILEMMAS IN THE BIOLOGICAL SCIENCES

**NB: The decision-making in question pertains only to dual-use research in the biological sciences identified as potentially problematic by virtue of coming under one of the pre-established headings of Experiments of Concern.**

### OPTIONS

DECISIONS	Option 1 The Complete Autonomy of the Individual Scientist	Option 2 Institutional Control	Option 3 Institutional & Governmental Control	Option 4 An Independent Authority	Option 5 Governmental Control
Who are the Decision-makers regarding Im/missible Research?	Individual researcher	(i) Scientists in University (collegial) (ii) Corporation (iii) Govt Res. Centre	(i) Scientists in University (collegial) (ii) Corporation (iii) Govt Res. Centre	Independent Authority	Government
Is Physical Safety & Security Regulation Mandatory?	No	Yes	Yes	Yes	Yes
Is Licensing Dual-Use Technology Mandatory?	No	No	Yes	Yes	Yes
Is Education & Training Mandatory?	No	No	Yes	Yes	Yes
Is Personnel Security Regulation Mandatory?	No	No	Yes	Yes	Yes
Who are the Decision-makers regarding Censorship/Constraint of Material proposed for Dissemination?	Individual editor	(i) Individual editor (ii) Corporation (iii) Govt. Res. Centre	(i) Individual editor (ii) Corporation (iii) Govt. Res. Centre	Independent Authority	Government

