Bioterrorism and Science: The Censorship of Scientific Journals Will Do More Harm than Good

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Science is based on the open communication of research and information. Scientists often build on the work and results that their colleagues have published in scientific journals. This process of incremental development prevents scientists from "reinventing the wheel" before continuing forward with original research. It stands, therefore, that the publication and distribution of research is necessary for future research to be productive. However, the dissemination of research has an adverse side effect in the current world. Scientific journals not only inform scientists about recent developments in their field of research, they also inform terrorists. It is possible for terrorists to use the same information found in scientific journals, intended for the benefit of the scientific community, to harm other people. The September 11th attacks force journal editors and reviewers to consider whether censorship is necessary to prevent further, more severe, terrorist attacks. I believe, however, that broad censorship of scientific journals will hurt our own efforts at biodefense and health care more than it will hinder terrorists looking to make biological agents.

In order to understand the current anxiety over bioterrorism we must look at the history of terrorism, both biological and conventional. Bioterrorism was a worry of

American scientists and policy makers long before the attacks on September 11th. It has been estimated that, during the Cold War, the Soviet Union employed as many as 60,000 people in a biowarfare research program ([Anonymous] 2000). Ex-Soviet biowarfare researchers have reported the development of a strain of plague resistant to 16 different antibiotics by the Biopreparat, a clandestine network of research facilities located in Russia and Kazakhstan (Dennis 2001). It is certain that the US government was aware of the Soviet interest in biowarfare and thus also had biowarfare and defense programs. It wasn't until Iraq used chemical weapons against the Kurds that we thought a modern state would actually employ chemical or biological weapons. Then, in 1995, the Japanese cult Aum Shinrikyo released sarin gas on a subway, killing 12 ([Anonymous] 2001), and demonstrated that there was need for real concern about chemical and biological terrorism. In addition to the September 11th attacks, the American public was also subjected to anthrax attacks during the final months of 2001. As the first biological attacks on US soil in more than a decade, these emphasized that bioterrorism is still around and that the United States is still unprepared for a large-scale biological attack ([Anonymous] 2000).

Two papers that were released around the time of the attacks raised fears in the scientific community of bioterrorism. The first paper, published in 2000 by a team of Australian researchers, dealt with mousepox, a virus closely related to smallpox (Jackson and others 2001). The researchers attempted to control mouse populations in Australia by inoculating the mice with a virus designed to stimulate antibodies against mouse eggs, rendering them infertile. In addition to inserting a protein from the mouse eggs, the team also spliced a gene called IL-4 into the virus. The insertion of IL-4 was supposed to boost antibody production. In practice, however, it disabled the immune system's cell-mediated response. With the immune system disabled, the normally mild mousepox infection killed the entire mouse population, including those mice that had been vaccinated against mousepox.

The second paper, published in 2002, details the synthesis of an infectious poliovirus agent "solely by following instructions from a written sequence" (Cello and others 2002). This team, based at the State University of New York at Stony Brook, obtained commercially available DNA material and used common chemical processes to synthesize polio. Together these two papers have drawn international attention from governments and scientists alike.

The implications of each paper are obvious. The Australian paper dealt with mousepox, a close relative to the human pathogen smallpox. It is very possible that splicing the IL-4 gene or its human equivalent into the smallpox virus can have similar effects on humans—crippling our immune system—thus increasing the lethality of the virus. The polio paper demonstrates that anybody with access to the proper DNA material and knowledge of common chemical processes and the genetic sequence to a virus, many of which are available on the Internet, can synthesize lethal human pathogens. Both of these papers clearly can aid a bioterrorist. Because of these publications the United States and British governments are urging the censorship of "sensitive but unclassified" information ([Anonymous] 2002).

Censorship, rather than impeding bioterrorism, will only hinder or halt beneficial research for biodefense. These two articles would have been stripped of detailed information, if not removed from publication. It is also very likely that the poliovirus genetic sequence is considered “sensitive but unclassified” due to the dangerous nature of the virus and the current population’s lack of resistance. The genetic sequence thus would never have been made available to the general scientific community had censorship been in place prior to the publication of the poliovirus genome.

While censoring publications such as those described above and preventing public disclosure of information such as the poliovirus genome might prevent bioterrorists from taking advantage of dangerous information, it will also hinder biodefense researchers trying to protect the general population from any biological attacks. Without full detail of the procedures used to synthesize the poliovirus or create the mouse “supervirus,” the research community is unable to verify the claims of the paper and reproduce the results. Furthermore, anyone wishing to use that research as a basis for future vaccines or to develop new biological agent detection techniques would be unable to do so, since there wouldn’t be any substantial information provided in the articles if the articles were published at all (Verma 2002).

With the knowledge of how biowarfare researchers design agents, those attempting to protect the general population may be able to create detection mechanisms or treatments for whole classes of pathogens, known or unknown. Such collaboration will be impossible with censorship (Salyers 2002). Biodefense researchers are always looking for new techniques to create vaccines in anticipation of new pathogens that have yet to be discovered or created. Biowarfare researchers can assist them only if there is open communication between both groups.

Censorship will also harm the quality of research conducted on censored pathogens. Because a significant part of a scientist’s reputation and career is based on the work he publishes, and its reproducibility, many will simply specialize in uncensorable—and thus publishable—areas, draining talent from biodefense and biowarfare research ([Anonymous] 2002). Those scientists still involved in censored research will be hindered by additional layers of bureaucratic "red tape" that will slow the development of detection methods and vaccines (Cohen 2001).

In addition, there is nothing stopping a bioterrorist from exploring the potential of an uncensored agent. As Gigi Kwik at the Center for Civilian Biodefense Strategies at Johns Hopkins University says, if we censor the 38 worst agents, which many scientists are pushing for, then a terrorist will simply "go for number 39, which is still nasty, but didn't make our list" (Cohen 2001). There are many agents that can be easily modified for malicious purposes, either to increase their virulence or to make them harder to detect and treat (Dennis 2000). Censoring a subset of agents will just encourage terrorists to be more creative in their creation of biowarfare agents.

Finally, censorship can be abused to hide embarrassing facts about our biowarfare or biodefense programs. Making the researchers involved in biological agent research publicly accountable for their actions can bring to light weaknesses and faults in those research programs. With censorship, those problems will never reach the general scientific community and will eliminate the advantages of peer review and criticism ([Anonymous] 2002).

Some might feel that censorship is worth the risk of hindering biodefense research. Biodefense research, however, is not the only field that will be harmed with censorship; medical care research will suffer as well. If the poliovirus sequence had not been published, an important treatment for malignant gliomas, tumors that occur in tissue intermingled with the essential elements of nervous tissue such as the brain or spinal cord, might not have been discovered. According to Clarke, a team of microbiologists at Duke University is currently working on a treatment for gliomas that uses the polio virus spliced with a region of a human rhinovirus, a virus that causes common colds. The resulting hybrid does not cause polio but binds directly to the cancerous cells and destroys them. Tests conducted on mice showed the virus rendering the brain tumors undetectable in 8 days, and nonhuman primate experiments demonstrate that the hybrid does not cause any of the symptoms of polio. Should this research reach fruition, it is possible that the same virus that once paralyzed millions could now be used to cure a once untreatable and extremely fatal form of brain cancer (Clarke 2001). Such a development might have been impossible with censorship, since the researchers were able to create the hybrid virus only by modifying the poliovirus genetic sequence discovered and published by other scientists.

Furthermore, censorship is unnecessary because, even if terrorists acquire "dangerous knowledge" through open and public journals, they will lack the practical means to apply that knowledge and produce biological weapons. A successful attack requires the bioterrorist to obtain the correct pathogen, handle the pathogen safely, grow the pathogen in an environment designed to foster the desired characteristics, store the pathogen until deployment, and disperse the pathogen over a large area ([Anonymous] 2000). These are not simple tasks. The pathogen, in its natural state, is a product of evolution. Moving a pathogen from its natural environment will decrease the pathogen's stability and lethality (Dennis 2000). It is unlikely that terrorists, with their limited resources and skills, can surmount the challenges associated with bioweapons. Currently, without censorship, there has not been a major biological attack using conventional agents, and there has never been an attack of any severity using exotic or modified agents. Previous bioterrorism attacks have infected only a small number of people or have only made victims ill, and few people have died due to bioterrorism. This suggests that terrorists are not able overcome the obstacles in producing bioweapons or are unable to apply the knowledge found in public journals.

Because terrorists lack the required skills and the resources, they may turn to individuals who already have experience producing biological warfare agents and delivery systems. Since the former Soviet Union employed over 60,000 for biowarfare research, it is possible that terror groups may turn to those workers for help in constructing a biological weapon. It is important to keep in mind that, of the 60,000 ex-Soviet workers, only 5% were senior-level scientists and only 100 or so knew of all of the steps required to produce a bioweapon ([Anonymous] 2000). Thus it is doubtful that terrorist organizations will be able to find a scientist—let alone enough to compose the team that will be required for rapid development—with the skills needed to weaponize biological agents. Furthermore, while some individuals may have the skills necessary to build biological weapons, they are not eager to help terror groups. The Aum Shinrikyo spent $30 million when building their sarin gas bombs. The group came away with nothing—save 12 civilian deaths—in return for their investment in ex-Soviet workers' skills and technology ([Anonymous] 2001). It is unlikely that a terrorist group will be able to spend more than $30 million to buy the assistance of skilled individuals.

It is also unlikely that terrorists would be willing to buy the expertise needed to create a biological weapon even if they were able to afford such a large expense. $30 million can buy a significant amount of conventional weaponry that has been used effectively in past attacks. Witness the aftermath of the Oklahoma City bombing that involved a single truck full of fertilizer or the September 11th attacks that used two airplanes full of jet fuel as missiles. Not only were these terrorist attacks inexpensive, but they were also effective at killing a large number of people and provided the media with scenes of destruction that frightened people immediately unaffected by the attack, all over the world. Assuming there are individuals able and willing to help terrorists construct a bioweapon, it seems that the costs of buying their skills are not worth the uncertain effects of a biological attack when conventional weapons are proven to be effective.

As it is unlikely that terrorists would be able to successfully fund the preparation of a biological attack, they would probably turn to rogue nations for assistance. Governments sympathetic with a terrorist group are the only entities capable of providing the necessary resources to create an effective biological weapon. More than two dozen countries are believed to have weapons of mass destruction. While some of those countries may have a nuclear-only arsenal, it is possible that many have biological weapons in their stores. As yet, no countries have been linked to assisting any terrorist groups with the development of biological weapons ([Anonymous] 2001). While there may be countries able to assist terrorists, no one wishes to be linked to a biological attack on the United States or one of its allies. Such an attack will likely align the majority of the world's nations against the terrorist group and, if linked directly to the group, the government that assisted them.

Assuming that terrorists are able to find the talent and resources to manufacture large quantities of biological agents and have managed to deploy the agents effectively, there is no guarantee that the agents will be effective as a weapon. Conventional biological warfare agents that aren't genetically modified and that can be handled without extreme care, such as sarin gas or anthrax, require concentrated doses to have any serious effect on the victims. Martin Hugh-Jones, an epidemiologist at Louisiana State University and the coordinator of the World Health Organization Working Group on Anthrax Research and Control, has described a hypothetical attack on Grand Central Station in New York City with anthrax. In the attack a suitcase full of anthrax is placed in Grand Central Station and programmed to release the agent during rush hour. According to his results many victims wouldn't develop any symptoms, and those that did would believe that they had a mild case of the flu rather than an infection from anthrax ([Anonymous] 2000).

Engineered agents are even less likely to be effective over a long period of time or over large distances. Millions of years of evolution have produced viruses tailored for the environments they occupy. Altering the genetic sequence of a virus can produce a strain that is more lethal or virulent than the naturally occurring strains, but the engineered strains are no longer tailored for their environments. Traits such as toxin production are taxing on the organism producing the toxin and will remain in later generations only if the added or modified genes provide the new strain an advantage in natural selection. Even if the engineered strain remains competitive in the evolutionary process, there is nothing preventing the new strains from further mutating to better adapt to their environment and losing the characteristics that make them effective weapons (Dennis 2000). Everything from natural UV radiation to dry climates to daily temperature variations weakens viruses. There is simply no guarantee that bioweapons will be effective in large populations, in open environments, or over a long period of time.

Finally, from a logistical standpoint, it will be nearly impossible to implement and enforce censorship in scientific publications. In order for any form of censorship to be effective there must be global agreement to abide by the dictated terms. If only a subset of journals censor their publications, then scientists will simply submit their works to more open journals. The same principle applies to employers and nations. Should only a few corporations or nations agree to censor their researchers, then those scientists will move to companies or nations that allow free publication. Other public venues such as conferences and symposiums will need to be monitored for content, and all of the speakers will have to agree to stick to noncensored topics. Finally, the Internet will always offer a forum for any scientist to post any information that he or she wishes to. It is very possible that communities similar to those that have formed to share other information such as media or code would be organized to promote the dissemination of scientific work. Partial censorship will cause those being censored to find alternate methods of collaborating with their peers, and global censorship will be extremely difficult to implement.

We need only look at the example of nuclear technology to see how futile censorship is. Nuclear secrets have been censored since the Manhattan Project, but that has not stopped the proliferation of nuclear devices around the world. There is no reason to believe that biological warfare will be any different—other countries are still free to perform their own research and development regardless of the United States's or Great Britain's policies. If these two governments proceed in their attempts to censor science, we must, at the very least, ensure that any censorship is extremely limited and very well defined. Only information that can be directly and immediately used to improve bioterror weapons should be censored. This would mean that papers such as the two cited above for polio synthesis and the creation of a deadly and virulent mousepox virus would have the information that can be used to adapt those techniques to other biowarfare agents expunged and nothing more. In the end, those calling for censorship should maintain a sense of perspective. After all, airplanes were used to kill thousands in the September 11th attacks. Why not restrict research on aircraft fuel or plane design? The benefits of those lines of research are too great to be hindered by general, ineffective censorship. Biological research, too, offers many opportunities to improve our quality of life and should not be hurt by useless censorship.

Works Cited

[Anonymous]. 2000. The invisible enemy. Economist; 357: 93-94.

[Anonymous]. 2001. The terror next time? Economist; 361: 73-75.

[Anonymous]. 2002. Secrets and lives. Economist; 362: 75-77.

Cello, Jeronimo, Aniko V. Paul, and Eckard Wimmer. 2002. Chemical synthesis of poliovirus cDNA: generation of infectious virus in the absence of natural template. Science; 297: 1016--1018.

Clarke, Tom. Virus crosses brain cancer. 2001. Nature.com [online]. Available: http://www.nature.com/nsu/nsu_pf/010524/010524-9.html. Accessed 2003 Sept 15.

Cohen, Philip. 2001. Recipes for bioterror: censoring science. New Scientist; 177: 10.

Dennis, Carina. 2001. The bugs of war. Nature; 411: 232--35.

Jackson, Ronald J., Alistair J. Ramsay, Carina D. Christensen, Sandra Beaton, Diana F. Hall, and Ian A. Ramshaw. 2001. Expression of Mouse Interleukin-4 by a Recombinant Ectromelia Virus Suppresses Cytolytic Lymphocyte Responses and Overcomes Genetic Resistance to Mousepox. Journal of Virology; 75: 1205--210. Available: http://jvi.asm.org/cgi/content/full/75/3/1205. Accessed 2003 Sept 15.

Salyers, Abigail. 2002. Science, Censorship, and Public Health. Science; 296: 617.

Verma, Inder M. 2002. Censorship of scientific publications: a bad idea. Molecular Therapy 5: 337.