Should Science be Silenced?

Ryan Knodle[1], Gillian Bowser[2], and Mark Brown[3,*]

[1]Department of Microbiology, Colorado State University, Fort Collins, CO

[2]Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO

[3]Flint Cancer Center, Department of Clinical Sciences, Colorado State University, Fort Collins, CO

[*]Corresponding Author: Mark A. Brown, Flint Cancer Center, Department of Clinical Sciences, Colorado State University, Campus 1052, Fort Collins, CO 80523-1052, USA. Phone: (970) 491-5782; Fax: (970) 491-3483; Email: M.Brown@colostate.edu

Keywords: Scientific Censorship, Microbiology, Social Justice

Abstract

Since the emergence of news related to the development of a modified H5N1-virus, a media and political firestorm has ensued. Many global health officials have condemned the publication of the results and methods related to the H5N1 findings, citing obvious threats of bioterrorism. Adamantly opposing the redaction and limitation of the research are members of the scientific community, who are calling the attempts at censorship a blatant disregard for the openness of science and the dissemination of discoveries. Herein, we discuss the fallout of these recent events and their impacts on the scientific and global health communities.

1. Discussion

Perceived danger can be a persistent specter, especially when it involves input from the public and/or institutions in positions of power. Galileo Galilei could attest to this, as his proclamations confirming the postulations by Nicolous Copernicus were heavily censored by the early Church (Harris, 2010). In 1500, the perceived danger manifested as science attempting to circumvent the authority of God and the Church. In the early 1970's, the phrase "expletive deleted" became part of America's vernacular as Richard Nixon's recorded conversations were largely censured. The perceived danger here was akin to the Federal Communications Commission (FCC) censorship of music in the early 2000's: *the younger demographic of the public need not be exposed to such a high volume of vulgar language*. After Cpl. Pat Tillman's death via friendly fire in Afghanistan in 2004, the proceedings of the internal investigation sent to Mary Tillman, Pat's mother, from the U.S. Army were heavily redacted; the perceived danger being the release of potentially incriminating evidence against the Army through an attempt at transparency.

Currently, we stand at a crossroads in the broad spectrum of science. For years, scientists have played roles that have transcended simple researchers and innovators. They have acted as attorneys working tirelessly to find "the truth" and to expose "the truth." Of course, the majority of historical examples involve scholars who were stifled and subdued by higher powers whose purpose was to hinder the efforts of discovery and the subsequent change that ensued. When we teach our students of Galileo Galilei, Charles Darwin, Gregor Mendel, and Rosalind Franklin, we speak of them in an almost eulogizing manner, heralding them as visionaries who held firm in their beliefs despite seemingly insurmountable pressure to withhold their findings and limit the scope of discovery.

In retrospect, the perceived danger surrounding these cases was unfounded and focused primarily on maintaining the current order and avoiding the disruption of notions that had been accepted for years. Today, however, the danger can hardly be termed perceived. The looming threat of an organization or individual manipulating a deadly pathogen in the effort to harm others is not foreign in our society. Consider the 1984 Rajneeshee attack in Oregon where a group aiming to incapacitate the voting population before a county election contaminated salad bars in ten restaurants with *Salmonella enterica* (Jacobs, 2004). Although there were no fatalities as a result of the mass infections, 751 residents suffered food borne illnesses. Take, then, the use

of anthrax spores both in Tokyo in 1993 and across the Eastern United States following the September 11 attacks in 2001 (Bush & Perez, 2012). The malicious use of infectious microbial agents is all too familiar in the psyche of the United States, and of the world.

This brings us back to the crossroads, specifically, to the Erasmus Medical Center in Rotterdam, Netherlands, where recent research has produced a variant strain of the Influenza A H5N1 virus which can be easily transmitted between humans (Enserink, 2012). Until now, the famed and feared "bird flu"-termed so due to its vector being an avian species in Southeast Asia-had only been observed as a virus that could be transmitted between avian species and from birds to humans. Human to human transmission has been extremely rare, but has occurred in few, isolated cases. This is largely due to the virus's binding sialic acid residues in the lower respiratory tract (Oshansky et al., 2011) which differentiates both the seasonal influenza and H1N1 strains which are spread via respiratory secretions of the oropharynx and nasopharynx. Transmission from human to human has thus not been an effective means of propagating the virus. Although novel Influenza A H5N1 has lower virulence when compared to any of the H1N1 strains or seasonal influenza strains (Tang, Shetty, Lam, & Hon, 2010), it maintains a much higher pathogenicity (Fukuyama & Kawaoka, 2011), being incredibly adept at causing disease. The mortality rates for H5N1 in humans has historically been 60%, higher than all other influenza subtypes(Fukuyama & Kawaoka, 2011). The major outbreaks have occurred in Hong Kong (1997, 2003), Thailand (2003-2005), Indonesia (2004), and Cambodia (2005).

One of the major concerns of the microbiological research community and global health officials of influenza and other viruses with segmented genomes has been genetic reassortment after co-infection in a host. This mechanism explains the need to modify the seasonal influenza vaccine every year. Multiple genetically distinct strains of influenza infect the same host at once. The viruses are internalized into the same cells in the respiratory tract and upon transport to the nucleus, the 8 segments of negative sense single-stranded RNA (ssRNA) are shuffled. When new virions are produced, 8 segments of ssRNA are packaged at random in daughter virions. These combinations may produce no new strains of the virus; however, packaging of certain combinations of ssRNA segments can create new viruses, sometimes even combining the most pathogenic characteristics of both parent strains. This is what global health officials have feared about H5N1: that co-infection of a host with a novel H1N1 strain could create a daughter virus containing the pathogenicity of H5N1 and the virulence of H1N1. Put simply, a virus that is as

contagious as the 1918 Spanish Influenza virus with a mortality rate around 60% as exhibited by the bird flu outbreaks in Southeast Asia.

Microbiologists have understood this to be a very real possibility. The question has not been if it is going to happen, but rather when it will happen. It seems as if Dr. Ron Fouchier and Dr. Yoshihiro Kawaoka answered that question in January. While performing research into possible mutations that could make H5N1 more easily transmissible between humans, they found such a mutation. The purpose of the research was to identify possible mutational mechanisms to prepare vaccines that would have significant efficacy against any mutation that facilitated human to human transmission. Operating under the logic that co-infection and reassortment is likely to occur and that production of the subsequent virus strain would be alarmingly detrimental to global health, Drs. Fouchier and Kawaoka sought a means to immunize the population before such mutations occurred.

The news about their findings has since created a media and political firestorm, with many global health officials and government members condemning the complete publication of the results and methods, citing obvious and imminent threats of bioterrorism if the information fell into the wrong hands (Becker, 2012). Adamantly opposing the redaction and limitation of the research are members of the scientific community, who are calling the attempts at censorship a blatant disregard for the openness of science and the dissemination of discoveries (Becker, 2012; Fouchier, García-Sastre, & Kawaoka, 2012). And herein is our censorship issue: is the danger that releasing this information poses greater than the potential benefit to global health if the information is used for further vaccine research? This point has been well-argued by both sides, with the National Science Advisory Board for Biosecurity (NSABB) dictating that the potential risks far outweigh any potential gain. The NSABB is an independent group that advises the Department of Health and Human Services, and has spoken out against the publication of all of the details of Fouchier and Kawaoka's research. The chief proponents of fully publishing the information, including the materials and methods, have been both Fochier and Kawaoka as well as a number of virologists who are considered experts on influenza. Dr. Fochier, who has been the public figure on the side opposing global health critics, argues that any terrorist group or rogue nation who wanted to maliciously use the information in an act of bioterrorism does not need the published research to create the extremely dangerous virus if they have the resources to do so.

So, disregarding the political aspects of this debate, what do scientific journals think? Surely, if they decide it is too dangerous to publish, does it make much difference what anyone else thinks? The two leading voices on the side of scholarly publications have been *Science* and *Nature*, both of which reviewed different manuscripts published by Drs. Fouchier and Kawaoka. The journals released a joint statement, summarizing the current situation, and discussing the implications on global security, governmental concerns, and the publishing community. In short, the two journals agreed with the NSABB that the magnitude of risk was exceedingly high, and that the two articles should not be published in full. Originally, both journals agreed that the articles should be printed, pending peer review, in the absence of some crucial information that could be utilized by bioterrorist organizations. After consultation with the World Health Organization, however, the journals and the WHO decided that there was no practical way to censor part of the information or try and decide which researchers or universities would be entitled to receiving the redacted information for research purposes. In early May, both Journals decided that they would proceed with the publication of the articles in full (Becker, 2012).

2. Conclusions

What does this mean for us? For the most part, nothing. The liberties and scope of discovery are not being limited here. The information concerning the materials and methods necessary for recreating these experiments are being released to the world and, consequently, to global health organizations like the Centers for Disease Control and Prevention, the World Health Organization, and the National Institutes of Health. These results will be shared with government agencies around the world which can use the information to develop vaccines. In the meantime, we will defer to the judgment of global health agencies that have a better idea of assessing bioterrorism risks. The debate surrounding this decision should not be regarded as 'government stifling science', but rather, science and government working together to bring about health benefits for all people.

Acknowledgements

Bowser and Brown thankfully acknowledge support from the National Science Foundation (1140182), (0956059), and (1060548).

References

Becker, G. (2012). The H5N1 publication case and its conclusions. *Acta Biochim Pol, 59*(3), 441-443.

Bush, L. M., & Perez, M. T. (2012). The Anthrax Attacks 10 Years Later. *Annals of Internal Medicine, 156*(1_Part_1), 41-44. doi: 10.1059/0003-4819-155-12-201112200-00373

Enserink, M. (2012). In the Eye of the Storm, Two Rivals, Two Strategies. *Science, 335*(6064), 21. doi: 10.1126/science.335.6064.21

Fouchier, R. A. M., García-Sastre, A., & Kawaoka, Y. (2012). The Pause on Avian H5N1 Influenza Virus Transmission Research Should Be Ended. *mBio, 3*(5). doi: 10.1128/mBio.00358-12

Fukuyama, S., & Kawaoka, Y. (2011). The pathogenesis of influenza virus infections: the contributions of virus and host factors. *Current Opinion in Immunology, 23*(4), 481-486. doi: 10.1016/j.coi.2011.07.016

Harris, J. C. (2010). Galileo galilei: Scientist and artist. *Archives of General Psychiatry, 67*(8), 770-771. doi: 10.1001/archgenpsychiatry.2010.95

Jacobs, M. K. (2004). The history of biologic warfare and bioterrorism. *Dermatologic clinics, 22*(3), 231-246.

Oshansky, C. M., Pickens, J. A., Bradley, K. C., Jones, L. P., Saavedra-Ebner, G. M., Barber, J. P., . . . Tripp, R. A. (2011). Avian Influenza Viruses Infect Primary Human Bronchial Epithelial Cells Unconstrained by Sialic Acid α2,3 Residues. *PLoS ONE, 6*(6), e21183. doi: 10.1371/journal.pone.0021183

Tang, J. W., Shetty, N., Lam, T. T. Y., & Hon, K. L. E. (2010). Emerging, Novel, and Known Influenza Virus Infections in Humans. *Infectious Disease Clinics of North America, 24*(3), 603-617. doi: 10.1016/j.idc.2010.04.001