Journal Publication Policies on Biosecurity and Dual-Use Research of Concern

Peer-reviewed journals are integral to science because they shape the dissemination, credibility, and impact of research. They serve as gatekeepers, setting the standards for what counts as legitimate scientific knowledge, influencing the trajectory of academic careers and informing institutional funding decisions. All of these, in turn, affect broader cultural norms among researchers and institutions around responsible research, biosafety and biosecurity. Scientific publishing is also a vital component of the global response to pandemics and other potential biosecurity threats. A swift and coordinated response to such threats is key, and the COVID-19 pandemic, as well as previous epidemics, demonstrated both the limits and the flexibility of traditional publishing in responding to emergency crises. Furthermore, publishing practices and DURC policies at prestigious journals are bound to have a major influence on research decisions and outputs in the short-term that will inform future pandemic responses, or affect the management of dual-use risks in the present, a source of enormous existential risk.

This primer is aimed at biosecurity-minded science policymakers, biosecurity experts, and open science advocates looking to understand the role of journals in managing biosecurity risks and Dual-Use Research of Concern (DURC). While journal policies on biosecurity are directly relevant to specific areas of science policy and research governance, they are often overlooked in broader debates on open science and alternative publishing models. When security concerns do enter these discussions, they are often invoked to justify maintaining traditional publishing structures rather than exploring how more open models might be adapted, or even leveraged, to incorporate biosecurity considerations. By providing a clearer picture of journal policies and editorial practices, this primer hopes to inform policy discussions on reforming peer review, shaping publication oversight mechanisms, and integrating security considerations into evolving scientific publishing landscapes.

From a biosecurity perspective, the ongoing debates about traditional publishing models - marked by growing disillusionment and tensions - present a largely untapped opportunity. Engaging with discussions on open science and reforming peer review offers a strategic opportunity to significantly enhance biosecurity and DURC - awareness, which is lacking in research spaces, while leveraging growing political momentum and institutional interest in rethinking science as a whole.

While biosecurity policy rightly tends to intervene at earlier stages of the research cycle - focusing on funding and oversight across various industries rather than publication - journals remain central to discussions about the responsible dissemination of sensitive research. As primary arbiters of what enters the scientific record, journals have faced scrutiny over their role in managing potentially harmful research. In today's digital world, the rare researcher acting in bad faith (or gross negligence) can always find ways to distribute sensitive information to platforms that can be easily accessed by malicious actors. However, peer-reviewed journals remain a cornerstone of scientific communication, shaping research norms, career advancement, and institutional funding priorities.

Relative to their outsized influence, the lack of transparency of peer review and editorial decision-making raises questions about how DURC considerations factor into shaping which research gets published, and thereby elevated in status and impact. Despite their access to unrivalled financial and expert resources, journals' responsibilities in mitigating biosecurity risks remain debated, with some editors and experts arguing against the feasibility and ethics of placing such financial and legal burdens on publishers over funders and institutional review committees.

This short paper will explore the history and key debates surrounding the publication of potentially DURC-sensitive research in peer-reviewed journals, including the extent to which they have clear policies. To address this gap, I will summarise the current landscape of journal policies on DURC and infer internal decision-making processes where the available information allows. Understanding the perspectives of publishers and journal editors is essential for developing informed policy strategies to further biosecurity at the publication stage. The paper will conclude by outlining the main arguments against implementing journal-based DURC policies, especially those put forward by editors, alongside counterarguments. Ultimately, this primer aims to provide clarity for those questioning whether intervention at the publication stage is feasible, effective, or even sensible.

Summary of influential DURC life sciences publications and relevant regulatory changes

Year link to section	Publication	Dual-use relevance	Primary contemporary arguments		Notes
			Defending publication	Criticising publication	
2001	Mousepox (Australia)	Gene insertion (IL-4) approaches could dramatically increase virulence, even against vaccinated hosts.	- **Awareness-raising of risks:** in this case, the Australian government specifically highlighted the potential for awareness-raising to mitigate the risk of another research group unknowingly creating a more dangerous virus	**- Blueprint/roadmap for malicious actors**	- The scientific community did not have all the necessary information to effectively assess the dual-use risks of its publication (e.g. smallpox sample storage); some information is rightly withheld for security purposes - The nature of the critical findings could not have been known or anticipated earlier in the research cycle, so intervention at the publication stage is still vital
	US Anthrax Attacks following 9/11*:* Fuelled debates around scientific openness, categorising "sensitive but unclassified (SBU) information", the misuse of scientific information, defining 'dual-use' research in the life sciences and pre-publication review of sensitive research				
2002	Poliovirus (US)	Created live polio virus from gene fragments bought online; eradication in the wild no longer guarantees against re-emergence	**- Awareness-raising of risks**	**- Blueprint/roadmap for malicious actors** **- May harm public trust in scientists**	- Unlike smallpox, polio virus samples are available from suppliers.
2003 2004	Editors and authors issue Statement on Scientific Publication and Security; **Fink Report.** Both strongly advocated for self-regulation of publication review by the scientific community. **NSABB** established (by DHHS on recommendations of Fink Report; operational from late 2005; defined 'DURC' in 2007). As a federal advisory committee, journal editors cannot directly refer issues or manuscripts to NSABB; NSABB makes recommendations on publication decisions at the request of the government.				
2005	Modelling a bioterror attack on US milk supply (US)	Modelled a theoretical bioterrorist attack on the U.S. milk supply with botulinum toxin, estimating extent of illness and death and suggested preventative government and industry measures	**- Already-out-there:** critical information already readily accessible **- Avoiding obscuring the scientific frontier:** limiting open dissemination could prevent need-to-know actors from being well-informed, and could lead the government to over- or underestimate its seriousness relative to other risks, while doing little to limit bad actors' capabilities	**- Blueprint/roadmap for malicious actors**	- NSABB not yet operational; DHHS made unprecedented direct request to journal to not publish; the first time publication was delayed due to government intervention - Noted as a prime example of research that falls outside of traditional biosafety and biosecurity guidelines and categories. The criteria for triggering oversight mechanisms may be inadequate here.
	Reconstruction and virulence analysis of 1918 Influenza virus (US)	Identified genetic traits responsible for extremely high virulence of 1918 strain's via reconstructing the virus	**- Awareness-raising of risks** **- Avoiding obscuring the scientific frontier**	**- Blueprint/roadmap for malicious actors** **- Mere existence of virus generates unacceptable risk** (e.g. by accidental release, theft)	- The first formal referral of a manuscript to the NSABB - Editors raised concerns about government encroachment

Summary of influential DURC life sciences publications and relevant regulatory changes (continued)

2011 /2012	H5N1 Influenza (US-based *Nature* paper; Netherlands-based *Science* paper for which NSABB initially recommended redactions)	Identified mutations that allowed H5N1 to spread via airborne transmission between ferrets, potentially providing methodology to create deadly human-human transmissible H5N1 from human experimentation alone.	**- Pandemic preparedness relies of the principle of free sharing of information** **- Already-out-there** **- Avoiding obscuring the scientific frontier** **- Critical biosecurity-relevant information** (e.g. prioritising vaccine development/preparedness)	**- Blueprint/roadmap for malicious actors** **- Theoretical benefits of risky research are limited by system-level constraints:** Benefits to public health/security of publishing potentially risky molecular-level research is strictly dependent on the capacity at a systems-level to translate the research into implementable changes (e.g current surveillance infrastructure, vaccine technology)	- The publication that came closest to being government censored on biosecurity grounds - A government had conceptualised publication as exportation of dual-use goods; the court ruled based on issues such as basic vs applied research as opposed to benefit/risk to public health and security - Unprecedented intensity of disagreement and debate, global and highly polarised: (1) thrust debates around dual-use and "gain of function" research into mainstream, (2) led to first voluntary moratorium on avian influenza transmission research (and later contributed to the 2014-17 NIH GOF funding pause) and (3) led to new US government DURC oversight policies (*below* - which the ultimate decision in 2012 to publish was informed by)
2012 2014	Federal DURC Policy - Federal oversight and risk mitigation of non-classified research involving a specified agent at institutions receiving federal funding Institutional DURC Policy - Policies, practices and procedures to be implemented at the institutional level for risk mitigation				
2014 — 2017	**NIH funding pause on gain-of-function research** involving influenza, SARS, and MERS viruses. Lifted in response to the release of the P3CO framework. **P3CO framework**: A process spearheaded by NSABB and HHS, the PC3O framework guides the pre-funding review of proposed research that could enhance the lethality or transmissibility of a potential pandemic pathogen. It does not apply or hold direct relevance to publication decisions.				
2017 /2018	Horsepox (US)	Successfully recreated the horsepox virus (a close relative of smallpox) from mail-order synthetic DNA fragments	**- Direct application in treating disease:** in this case, claimed to be a development of improved vaccine for smallpox **- Already-out-there:** Despite the step-by-step methodology described, it was stressed that orthopox synthesis experiments were still technically challenging	**- Blueprint/roadmap for malicious actors**	- Bypassed any formal biosecurity review, including by the NSABB. The research was privately funded and conducted in Canada, so US DURC policies did not apply. However, the NSABB or similar body could have been consulted before publication - Increased debate around biosecurity screening and internal review processes in journals and publishers - Led to stronger calls to expand DURC policies to explicitly cover synthetic biology and the resurrection of extinct or creation of novel viruses, rather than only the modification of (specified) existing pathogens - Increased calls for stricter regulation and screening of gene synthesis providers
2024	Updated US policy on oversight of dual-use research (superseding the 2012 and 2014 DURC policies)				

Mousepox paper | 2001

In 2001, Australian researchers published a paper demonstrating that the insertion of the mouse interleukin-4 gene into the mousepox virus produced a strain far more virulent, which even killed vaccinated mice. The discovery implied that such gene-insertion methods might enable the production of vaccine-resistant smallpox, a disease for which no other defense currently exists. Defending the decision to publish, the project leader said "*We thought it was better that the information came out in case somebody constructed something more sinister… We felt we had a moral obligation because it is existing technology*." A fellow Australian scientist echoed the awareness-raising argument: "*The best protection against any misuse of this technique was to issue a worldwide warning.*" On the other hand, the director of the Center for Civilian Biodefense Studies at Johns Hopkins University, said "*I can't for the life of me figure out how we are going to deal with this*," regarding the increasingly frequent appearance of papers in journals that are effectively blueprints for making more harmful microorganisms. However, researchers themselves often consider the dual-use implications of their work and take precautions before submitting their manuscripts: the research group brought their work to the attention of Australian government officials before going ahead with publication. The Australian government ultimately felt that the information should be disseminated, if only to mitigate the risk of another research group adding an immunomodulatory gene to a contagious virus and unwittingly creating a more dangerous one without having prepared for it. With the ensuing controversy following publication, the research was soon terminated because of dual-use concerns.

The mousepox experiment is also a useful illustration of the nuance required in assessing security risks from life science publications and the challenges of self-regulation by scientists who lack the necessary information. Would-be bioterrorists looking to capitalise on the findings would require access to the smallpox virus. The only remaining samples of smallpox virus are held in high-security storage in the US (CDC) and Russia (State Research Centre of Virology and Biotechnology), and detailed information of the storage is classified information held by intelligence and security experts. This information - a prerequisite for making reliable assessments of the likelihood of smallpox proliferation and therefore the potential for applying the mousepox paper findings to smallpox by a lab - would not be available to scientists lacking a thorough security clearance. As such, it's been noted that the scientific community is, in some cases, not well-suited to make a risk-benefit analysis of publication.

It should be added that only two years later, a team of researchers building on the IL-4 insertion work in this paper made an even more virulent and deadly mousepox virus, but in doing so also managed to find two treatment combinations to protect against the customised virus, demonstrating the utility of 'gain-of-function' research in pre-empting treatments for potential mutations/strains.

The Australians' experiments were initially aimed at developing ways to induce mouse infertility as a means of pest control and their work ended in the publication of information that could, some argued, potentially be used to further bioterrorism goals and/or critical vaccine development. The mousepox paper represents one of many examples of dual-use discoveries that could not have been easily foreseen or mitigated during the very earliest

stages of the research cycle, highlighting the need for effective monitoring and review at the publication stage.

Poliovirus paper | 2002

US scientists sponsored by the US Defense Department had spent years working on chemically synthesising the poliomyelitis (polio) virus. In the aftermath of the US anthrax attacks, through assembling sequences of genetic material purchased online based on the published polio genome they were able to create live polio virus which paralyzed and killed mice. These findings, published in *Science* in 2002, demonstrated that the eradication of a virus in the wild and the inability to source pathogens from natural reservoirs doesn't guarantee its permanent suppression, as synthesis in a lab from the genome alone can be sufficient to produce them. The lead researcher later asserted that "*to most scientists and lay people, the reality that viruses could be synthesized was surprising, if not shocking. We consider it imperative to inform society of this new reality, which bears far-reaching consequences*." So, like the mousepox paper, the primary justification given for publication and dissemination was raising awareness of "*this new reality*" in the hopes that doing so will make us safer and more prepared for the risks posed by dual-use technologies at the scientific frontier.

The decision to publish the poliovirus paper drew widespread debate in the scientific community over whether the prestigious journal should have published the chemical synthesis of a viral, harmful pathogen, as many suggested that the information could be maliciously misused by readers. A US congressmen accused Science of publishing "*a blueprint that could conceivably enable terrorists to inexpensively create human pathogens*". The Editor-in-Chief of Nature publications later argued that '*the achievement of synthesizing a virus certainly deserved public attention. But to highlight to a large public audience exactly how to do so—in the absence of significant innovation or insight—ran the risk of unnecessarily reducing public trust in scientists' sense of responsibility*', while the editor of Science defended the decision to publish by asserting that "*Sticking one's head in the sand and hoping that unpleasant realities will go away has never been a fruitful approach to science or public policy*", while conceding that "*there should continue to be serious conversations about the relationship between scientific research, publication, and security*."

Echoing the debate surrounding the publication of the mousepox paper, an angle often missing from within the scientific community is biosecurity-relevant knowledge of the capacity for a would-be-terrorist to make use of any given dual-use information. It could be argued that the publication of their polio virus synthesis technique did not plausibly increase a malicious actor's accessibility to the organism, because, as the main author would later explain, "*they already had an ample supply of poliovirus available. Polio is present in old medical samples that are stored in freezers, and it can still be bought from suppliers. It's not like smallpox, which isn't as easily accessible*". This route would have been far easier and far less costly than synthesising the virus themselves. Synthetic biology has, of course, made great strides since 2002, such that now it's relatively straightforward to synthesise a virus from easily purchased gene fragments. In a red-teaming exercise at an MIT lab overseen by the FBI, researchers were able to acquire enough genetic fragments (from 36 out of the 38 providers requested, to a fictitious and highly suspicious lab), and then through conventional synthetic biology techniques, assembled constructs equivalent to those that would generate

a harmful strain of the 1918 Influenza virus. In hindsight, our present-day reality fails to make contemporary assessments of the dual-use risks and benefits of publishing breakthrough 'blueprint' studies like the 2002 paper (i.e. furthering bioterrorism vs raising awareness about potential future risks) any less challenging.

Calls for change

Editors issue a statement | 2003

During the year following the anthrax attacks of 2001, openness of scientific communication in the life sciences became a contentious topic, especially in light of published research with perceived bioterrorism risks such as the mousepox and poliovirus papers. In early 2003, 32 journal editors and authors issued their "Statement on Scientific Publication and Security", simultaneously published in *Science*, *Nature*, the *Proceedings of the National Academy of Sciences (PNAS)*, and by the *American Society for Microbiology (ASM)*. The statement was a culmination of meetings led by the *ASM* and the National Academies in response to the growing debate around minimising the risk of bioterrorism without jeopardising the ability to repeat experiments and validate scientific claims: "*questions… asked by the scientists themselves and by some political leaders about the possibility that new information published in research journals might give aid to those with malevolent ends*." Crucially, the editors affirmed that "*there is information that, though we cannot capture it with lists or definitions, presents enough risk of use by terrorists that it should not be published*."

On biosecurity review processes, the statement asserts that "*scientists and their journals should consider the appropriate level and design of processes to accomplish effective review of papers that raise such security issues"*, while also asserting that some journals have "*already devised procedures that might* [emphasis added] *be employed as models in considering process design*". On the outright rejection or redaction of sensitive information, they state that "*on occasions an editor may conclude that the potential harm of publication outweighs the potential societal benefits. Under such circumstances, the paper should be modified, or not be published*." Nevertheless, they also "*must protect the integrity of the scientific process by publishing manuscripts of high quality*", and that without their role in providing "*independent verification - a requirement for scientific progress - we can neither advance biomedical research nor provide the knowledge base for building strong biodefence systems*", stressing the importance of their role in scientific publishing from a security perspective.

While in many respects a step in the right direction, the tone of the statement lacked urgency and political will, and the acknowledgements themselves were (perhaps unsurprisingly) vague and unbinding.

The Fink Report | 2003

In 2003, the National Academies published *Biotechnology Research in an Age of Terrorism*, more commonly known as the "Fink Report," which centered on some of the same components as the NIH guidelines for research involving recombinant DNA back in the 1970s. The Fink Report was compiled by experts mostly from the academic community and

therefore *largely represented the response of the scientific community* to increased concerns about bioterrorism. The conclusions/recommendations relevant to publication biosecurity review were: (1) Highlighting the concept of dual-use research in life sciences through identification of the 'dual-use dilemma', which had received far less attention in life sciences compared to research in physical sciences and engineering; (2) A review system for seven categories of 'experiments of concern': those that would greatly alter transmissibility, detectability, vaccine effectiveness or antibiotic resistance, host range, pathogenicity or enable weaponisation of a biological agent; (3) Publication review should rely on self-governance by scientists and journals rather than formal government regulation. "*The Committee believes that the risks of a chilling effect on biodefense research vital to U.S. national security as the result of inevitably general and vague categories is at present significantly greater than the risks posed by inadvertent publication of potentially dangerous results.*" *"Proposals to limit publication have caused great concern and controversy among both scientists and publishers… [and] ultimately… would have to be acceptable to… journals… both in the US and internationally"; (4)* The **formation of a national advisory board** to help guide both the government and research community in addressing issues involving dual-use research and biosecurity

The NSABB | 2004

In response to the recommendations made in the Fink Report, in 2004 the U.S. government established the National Science Advisory Board for Biosecurity (NSABB) to assist the federal government in assessing the potential risks of life sciences research and to offer advice to policymakers, research institutions, and researchers about the conduct, oversight, and dissemination of sensitive research. The committee is composed of a voting panel of 25 non-government experts with a broad range of expertise that addresses issues relating to biosecurity and dual-use research, including "strategies to work with journal editors" in developing guidelines on the dissemination and publication of dual-use life sciences research. It's crucial to note here that as a federal advisory body, only at the request of the US government will the NSABB review manuscripts potentially describing DURC, and the NSABB in turn can only advise the US government; journals cannot directly refer issues to the NSABB and critically, journal editors remain the sole arbiters of the decision to publish. As almost all life science experiments could potentially be considered "dual use" while only a small set of them pose significant risks, the NSABB would later create a new, special category, "dual use research of concern" (DURC): "*Research that, based on current understanding, can be reasonably anticipated to provide knowledge, products, or technologies that could be directly misapplied by others to pose a threat to public health and safety, agricultural crops and other plants, animals, the environment, or materiel*."

Modelling a terrorist attack on the milk supply | 2005

Before the NSABB became operational, a paper approved for publication in the *Proceedings of the National Academy of Sciences (PNAS)*, provided under embargo to reporters, laid out a mathematical model of the effects of a potential bioterrorist attack on the U.S. milk supply with botulinum toxin. The study estimated the extent of illness and death that would result and suggested preventive measures the government and industry could take. Soon after

learning of the paper, the DHHS made an unprecedented request to the journal not to publish, as it could be a "*road map for terrorists*" and "*not in the interests of the United States*". As a result, the publication was delayed and the embargo extended. The journal soon went ahead with publication all the same, explaining that "*all of the critical information in this article that could be useful to a terrorist . . . are immediately accessible on the World Wide Web through a simple Google search*." The importance of open dissemination for national biosecurity was also stressed: "*If the types of calculations and analyses in the Wein and Liu article are carried out only by government contractors in secrecy, not only are the many actors in the U.S. system who need to be alerted unlikely to be well informed, but also the federal government itself may become misled—either greatly overestimating or underestimating the seriousness of a particular danger relative to other concerns*." Arguments of this nature center on the idea that obscuring the scientific frontier could limit the progress of the scientific enterprise - which forms a critical part of effectively preparing for and responding to biosecurity threats - while limiting the capabilities of terrorists very little, if at all.

The events surrounding the publication are also a prime example of the management of dual-use research taking place outside traditional biosafety and life sciences oversight, often involving big data and conducted by individuals unfamiliar with biosecurity guidelines. As a theoretical modelling study, the criteria and procedures for triggering special consideration of publication outside of conventional biosecurity-relevant fields like virology and synthetic biology may be inadequate.

The reconstruction of the 1918 influenza virus | 2005

The NSABB had now been established, but had yet to convene its first meeting when the system was put to the test. In late 2005, the journal *Science* received a paper describing the 'reconstruction' of the Spanish Flu virus, which killed around 50 million people worldwide in 1918-19, based on the full sequence of the virulent 1918 influenza strain published in *Nature* around the same time. The findings identified the genetic traits responsible for the strain's extremely high virulence, testing its effects on mice (with all mice dying from the 1918 strain within 6 days, compared to none with the contemporary flu strain). The research had been funded by the federal government, and so, for the very first time, the US HSS Secretary formally referred the Science manuscript to the NSABB and sought its advice on the future benefits and potential risk of misuse from its publication. The NSABB considered that the scientific benefit of the information outweighed the potential risk of misuse and unanimously recommended its publication. Ebright, a bacteriologist who serves on biosecurity panels felt that the researchers had "*constructed, and provided procedures for others to construct, a virus that represents perhaps the most effective bioweapons agent now known*", while an article in the New York Times, described the published genome as "*essentially the design of a weapon of mass destruction*." On the other hand, similar scientific frontier-obscuring arguments to the milk supply paper were made in defending its publication, as well as those stressing such papers' vital potential to aid our preparation for a future influenza pandemic. The editor of Nature, Philip Campbell, expressed a view likely shared by many journal editors, "*We are happy to cooperate with the NSABB to consider the principles by which dual-use results can be published responsibly… but government*

bureaucracies and committees may push to avoid perceived risks, at the potential expense of benefits to public security."

H5N1 'Gain-of-Function' controversy | 2011 - 2012

Echoing Campbell's concerns, another dilemma ensued six years later, again regarding a pair of influenza virus papers. Researchers have long been interested in preempting the various potential natural mutations of influenza viruses before the next influenza pandemic, which would represent a public health risk of global concern. In 2011, a team of scientists in the US and another in the Netherlands succeeded in mutating the H5N1 avian influenza virus into a strain directly transmissible (through the air) between ferrets, whose respiratory systems closely resemble those of humans. This breakthrough demonstrated the potential for a novel human-to-human transmissible influenza virus to be generated through human experimentation alone. The team in the US submitted a manuscript for publication in *Nature*, while Fouchier's Netherlands-based team submitted to *Science*. The journal's editors had the manuscripts referred to the NSABB, who unanimously recommended against publishing either paper, subject to the redaction of certain methodological details - an unprecedented move - with one board member stating "*My concern is that we don't give amateurs—or terrorists—information that might let them do something that could really cause a lot of harm*." Revisions were made to the papers, but after a WHO consultation, and informed by the newly released 2012 Federal DURC Policy, the NSABB recommended their full publication, without redactions, three months later.

The entire episode was unprecedented and rather remarkable, from a biosecurity perspective, for a number of reasons. Firstly, the *Science* publication may be the research paper that has come the closest, possibly up to the present day, to being government censored on biosecurity grounds. Secondly, for the very first time, a government had, in biosecurity terms, conceptualised scientific publication as exportation of dual-use goods. As *Science* is based outside the EU (and whose content/information can be accessed internationally), the Dutch government leveraged the EU Regulation 428/2009 (which sets out the community regime for the control of exports, brokering and transit of dual-use items), to command Fouchier, the leader of the Netherlands-based team, to apply for an export permit, which was eventually granted, allowing publication to go ahead. Fouchier would later go to court (twice) to challenge, ultimately unsuccessfully, the legality of this move by the government. This challenge primarily rested on the question of basic vs applied research, as controls on technology in EU Regulation 428/2009 don't apply to basic scientific research, under which Fouchier argued his paper should fall (understanding mammalian transmissibility of influenza strains). However, it could be contested that there was an undeniable public-centric motivation behind the research in and its direct implications (and applications). In the abstract of the 2012 *Science* publication, the authors explain that they undertook these genetic modifications "*To address the concern that the virus could acquire this [airborne transmission] ability under natural conditions*". Furthermore, a leader of the US-based team released a statement responding to an article stressing the unjustifiable risks posed by 'gain-of-function' research involving potential pandemic pathogens (PPPs), in which he asserts that their research had broader public policy applicability and had already contributed to pandemic preparedness: "*the ferret transmission studies in my lab and Ron Fouchier's lab demonstrated that H5N1 viruses have pandemic potential and it is important*

to continue to stockpile H5N1 vaccines... This is a critical point since vaccines expire and decisions by policymakers as to whether we continue to stockpile H5N1 vaccines should be based on scientific facts." Regardless, it's telling that in neither case did the court have to address the arguably more pertinent ethical question of weighing the risks and benefits of its publication to public health and security.

Similarly unprecedented was the sheer intensity of disagreement and debate surrounding the controversy, which was global and highly polarised. Various governments, as well as the WHO, weighed in on the issue; large swathes of the scientific community were divided, and a temporary research moratorium was established. Prior to the H5N1 controversy, dual-use concerns had largely been ignored in the mainstream scientific community and science policy spaces, but the debate that erupted thrust the dual-use dilemma into the popular consciousness among scientists - virologists, in particular - and policymakers. The NSABB expressed that "*The life sciences have reached a crossroads*" and that "*physicists faced a similar situation in the 1940s with nuclear weapons research*". The episode would become the defining case in the ongoing debate around 'gain-of-function' research and ultimately led to new US government policies on DURC (most directly the 2012 Federal DURC Policy, which established formal oversight for federally funded DURC, and the 2014 Institutional DURC policy, which addressed oversight at the institutional level; both were recently superseded by a unified 2024 policy).

The arguments made for and against publication within the NSABB are also revealing. In the NSABB's eventual recommendation to publish all of Fouchier's data and methodology, among their primary justifications was that "*Global cooperation, critical for pandemic influenza preparedness efforts, is predicated upon the free sharing of information and was a fundamental principle in evaluating these manuscripts*". It could be argued again, however, that assessing the utility of such a principle on a case-by-case basis demands broader biosecurity-relevant context. The benefit to public health of the publication of potentially risky molecular-level research is strictly dependent on the capacity, at a systems-level, to actually translate and leverage that research into implementable changes. A minority of the NSABB board argued that "*the current surveillance infrastructure is ill-equipped to detect the emergence of highly transmissible influenza viruses in real time prior to their dissemination in nature*", while the NSABB chairman noted that "*Even if we did spot [an emerging influenza virus] early on, I don't think we have sufficient vaccines. The vaccines aren't good enough, and the drugs are not good enough to stop this emerging and being a pandemic*". If the benefits of research cannot be applied due to systems-level constraints then we should be cautious about arguing that the theoretical benefits, from an abstracted, principled stance, still outweigh the risks.

On the other hand, without analysing the particulars of research findings, the risks can also be easily overstated. In the *Science* paper, not a single ferret died after airborne infection with H5N1, which is consistent with the phenomenon that virulence tends to decrease as transmissibility increases. And echoing previous cases, the question again arises whether publication would actually increase accessibility among malicious actors in real terms. While supplies of human-human transmissible H5N1 were and are not readily available (unlike polio virus), it was put forward that "*there is already enough information publicly available to allow someone to make a transmissible H5 HA-possessing virus*." However, synthesising complex information from diffuse and disparate sources into a single readable paper is itself

skill- and time-intensive work that could arguably qualitatively increase accessibility for malicious actors without such resources available to them. The critical nuance here is that factors such as management style, organisational makeup, and other intangible social relations (e.g. ease of access to expertise and real-time troubleshooting) are not easily replicated or transferred between groups or institutions. As such, the extent to which these skills, institutional structures and social relations can be reliably generated across different contexts is central to assessing the risks posed by the dissemination of methodological information through publication.

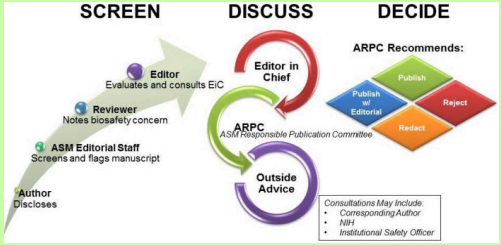
Horsepox (2017) —

[tbc]
Further commentary:
Biosecurity Implications for the Synthesis of Horsepox, an Orthopoxvirus -
Synthetic horsepox viruses and the continuing debate about dual use research -
Step-by-step horsepox study stokes dual-use controversy

Discreet dissemination

[tbc]
The case for “discreet dissemination” has been made by a number of institutions and policymakers in various forms. In ‘Biosecurity Dilemmas’ (Christian Enemark, 2017),, Enemark argues that…

Dual-use and biosecurity policies of major life science publishers (as of 2025)

Publisher (link to policies; major DURC-relevant journals listed)	**Dual-Use Policies?**	**Features**	**Formal biosecurity review procedure?**	**Developments, available information on submissions for review**
American Society for Microbiology (ASM) Journal of Clinical Microbiology	**Yes**	*"ASM members are obligated to discourage any use of microbiology contrary to the welfare of humankind, including the use of microbes as biological weapons. Bioterrorism violates the fundamental principles expressed in the Code of Ethics and Conduct of the Society and is abhorrent to ASM and its members… Members of the ASM Responsible Publication Committee (ARPC) will evaluate the rare manuscript that might raise such issues during the review process… ASM editorial staff screens all submissions for microbes and toxins on the HHS and USDA Select Agents and Toxins List (SATL) to trigger automatic review by the Editor in Chief, who will convene the ASM Responsible Publication Committee (ARPC), if necessary. Following consideration of the scientific import and national security concerns, the ARPC will provide a recommendation for the publication of the manuscript."*	Yes - extensive: Dual-Use Research of Concern (DURC) Review at American Society for Microbiology Journals 	- 1-2 dual-use papers per year considered dual-use at the ASM journals 2004-2008 - Following 2011/2012 GOF controversy, ASM instituted ad hoc process of reviewing manuscripts with potential DURC content, which evolved into a formal process
Nature Publishing Group Nature; Nature Medicine; Nature Biotechnology; Mucosal Immunology; npj Vaccines; Nature Reviews Microbiology	**Yes**	*"For such information to be published, the benefit to the research community, society, or to public health, must outweigh any risks. We reserve the right to take expert advice in cases where we believe that concerns may arise, and we may require a manuscript to undergo peer review specifically to assess the dual use risk. Where the risk of misuse outweighs any potential benefit, publication is declined; published content may be corrected, retracted or removed."* *Such concerns include, but are not limited to, biosecurity, nuclear and chemical threats…Authors of any paper describing agents or technologies whose misuse may pose a risk must complete the dual use research of concern section of the Nature Portfolio Reporting Summary…We have established an editorial monitoring group to oversee the consideration of papers with biosecurity concerns. The monitoring group includes the Editor-in-Chief of Nature Portfolio publications, the Head of Editorial Policy, Nature Portfolio and the Nature Portfolio Editorial Director and it is responsible for maintaining a network of advisors on biosecurity issues."*	Yes - although details of the process are not publicly available. *"As a general rule, all incoming papers are assessed for potential biosecurity risks. Any of the parties— authors, reviewers, or editors—can initiate a biosecurity review for a specific paper, although in most cases it is the editor who flags a paper. Nature established internal guidelines and a risk-benefit analysis checklist that is roughly based on the recommendations of the [Fink Report]... Flagged papers are reviewed by a special Biosecurity Panel that determines whether a special security review is warranted. In some cases, the regular scientific referee might also have a biosecurity background and can assess both aspects of a paper. In other cases, the manuscript is sent to additional referees with a background in biosecurity issues."* (Aken, Hunger; 2009)	- Formal biosecurity review policy since 2003 *"about 15 papers were subjected to a special security review in 2005 and 2006 across all Nature journals. While no paper was rejected or significantly altered on security grounds, the Nature Publishing Group emphasizes that all papers that may raise biosecurity concerns are accompanied by editorials, press releases, or pieces in the News or Commentary sections of the journals to put the work in perspective."* Aken, Hunger 2009 *Campbell said that Nature has had a few papers of dual use concern since the 2011 GOF controversy. "There are six examples of such papers from 2015 and 2016" for which a technical assessment was seen as needed. In each case, he said, the outcome was "that no paper was rejected on the basis of risk."*National Academies of Sciences, 2017 *"of the 74,000 biology papers received by Nature and the Nature group of journals during 2004-08, just 28 papers were considered of dual use concern".*

Dual-use and biosecurity policies of major life science publishers (as of 2025)

Science journals (AAAS)	**Yes**	*"Authors and reviewers are expected to notify editors if a manuscript could be considered to report Dual Use Research of Concern (DURC)." "Papers identified as possible DURC risks, or analogous risks in the physical sciences, will be brought to the attention of the Editor-in-Chief for further evaluation. If necessary, outside reviewers with expertise in the area will be consulted."*	Almost certainly, but no further details on a formal review process other than "***papers identified**… will be brought to the attention of the Editor-in-Chief for further evaluation. If necessary, outside reviewers with expertise in the area will be consulted*." However, given AAAS's widespread engagement with biosecurity and dual-use issues, it's likely that biosecurity issues feature prominently in editorial procedures and review guidelines.	- 1 dual-use paper per year 2004-2008. - No biosecurity policies in 2009, so were developed since then.
Springer Clinical Reviews in Allergy and Immunology; Journal of Clinical Immunology; Cell and Bioscience	**Yes**	Springer appears to have adopted *Nature Publishing Group*'s public facing editorial policies on DURC since the merger to *Springer Nature*. These policies are present in writing all Springer-owned journals that were checked.	Unclear - no publicly available information on whether Springer-owned journals carried over the same thoroughness in managing dual-use issues and biosecurity review as in *Nature* after the merger.	
Taylor and Francis Emerging Microbes and Infections; Critical Reviews in Biotechnology; Critical Reviews in Clinical Laboratory Sciences; Critical Reviews in Biochemistry and Molecular Biology	**Yes** - although only brief mention and only at publisher level	Editorial policies available only at publisher level: "*Taylor and Francis journals will only consider research which has been carried out in compliance with **institutional biosafety and biosecurity policies**, which in turn should be informed by national or international recommendations. Researchers **should be aware of Dual Use Research of Concern (DURC)** related to their work*,". However, all journals appear to use essentially the same text for '*Instructions for authors*', which, despite '*Ethics of Experimentation*' and '*Health and Safety*' sections, makes no mention of dual-use or biosecurity terms.	Unclear	

Dual-use and biosecurity policies of major life science publishers (as of 2025)

Wiley Journal of Medical Virology; Current Protocols	**Yes** - minimal at publisher level, but one journal (Current protocols) had guidelines on biosecurity issues.	*"Authors are responsible to identify any unusual inherent hazards or risks in a manuscript, include appropriate warnings, and refer to relevant safety precautions. This could be products, chemicals, operations, or technologies posing a threat to public health and safety, the environment, plants, animals, or equipment… Journals should ask authors to inform them at the time of manuscript submission if their study has potential for both benevolent and malevolent application. This is often referred to as "dual use research.""* Current Protocols does include biosecurity issues, and states that it will not publish papers relating to 7 experiments laid out in Fink Report: "*Acknowledging that some experiments and microorganisms can be considered to have "dual use"—i.e., in which technology can be used legitimately for human betterment or misused for bioterrorism—the Committee on Research Standards and Practices to Prevent the Destructive Application of Biotechnology (headed by Gerald Fink and part of the National Research Council, Division on Policy and Global Affairs) has identified seven classes of experiments that warrant special review by experts. Based on these recommendations, it is the policy of the editorial boards of Current Protocols NOT to publish protocols that describe in* detail experiments that…" Instructions for authors at Wiley: "*Where a reviewer is concerned that an article might include information that could be a threat to security then the Editor will treat the article as possible DURC (dual use research of concern) and may consult a specialist reviewer. Their advice will be taken into account by the Editor in making any final decision on publication."* Individual journals: Author guidelines at individual journals, such as the Journal of Medical Virology include a short ethics section, but no mention of dual-use or biosecurity issues. Similar guidelines across Wiley journals, e.g ore in-depth ethics section in Journal of Pathology	Unclear - it's possible that 'Current Protocols' has a formal biosecurity review process given their outright refusal to publish certain kinds of dual-use research. In Instructions for authors at Wiley: "*Where a reviewer is concerned that an article might include information that could be a threat to security then the Editor will treat the article as possible DURC (dual use research of concern) and may consult a specialist reviewer. Their advice will be taken into account by the Editor in making any final decision on publication."* However, in guidelines of all other individual journals, no mention of dual-use or biosecurity issues are made, so it's difficult to determine whether this policy is understood and implemented at its various journals.	
Elsevier Cell; The Lancet; Journal of Clinical Investigation; Journal of Biomedical Informatics; Biomedical Journal	**None** - despite dedicated '*Ethical Publishing*' section	Their editorial policies' '*Ethical Publishing*' section includes: *"**Hazards and human or animal subjects:** Statements of compliance are required if the work involves chemicals, procedures or equipment that have any unusual hazards inherent in their use",* but no mention of dual-use or biosecurity terms.	Unclear - however, *'The Lancet'* editors indicated that "*the editorial decision-making team discusses all accepted papers from various angles*" (not a direct quote) (2009)	

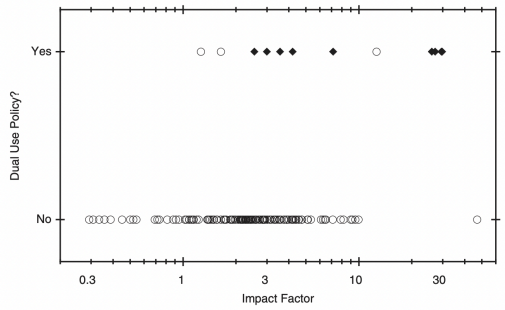
The Persistent Gaps in Journal Policies on Biosecurity

[work in progress]

The growing number of editorial policies and guidelines for authors that at least mention biosecurity and dual-use issues, as well as the establishment of formal review procedures at a select few publishers (ASM, AAAS and Nature), is a promising and commendable development. A recent study from 2024 showed that "*from Google Scholar, 12/20 journals within the "Life Sciences & Earth Sciences" category had policies on DUR; from Scimago, 9/16 of the "Biochemistry, Genetics, and Molecular Biology" category had policies; and 8/19 of the "Immunology and Microbiology" category had policies"*.

These figures demonstrate significant progress from an earlier study. A 2009 study is among the only two other studies investigating journal DURC policies; given the importance of journals in signalling and monitoring dual-use and biosecurity issues, this represents a worrying lack of attention to the topic. The study indicates that, in 2009, on their publicly available guidelines, only 2 (*ASM* and the *Nature Publishing Group*) out of the 18 publishers made any mention of biosecurity issues and review procedures. Only half of the publishers in the study included any information on ethical issues at all, which means that 7/9 publishers, in this sample in 2009, who were proactive in informing their authors and reviewers about ethical issues still failed to mention or specifically address biosecurity issues.

Figure 1. Distribution of Dual-Use Policy Status by Impact Factor and Publishing Group



The 9 diamonds denote journals in the Nature Publishing Group (NPG), all of which have a dual-use policy. The 146 open circles denote non-NPG journals, all but 3 of which do not have a dual-use policy.

A handful of publishers, primarily *ASM* and *Nature Publishing Group,* updated their dual-use policies following the Statement on Scientific Publication and Security, while the policies of most journals and publishers, despite signing the statement, would remain unchanged until wake of the 2011/2012 H5N1 GOF controversy. Even then, as of 2025, outside of a minority of major publishers - the same publishers who have been admirably engaged with biosecurity issues long before the establishment of the NSABB, often providing important advisory roles on various committees - the dual-use and biosecurity policies and procedures of most journals and publishers remain worryingly limited, or non-existent.

Views of journal editors on biosecurity and dual-use research of concern

[work in progress]
https://pmc.ncbi.nlm.nih.gov/articles/PMC3440065/?utm_source=chatgpt.com
https://link.springer.com/article/10.1007/s11948-014-9535-y
https://www.liebertpub.com/doi/10.1089/bsp.2010.0067
https://www.jstor.org/stable/26294166
https://liebertpub.com/doi/10.1089/apb.2024.0034?utm_source=chatgpt.com

[...]
A few insights can be gleaned from a report from 2017 by NASEM, which highlights: "*while not the subject of federal policies, scientific journals are critical players in the management of dual use research as they must make determinations about whether to publish potentially harmful research findings*". However, "*there is no mutually-agreed-upon approach to decisions surrounding the publication of DURC findings*". Interestingly, the former editor-in-chief of Nature "*reported that, in 2012, the editors of Nature decided that, as a general policy, the journal would not redact key findings or distribute information only to selected recipients. He suggested that redacting key data or methods disables subsequent research and peer review and that the distribution of redacted information to a select group of people on a need-to-know basis is practically infeasible because of questions such as: "Who holds the data?"; "Which criteria are used to determine who is allowed to see the redacted information?"; "Who decides by which mechanisms is the information then made accessible?"; and "How can information distributed to a university or public health laboratory remain confidential?" He suggested that biosecurity constraints on publication risk eroding the robustness of the field if reproducibility is not tested."* He added that "*Nature has had a few papers of dual use concern since the 2011 GOF controversy. "There are six examples of such papers from 2015 and 2016" for which a technical assessment was seen as needed. In each case, he said, the outcome was "that no paper was rejected on the basis of risk."* Another member "*suggested that few individuals are qualified to make appropriate decisions about DURC and argued that it is unfair to request that journals screen for DURC manuscripts, as they do not have the proper experience"* and that "*we "change the status quo and encourage [funding agency] responsibility by identifying potential DURC projects upfront".*

The report also states that 'the wider literature', for which the only study referenced is the 2009 study described above, how "*few journals have policies to address dual use research*". (stress this earlier that the high-level gov report itself only mentions this one study,).

Finally, a member "*recommended that the NSABB resume its efforts to build a network between the intelligence community and journal editors*".

The final source is a discussion of the role of journals in managing dual-use research comes from the minutes of a meeting held by the NSABB in January 2020, less than a week before the WHO issued a global public health emergency. They note that "*journal and preprint publishers have spotty policies on biosecurity requirements and almost no policies regarding population-level biosafety risks. A proposed solution is for the federal government to*

recommend best practices for journal publishers and funders outside the federal government. Funders would be asked to adopt similar policies to those of HHS, and publishers would be asked to publish manuscripts describing enhanced PPP research only if the funder provides documentation attesting that a review has been conducted and listing the risks and benefits identified in this review."

Importantly, *"review of documents before they are submitted to journals"* is included among risk mitigation plans to ensure security of enhanced PPP research. Regarding the role of journals, the speaker notes that *"over the past 16 years, the NSABB has engaged in a substantial amount of responsible communication and has developed important guidance [and] believes that this guidance is being implemented, including by journals"*.

Importantly, *"One concern is that journals are becoming the first and not the last line of defense. Furthermore, if a manuscript does not meet the publication criteria for one journal, the authors can submit it to a less prestigious journal that lacks strict requirements.The submission of manuscripts with a certification that the research was reviewed and approved by a preapproval review committee might make publication decisions easier for journal editors. Dr. Inglesby suggested that the NSABB or another advisory committee could help journal editors by reviewing manuscripts on research that might involve enhanced PPP and noted that the NSABB has been charged in the past to review manuscripts. Many journals formulated their policies at a time when the focus was more on biosecurity than on population-level biosafety, such as accidental release of an enhanced PPP. These policies could be improved because, for example, not all reviewers or all journal editors know how to identify this type of research."*

Publishers and journals should implement coordinated dual-use policies and formal biosecurity review procedures

[rough plan]
Arguments for:

1. As risks from AI-driven biotechnology and biomedical advancements multiply, interventions that work towards a more biosecurity-robust system of research will inevitably accelerate. Among those, interventions at the publication stage are still critical enough such that if prepublication review is not carried out through self-regulation (by journals and internal institutional committees), then external censorship by governmental bodies may have to be imposed, depending on the speed of the crisis. This would likely have major political consequences for the scientific enterprise as a whole.
2. As one of the powerful actors in the scientific enterprise and a key cog in the incentive structures for scientists' decision-making earlier in the research cycle, journals have a duty to uphold their responsibilities for elevating safe science. The importance of journals in the scientific enterprise has been questioned with the rise of open science, but publishers have a key opportunity here to justify their editorial costs by upholding an important, for the good of science and broader society. In the research process, after applying for funding and negotiating clinical trial coordination, communication with journals and publishers is the next and final access to institutional resources and access to expertise. Many scientists may not be

sufficiently aware of dual-use issues, but as the one port of call that almost all disseminated research passes through, journals must be in a position to provide desperately needed guidance and monitoring of security concerns. It should be remembered that public trust in scientific institutions and science itself is on the line: if enormous distrust among scientists about the erspon…Funders have restrictions… journals have the resources and access to the networks wouldn't be difficult, so it makes sense that it is them that a major part of the responsibility should fall on.

3. It's possible and has been done. The extensive dual-use and biosecurity policies of ASM serve as a prime example of a publisher accepting responsibility…, even when acting unilaterally and largely in isolation. Establishing procedural channels of communication with networks of biosecurity expertise on publication decisions, or even dedicated biosecurity boards for communities of publishers, may be difficult, but certainly not insurmountable, especially with coordinated initiatives between publishers and biosecurity orgs.
4. Research findings often cannot be anticipated earlier in the research process. As such, approaches that avoid monitoring, reviewing and on the rare occasion restricting the publication and dissemination of research will necessarily leave major gaps where unmonitored developments in experimentation are bound to occur.
5. Advances in AI may be able to lower the costs and of the initial screening. The potential for AI to aid in the review process has received attention, some of it overhyped. However, it's not too difficult to imagine a process by which AIs reduce the load on a biosecurity review board by limiting. This will be discussed in more detail in the preprints section, as the costs to carry out biosecurity review present a far greater issue there.

Publishers and journals should NOT implement dual-use policies and formal biosecurity review procedures

[work in progress]
Arguments against (before for?):
https://www.ncbi.nlm.nih.gov/books/NBK458500/#:~:text=Campbell%20said%20that%20Nature%20has,on%20the%20basis%20of%20risk.%E2%80%9D

1. Scientific freedom and the dangers of censorship:
    a. Threat to scientific freedom: censorship could hinder scientific progress and transparency, making it harder for researchers to collaborate and address threats.
    b. Precedent for broader censorship: allowing journals to censor research could set a dangerous precedent, leading to broader restrictions on controversial but beneficial science (e.g., climate science, vaccine research).
    c. Potential for political or commercial influence: decisions on censorship could be influenced by political agendas, economic interests, or industry lobbying rather than purely ethical concerns.

Counterargument: History tells us that restrictions on freedom have, very often if not always, appeared in the form of calls to contain security risks, whether fabricated/cynically/exaggerate or genuine. This is certainly true. However, the number of papers…. The degree of broader censorship, on security grounds, let alone on political or commercial grounds as a result of implementing procedures on durc is difficult to quantify. The incentives for journals that lean towards publishing over restriction need little explanation and the high retraction rate, even among the most prestigious journals, has done little to dislodge their income or status. To be clear, this is not necessarily a bug, but instead a feature. Institutions that can survive high profile retractions without major financial consequences may well be a good thing for science, depending on your view… Have to attempt to weigh up the risks. However, if this is indeed the primary objection to …, the evidence has yet to be presented by journals and the case has yet to be made. The lack of transparency of the review process makes this more challenging. Biosecurity experts and science policymakers should welcome further debate and discussion with publishers on this matter.

2. Lack of Expertise in Security Risks. A point stressed by editors and publishers repeatedly is that an editorial team will lack the necessary training to assess security risks accurately, leading to inconsistent or biased decisions. The costs of finding and training biosecurity experts to assess every potentially sensitive paper is prohibitively high. Educating scientists on the dual-use issues in their specific line of work and focusing on efforts to change the culture around funding would be more sensible.

   Counterargument: As with argument 3 above, this is not unsolvable. It seems as though the issue is a lack of political will and upfront social…, rather than primarily the long-term maintenance costs. This is worth investing in, including from the long-term perspectives of journals facing growing debate, criticism and disillusionment among scientists as to their value and necessity. and funders and initiatives.
3. Sensitive information will always find other avenues – If mainstream journals refuse to publish certain research, scientists can always turn to alternative platforms (e.g., preprints, blogs, or non-traditional publishers), with less oversight. This is compounded by the lack of mutually-agreed upon approaches for seeking guidance, expertise and decision-making on publication of DURC findings. All in all, sufficient coordination between most/all publishers and journals to manage this is likely to be near impossible.

   Counterargument: That information hazards can be disseminated through means other than official channels will always and has always been the case. Since the internet… However, if the gatekeeper role of journals has value (and it clearly does to the extent that it continues to serve as a longstanding marker of value central to determining career prospects, institutional funding etc) then coordinated durc policies among publishers would set cultural norms… No policies by any or all publishers could ever stop a truly negligent research group from disseminating risky findings to platforms that could be easily accessed by malicious actors. Invoking such a scenario does not change…

4. (as a result of the above 1-3 arguments) There is little use in expending resources intervening at the publication stage. Efforts should instead be focused at the funding, planning etc**.**

   Counterargument: The argument that biosecurity efforts as a whole should be primarily targeted at journals, publishers and the publication and dissemination of already-conducted research is not being made by anyone serious, to my knowledge. Biosecurity experts have long been well-aware of the legal, ethical and logistical challenges of restricting dissemination of research, compared to intervening in other domains. As a result, while controversies and restrictions on publications may loom large in the consciousness of the public and for scientists, and perhaps publishers too, efforts by biosecurity advocates have tended to focus *overwhelmingly* on other areas. However, the high stakes demand interventions at all levels to minimise risk while maintaining systemic stability. And as mentioned, neglecting dissemination of already-conducted research will also miss all of the unanticipated developments since funding applications. The notion that harder… fallacy. These avenues are not mutually exclusive because they may not require the policial and expertise capital of the same actors or organisations, although there will undoubtedly be significant overlap.

[tbc]