We wrote a National Academies of Sciences, Engineering, and Medicine report discussing the misuse of life sciences research and ways to mitigate this threat. AMA!

NAS-AMA [1] and r/Science AMAs[1]

[1]Affiliation not available

April 17, 2023

Abstract

We're talking about how potential misuses of advances in life sciences research raise concerns about national security threats and about mechanisms that would allow researchers to manage the dissemination of the results of research while mitigating the potential for harm. We helped write a report on the subject for the National Academies I'm Arturo Casadevall, Professor and Chair in the W. Harry Feinstone Department of Molecular Microbiology and Immunology at The Johns Hopkins Bloomberg School of Public Health in Baltimore, Maryland. My research focuses on how microbes cause disease and how hosts can protect themselves against those microbes. And I'm Claire Fraser, Director of the Institute for Genome Sciences and a Professor of Medicine at the University of Maryland School of Medicine in Baltimore, Maryland. My research focuses on the role that the human gut microbiome plays in health and certain diseases. We will be back at 1 pm ET to answer your questions, ask us anything!

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REDDIT

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NAS-AMA R/SCIENCE

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CORRESPONDENCE:

DATE RECEIVED:
October 21, 2017

DOI:
10.15200/winn.150850.03860

ARCHIVED:
October 20, 2017

CITATION:
NAS-AMA , r/Science , We wrote a National Academies of Sciences, Engineering, and Medicine report discussing the misuse of life sciences research and ways to mitigate this threat. AMA!, *The Winnower* 4:e150850.03860 , 2017 , DOI: 10.15200/winn.150850.03860

Hi Arturo and Claire,

What an interesting topic. Unfortunately, I think we live in an environment where science is becoming increasingly politicized. Talking points and "political victories" seem more important than nuance and understanding in many cases.

Just recently, I was very disappointed with a statement from Bernie Sanders, where his response to the FDA approval of a new, lifesaving medicine was to immediately jump into a conversation about drug pricing. Never mind that the drug is ~5x better than the standard of care, will save lives and end up saving the system money. I use Bernie as an example, because while I think it is obvious to many when Republicans do this - it unfortunately is ubiquitous in our political system.

The question is, how do we get people to move past talking points and to start caring about details and nuance? In case you missed it, Bill Gates gave a talk recently (very interesting discussion on mosquitos, malaria, genome engineering etc.), and in the Q&A discusses this point.

SirT6

From Claire: I think it's obvious that complex issues such as DURC cannot adequately be addressed with talking points. Science advances are happening faster than ever, and along with that comes new insights and perspectives about what DURC is and what it isn't. We've become painfully aware of how little the scientific community knows and thinks about these broader issues with great scientific and societal impact. I lectured this week to a group of post-doctoral fellows, and in a room of ~50 people only 3 had heard of DURC. So we must begin these conversations early and we must continue them in a way that is relevant.

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SirT6

From Arturo - although your question is not related to DURC my sense is that we need to always keep the discussion going. I don't have an answer as to how to move past 'talking points' except to keep trying. I think that is all we can do and the good thing is that, in my experience, it sometimes works!

Do you believe that under certain circumstances research should be censored?

scienceaccount103040

From Claire: In principle, no. Instead, I think that the implications of potential DURC-related research need to be addressed before the research even begins. But there is always the possibility of unanticipated results emerging. So, I suppose that means my answer is a somewhat qualified no.

Hi

Thanks for participating in this AMA.

This is an interesting area for discussion. There is a certain parallel in technology research, in particular when “white hat” researchers discover security flaws in software and provide notice to vendors before publishing the potential weaknesses. The risk is exposing the security holes to potential hackers before fixes are applied.

In the same way, scientists must also have similar struggles when they discover something novel that can do much good for humanity, but when misused, may lead to harm. I’m sure we can think of examples, such as nuclear physics or genetic engineering.

Are you able to summarize for us how you propose to mitigate these risks while allowing the free sharing of scientific knowledge? Should there be a filter or are we to rely on the ethics and altruism of individual researchers? What about other jurisdictions and nation states?

Thanks in advance!

mvea

From Arturo - This is an unsolved problem and one of the central themes of the NAS report. The tension between free sharing of information to promote scientific progress versus the likelihood that

such information will be misused will always be there. I think that as everyone has become sensitized to the latter, there has been more self policing in science and that should minimize the risk. For example, many journals routinely screen for dual use research of concern and this did not happen a decade ago.

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From Claire: After nearly two decades of discussions, there is little national consensus with regard to appropriate policies for addressing issues associated with the conduct and dissemination of life sciences research that might qualify as dual use research of concern (DURC). The sponsors of our study asked the Academies to take note of where we are today and to explore various options. There have many discussions over the previous 16 years and the project sponsors felt that it was important to provide an ‘update” on where things stand today. As our report’s findings indicate, there are many areas where new thinking and approaches are needed. However, little consensus exists within the broad life sciences community as to what constitutes a risk or as to appropriate policies.

It is important to note that the United States has a solid record with respect to the safe conduct of biological research and the number of documented, publicly-known incidents of serious biosafety errors or lapses of biosecurity at laboratories has been small. This does not mean; however, that no additional actions are necessary.

The current report and its findings are meant to provide policymakers with baseline information for further deliberation. The report does not provide recommendations for further action. Despite the attention given to periodic controversies over DURC, available evidence suggests that most life scientists have little awareness of issues related to biosecurity. Further we note that there is a lack of an international commitment to addressing DURC and a lack of a systematic international discussion of DURC.

Welcome,

In your opinion, where are the areas of greatest concern as it pertains to the intersection of life sciences research and national security threats?

adenovato

I worry that 'all generals prepare to fight the last war' and that the focus is on the known threats with very little attention to the large number of potential biological threats that are not in the usual lists.

Welcome,

In your opinion, where are the areas of greatest concern as it pertains to the intersection of life sciences research and national security threats?

adenovato

From Claire: One of the research areas of great concern is a category called “gain of function research of concern” by analogy with DURC. GOFRC covers experiments to create viruses and bacteria with properties that do not exist in nature including increased virulence, transmissibility, pathogenicity, and antimicrobial/antiviral resistance. A relatively recent example of GOF research of concern was production of H5N1 influenza viruses that are airborne-transmissible in ferrets, compared to non-airborne transmissible wild-type viruses. On the flip side of this is the fact that there is a continual need to develop new vaccines and therapeutics and GOF studies may be essential to achieve these goals.

Do you have concerns about the abuse of mitigation mechanisms to silence controversial research under the guise of national security?

adenovato

From Arturo - the potential abuse of mitigation mechanisms to suppress controversial research is always a concern but I am not aware of any instance where this has happened.

How did you get involved in this kind of work? How do you go from health and the gut to national security?

scienceaccount103040

From Claire: Before I was in involved in research on the gut microbiome I was heavily involved in microbial genomics studies - many focused on human pathogens. In fact, when the anthrax letters were mailed in 2001, I was working on a Bacillus anthracis genome sequencing project. This work positioned me and my research team to partner with the FBI as part of the Amerithrax investigation. That expertise was relevant when the NSABB was chartered in 2004. As the tools of genomics evolved it became possible to study bacteria in complex communities. My research also evolved and the community that I have become most interested in is the one that resides in the human gut.

Thanks for the AMA!

Can you summarize your report for a layman?

useful_person

From Claire: In today’s world of rapidly advancing science, where tools and technologies are more widely available than ever before and where the dissemination of scientific findings occurs through multiple channels and at multiple levels, developing policies for managing the dissemination of knowledge, tools, and techniques produced by scientific research has become ever more difficult.

In view of ongoing concerns about the communication of biological research results that might present

significant risks, and in the wake of incidents (such as the 2001 anthrax mailings) in which naturally occurring biological materials were used for nefarious purposes, the United States has given significant attention to policies and practices that can enhance biosecurity.

Our committee was charged with reviewing policies associated with dual use research of concern (DURC). Its objective was to review possible mechanisms for managing dissemination of research findings that strike an appropriate balance between the value of openness in scientific research and the needs of national security. As such, this encompasses the roles and responsibilities of students, researchers, institutions, and the federal government in the conduct of research. While one might think of dissemination in terms of publication, the committee, with encouragement from the project's sponsors, considered the management of dissemination as occurring along a spectrum from idea generation to the formal publication of research results in journals.

The sponsors of our study asked the Academies to take note of where we are today and to explore various options. The current report and its findings are meant to provide policymakers with baseline information for further deliberation. The report does not provide recommendations for further action. Despite the attention given to periodic controversies over DURC, available evidence suggests that most life scientists have little awareness of issues related to biosecurity. Further we note that there is a lack of an international commitment to addressing DURC and a lack of a systematic international discussion of DURC.

Thanks for the AMA!

Can you summarize your report for a layman?

useful_person

From Arturo - here is a brief summary: biological research can be used for good and evil. The scientific community, governments and funders are each trying to figure out how to balance the free flow of information to promote scientific/medical progress without also letting out facts that can be used for mischief. After more than a decade of discussion there is no clear consensus on how to achieve this balance. The report provides an up-to-date summary of the situation and includes findings that can help the various communities identify key issues for further deliberations.

Hi and thanks for joining us today!

I understand it's very difficult to quantify prevention but has DURC ever really done anything but slow scientific advancement? It would seem the committee agrees with that sentiment.

Papers like this: https://www.nature.com/articles/ncomms14130#f1 can languish under DURC embargo for potentially years. Is it justified?

PHealthy

From Claire: To our knowledge, there has not been a situation where a DURC-related embargo resulted in manuscripts languishing for years. Our committee agreed that addressing DURC-related concerns at the time of manuscript submission is too late.

The research controversy surrounding the H5N1/GOF example brought DURC to the forefront of international conversation. And, as we saw, this led to a number of international discussions and ultimately to the development of policies designed to identify DURC earlier in the research cycle and that make risk assessments an integral part of the research cycle.

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From Arturo - there is some data that research on agents in select list is slowed and is more costly relative to those not in the list simply because of the friction of working within those rules. I agree that evaluation of papers for DURC can slow publication because this necessarily entails extra review. However, for most papers the review process is rapid and this is probably wise since any accidental release or deliberate misuse of published information could result in great harm to society - and would likely result in more regulations to science.

So how important is the gut micro biome to health?

frostedturkeypanini

From Arturo - I think it is very important

So how important is the gut micro biome to health?

frostedturkeypanini

From Claire: It is essential to health. The bacteria found the gut microbiome carry out a number of essential functions including digestion of complex carbohydrates, synthesis of key metabolites and vitamins, maturation of the immune system, and protection from pathogens. We couldn't live without our gut microbes.

Welcome and thanks for taking the time to speak with us about your research!

Arturo, I've heard that because of growing antibiotic resistance and the connectedness of the world, that a major plague is a potential risk. Is this the case and are there any steps that we as both individuals and voters can take to help?

Claire, How much do gut microbiomes vary from person to person and what can go wrong with them? If someone has something wrong with their gut microbiome, are there steps they can take to correct it?

PapaNachos

From Claire; There is tremendous variability in the composition of the gut microbiome across individuals and populations. This reflects the influence of both host genetic factors and a lifetime of different environmental exposures. A large number of studies have observed differences in the gut microbiome between healthy subjects vs those with specific diseases. We have to be very careful at this point not to over extrapolate these findings. They are only associations and say nothing about cause and effect. Diet has a profound influence on the composition of the gut microbiome - we can take steps to feed our beneficial bacteria by eating a high fiber and lower fat diet. We can also avoid unnecessary exposure to antibiotics - using them only when medically indicated.

Thanks for coming to talk with us! I teach ethics to our senior undergrads (in CS), and one of the discussions we have in class is: "Is there a technology you would choose not to do research on, because of its potential misuse by bad actors? Or would you develop it and advocate for its safe use?" My question for you is: What would you tell students about this question?

asbruckman

From Arturo - I think that one should always consider the goal of the work when beginning a project. The essential problem with many technologies is that they can be used for good and bad purposes. The problem is not with the technology per se but the intent of the user. I cannot think of any technology that one would immediately take off the table because it may be used by bad actors. Instead, I would ask whether the technology or research question is important and useful and approach the problem from that angle.

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From Claire: This is the proverbial $64,000 question, isn't it? In general, the majority of scientific experiments do not raise biosecurity concerns. However, there are some areas where there is disagreement over whether an experiment should be done. With any new technology it may be unrealistic to think that all potential stakeholders will reach the same conclusion. Moreover, different stakeholders might very well see different risk/benefit ratios in the application of specific technologies. An important message for your students is that there may not be a single right answer to these kinds of thorny questions. Instead, ongoing discussions grounded in scientific facts, rather than fear, are essential to make the most informed and socially responsible decisions.

From Arturo - We're signing out now. Thanks for these great questions and discussion. If you are interested in learning more, please visit the webpage for the study: http://sites.nationalacademies.org/PGA/stl/durc/index.htm