

SynthRITE (*Research, Innovation, Technology, and Ethics*):

An Online Community to Facilitate Biosecurity and Biosafety Discourse and

Address Key Deficits in Current Approaches

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Introduction

In 2018, Noyce et al. published a paper describing the construction of an infectious horsepox virus vaccine from chemically synthesized DNA fragments.¹ With publicly-available genetic sequence for a strain of horsepox and easily accessible lab facilities, Noyce and his collaborators were able to synthesize the genetic cousin to smallpox.² They concluded in a follow-up article that their work “shows that no viral pathogen is likely beyond the reach of synthetic biology”.³ The work of Noyce and his collaborators underscores a set of increasingly pressing biosecurity and safety challenges.⁴

Today, scientific knowledge and technological capabilities have outstripped the mechanisms for enforcing existing norms and regulations. Noyce and his collaborators appropriately disclosed their research and risk mitigation plans to University, national, and international oversight bodies due to his motivation to adhere to relevant protective regulations in light of the biosecurity challenges of his work. It was due to the researchers’ commitment to safety and transparency that regulatory authorities were able to exercise oversight, an opportunity that would have been missed in an undereducated scenario. As Gregory Koblentz, director of the Biodefense Graduate Program at George Mason University noted in a 2017 commentary, “there is currently no mechanism for detecting or punishing violations of the [WHO Advisory Committee on Variola Virus Research] recommendations”.⁵

¹ Ryan S Noyce, Seth Lederman, and David H Evans, "Construction of an infectious horsepox virus vaccine from chemically synthesized DNA fragments," *PLoS one* 13, no. 1 (2018).

² Gregory D Koblentz, "A Critical analysis of the scientific and commercial rationales for the de novo synthesis of Horsepox virus," *mSphere* 3, no. 2 (2018).

³ Ryan S Noyce and David H Evans, "Synthetic horsepox viruses and the continuing debate about dual use research," *PLoS pathogens* 14, no. 10 (2018).

⁴ Koblentz, "A Critical analysis of the scientific and commercial rationales for the de novo synthesis of Horsepox virus."

⁵ Gregory D Koblentz, "The de novo synthesis of horsepox virus: implications for biosecurity and recommendations for preventing the reemergence of smallpox," *Health security* 15, no. 6 (2017).

In other words, for today's regulatory framework to provide oversight of research activities, researchers must be 1.) aware of regulations applicable to their work and 2.) motivated to be as transparent as possible. Neither is assured, as Noyce observed.⁶

The Global Health Security Agenda (GHSA): Action Package Prevent-3 (APP-3) Working Group highlighted the need for increased biosafety training that integrate new standards in nearly all countries, necessitating capacity-building and mechanisms to share best practices and information between countries.⁷ While official technical capacity-building activities, like those administered by agencies in the United States are important, additional opportunities for forums of communication using cross-regional and cross-sector discourse are essential. For example, iGEM is an international conference that promotes exploration of synthetic biology among students from global learning communities and aims to improve the culture of responsibility and raise awareness around ethical and safety implications of dual-use technology.⁸ By preparing these students with skills to innovate in safe, regulated and peer-reviewed channels, iGEM fosters creativity with capacity for strong biosecurity standards of practice. Similar forum-based interventions could be used to educate students and researchers on existing recommendations and regulations applicable to their research and augment official biosafety, security, and ethics training that they receive from their institutions.

Moreover, perhaps more concerningly, the pace of scientific advancement has also surpassed the rate at which the international community develops and reaches consensus on new

⁶ Noyce and Evans, "Synthetic horsepox viruses and the continuing debate about dual use research."

⁷ APP3 Working Group, "The Global Health Security Agenda (GHSA): Action Package Prevent-3 (APP-3) Working Group," (2017), <https://www.ghsagenda.org/docs/default-source/default-document-library/APP3-WG2017-Deliverable3-Final-508.pdf>.

⁸ Sarah R; Morse Carter, Stephen S; Yassif, Jaime M, "Proposed Global Norms for Microbiology, Synthetic Biology, and Emerging Biotechnologies," *NTI Biosecurity Innovation and Risk Reduction Initiative Working Group Meeting* (2019).

norms and regulations. Public conversations around regulating new technologies, like bioprospecting and CRISPR-Cas9 experiments, have barely begun. New technologies necessitate inclusive global regulation opportunities, however in this regulatory and oversight vacuum, private synthetic biology companies self-regulate with self-developed codes of conduct. Frameworks have been proposed; however, none have been implemented as part of an enforceable governance system. Results from the APP-3 working group suggests that most countries have not developed capacity beyond “a basic foundation for biosafety and biosecurity activities”.⁹ This underdevelopment is attributable to lapses within the current siloed, exclusionary models of regulation development and an overreliance on expensive Western-led conferences lacking in diversity needed to achieve implementable cross-regional and cross-sectoral innovation. Solutions are needed to bring all stakeholders from all regions, including students, and all sectors, both public and private, to the discussion table to grapple with the biosecurity and safety implications of advancing scientific developments.^{10,11}

Recommendations

In the absence of adequate training and awareness, sluggish national and international efforts, and sufficiently inclusive forum for biosecurity and safety discourse,¹² we propose the development of an online community dedicated to debating and discussing biosecurity, biosafety, and ethical questions and concerns raised by students and researchers in both industry and academia. We call this community *SynthRITE (Research, Innovation, Technology, and Ethics)*.

⁹ APP3 Working Group, "The Global Health Security Agenda (GHSA): Action Package Prevent-3 (APP-3) Working Group."

¹⁰ C Raina MacIntyre et al., "Converging and emerging threats to health security," *Environment Systems and Decisions* 38, no. 2 (2018).

¹¹ Kay Michael Van Der Horst, 2019.

¹² John Jacocks, 2019.

Students and researchers already use online forums to discuss lab safety and ethics. For example, Reddit, an anonymous social media site, hosts hundreds such forums, including r/labrats, r/labsafety, and r/chemistry, where posters freely discuss observations, challenges, current news, and share knowledge. As the proliferation of Reddit communities among other social platforms show, students and researchers are hungry to share their safety, security, and ethical concerns and gain insight from their peers around the world.

SynthRITE aims to cultivate the active communities and discussions found on Reddit and other social media while integrating the expertise and resources found in existing biosecurity and safety communities, like the Association for Biosafety and Biosecurity (ABSA) and iGEM. With this integration and biosecurity-focused mission, SynthRITE would not only facilitate these same conversations and the same professional and personal growth that students and researchers experience using existing social platforms but also provide key additional benefits:

1. SynthRITE's mission is to connect new stakeholders to the international biosecurity and safety discussion. To that end, SynthRITE would develop an international Collaborator Network, integrating the expertise and resources found in existing biosecurity and safety communities, like the Association for Biosafety and Biosecurity (ABSA) and iGEM. Student scientists would have access to training materials, like ABSA's Basic Biosafety On-demand Module. Additional content could include country-specific information on existing regulations would be rendered in accessible language with links to source documents, and answers to key and frequently asked questions would be published. The site could also host moderated summaries of contemporary debates around high-profile and controversial topics, like CRISPR, serving as a primer for those unfamiliar with current biosecurity and safety challenges. We aim to address a key deficit of current social

platforms where existing resources are separate and disaggregated from audiences seeking validated information about biosecurity and safety.

2. SynthRITE would also seek to promote conversations and pressing issues in biosecurity and biosafety. While top and trending threads on Reddit and other social platforms are driven exclusively by users, SynthRITE, in conjunction with the Collaborator Network, could actively promote topics that have been identified as unresolved or under-represented and drive substantive discourse and awareness. These topics would remain otherwise ignored, and posters would otherwise be left out of the discourse surrounding key biosecurity and biosafety challenges. Importantly, these conversations would attract participants from across sectors and expertise, fostering cross-sectoral debates and, potentially, solutions.
3. All discussions on SynthRITE would benefit from the oversight and moderation provided by members of Collaborator Network organizations. Social media is rife with conjecture and misleading information; the Collaborator Network would help to establish a culture of evidence-based discussion and the formulation of research agendas to fill evidence gaps where they exist. Through this, SynthRITE members can not only trust that they are learning but also directly contributing to global efforts to improve biosecurity.
4. Given SynthRITE's mission to promote biosecurity and biosafety, social listening methods could be applied to the forum to identify critical threats that are posted by users and intervene if necessary. Furthermore, these same methods could be used to aggregate discussion trends and develop a more comprehensive understanding of the day-to-day safety and security challenges faced by students and researchers in the real-world. This

information would feed back to the Collaborator Networks to guide research and policy priority setting.

Conclusion

Current mechanisms for enforcing existing norms and regulations rely on researcher awareness of both the legal and ethical consequences of their work. Undoubtedly, these mechanisms need to be strengthened; but, to prevent inadvertent security and safety consequences, researchers still need guided training. Cultures and norms of safety and ethical science should be fostered so that scientists can more effectively adhere to laws and regulations. Official technical capacity-building activities are important, but forums for communication, competition and discussion play a key role in sustaining continual education and established norms.

Furthermore, more inclusionary and accessible forums are needed beyond conferences and scientific journals which are far too exclusive and reactionary to grapple with the biosecurity and safety implications of new scientific developments. New stakeholders in industry and academia need a place to learn about and participate in the critical biosecurity and biosafety conversations that governments and policymakers are having.

The development of *SynthRITE*, an online community, would allow students and researchers to discuss safety, security, and ethical concerns of their research, allow cooperation among users, and facilitate monitoring of real-world safety and security challenges. *SynthRITE* represents a cohesive vision for connecting novel stakeholders around the world and strengthening the discourse around biosecurity and biosafety. By focusing on inclusivity, education and awareness, *SynthRITE* is an innovative and important next step in aiding development of new international norms for governing emerging technologies.

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SynthRITE

Connecting new biosecurity partners

The Problem

- Awareness** | Researchers often don't know the risks or ethics
- Siloes** | New stakeholders are not connecting with experts
- Social Media** | Conversations are happening but without guidance

A Solution

SynthRITE | Members

- Students
- Clinicians, veterinarians, engineers, etc.
- Emerging nations

&

SynthRITE | Collaborators

- Think tanks
- Professional organizations (ABSA, iGEM, etc.)
- NGOs, WHO

Engage:

Stakeholders including the next generation can engage on hot topics, new ideas, and pressing challenges

Explore:

By bringing new people together, fostering conversations, **SynthRITE** promotes the exploration of new challenges and new solutions

Educate:

As part of the Collaborator Network, traditional stakeholders can share educational resources and contribute to the development of new tools.

Social Listening

Track:

Using modern social listening tools, **SynthRITE** could be used to understand how new ideas and policies will be received or where the consensus on controversial issues might be.

Alert:

These social listening tools could also be used to illuminate emerging issues and highlight trends for the Collaborator Network that need immediate attention.

Key Outcomes | SynthRITE



Bringing new stakeholders and traditional experts together



Fostering cross-sectoral collaboration



Training and inspiring a new generation



A valuable new source of data on key biosecurity conversations