

“The main candidate for biological risk over the coming decades thus stems from our technology—particularly the risk of misuse by states or small groups.” (Ord, *The Precipice*)

If there was anything that the COVID pandemic taught the human race, it was to incentivize scientific studies in the biological sector. One emergent field of knowledge is ‘microbiome research’, which aims to identify microbial communities coexisting within the human body’s gastrointestinal tract, and analyze the collected data to ‘weaponize’ the body’s inherent microbe ecosystems to find treatments for difficult-to-cure diseases, such as cancer or diabetes<sup>[1]</sup>. Select researchers have taken a step further, exploiting the complex properties of the human microbiome to develop ‘probiotics’, live microorganisms that can be administered in sufficiently minimal amounts to improve a host’s health<sup>[2]</sup>.

Unfortunately, the faux sense of immediacy in microbiome research is a double-edged sword. On one hand, we hastened the extensive procedure of sampling microbiota — the democratization of microbiome knowledge led to increased interest for sampling fecal stools among wider populations of varying ages, genders, and lifestyles<sup>[3]</sup>; the expanded coverage of samples is significant especially as current microbiota data are concentrated on Western samples; pushing for geographic distribution will offer newer insights for unstudied microorganisms that can be utilized as probiotic medicine<sup>[4]</sup>. On the other hand, accelerating microbiome research worldwide without establishing prerequisite safeguards poses risks for emergence of novel infectious pathogens, created non-intentionally or intentionally.

To understand the best course of action for preventing such biological disasters, I will approach this issue from the perspective of internationalism, assuming the position of **World Health Organization Director-General** tasked to regulate microbiome research advancements.

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[1] Winn, Z. (2021, January 5). *Turning microbiome research into a force for health*. Massachusetts Institute of Technology. <https://news.mit.edu/2021/microbiome-research-health-0105>.

[2] Wieërs, G., Belkhir, L., Enaud, R., Leclercq, S., Philippart de Foy, J.-M., Dequenne, I., de Timary, P., & Cani, P. D. (2020). How Probiotics Affect the Microbiota. *Frontiers in Cellular and Infection Microbiology*, 9(454). <https://doi.org/10.3389/fcimb.2019.00454>.

[3] Allaband, C., McDonald, D., Vázquez-Baeza, Y., Minich, J. J., Tripathi, A., Brenner, D. A., Loomba, R., Smarr, L., Sandborn, W. J., Schnabl, B., Dorrestein, P., Zarrinpar, A., & Knight, R. (2019). Microbiome 101: Studying, Analyzing, and Interpreting Gut Microbiome Data for Clinicians. *Clinical Gastroenterology and Hepatology*, 17(2), 218–230. <https://doi.org/10.1016/j.cgh.2018.09.017>.

[4] See Allaband et al. (2019), “What Sort of Microbiome Data Should I Collect?”, which explains confounder variables.

## **“Uniquely high stakes”**

In *The Precipice*, Ord argues that engineered pandemics is one leading cause of existential catastrophes, ‘high-stake’ risks that can eliminate the human population<sup>[5]</sup>. The author is right in this conclusion. Historically, natural pandemics such as the Black Death (*Yersinia pestis*) and Spanish flu (*H1N1* virus) led to death tolls ranging from 25-150 million collectively<sup>[6]</sup>. And in modern times, pathogen engineering is within reach. For instance, the microbiome contains strains of *Escherichia coli*, *Staphylococcus aureus*, and *Clostridium difficile* — all of which can be genetically sampled to produce resistant strains untreatable by antibiotic drugs<sup>[7]</sup>. Additionally, microbiota ecosystems are home to 100 trillion more protozoa, fungi, viruses, and bacteria, most of whom unexplored for their potential in being modified as fatal bioagents or toxin drug derivatives that can be transmitted furtively (akin to the 2001 Anthrax attacks)<sup>[8]</sup>.

There are several directions that could be taken for this transformative technology; the first is outright banning microbiome developments, but I consider this the most problematic resolution. Preventing existential catastrophe does not equate to preventing scientific development, especially as microbiota presents us with novel treatments to the proliferating number of chronic diseases. These include arthritis, eczema, hypertension, diabetes, liver and kidney complications, cancer, bowel syndromes, and as discovered quite recently, mental health disorders such as schizophrenia, Alzheimer’s, and Parkinson’s (which can be treated using bacteria involved in neurotransmitter pathways between the gut-brain system, such as *Lactobacillus*)<sup>[9]</sup>. To ban microbiome studies would deprive us of a chance to revolutionize the pharmaceutical industry and eliminate avenues that biomedical scientists could pursue.

The second course of action is to allow nations to continue independent studies on the microbiome, equally-perilous as the first. This poses two risks: (1) *mutually assured destruction* (MAD), pushing superpowers to compete for production of microbiota-based bioweapons, similar

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[5] Ord, T. (2020). *The Precipice: Existential Risk and the Future of Humanity*. Chapter 6, Quantifying the Risks.

[6] Death toll estimates combined from: [Spanish Flu](#) (Jordan, 2019); and [Black Death](#) (Howard, 2020).

[7] Heilbronner, S., Krismer, B., Brötz-Oesterhelt, H., & Peschel, A. (2021). The microbiome-shaping roles of bacteriocins. *Nature Reviews Microbiology*, 19(11), 726–739. <https://doi.org/10.1038/s41579-021-00569-w>. [Not open access]

[8] Ord, 2020. See Chapter 5 (Future Risks), Pandemics subsection.

[9] Ord, 2020. See Chapter 5 (Future Risks), Information Hazard subsection.

to how they compete in nuclear arms race<sup>[10]</sup>, and (2) *information hazard*, which Ord defines as “dangerous data that is freely available.” For example, Ord explains that published genomic sequences of smallpox can be used by any group to ‘resurrect’ the virus (given access to needed technology)<sup>[11]</sup>. Similarly, publishing microbiome information under the crusade to “make all information free” makes it easier for bioterrorists and non-state groups to repurpose beneficial probiotics into fatal bioagents.

### ***Sovereignty and the ‘great power’ problem***

In my purview as WHO’s Director-General, the best procedure is to enforce regulatory policies that mitigates chances of engineering pathogens and pandemics. Fortunately, such policy is already being crafted and only needs the approval of the international community.

Earlier this 2023, the WHO published the Zero Draft of the CA+ pandemic treaty, which will provide the organization with greater jurisdiction in monitoring ‘potential outbreaks’ and overseeing scientific research endeavours within countries<sup>[12]</sup>. The CA+ treaty will give WHO three new functions: (1) implement surveillance systems in national laboratories and supply networks (making it easier to monitor state-based biowarfare programs that can be reported to the UN for sanctions, thus alleviating risks of MAD), (2) impose censorship activities for confidential scientific information (ensuring lesser information hazards), and (3) in times of health emergencies, WHO’s instructions on border closures, travel restrictions, quarantine, and medical examinations will be legally-binding<sup>[13]</sup>.

Overall, the CA+ treaty serves as an indispensable policy that grants assurance for the preservation of the human race against biology-associated threats, especially the microbiome. Despite this, there is strong opposition to my proposed regulatory policy, arguing against the

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[10] Ord, 2020. See Chapter 5 (Future Risks), Pandemics subsection: “While there is no evidence of deliberate attempts to create a pathogen to threaten the whole of humanity, the logic of deterrence or mutually assured destruction could push superpowers or rogue states in that direction.”

[11] Ord, 2020. See Chapter 5 (Future Risks), Information Hazard subsection.

[12] World Health Organization. (2023, February 1). *Zero draft of the WHO CA+ for the consideration of the Intergovernmental Negotiating Body at its fourth meeting*. [https://apps.who.int/gb/inb/pdf\\_files/inb4/A\\_INB4\\_3-en.pdf](https://apps.who.int/gb/inb/pdf_files/inb4/A_INB4_3-en.pdf).

[13] Bell, D. (2023, March 3). *What the WHO Is Actually Proposing*. Brownstone Institute. <https://brownstone.org/articles/what-the-who-is-actually-proposing/>.

erosion of national sovereignty<sup>[14]</sup>. Critics argue that WHO's global administration can deter biotreats, but requires nations to 'surrender' independence to an international body — a concept most nations are not welcoming of.

However, I believe that only through the CA+ treaty can we avoid the entirety of microbiota threats; this is due to the “great power” problem<sup>[15]</sup>. This ‘power’ dilemma arises when highly-influential nations do not concede to WHO's recommendations to terminate bioweapon programs or censor information; when these influential nations dismiss WHO regulations, other developing nations follow suit. Justifiably, WHO needs to permeate national policymaking processes in order to monitor biotreats within countries and deter heavy publicization of confidential microbial knowledge. I know that immediate imposition of the CA+ treaty will be openly defied, thus I will first lobby for public and governmental approval through open discussions with every nation. During these discussions, I will highlight the comparative advantage of the treaty:

- (a) For countries like Russia, USA, or China, they get to avoid MAD with fellow superpowers and better allocate their resources to goals other than microbiome-based biowarfare (ex. using microbiome to develop probiotics that can aid their public health sectors instead).
- (b) For less-developed nations, they receive assured protection from microbial threats which they cannot protect themselves from, considering their lack of scientific progress.

Along with promoting comparative advantages, I will also highlight the catastrophic consequences that can be avoided by monitoring microbiota data, such as reemergence of bioterrorism and spread of crime associated with probiotic drugs. These benefits will hopefully incentivize both developed and developing nations to concede to the CA+ pandemic prevention policy, and allow the WHO to regulate their study on microbiomes and control the risks of fatal pathogens and derivatives.

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[14] Taylor, L. (2023). Covid-19: WHO treaty on future pandemics is being watered down, warn health leaders. [Report]. 1246. <https://doi.org/10.1136/bmj.p1246>.

[15] Originally obtained from Effective Altruism, posted anonymously in the forum. The author discusses how states can influence risk reduction procedures. (2022). *What if states don't listen? A fundamental gap in x-risk reduction strategies*. Effective Altruism. [https://forum.effectivealtruism.org/posts/sFxtu6ZKAScDSqLrK/what-if-states-don-t-listen-a-fundamental-gap-in-x-risk#Possible\\_Objections\\_to\\_Working\\_on\\_State\\_Sovereignty\\_as\\_an\\_EA\\_Priority](https://forum.effectivealtruism.org/posts/sFxtu6ZKAScDSqLrK/what-if-states-don-t-listen-a-fundamental-gap-in-x-risk#Possible_Objections_to_Working_on_State_Sovereignty_as_an_EA_Priority).

After all, amid biological development, we have a choice. Do we ban microbiome research and limit progress? Allow unmonitored studies and pose risks of catastrophe? Or do we find **middle ground** and advocate for regulated research? The third option is the most appropriate action plan if we wish to achieve humanity's fullest potential while minimizing biological risks. As we sit in the precipice, regulation and supervision are our key deterrents to human extinction.

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