Do we need a Global Virome Project?

There is debate in the scientific community about whether the animal-human infectious disease nexus warrants substantially more funding, science effort, and global policy discussion. One promising idea is to develop a global atlas of pathogens that are, as yet, unknown but might threaten humanity already or are likely to evolve into clear threats. Such an atlas would be a foundational necessity for anticipating and reducing the threats, but it would also be ambitious and costly, even if it was restricted initially to viruses, as in the proposed Global Virome Project.[1] Michael Osterholm, the director of the University of Minnesota's Center for Infectious Diseases Research and Policy, is a noted doubter. "I wouldn't sit here and say, 'Such studies shouldn't be done,' but I still fail to see at this point how it's going to better prepare the human race for the next infectious disease that jumps from animals to humans," Osterholm said, wondering whether we could even hear the signal through the static that so much data would create.[2]

Others look to many past and present spillovers of pathogens from animals to humans and see a pattern. In some cases, inadequate preparedness and vigilance have led to humans being sentinels for animal diseases. In other cases, the pathogens might not cause disease symptoms in animals but an absence of basic data on the reservoir results in delayed diagnosis and preventable morbidity and mortality in humans. Spillovers where scarcity of data caused deadly and costly delays in diagnosis and response to human illness include novel strains of influenza, Ebola virus, Marburg virus, Dengue virus, AIDS, and tuberculosis between pastoralists and their livestock in Ethiopia.[3] According to the World Organisation for Animal Health, 60% of pathogens capable of causing symptoms in, and even killing, humans originate in animals.[4] The spillover of Middle East respiratory syndrome coronavirus from camels in Saudi Arabia in 2013 was exported halfway across the world, causing an outbreak in humans and a severe, though thankfully temporary, shock to the economy of South Korea in 2015. Severe acute respiratory syndrome from civets in China spread to infect people in over 30 countries in 2003. Other infectious zoonotic pathogens, such as malaria, rabies, Zika, or Lyme disease, transmit in human populations, although not directly through human-to-human contact.

Viruses and other microbes are phenomenally successful. They are the oldest form of life on Earth and together comprise 60% of the Earth's living matter. Most are beneficial or cause no great harm to humans and their livestock, but some are a formidable and constant challenge to humanity. In their June 2019 consensus statement,[5] leading microbiologists reviewed the implications of climate change for microorganisms and what is known about microbial effects on climate change. They issued a stark warning about the consequences of inadequate microbial research, arguing that our knowledge about viruses and other microbes is surprisingly and dangerously scant. Since 2009, the US Agency for International Development has supported the PREDICT project in 35 countries and US research institutions to provide proof of concept that collecting samples from host species can lead to important scientific findings.[6] The Prince Mahidol Awards Conference in 2018 in Bangkok, Thailand, highlighted the importance of the topic: "Global trends indicate that new microbial threats will continue to emerge at an accelerating rate, driven by our growing population, expanded travel and trade networks, and human encroachment into wildlife habitat. Most emerging viruses are zoonotic, that is, transferred between vertebrates and humans… Estimations show that there are more than 1·5 million mammalian and waterfowl viruses, spanning across 25 viral families. Compared with the more than 260 viruses known in humans, the unknown viruses represent 99·9% of potential zoonoses. These viruses usually remain undetected until they cause disease in humans."[7]

Much like map-making for newly-discovered continents, the Global Virome Project would be a pathway to improve capacity to detect, diagnose, and discover viruses that potentially pose threats to human populations, particularly in low-income and middle-income countries. Between 631 000 and 827 000 unknown viruses might be zoonotic and thus have the potential to infect humans after spillover from host animal populations. The big idea is to gradually build a global atlas of most of the planet's naturally occurring potentially zoonotic viruses by systematically creating the missing maps. Broadening the knowledge base on viral sequences, geographical ranges, and host distributions would provide vital intelligence about humanity's formidable microbial enemy. The three specific benefits that the project would provide are early warning of future threats, data to improve prevention and reduction of these threats, and inputs for advance preparation of responses for unexpected outbreaks of unknown diseases.

Major global actors are starting to engage. "China will help lead a project to identify unknown viruses from wildlife to better prepare humans for major epidemics—if not global pandemics...The Global Virome Project will start in China and Thailand with field work to collect samples from wild animals and analyze the viruses detected", said Gao Fu, the head of the Chinese Centre for Disease Control and Prevention.[8] Cost estimates for the Global Virome Project range from an initial \$1·2 billion to \$3·4 billion over a 10-year period.[9] The projected cost is modest when it is put in perspective, in at least four regards.

First, even a single regional disease outbreak, especially one that crosses borders, can result in considerable human illness and death and cost tens of billions in productivity, trade, economic growth, and social welfare. For example, the economic, health, and social costs of the 2014–15 Ebola outbreak in west Africa are estimated to be over \$53 billion.[10] The economic cost of pandemics of novel influenza (or other readily transmissible viral diseases) has been conservatively estimated as \$80 billion annually when averaged over a century.[11] Investments to reduce these risks yield high economic benefits. An expenditure of \$400 million a year on the Global Virome Project—which is at the higher end of the Global Virome Project cost range—would be equivalent to just 0·5% of the ongoing annual economic risk of \$80 billion from pandemic influenza (and other readily transmissible viral diseases) and thus be justified as a prudential measure. The Global Virome Project would complement ongoing efforts, such as the Coalition for Epidemic Preparedness Innovations, the International Vaccines Task Force, and the surveillance and preparedness capacity-building projects in the REDISSE programme financed by the World Bank.

Second, analyses of viral risks would increasingly become possible as data collection proceeds; such analyses would be important inputs to the newly created Global Preparedness Monitoring Board, which assesses efforts to reduce pandemic risks.

Third, the viral atlas might yield large co-benefits since concentrated research in one area often leads to unforeseen benefits elsewhere; for example, in the mapping of the human genome and the development of the internet.

Fourth, the Global Virome Project would create an international partnership that cuts across political adversaries for a common cause—China and the USA are two key actors in preventing infectious disease outbreaks and the mutual gains for them and the rest of the world are substantial.

Both the supporters of the Global Virome Project and its skeptics need to be heard. An objective, apolitical assessment would be helpful in deciding whether spending up to \$3·4 billion over the next decade is likely to produce scientific knowledge whose benefits are greater than the costs. If the conclusion of such an assessment is that filling in some of the missing knowledge about viruses has significant merit, then the second step would be to set out how, where, and when to take it forward, and how to arrange adequate and sustained financing. Side discussions at venues such as the G20 or the UN General Assembly, could be opportunities for policy makers to set out implementation arrangements. They will need to draw on the advice of knowledgeable experts, including animal and human health researchers from low-income and middle-income countries, biomedical industry interests, economists, financial analysts, and big data expertise. How about it?

*Olga Jonas, *Richard Seifman*
Harvard Global Health Institute, Cambridge, MA, USA; and Technical Review Panel, The Global Fund, Washington, DC 20015, USA
seifmanrichard@gmail.com

We declare no competing interests.

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