Interventions to prevent pathogen spillover and curb early disease spread among domestic animals and humans:

A summary of analysis prepared by the Coalition to Prevent Pandemics at the Source

Global failure to address the deeper causes of infectious disease emergence

Most emerging infectious diseases in humans are zoonotic, meaning that they originate in animals, particularly wildlife, and then spill over into humans. Examples of infectious diseases with zoonotic origins include HIV and SARS.(1, 2) While the origins of the COVID-19 pandemic are still being investigated, most scientists accept that SARS-CoV-2, the causative virus of COVID-19, emerged in humans through spillover from an infected animal.(3, 4) Spillover will be the most likely cause of the next pandemic.

The increasing frequency of spillover events is due to three underlying drivers: land use changes, poor biosecurity in animal husbandry, and wildlife markets and trade.(5, 6) The ecological disruption that occurs when humans convert land areas with functioning and biodiverse ecosystems for activities such as agriculture or to create urbanized centers often results in increased contact between people, domestic animals, and wildlife, thereby providing opportunities for pathogen spillover.(7) Of all ecosystem types, the clearing and degradation of tropical forests generally carries the highest risk of spillover.(8)

Spillover events resulting in outbreaks, epidemics, and pandemics will continue to occur at an accelerating pace in the future if these drivers are left unaddressed.(9) Unfortunately, spillover prevention has been largely sidelined as the world attempts to "build back better" from COVID-19.(10) Instead, most of the discourse, often couched as prevention, has focused on post-spillover interventions such as health system strengthening and vaccine development.(11, 12) Such interventions are essential but insufficient to safeguard the world against pandemics because emerging pathogens often have characteristics that defy public health and clinical wisdom thus rendering conventional interventions ineffective, even when outbreaks are identified early. Furthermore, we cannot assume that we will have a timely and effective vaccine for every future Disease X given the challenges of pharmaceutical development and the possibility for viral mutations that could dampen vaccine efficacy. Finally, as we have seen with COVID-19, the population-level effectiveness of vaccines even when available is hampered by the rampant spread of misinformation and inequitable access.

All of this underscores the need to combine pre-spillover and post-spillover interventions to minimize the risk of future outbreaks, epidemics, and pandemics. Incorporating pre-spillover interventions will have massive return on investment.(13, 14)

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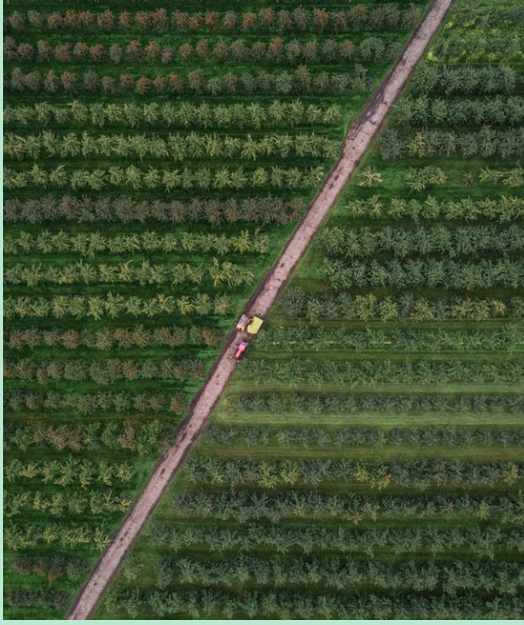
INTERVENTIONS THAT CAN REDUCE THE RISK OF FUTURE PANDEMICS

We must urgently scale up interventions to prevent pathogen spillover and curb early disease spread among domestic animals and humans. The following interventions, under five categories, have been deemed most important based on expert opinion of leading scientists and practitioners of public health, medicine, and wildlife and tropical ecology:



1 Stopping deforestation

Stopping deforestation addresses a root cause of spillover and should be applied in areas with relatively intact tropical forests. Unfortunately, tropical forest conservation is severely underfunded. For example, nature-based solutions such as tropical forests represent 30% of global action needed to stabilize climate, yet only receive 3% of global climate funding.(15) Climate benefit aside, the importance of this intervention to reduce the risk of future pandemics cannot be overstated. Three major approaches can be used to reduce deforestation: a) integrated policy approaches, b) payment for ecosystem services (PES), and c) community-based project approaches. Integrated policy approaches aim to remove incentives for deforestation alongside improved enforcement of existing environmental laws, including respect for Indigenous Peoples and their lands. The tremendous success of this approach was shown in Brazil from 2004-2012.(16) PES involves providing land stewards with cash incentives for maintaining or increasing forest cover on their lands. Community-based projects such as Health In Harmony's efforts in Indonesian Borneo have also effectively and affordably addressed forest degradation through use of on-the-ground service delivery to forest communities.(17)

2 Reducing human-wildlife contact in spillover hotspots

Reducing human-wildlife contact should be applied where land conversion is already in process and widespread, leaving in its wake a spillover hotspot. Many communities in spillover hotspots lack access to high-quality healthcare, sustainable livelihoods, food security, and education. Reducing human-wildlife contact in these areas will be best achieved through supporting communities in securing essential services so that they do not rely on activities that put them in contact with wildlife (e.g., logging, commercial wildlife trade). This requires engaging communities and listening to and investing in their intersectional solutions. This approach has been successfully implemented in Indonesia, Madagascar, and Brazil.(17)

3 Improving biosecurity in animal husbandry

Interventions to improve biosecurity (the set of measures designed to reduce the risk of introduction, establishment, and spread of infectious disease) in animal husbandry include structural measures (e.g., physical enclosures to separate domestic animals from each other and from wildlife) and operational measures (e.g., quarantining new animals, providing safe food and water).(18) Significant improvement in animal husbandry biosecurity deficiencies could be achieved through investment in public and private animal health services along with better engagement of animal caretakers and owners in identifying and addressing animal illnesses of public health concern.(19) Controlling vaccine-preventable diseases in domestic animals must also be prioritized. This provides a direct benefit to the animals through reduced morbidity and mortality from the disease targeted by the vaccine, and an additional benefit of reducing spread of emerging infectious diseases for which there are no vaccines. All too often in settings where vaccine-preventable diseases of domestic animals are prevalent, there are delays in the diagnosis of emerging infectious diseases with similar clinical presentations.

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4 Shutting down or regulating wildlife markets and trade that pose public health risks

Wildlife markets and trade, both legal and illegal, involve conditions that present a high risk for the emergence, amplification, and transmission of zoonotic pathogens.(6) Wildlife consumption is driven by demand for animals as food, pets, skins, traditional medicines, and display, and each poses a degree of risk, with the highest from commercial use of live and freshly butchered animals. Addressing aspects of wildlife markets and trade that lead to pathogen spillover will require investments in four areas:

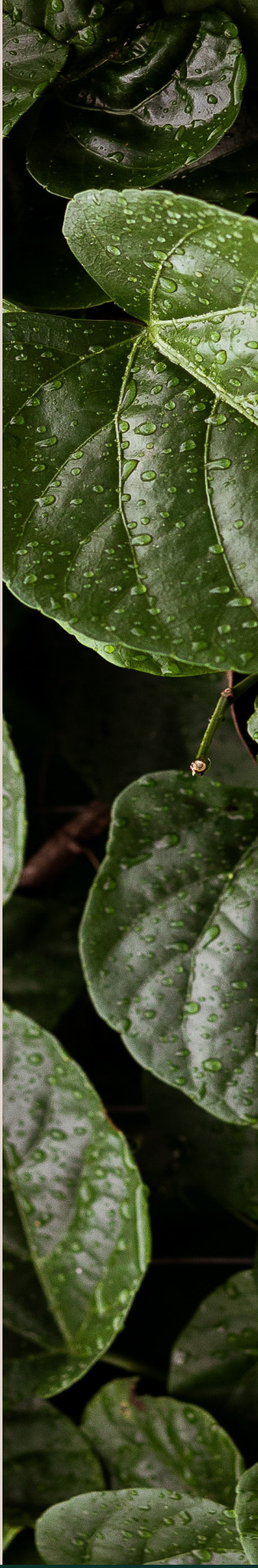
- Implementing policy restrictions on legal commercial wildlife markets and trade that lead to spillover
- Offering alternative livelihoods for those who currently depend on wildlife markets and trade for their income
- Enhancing legislation and law enforcement to address wildlife markets and trade
- Implementing campaigns to reduce the consumption of wild birds and mammals, applying best practices in behavioral science, psychology, economics, and social marketing

5 Enhancing surveillance at interfaces between humans, domestic animals, and wildlife

Surveillance refers to the range of active and passive ongoing data collection systems that monitor temporal changes in microbial abundance in a population; the presence, frequency and severity of disease in those infected by these microbes; and evolution of these microbes as they circulate in their natural reservoir and in new hosts, whether animal or human.(20) Such surveillance systems are key to program implementation, evaluation, and research for prevention of outbreaks, epidemics, and pandemics. Integrated surveillance of humans, domestic animals, and wildlife is part of a One Health framework.(21) Most surveillance systems today do not integrate all three. While such integration requires additional resources, it offers the most informative and comprehensive view of potential outbreaks, epidemics, and pandemics.

COST-EFFECTIVENESS OF IMPLEMENTING THESE INTERVENTIONS

The estimated cost of implementing these solutions is US$10 billion per year globally, which carries massive return on investment compared to the millions of lives and trillions of dollars lost from pandemics such as COVID-19.(13, 14) Despite their cost-effectiveness, the interventions described here continue to be excluded from plans to reform pandemic prevention, preparedness, and response.(10)



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