Medical Xpress

Researchers explain how humanity has 'engineered a world ripe for pandemics'

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A pandemic can strike at any time. It takes little more than the right roll of genetic dice in a virus circulating among animals, followed by a chance encounter with a person or some go-between species, like pigs or mosquitoes. But as the new coronavirus whips around the world with a speed matched by few of the infectious diseases that have emerged in modern times, it poses the question: Why now?

According to Stanford biological anthropologist James Holland Jones, we have always had spillover events, in which disease jumps from animals to people. "What's different now is that a spillover in one part of the world can have major consequences for the rest of the world," he said. "We have engineered a world ripe for pandemics."

Central to this vulnerability is the fact that our species moves around the world so much, and so quickly—whether for business, leisure, safety, education, economic necessity or other reasons. Many diseases are able to move right along with us. In fact, one of the most successful indicators of where pathogens will spread is the number of flight connections between cities, said Stanford biology Professor Erin Mordecai, who studies how climate, species interactions and global change influence infectious disease dynamics in both humans and natural ecosystems.

All this interconnectedness is particularly problematic with a disease like COVID-19, which can be transmitted by people who are not experiencing symptoms. "This disease is really nasty from a control standpoint," said Mordecai, an assistant professor of biology in the School of Humanities and Sciences and a fellow at Stanford Woods Institute for the Environment. "If you don't know you're sick, you might get on the plane and shed virus everywhere."

An engineered world

It's not only our highly mobile lifestyles that are helping give pandemics a runway to spread around the globe. It's also the way we crowd together in increasingly dense cities, interact with wildlife and alter the natural world.

"A pandemic is a rare event, but if you give it enough time, a rare event becomes a certainty," said Jones, an associate professor of Earth system science at Stanford's School of Earth, Energy & Environmental Sciences (Stanford Earth). "And honestly, they're not even that rare." Seasonal flu viruses, for example, come from a disease that regularly spills over from wildfowl to domestic livestock. "Every once in a while, we get a genetic reassortment and a novel, pandemic strain emerges," he said. That's what produced the influenza pandemics in 1918, 1957, 1968 and 2009.

Coronaviruses, such as the one that causes the illness COVID-19, circulate in bat populations. "They're not very deadly in bats," Mordecai explained. "But they spill over into another animal which then spills it over into humans."

The intermediate animal that passed the virus from bats to humans currently remains unknown, but the emergence of the new coronavirus has been pinpointed to a live animal market in Wuhan, China. "That is a dynamic that has been associated with past outbreaks, where you have a lot of people and a lot of different types of animals," Mordecai said. "Especially in food markets where animals might be slaughtered right there, there are opportunities for blood to intermingle and transmission and spillover to happen."

The larger context for this latest, deadly spillover is one in which humans dominate most of the Earth. "We encroach on biodiverse regions like tropical forests, displacing indigenous people with their myriad and accumulated adaptations to these environments—including, potentially, the pathogens—and expose ourselves to novel infectious agents," said Jones, who is also a Woods senior fellow.

Meanwhile, agricultural practices that commonly use antimicrobial drugs to speed up livestock growth or prevent disease among animals raised in cramped quarters contribute to the evolution of superbugs—microbes that resist treatment with antibiotics, antivirals or other drugs.

"We've done a lot to engineer a world where emerging infectious diseases are both more likely and more likely to be consequential," Jones said, "just as we've engineered a world where wildfires, floods, droughts and other local consequences of climate change are more likely and more consequential."

Behavior matters

Of course, the consequences of a disease outbreak are far from preordained. How humans respond to a disease matters. The 2003 outbreak of severe acute respiratory syndrome (SARS), for example, was controlled through aggressive social distancing, testing, quarantine and treatment. "Two of the places hardest hit by SARS, Singapore and Hong Kong, used that experience to prepare for the inevitable return of a similar respiratory infection," Jones said, "and they are two of the big success stories, so far, of the COVID-19 pandemic."

But the timing of our behavioral changes also matters. "Early in an outbreak, when the number of infections is low, randomness dominates and prediction is very difficult. As an outbreak gets larger, it starts to become more predictable," Jones said. As a result, even before an outbreak becomes noticeable, it can develop inertia. "This is why we need to act early, often in a state of pretty abject uncertainty."

Much remains unknown about how the new coronavirus will compare to past pandemics. It's possible that the school closures, social distancing and stay-at-home orders now in place will stop the pandemic long enough to allow the development of a vaccine, Mordecai said. Her group is currently studying the effect of different physical distancing strategies on the spread of the disease. "But even if we stopped it today, we would see more severe illness and death just from the progression of disease in those already infected."

Provided by Stanford University