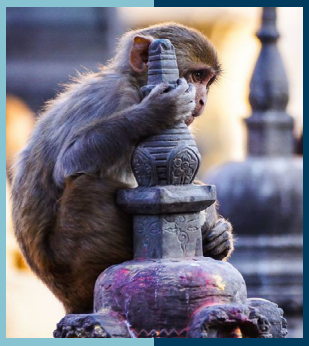
Fact Sheet

UCDAVIS One Health Institute
School of Veterinary Medicine



Global shifts in mammalian population trends reveal key predictors of virus spillover risk

The same processes that threaten wildlife increase our risk of spillover

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SNAPSHOT

- Human interaction with wildlife has serious public health implications on a global scale
- Disease emergence and the risk of a pandemic is directly connected to habitat loss, human exploitation of wildlife and species extinction
- Understanding the relationship between human activity and disease emergence (as shown in this study) gives us the power to change our behavior to reduce the risk of viral spillover and prevent the next pandemic
- Results from studies like this as well as the current COVID-19 pandemic can and should inform future public policy and shift thinking from preparedness to prevention

AUTHOR QUOTES

"We need to be really attentive to how we interact with wildlife and the activities that bring humans and wildlife together. We obviously don't want pandemics of this scale. We need to find ways to co-exist safely with wildlife in shared habitat." – Lead author, Christine K. Johnson

"This study highlights how species that have been driven close to extinction by exploitation have shared more viruses with people. Livelihoods that involve direct contact with wildlife are especially high-risk for disease spillover. In many ways, live wild animals kept in close contact in the wildlife trade and sold at markets is a perfect epidemiological setting for viruses to jump between diverse host species that would never normally come in contact in nature, and result in transmission of new viruses with pandemic potential to humans." – Lead author, Christine K. Johnson

"When we start to return to normal life after this pandemic, we must find ways to ensure safe and sustainable co-existence with wildlife in our shared environment. We are the dominant species on the planet, and we've altered ecosystems for our own benefit for centuries, but ultimately, nature will determine how long we all co-exist." – Lead author, Christine K. Johnson

"We must find ways to minimize disease transmission between humans and animals in a shared landscape. We're all paying close attention to bats right now, how we interact with them and how our behavior increases the risk of viral spillover." – Co-author Pranav S. Pandit

"I hope one important change that emerges from this catastrophe is that we start to recognize that microbes do not respect country or societal boundaries. We are one global health community and we are only as strong as our weakest links in regards to how we treat our wildlife, our environment and our public health." – Co-author, Tierra Evans Smiley

SUMMARY FINDINGS

1. Exploitation of wildlife and loss of natural habitat are key drivers in the emergence of zoonotic disease transfer from wildlife to humans:

    a. *As human populations continue to expand requiring more land (habitat destruction) and greater food resources (agriculture, wildlife hunting, wildlife trade), human-animal interactions will continue to increase, and the corresponding emergence of zoonotic viruses will also increase - exposing humans to a greater number of pathogens with pandemic potential such as the current COVID-19 pandemic.*

    b. *Large-scale human encroachment into wildlife habitat has resulted in movement of wildlife and increased human contact with wild animals, heightened rates of virus spillover and created losses in species abundance, and for many species, threatening them with extinction. Movement and redistribution of wildlife often enhances disease spread in wildlife populations, resulting in epidemics in wildlife and increased risk of spillover to humans when these epidemics are at their peak, especially if wildlife have redistributed close to human communities.*

    c. *Loss of biodiversity from over-exploitation and deforestation increases viral spillover risk, not only as humans interact more directly, but the loss of species diversity can favor higher abundance of some species that are especially well adapted to zoonotic viruses.*

2. Domesticated animals had a higher number of zoonotic viruses per species, which is a consequence of the very close interactions people have had with domesticated species over centuries. Some species of wildlife, especially rodents, have also increased in abundance and have adapted very well to human-modified habitat. The widespread presence of these species, especially those that have adapted to sheltering with people or depending on people for food, means a higher likelihood of interaction with humans which facilitates disease transfer.

    a. *Humans have a long history of close interaction with domesticated species, resulting in shared viruses. Domestic animals can also amplify infections as an intermediary for transmission of viruses from wildlife to humans.*

    b. *Wild animal species that have been best able to adapt to human-altered landscapes (think rats and mice or rhesus macaques living in urban environments) are more likely to interact with humans, increasing the likelihood of viral spillover.*

PREDICT Project – Emerging Pandemic Threats (links below)

The USAID Emerging Pandemics PREDICT Project is led by the One Health Institute with a consortium of partners. PREDICT 2 came to the end of its original 10-year funding period in September 2019. On March 31, 2020, PREDICT announced a limited term emergency extension to continue to provide technical expertise to support detection of SARS CoV-2 cases in Africa, Asia and the Middle East to inform the public health response.

The project will also investigate the animal source or sources of SARS CoV-2 using data and samples collected over the past 10 years in Asia and Southeast Asia. PREDICT first began in 2009 as an USAID-funded project to detect wildlife viruses that could pose a risk to human health and identify measures to reduce viral spillover.

PREDICT focused on strengthening capacity for early detection of zoonoses, by engaging colleagues in 30 countries and 60 laboratories around the world to initiate surveillance for zoonotic threats through concurrent surveillance in wildlife and people. In ten years, PREDICT trained more than 6800 scientists, laboratory and field workers as part of a growing One Health Workforce these individuals are on the front lines of COVID-19 response around the world.

HUMAN HEALTH & CONSERVATION IMPLICATIONS

Lots of studies have looked at pathogen spillover from the virus perspective; quite a few have also investigated host factors, but none had yet looked at how trends in species abundance could be driving spillover risk. Given the close linkage to habitat loss and viral spillover, an important next step is to study the specific types of habitat loss, the ecology of disease in relevant wildlife species, and determine if there is a relationship to ecosystem change and increased risk of spillover.

Humans have drastically changed the planet and nearly ⅓ of all vertebrate species are threatened or endangered. This research underscores that humans are driving the spillover of viruses from animals to humans, we are not innocent bystanders, waiting for the next major pandemic to emerge.

We have the power to change our behaviors and work towards a more sustainable way for humans and wildlife to co-exist. For example:

a. Live wild animals sold in markets where animals and people mix in high density and close contact present the perfect opportunities for host jumping between diverse and different species that would normally never come together in the natural world.

b. As natural habitat is diminished, wildlife come into closer contact with people and shift their behavior to adapt. This has hastened disease emergence from wildlife, which puts us at risk of pandemics because we are all globally connected through travel and trade.

Infectious diseases emerging from wildlife are increasing at a rate that is faster than ever. Given the interconnectedness of our people on the planet today and huge population growth, the risk of a spillover from an animal to a human causing a pandemic is also much higher today than ever before – indeed we are experiencing the profound impact of this from COVID-19. We hope studies such as these will inform the global conversation so we can shift thinking from pandemic response to pandemic prevention.

Once we are past the COVID-19 pandemic, we believe the lessons learned (the vast majority of ecological and epidemiological drivers are pieced together clue by clue afterwards), as well as results from studies like this can inform and drive decisions around land management, animal resource use and environmental policy to dramatically reduce the risk of and potentially even prevent the next pandemic.

PREDICT also sampled more than 164,000 animals and people at high risk interfaces and detected 949 novel viruses, including Bombali ebolavirus, Zaire ebolavirus, Marburg virus, and MERS and SARS-like coronaviruses.

Some key achievements include: technology transfer; training in the safe and ethical field surveillance of wildlife; community engagement on living sustainably with wildlife; detecting acute febrile illness for undiagnosed viral infections in human patients; biosafety; safe sample transport; safe and accurate laboratory detection; and timely sharing of findings with government partners in a One Health framework.

Because bats have been recognized as an important source of emerging infectious disease, the PREDICT consortium developed educational materials for people on how to live safely with bats, specifically designed for people who are living close to bats in marginalized wildlife habitat and rural communities.

Access the **Living Safely with Bats book**, available in 12 languages.

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RELATED LINKS & RESOURCES

- Journal Publication
- UC Davis Press Release
- Why do viruses jump from animals to humans? Clues to the COVID-19 pandemic - by Christine K. Johnson
- Habitat destruction and biodiversity loss at the root of emerging infectious disease - by Pranav S. Pandit
- One Health Institute COVID-19 FAQ
- Dr. Christine K. Johnson Bio
- One Health Institute PREDICT
- PREDICT-2 (2014-2019)
- Living Safely with Bats - Educational Materials