

REF21 Impact Case Study: Understanding disease spillover from wildlife to improve public health outcomes in a changing world

The health and economic consequences of wildlife disease spillover into human populations can be devastating, as evidenced by the COVID-19 pandemic. Research carried out at ZSL's Institute of Zoology (IOZ) and University College London (UCL) has improved understanding of how ecological, epidemiological and socioeconomic factors interact to drive spillovers of zoonotic diseases into humans. Our research has informed global zoonotic disease research funding priorities, for example guiding wildlife disease surveillance efforts (USAID's PREDICT programme); international policy priorities through the United Nations (UN), Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), and World Wide Fund for Nature (WWF); and public health responses to disease outbreaks through the Foreign Commonwealth and Development Office (FCDO), as well as improving public understanding of links between the extinction and climate crises on zoonotic disease spillover risk.

Underpinning research

Zoonotic diseases are a major global human health and economic burden but, in many cases, little is known about the underlying drivers of spillovers, severely hindering effective public health responses to prevent and manage future outbreaks. IOZ and UCL researchers have made seminal contributions to the understanding of zoonotic spillover risk by identifying and quantifying the drivers of disease transfer from wildlife to people, predicting emerging disease hotspots, and developing an interdisciplinary framework to inform disease management in a changing world.

Drivers of zoonotic spillover and identification of disease hotspots

In 2000, IOZ research co-developed a new paradigm for the links between ecology and human health where pathogens harboured by wildlife were highlighted as the source of a series of high-impact, human diseases, for example Ebola, Nipah and HIV/AIDS. This research identified that the emergence of these diseases was driven by human activities, such as changes in hunting practices, encroachment into remaining wildlife habitats and a growing international trade in wildlife. The [paper](#), published in the journal *Science*, provided a scientific rationale for what is now known as 'One Health' – an approach to designing and implementing programmes, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes. At IOZ, this idea was further developed with the first quantitative analysis of global patterns of human disease emergence, showing that the rate of disease emergence was increasing, that the majority of human infectious diseases were from wildlife, and that areas of high biodiversity and increased human population densities correlated with past emergence of zoonotic disease. This research also identified emerging 'disease hotspots', showing where new infectious diseases are most likely to originate and also that, in many cases, global resources to counter disease emergence were poorly allocated.

Preventing and managing disease spillovers

In 2012, a joint IOZ-UCL NERC-funded research project in the Ecosystem Services for Poverty Alleviation (ESPA) programme led to the development of a new framework to operationalise the ecological, social and economic conditions that facilitate zoonotic disease emergence and transmission. This framework was used in further UCL-IOZ research that quantified how socio-ecological changes in biodiversity, habitat, land use, poverty and climate affect risk of animal-to-human disease spillover in a number of high impact disease systems, such as Lassa fever and Ebola. These disease-forecasting models have improved knowledge of how spillover dynamics are affected by global changes, such as climate, land use and urbanisation.

Details of the impact

The impact of our research falls into three main areas: informing research funding priorities for zoonotic diseases; influencing international policy and public health responses to disease outbreaks; and improving public understanding of the links between environmental change and zoonotic disease spillover risk.

Informing research funding priorities for zoonotic diseases

UCL and IOZ research has informed funding priorities both internationally and nationally. Some key examples include:

- Our research on emerging disease hotspots was used as the basis for the geographical targeting of the US Government's international aid to countries at high risk of emerging diseases. From 2008 to 2019, approximately USD1.5 billion was spent through USAID's Emerging Pandemic Threats program, including the PREPARE, IDENTIFY, PREDICT, RESPOND, and One Health Workforce programmes.
- Our work contributed to the DFID (now Foreign and Commonwealth Development Office) scoping report in 2012 on the links between zoonotic disease emergence and livestock systems. This resulted in the establishment of the Zoonoses and Emerging Livestock Systems research programme, which allocated millions of pounds of funding to 17 projects.
- Our research contributed to the 2020 IPBES report on Biodiversity & Pandemics, and influenced the establishment of the EU's PREZODE initiative to develop research to prevent and manage future zoonotic disease outbreaks.
- Our work also informed the 2020 Trinity Challenge (a coalition aiming to improve the world's protection against health emergencies, using data-driven research and analytics) representing millions of pounds of investment.

Policy and public health responses

Research by IOZ and UCL is among key evidence linking emerging zoonotic diseases with land use and climate change. As a result, it has informed international and national policies and public health responses to disease outbreaks. Some key examples include:

- Providing a scientific rationale and synthesis of research for a 'One Health' multi-sector approach to improving public health outcomes, which is now a major component of pandemic prevention policy around the world
- Evidence used for the United Nations Environment Programme (UNEP)'s rapid assessment report (2020) 'Preventing the next Pandemic' led to UNEP joining an alliance with the World Organisation for Animal Health (OIE), Food and Agriculture Organisation (FAO), and World Health Organisation (WHO), recognising that there was a need to strengthen the environmental dimension of One Health global efforts.
- Underpinning evidence provided to the WWF 'Beyond Boundaries' 2020 report contributed directly to WWF work to influence policy and practice in a range of areas on linkages between environmental degradation, emerging infectious disease risk and human health.
- Evidence on the impact of ecosystem degradation on zoonotic risk was included in The Dasgupta Review commissioned by the UK's HM Treasury setting out how nature should be accounted for in economics and decision making. This will inform policy discussions at the Convention on Biological Diversity (CBD) COP 15, United Nations Framework Convention on Climate Change (UNFCCC) COP 26, and the G7 meeting in 2021.
- Evidence on zoonotic disease emergence is informing discussions within UK government and the G7 to develop a more strategic approach to understanding emerging zoonotic and biodiversity threats.

Increasing public understanding of zoonotic disease risk

Our research in understanding zoonotic disease spillover processes has been communicated extensively through the international broadcast news and print media, thereby improving public understanding of zoonotic disease risks. Clear scientific communication has been particularly relevant during the global COVID-19 pandemic and IOZ-UCL researchers appeared in over 150 national, specialist, and international media outlets in 2020, sharing the research with an estimated audience of over 300 million people. Highlights included contributions to BBC Radio 4's flagship news show the 'Today Programme' and its 'Inside Science' programme, as well as the BBC World Service. Additionally, the researchers gave a cross-departmental talk within the UK Government on predicting pandemics and wrote a special briefing to UK Government's Cabinet Office. This informed several of the UK prime minister's speeches for example, to the UN Summit on Biodiversity and to the UN General Assembly in 2020. Our research also provided evidence on the environmental links to the emergence of zoonotic diseases for the UK Environmental Audit Committee in 2020.



ZSL's research on straw-coloured fruit bats *Eidolon helvum* improves understanding of the ecology of viral pathogens of known or potential zoonotic risk in fruit bats in West Africa