

BRIEFING

Emerging Zoonotic Diseases

- Emerging zoonotic diseases (zoonoses) pose an increasing global health and economic security threat.
- Recent outbreaks include Ebola, H1N1 swine flu and severe acute respiratory syndrome (SARS).
- An interdisciplinary 'One Health' approach involving human and animal science, health and policy is vital for mitigating this threat.

SUMMARY

Zoonoses are infectious diseases that can be transmitted to humans from vertebrate animals, including livestock, pets and wildlife. Over 200 such diseases have been described, 56 of which are together globally responsible for 2.5 billion cases of human illness and 2.7 million deaths each year.

A key concern in this field is emerging zoonoses: those that have been newly identified, or are increasing in incidence or geographic distribution. Environmental change and shifting trade, travel and farming practices increasingly facilitate the global spread of disease and bring humans into contact with animal pathogens with zoonotic potential.

Emerging zoonoses have major consequences for public and veterinary health and economic productivity across the world. They account for an estimated 60% of emerging human pathogens. Many can cause severe and potentially fatal illness in humans and are a cause of serious epidemics and pandemics. Some, including bovine spongiform encephalopathy (BSE), also cause disease in livestock, affecting agricultural productivity.

Science plays a major role in mitigating the threat of emerging zoonoses through disease surveillance, understanding the causes of disease emergence and transmission, and developing vaccines and control measures. Maximising the impact of this research requires a 'One Health' approach, which sees interdisciplinary collaboration across human and animal science, health and policy.



IMPACTS AND THREATS

In this highly globalised world, a major threat to health security is a pandemic disease that is easily transmitted between humans and causes serious illness. This is the concern with zoonotic influenzas, such as those that originate in birds or pigs. Pandemic influenzas were rated as the most significant civil risk to the nation in the *UK National Risk Register of Civil Emergencies 2015*. The 2009 H1N1 swine flu pandemic caused an estimated 280,000 deaths worldwide, but a more severe swine flu or avian flu pandemic could kill millions.

THREATS FROM CORONAVIRUSES

The global threat posed by zoonoses that emerge from 'nowhere' is illustrated by the 2003 outbreak of severe acute respiratory syndrome coronavirus (SARS-CoV), which emerged in Hong Kong but affected 37 countries. Over 8,000 cases, including nearly 800 deaths, were reported. The outbreak was estimated to have cost the global economy \$40 billion. Initially, the identity and the source of the virus were unknown. Subsequent research indicated that live animal markets provided an environment in which the virus evolved to jump from animals to humans.

Currently, there is concern about Middle East respiratory syndrome coronavirus (MERS-CoV), which emerged in Saudi Arabia in 2012 and is suspected to be zoonotic. Over 1,100 cases and 440 deaths have been confirmed, including travel-related cases worldwide. At present, human-to-human transmission of MERS-CoV is more limited than SARS-CoV, but it has a much higher mortality rate.

Human immunodeficiency virus (HIV), the virus that causes acquired immunodeficiency syndrome (AIDS), is another example of a serious human disease with animal origins. HIV evolved following zoonotic transmissions of simian immunodeficiency viruses found naturally in African primates.

The economic costs and losses associated with emerging zoonoses are substantial. The World Bank conservatively estimated that six major zoonotic outbreaks between 1997 and 2009 resulted in total economic losses of \$80 billion (equivalent to \$6.7 billion per year). In contrast, investments to raise prevention and control systems to internationally-recognised levels in low- and middle-income countries would likely amount to \$1.9–3.4 billion per year.

Also of concern is the increasing global distribution and prevalence of several zoonoses, such as West Nile virus and Crimean–Congo haemorrhagic fever virus, which are transmitted among animals and humans by mosquito or tick vectors. Causes may include increases in the size and distribution of vector populations due to climate change, and unintended introductions through trade and travel, or migration of wild animals. West Nile virus has been rising in incidence in Southern and Eastern Europe; there is a risk that warmer weather and inadvertent introductions could see it and other vector-borne zoonoses spread to Northern Europe in the future.

SECURITY THROUGH SCIENCE

High-quality science is vital for providing security against emerging zoonoses. Research on emerging zoonoses includes the following areas:

- **Surveillance** to detect emerging disease threats and to track their spread in human and animal populations.
- **Diagnosis** of diseases in humans and animals using laboratory methods, and the development of more effective diagnostics.
- **Modelling** the transmission and spread of diseases, including the possible impacts of climate change and other factors, to predict outbreaks and evaluate potential control measures.
- **Understanding the contribution of human activities** to the emergence and transmission of zoonoses at local through to global scales.
- **Investigating the molecular biology of pathogens** and their interactions with human and animal hosts to better understand how they are transmitted and cause disease.
- **Developing vaccines and disease control measures** to limit the occurrence of emerging zoonoses and to protect against them.

National and international work on these themes is undertaken in the UK, often collaboratively, by universities, research institutes, and government agencies such as Public Health England (PHE) and the Animal and Plant Health Agency (APHA).

PREPAREDNESS THROUGH POLICY

Policy-makers can work with the scientific community to improve our preparedness against emerging zoonoses:

- **A 'One Health' approach**, which sees collaboration across human and animal science, health and policy, is vital to mitigate the threat from emerging zoonoses. Strengthening international surveillance systems and control measures through organisations like the World Health Organization and World Organisation for Animal Health is a key priority.
- **Enhanced dialogue between scientists, policy-makers and the public** about the evidence, risks, uncertainties and costs associated with emerging zoonoses, would better inform investment priorities and mitigation policies.
- **Longer-term investments in proactive surveillance and research** are required to better understand the causes of disease emergence, even where the short-term impact on public health is unclear.

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