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World faces epidemiological transition

Emerging and re-emerging animal diseases a growing problem for public health


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The number of animal diseases affecting humans is set to escalate as the world undergoes a new epidemiological transition, say researchers this month in *BioScience*. Experts say that "dramatic" changes to the environment have sparked lasting alterations to human disease patterns.

"We appear to be undergoing a distinct change in global disease ecology," write Montira Pongsiri, of the US Environmental Protection Agency in Washington, DC, and colleagues. "The recent emergence of infectious diseases appears to be driven by globalization and ecological disruption."

A similar shift in disease patterns, a phenomenon known as 'epidemiological transition,' occurred during the Industrial Revolution. In that transition the number of people affected by infectious diseases plummeted in the developed world and life expectancy lengthened, while the rise of manufacturing and pollution levels increased the risk of new diseases including cancer, allergies, and birth defects.

This time, scientists see changes in land use, farming practices, and climate behind the escalating numbers of zoonotic disease outbreaks in humans.

Reviewing the evidence for transition

Pongsiri and colleagues reached this conclusion with a review of studies about five emerging and re-emerging diseases. For each disease they looked at how changes in biodiversity at the genetic, molecular, species and habitat level affected the risk and incidence of human disease. They argue that the loss of animal and plant species, together with the destruction of their habitats, brings people into closer contact with animal diseases, particularly those transmitted by vectors such as mosquitoes.

Jan Slingenbergh, from the United Nations Food and Agriculture Organization, says there is mounting evidence, but as yet no scientific proof, pointing to a rise in the emergence of new diseases. At least 45 diseases that have jumped the human-animal species barrier have been reported to UN agencies over the last two decades, he says.

This rise has been brought about by changes in agriculture, land use, and the earth's climate, which have in turn reduced biodiversity. This impacts how diseases circulate at the animal-human interface, explains Slingenbergh.

Rabies and vector-borne diseases

Over the past few decades, the rabies virus has spilled over from dog populations into other animal species and, increasingly, humans, says Slingenbergh. Rabies has now been reported in racoons in the USA, as well as kudu antelopes in Namibia. This year, the virus caused human infections for the first time in Bali, Indonesia.

The UN has seen a "notable" increase in the number of countries asking for assistance to control the disease in dog populations this year, adds Slingenbergh. Preventing rabies transmission between dogs reduces the risk to people, who can pick up the virus through the bite of an infected animal.

Meanwhile malaria incidence is likely to increase as a warming climate means the mosquitoes that carry the malaria parasite can extend their geographical reach, say Pongsiri and colleagues. For another mosquito-borne disease, West Nile fever, the number of different bird species plays a part in the risk of human disease. **Research in the USA** has suggested that people living in areas with the lowest diversity of bird species are at the highest risk of getting infected with the West Nile virus.

Evidence also suggests that the risk of contracting Lyme disease, which is carried by ticks, is highest in areas of forest with few species and fragmented landscape, add the authors.

Farming and flu

In addition to climate and land-use changes, Slingenbergh says changes in animal farming have altered the circulation of zoonotic pathogens and influenza. In countries like China, higher demand for poultry meat has led to a massive rise in populations of domestic wildfowl, he explains. In Southern China alone, there are now around 700 million domestic ducks.

In the case of flu, a growing number of viral subtypes have moved from wild animals into farmed and domestic waterfowl, which live in closer contact with humans. A similar expansion in the number of flu strains in swine has also been seen over the past decade, he adds. “At the end of the 1990s, there was just one subtype of swine flu. Now there are three subtypes, each with multiple strains.”

The behaviour of these new viruses is unpredictable — scientists don’t know how likely they are to jump the species barrier into humans. But with more of these viruses circulating, there is a higher chance of this happening, according to Slingenbergh. Flu viruses are getting closer to people, he says, and food and agriculture practices are to blame.

What does the future hold?

“There is no evidence to suggest this is going to end any time soon,” says Slingenbergh. “Agriculture looks set to continue growing for another two decades, and we are only at the beginning of climate change.”

David Murrell, an ecologist from University College London, also believes the emergence and re-emergence of diseases will continue into the next century at least. Habitat loss shows little signs of slowing, he adds, so we can expect to see more contact between humans and wild animals or animals kept in farms and households.

Murrell adds globalisation to the pressures behind disease emergence, and says it is here to stay . “Globalisation is a big concern regarding the emergence of novel diseases,” he explains. Before the world became so interconnected, deadly and newly emerged diseases were not capable of spreading widely. “Now it is very possible that they will spread across countries and continents within days, thereby sustaining the outbreak.”

Although globalisation can help new diseases to spread far and wide, not all regions of the world will be affected equally by this epidemiological transition, according to Murrell. Developing countries lying closest to the equator will be hardest hit, he says. By having the most biodiversity to lose, they are more likely to see increased outbreaks of zoonotic disease.

Reference and links

1. Pongsirir MJ, Roman J, Ezenwa VO, Goldberg TL, Koren HS, Newbold SC, *et al.* Biodiversity loss affects global disease ecology. *BioScience* 2009, **59**:945–54. **doi**: 10.1525/bio.2009.59.11.6

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