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Disease epidemics present a global one health challenge

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The International One Health Congress takes place every second year and aims to bring together academics and policy makers in the fields of human, animal and environmental health to address challenges which exist at the intersection of these fields. This year, I attended the fifth congress, which was held in the Canadian city of Saskatoon and addressed several important topics. One which emerged as a common issue globally was the threat of disease outbreaks.

Zoonotic diseases represent the biggest potential risk of causing the next global pandemic. However, they are currently the cause of approximately a billion cases of illness and a million deaths each year. This represents a chronic burden in terms of health, welfare and economic prosperity in areas where these diseases are endemic. Strategies when dealing with disease outbreaks must therefore be structured to respond to current problems as well as to anticipate future issues. This can be achieved using an approach that places equal emphasis on the aspects of outbreak prevention, preparedness and response.

Preventing emergence of new diseases is the first aspect that needs to be tackled in prevention of epidemics. Using the same principle as capture-recapture to estimate animal populations, the Global Virome Project has estimated that there are 1.67 million unique viruses yet to be discovered in bird and animal populations worldwide, some of which may have the potential to infect multiple species. As susceptible new hosts are increasingly exposed to a novel pathogen, there is more opportunity for that pathogen to adapt to cause disease in that species. Once the disease is established in a species that has frequent contact with humans, this process can be repeated, increasing the chances of the pathogen adapting to infect people. When human health is directly affected by an outbreak of a zoonotic disease, the costs of disease control and dealing with the impact of the pathogen increase rapidly (fig 1). Studies have shown that risk factors for disease emergence are the same as drivers of biodiversity loss i.e. changes in land use and the food production industry. Protecting biodiversity is therefore important for preventing disease epidemics, but this is a challenge as many places with high biodiversity experience frequent conflict and natural disasters, leading to weak public health and environmental protection systems. A study presented from Cote d'Ivoire provided an example of how land use change from primary forest to agricultural land for growing crops drives emergence of disease. The species diversity and behaviour of *Aedes* mosquitoes in and around forests was compared. Mosquito diversity was much lower outside the forest, with *Aedes aegypti* being the predominant species found outside the forest. Furthermore, mosquitoes outside the forest were far more likely to bite people because they had adapted to do so in the absence of other hosts. *Aedes aegypti* is known for being an effective vector of diseases to humans, including yellow fever, dengue fever, chikungunya and Zika virus. The risk of contracting an arbovirus was therefore higher for people outside the forest than in it.

Once a disease has become capable of infecting a population of animals or people, outbreaks can be prevented by breaking the cycle of transmission. To achieve this, ensuring availability of and access to clean water and good sanitation is of paramount importance. In agricultural settings, excellent biosecurity should be practiced in accordance with good farming practices. Vaccination is also a very valuable tool. A study by the One Health Institute at the University of California, Davis that produced a model forecasting spread of influenza

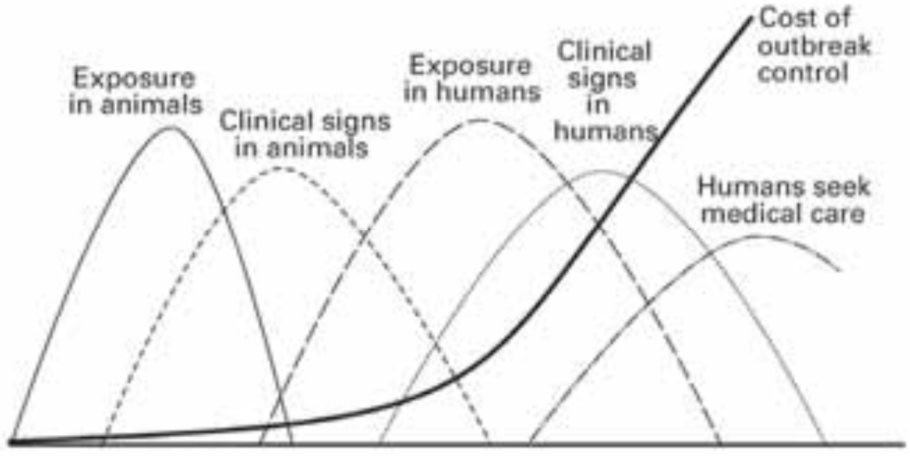


Figure 1: A hypothetical scenario in which a zoonotic pathogen is transmitted from animals to humans. Early intervention in outbreaks of zoonotic disease prevents both human cases and associated costs.
Source: World Bank 2012/ adapted from IOM (2009)

viruses in Rwanda showed that vaccination of main population centres hugely decreases the risk of nationwide viral disease outbreaks, no matter where the virus initially enters the country. However, vaccine usage challenges exist worldwide, including accessibility, storage (especially where the cold chain cannot be maintained) and the anti-vaxxer movement.

Because it is impossible to prevent all disease outbreaks, preparedness is as important as prevention. Disease outbreaks should be planned for with the assumption that they will happen, rather than the idea that they may or may not happen. Every country and region should have contingency plans detailing actions to be taken in the event of a disease outbreak, and these plans should be tested and updated frequently by performing outbreak simulation exercises.

Unfortunately, the benefit of prevention and preparedness activities is usually not directly measureable, meaning that most countries struggle to secure funding for these purposes, instead receiving additional government funding for crisis reaction only after a disaster has occurred.

Regardless, response to disease outbreaks is an area of vital importance and one in which there are the most initiatives to making one health operational. Disease outbreaks represent a threat not only to health, but disrupt economic and social systems and can have catastrophic effects on food safety and security, community structures, economic opportunities and education. When disease outbreaks occur in resource-poor communities, the cycle of poverty is aggravated.

Outbreak response must therefore aim to tackle not only the control of the disease itself, but the negative effects caused by the disease to reduce the impact of the outbreak. For instance, the effect of disease outbreaks on travel, tourism and trade is often much more severe than the direct losses caused by the disease. For instance, when H1N1 influenza (also known as swine flu) emerged in Mexico, the number of tourists visiting the country dropped by one million over the following year, resulting in a loss of $1.2 billion to the tourism industry. During the Rift Valley fever outbreak in South Africa in 2010 and 2011, wool production dropped by 2.2 million kg due to both direct stock losses and the resulting trade bans that were implemented by several countries.

It is therefore in the interest of all industries and communities to strengthen public health systems, including human, animal and environmental health, and those potentially affected by disease outbreaks should be consulted during contingency planning and disease outbreak response.

References and further reading:

The World Bank has released a report detailing the role each sector of the economy can play in strengthening public health systems, available at http://documents.worldbank.org/curated/en/961101524657708673/One-health-operational-framework-for-strengthening-human-animal-and-environmental-public-health-systems-at-their-interface

The Fifth International One Health Congress: https://onehealthplatform.com/international-one-health-congress

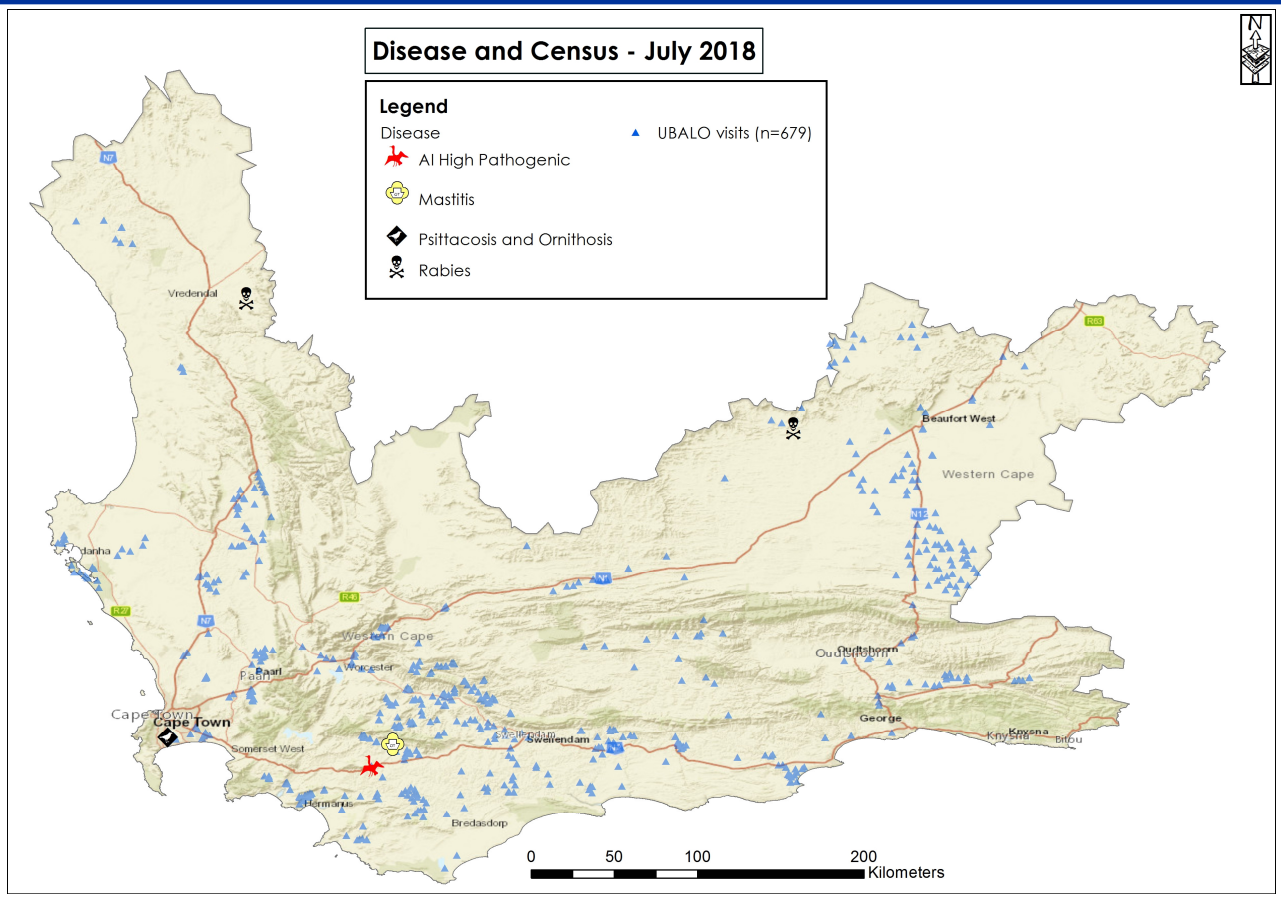
The Global Virome Project: http://www.globalviromeproject.org/

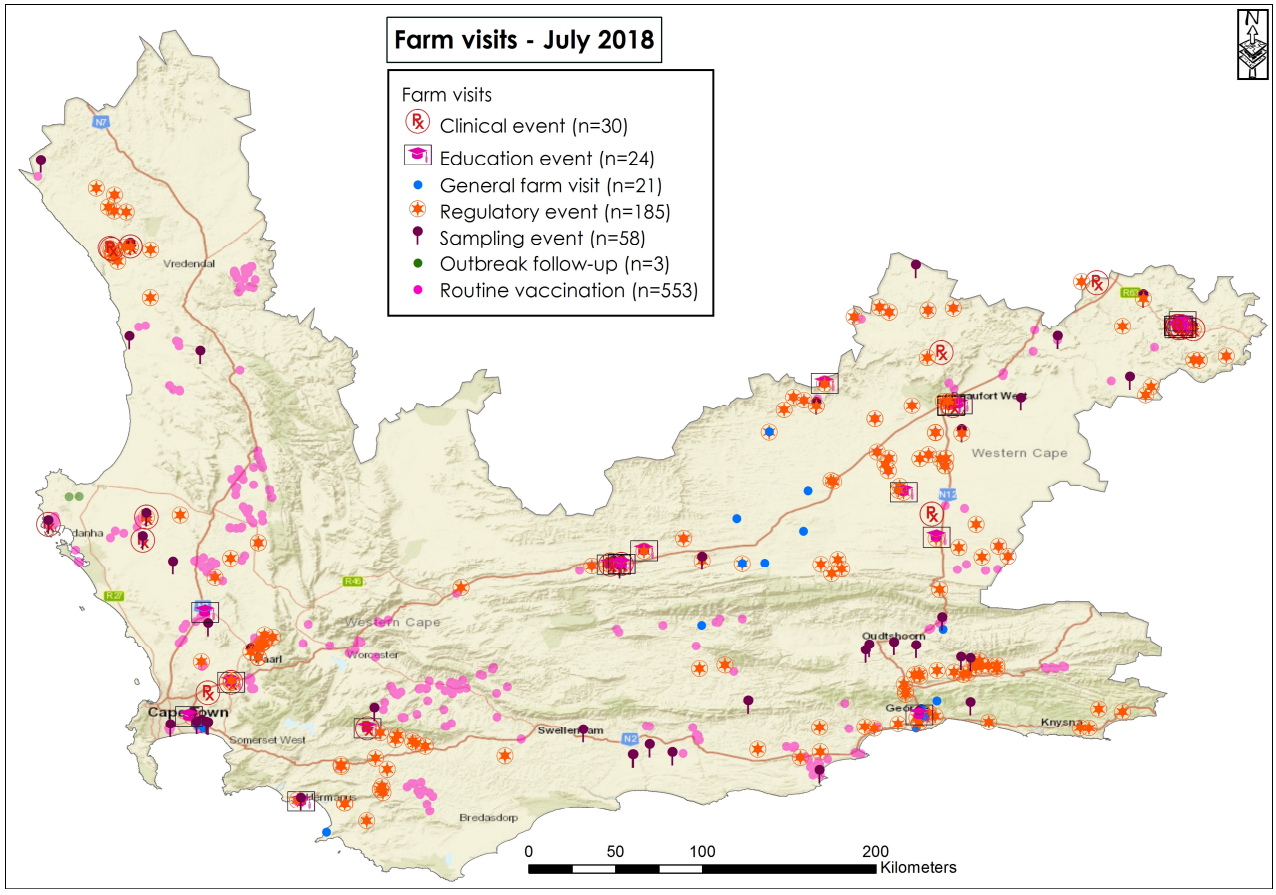
Zahouli et al., 2017 Effect of land-use changes on the abundance, distribution, and host-seeking behavior of *Aedes* arbovirus vectors in oil palm-dominated landscapes, southeastern Côte d'Ivoire. *PLOS ONE*. https://doi.org/10.1371/journal.pone.0189082

Thank you to all the presenters and colleagues at the Fifth International One Health Congress who shared their work and ideas incorporated in this article.

Figures 2 and 3: The city of Saskatoon is named after a type of edible berry that grows on the surrounding prairie. (L van Helden)

Disease and surveillance





Outbreak events

On a farm near **Vanrhynsdorp**, a farmer was outside his house with his wife and daughter when a **common duiker** (*Sylvicapra grimmia*) came running towards them from a nearby field. As it approached, they saw that the duiker was foaming at the mouth and appeared very aggressive. It proceeded to charge and attack the people, leaving the daughter wounded in the leg by its horns. The farmer shot the duiker and immediately alerted the animal health technician in Vanrhynsdorp to come and collect the carcass. An examination of the dead duiker revealed scabs and abscessation as the result of recent bite wounds on the neck, shoulder and front limb (figs 4 and 5). A sample of brain tissue was taken for rabies testing. The daughter was immediately taken to a local health facility for rabies post-exposure prophylaxis, which proved to be a necessary precaution as subsequent testing of the duiker's brain was positive for **rabies**. Officials visited all farms in the surrounding area and vaccinated domestic dogs and cats against rabies.

Figures 4 and 5: A rabid duiker with evidence of bite wounds on the neck, shoulder and front limb (J Kotze)

A second case of **rabies** occurred this month on a farm west of **Beaufort West** when a **bat-eared fox** wandered into the farm house. The farm dogs alerted their owner to its presence by barking, but did not attack or bite it. The farmer killed the fox before any human or animal contact occurred. All dogs and cats on the farm and in the area were vaccinated during a campaign in May 2018, but surrounding farms were visited again and any previously unvaccinated animals that were found were vaccinated.

A **blue crane** near **Caledon** was seen standing with its head tucked underneath its wing. The farm manager approached it but it did not fly away and seemed to be weak and disorientated. The local animal health technician was contacted to collect the bird, which subsequently died during transport to the laboratory in Stellenbosch. Brain, tracheal and cloacal swabs taken from the carcass tested positive on PCR for **H5N8 avian influenza**. Many blue cranes have been observed in the area around where this crane was found, but no other sick or dead birds have been reported. Neighbouring broiler chicken farmers were warned of avian influenza presence in the area and advised to improve biosecurity.

The new owner of an **African grey parrot** in Retreat, **Cape Town**, had had his bird for approximately three weeks before he noticed it rapidly lose weight and die. He sent the bird to the Provincial Veterinary Laboratory in Stellenbosch where, after a necropsy and PCR testing of cloacal swabs, a diagnosis of **psittacosis**, caused by *Chlamydophila psittaci*, was made. An investigation by State Veterinarian Boland traced the bird from the pet shop to someone who had bought the bird from another pet shop. The second pet shop provided the details of an individual from whom they had obtained the bird, but this person was impossible to contact or trace. Neither pet shop sells parrots anymore and so no in-contact birds were identified. State Veterinarian Boland explained the risks and zoonotic potential of psittacosis to all people that had been involved along the tracing pathway and instructed them to report any future suspect cases they may encounter.

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