

PREVENTING THE NEXT PANDEMIC

Zoonotic diseases and how to
break the chain of transmission



A Scientific Assessment with Key Messages for Policy-Makers
A Special Volume of UNEP's *Frontiers Report Series*

SECTION 1: Zoonotic Diseases Overview

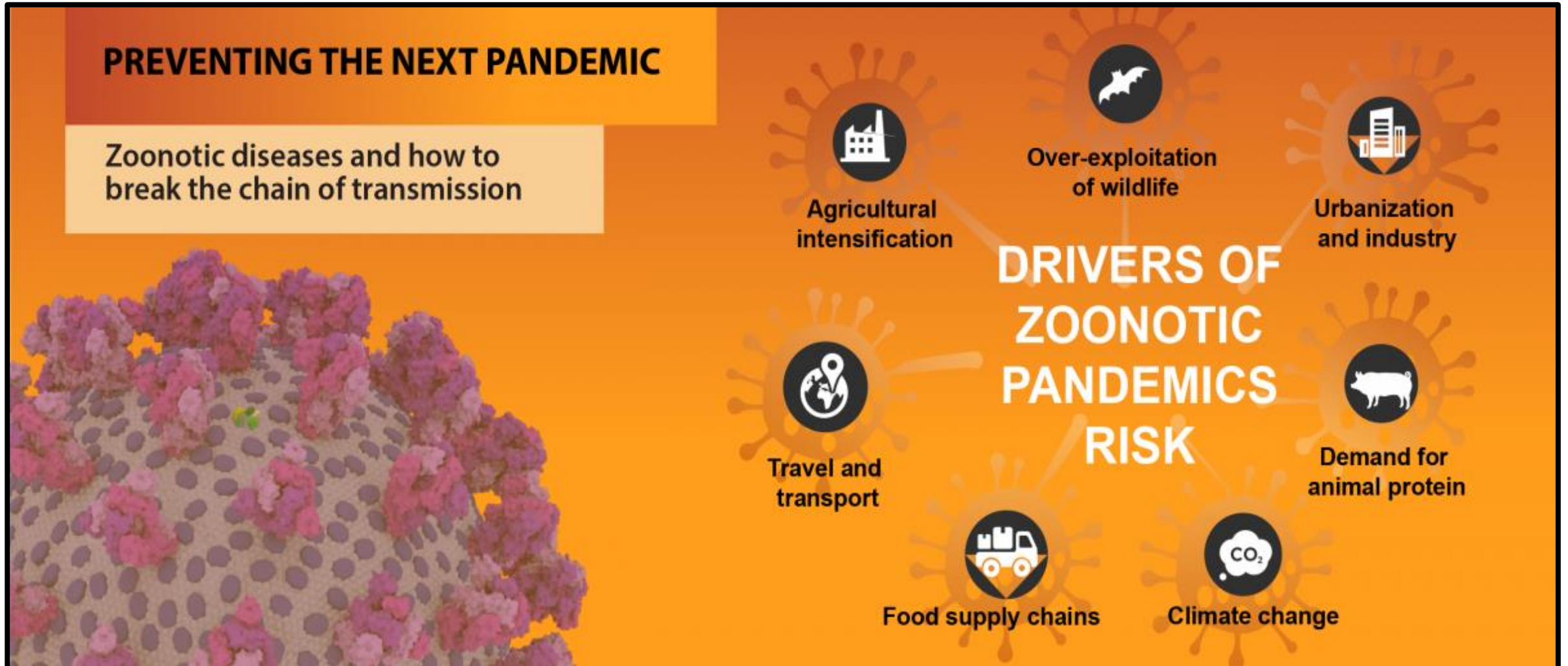
Diseases that can be transmitted between animals and humans

Characteristics of Zoonotic Diseases

- 60% of all emerging infectious diseases in humans are zoonotic.
- Viruses are the most likely type of emerging pathogens.
- Human-livestock interaction enhances the chances of spill-over.
- Livestock serves as an epidemiological infection bridge between wildlife and humans.
- COVID-19, Ebola, bird flu, and SARS are examples of recent zoonotic diseases.

SECTION 1: Zoonotic Diseases Overview

Seven Factors that Drive Zoonotic Outbreaks



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Seven Factors that Drive Zoonotic Outbreaks

1) Increasing demand for animal protein

- High income countries have seen little change in their consumption of animal source foods. On the other hand, South East Asia has experienced a dramatic increase: Their share of total calories from both fish and animal products has doubled.
- This trend of increasing meat consumption is likely to continue, particularly in low and middle income countries, coupled with population growth.

2) Unsustainable agricultural intensification Changes in animal or human host

- Increasing demand for meat has led to intensification of livestock production.
- Intensively bred livestock tend to be genetically homogenous, which makes them more vulnerable to disease.
- Diseases can jump from livestock to humans, or through intermediate hosts such as domestic animals.

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3) Increased use and exploitation of wildlife

- Use and trade in live and dead animals can lead to increased close contact between animals and people throughout the supply chain.
- Harvesting for wild meat; recreational hunting; trade in live animals; and use of animal parts for decorative or medicinal purposes are all risk factors for zoonotic diseases.

4) Unsustainable utilization of natural resources accelerated by urbanization, land use change, and extractive industries

- Rapid and unplanned urbanization can create, novel, diverse, and increased contacts among wildlife, livestock, and people.

5) Travel and Transport

- Through animal trade and human travel, diseases can now move around the world in periods shorter than their incubation periods (the time between exposure to a pathogen and the first sign of clinical illness).

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6) Changes in food supply chains

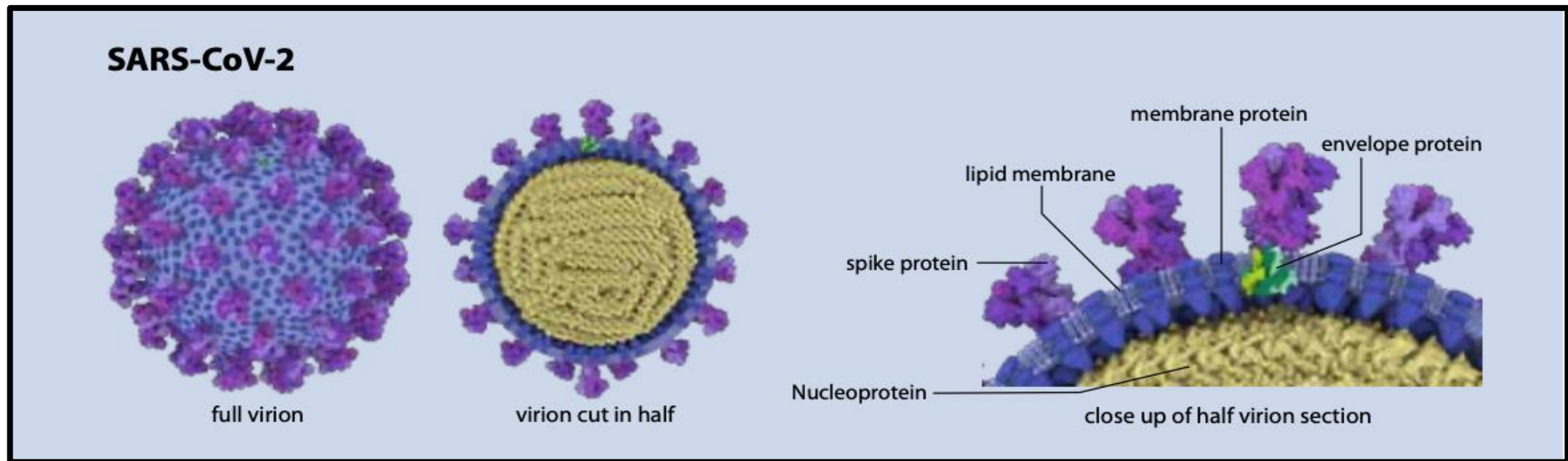
- Increased demand for animal source food, new markets for wildlife food, and poorly regulated agricultural intensification are lengthening and diversifying food supply chains, particularly in low and middle income countries.
- These factors are creating additional opportunities for disease transmission.

7) Climate change

- Many zoonoses are climate sensitive and a number of them will thrive in a warmer, wetter, and more disaster prone world foreseen in future scenarios.

Section 2: Coronaviruses

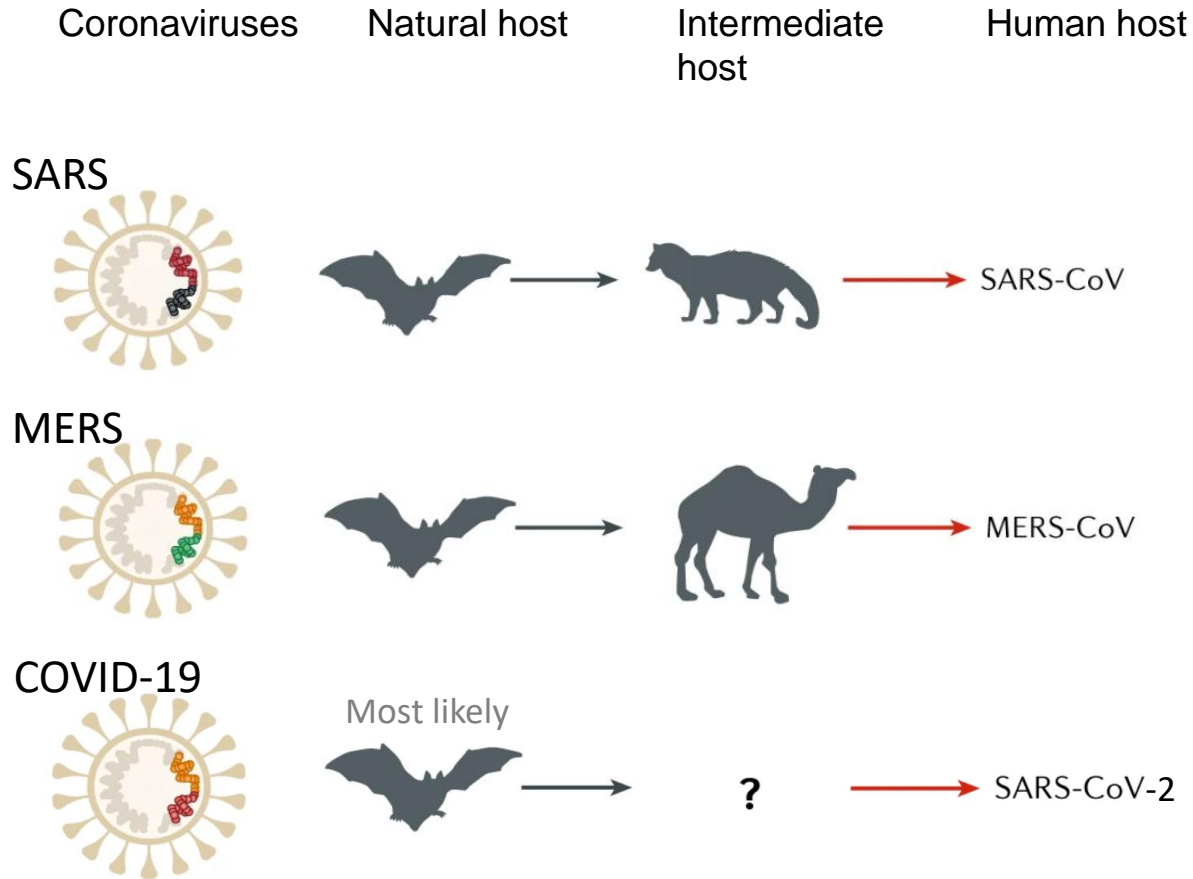
Coronaviruses are a large group of viruses that infect many animals and humans and are responsible for numerous diseases. They are named “corona” for the crown-like arrangement of the spike-shaped proteins on the surface of their membranes.



SECTION 2: Coronavirus

- The novel coronavirus is named SARS-CoV-2 and responsible for COVID-19. It appears to be a recent mix, or genetic recombination, of coronaviruses. As a result of this recombination, one of the proteins of SARS-CoV-2 enables the virus to enter the cells of humans. Other research has shown the virus to be 96 per cent identical to a previously identified bat coronavirus, with a common ancestor about 50 years ago.
- It is hypothesized that this is the origin of the unknown pathway that resulted in the transmission of SARS- CoV-2 to humans in 2019.
- Bats are known ecological reservoirs for a large number of zoonotic viruses including SARS-related coronaviruses. These viruses cause Ebola, Hendra, MERS, Nipah and SARS. Because of coevolution, bats can host these viruses without getting sick.

SECTION 2: Coronaviruses

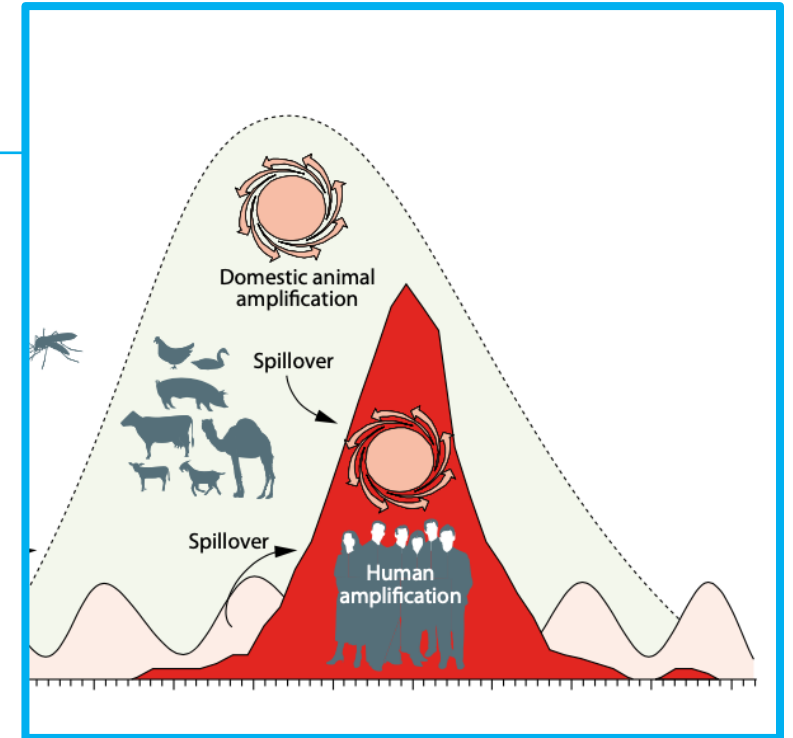


Adapted from Cui et al. (2019)

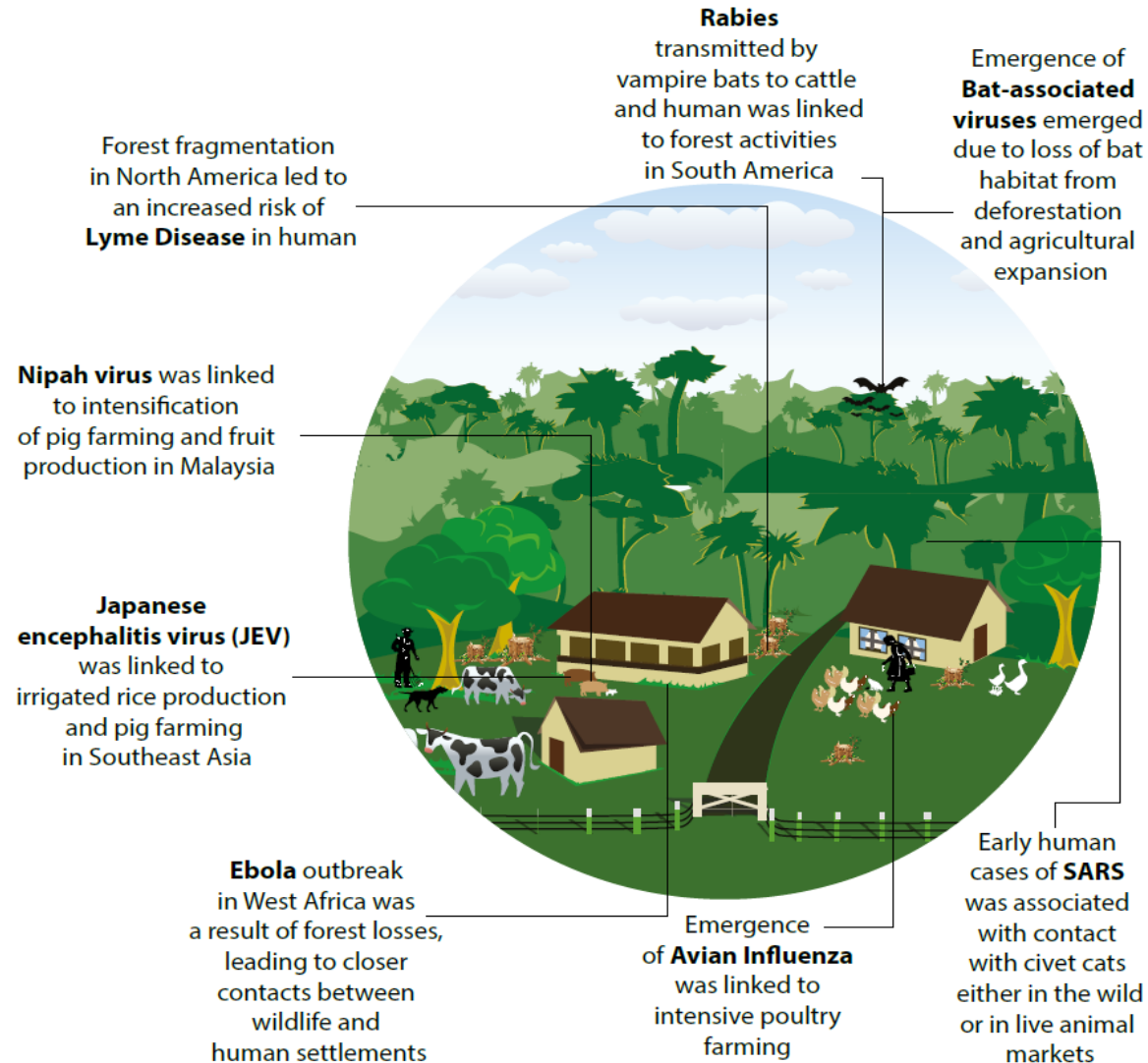
- In the past, coronaviruses that circulated in humans caused only mild infections. This changed in 2002 when SARS broke out in China.
- Coronavirus disease outbreaks followed rapid intensification of agricultural practices and systems, and dramatic changes in the ways animals were kept or farmed, many of which were made without proper precautionary measures being taken
- SARS-CoV and SARS-CoV-2 may be associated with wildlife harvest, trade practices and the intensification of wildlife farming in East Asia. By 2006, nearly 20,000 wildlife breeding and farming ventures were established in China. As wealthy consumers tend to prefer wild-caught animals, the meat from these farms is often consumed by China's rapidly growing middle class.

SECTION 3: Linkages between environment and emergence of zoonotic diseases: a complex relationship!

- Disturbed habitats often favour opportunistic or generalist species that happen to be reservoirs for viruses.
- The disease transmitting vectors in highly biodiverse areas feed on a larger variety of hosts which are poor reservoirs of the pathogens. The **dilution effect** occurs because communities with more species dilute transmission events by reducing the number of susceptible animals. (e.g., West Nile virus and tick-transmitted Lyme disease). However, ecological systems are complex, and empirical evidence for the dilution effect hypothesis has been inconsistent.
- The **co-evolution** theory suggests that as humans alter landscapes and former intact habitats are lost, forest fragments serve as islands harbouring wildlife hosts of pathogens that undergo rapid diversification, leading to greater probability that one of these pathogens will spill over into human populations, where they will cause new disease outbreaks.



SECTION 3: Drivers Of Past Zoonosis Emergence



SECTION 3: Linkages between environment and emergence of zoonotic diseases

Trade in wild meat and live animals

Disease transmission can occur through direct contact with any of the following:

1. Hunted and consumed wild animals;
2. Traded wild animals (including at markets);
3. Wild animals kept as pets or in zoos, sanctuaries or laboratories
4. Domestic animals

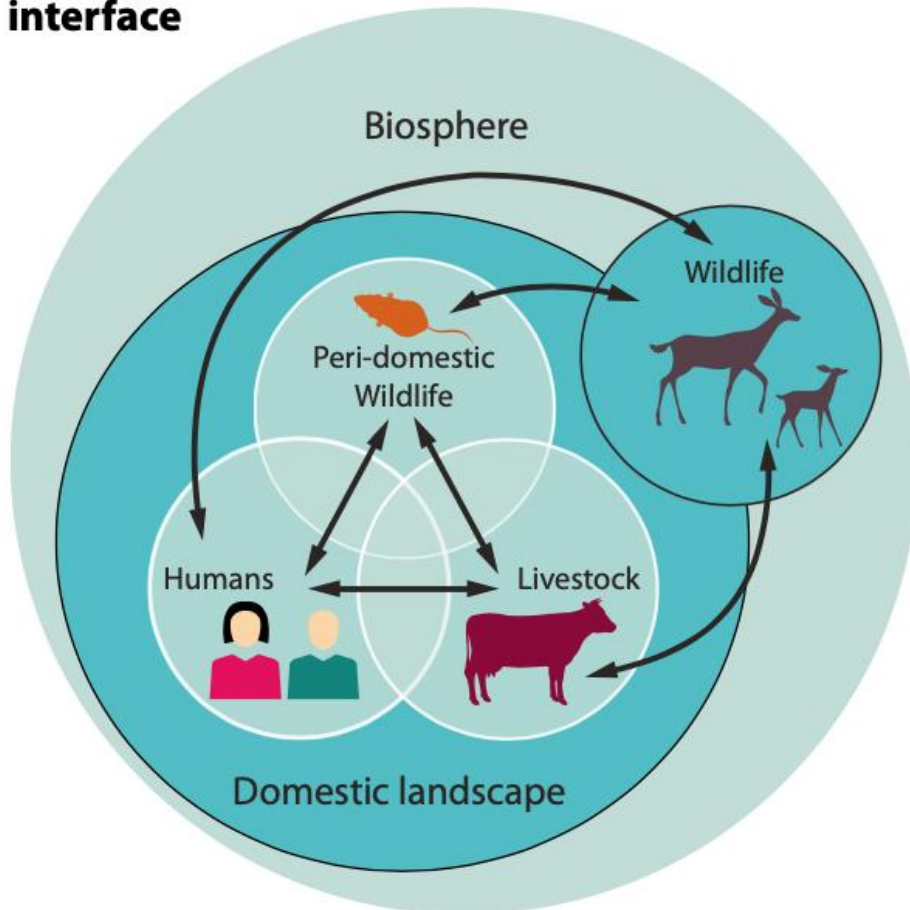
Live animals and animal products are brought into close proximity with people in different forms, as part of national and international legal and illegal wildlife trades—as food, sale items, pets or medicines. A mix of animal species are traded in markets—wild, captive-bred, farmed and domesticated—in transport vehicles and in market cages. Viruses transmitted to people during practices that facilitate the mixing of diverse animal species such as in markets have been shown to have significantly higher ‘host plasticity’—a taxonomically and ecologically diverse host range.



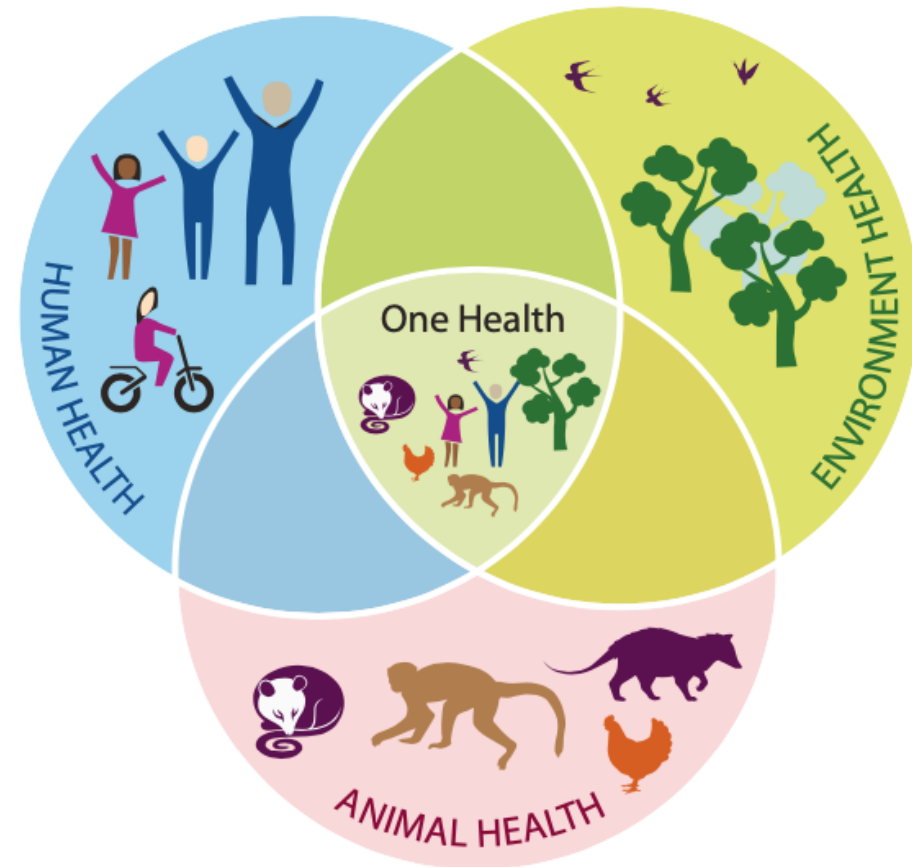
Section 4: Managing and Preventing zoonoses: One Health can help

One Health approach can be defined as the collaborative effort across multiple disciplines to attain optimal health for people, animals and the environment.

Pathogen flow at the wildlife-livestock-human interface



One Health



Source: Adapted from Jones et al. (2013)²⁵

Section 4: Managing and Preventing Zoonoses: One health can help

- One health has emerged as a key tool for preventing and managing diseases occurring at the interface of human, animal and environment health.
- The pathogens originate in animals, and the emergence or spill-over of the diseases they cause in humans is usually the result of human actions, such as intensifying livestock production or degrading and fragmenting ecosystems or exploiting wildlife unsustainably. As such, their management should be inter-sectoral.
- At the global level, three intergovernmental organisations, from different sectors, have specific mandates that address zoonotic diseases: the World Health Organization (WHO), the World Organisation for Animal Health (OIE), and the Food and Agriculture Organization (FAO).
- Adopting a One Health approach, which unites medical, veterinary and environmental expertise, will help governments, businesses and civil society achieve enduring health for people, animals and environments alike.

Section 5: Preventing future zoonotic pandemics: Policy Recommendations

.....to reduce the risk of future zoonotic pandemics and to 'build back better'

- raise awareness of health and environment risks and prevention;
- improve health governance, including by engaging environmental stakeholders;
- expand scientific inquiry into the environmental dimensions of zoonotic diseases;
- ensure full cost financial accounting of the societal impacts of disease;
- enhance monitoring and regulation of food systems using risk-based approaches;
- phase out unsustainable agricultural practices;
- develop and implement stronger biosecurity measures;
- strengthen animal health (including wildlife health services);
- build capacity among health stakeholders to incorporate environmental dimensions of health;
- mainstream and implement One Health approaches.

Section 5: Preventing future zoonotic pandemics: Policy Recommendations and 3 conclusions

1. Human activities promote the emergence of zoonotic infections.
2. We need to strengthen capacity to better understand disease emergence. This includes the monitoring of human and wildlife health in intact ecosystems to establish baselines, and to monitor at the different stages of the development process to understand the exact inter-relationships between a changing environment and the emergence and spread of diseases
3. We can *build back better* by applying the *One Health* approach, including the strengthening of the environmental angle, support to public health services in the rural areas of developing nations, and the inclusion of the health perspective in development planning.

...and then there is the question of wildlife markets, we need to reduce unsafe, illegal and unsustainable practices. But we also need to ensure that people living with and alongside wildlife benefit from wildlife in ways that incentivise the long-term conservation of species and their habitats and make wildlife an economically viable land use option.



Thank you

