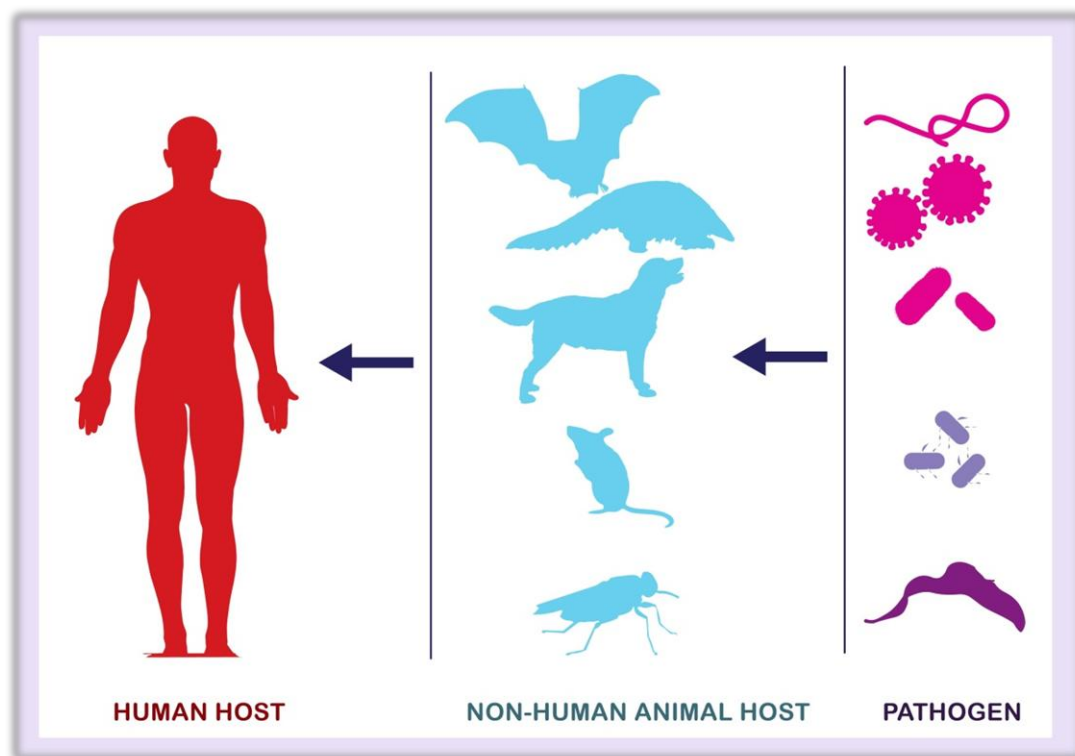


What are Zoonotic diseases?

Pathogens cause diseases and can be very specific to the host they infect, but sometimes they can infect other closely related species. When a pathogen is transferred from another animal to humans to cause a disease, it is called zoonotic. The disease is not caused by the animal; it is caused by a microorganism such as a virus or a bacterium. The animal is simply a “vector”: a player in the relay race, transferring the disease to humans.



A familiar example of zoonosis is Rabies. When dogs are infected by the rabies virus (a Lyssavirus), they behave unpredictably and aggressively. The virus is present in infected dogs’ saliva and if a human is bitten by a rabid dog, the virus may enter and infect them.

Illustration: Pranjal Gupta

Bacteria like anthrax can be transferred to humans through close contact with sheep and other livestock. In another zoonotic disease, a eukaryote, *Trypanosoma* which causes African sleeping sickness is transferred to humans from other wild or domesticated animals by the tsetse fly.

By some estimates, 60% of all the new human diseases seen in the last 30 years are zoonotic! A new zoonotic disease arises when a pathogen that infects other animals starts infecting humans. This could be because the pathogen is able to infect a larger host range and has encountered a human host. It could also be because new mutations in the pathogen allow it to change or expand its previous host range and so it can now infect humans.

CoronaVirus Disease 2019 (COVID-19) is caused by the virus, Severe Acute Respiratory Syndrome CoronaVirus 2 (SARS-CoV-2). It is called a zoonotic disease because the virus is known to originally infect animals such as bats and pangolins. The virus moved from one of these species to humans, although the exact animal host has not yet been identified.



/indscicovid



Indian
Scientists'
Response to
COVID-19

Are some animals more likely to cause zoonotic diseases?

Many of the zoonotic diseases that have drawn worldwide attention recently: SARS (Severe acute respiratory syndrome, two independent outbreaks now), MERS (Middle east respiratory syndrome) Ebola, Nipah and Hendra viruses, are thought to have moved from bats to humans. But this may not mean that bats harbour more viruses capable of infecting humans than other animal species.

Humans are more likely to be infected by viruses that infect other mammals. The increased rate of bat-zoonoses is likely because there are many more species of bats than most other groups of mammals. In addition, bats are widespread. They live in several different kinds of habitats and often in dense mixed colonies around human settlements.

This increases the chance of human-bat contact. Similarly, rodents are another class of mammals that are ‘species rich’ and live close to humans and have contributed to zoonoses in the recent and distant past (e.g., bubonic plague outbreak in Surat in 1994 and the black plague in the 1300s).

Viruses can transfer between animal hosts too before they infect humans. In several cases of zoonotic diseases, even if a closely related virus is identified in one possible source organism, the virus could have transferred to humans through a different unidentified animal host.



/indscicovid



Indian
Scientists'
Response to
COVID-19

Has the incidence of zoonotic disease outbreaks increased recently?

Our estimate of zoonoses are also limited by infections that not only make the initial jump from another animal to a human, but can also move between humans successfully. If the virus is not transferred between humans, a zoonosis may only cause a few cases locally and not become an epidemic outbreak. Even so, we have recorded 3 times as many zoonotic outbreaks as in the 1980s, and they are caused by a more diverse set of pathogens.

Viruses are the most common source of recent zoonotic diseases. They mutate rapidly, continually producing new viruses in new animal hosts. Like in all organisms, most mutations make viruses less successful and these are quickly removed from the population. Some mutants, however, are improved versions.

In viruses, this means they either cause more severe disease or acquire the ability to infect a new host. This is typically a rare event. But the large number of such viruses combined with increasing human-animal contact is thought to be a key factor in the increased incidence of severe zoonotic outbreaks.



/indscicovid



Indian
Scientists'
Response to
COVID-19

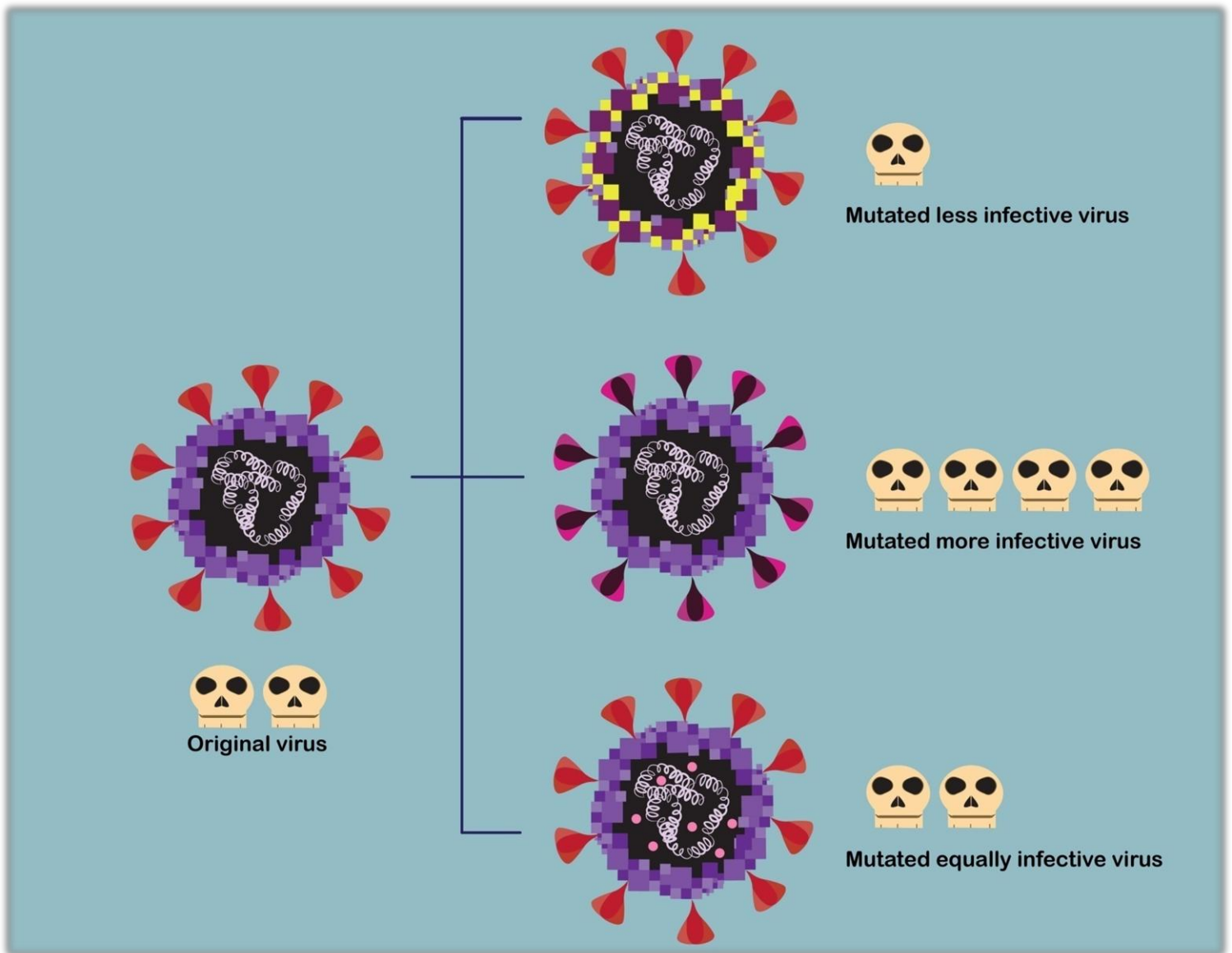


Illustration: Pranjal Gupta

Humans share the largest number of viruses with domesticated mammals. Large-scale animal husbandry places people in close contact with many animals. Destruction of wild habitats as well as illegal trafficking, hunting and trade of exotic animals brings people into contact with animals and their viruses that they would otherwise never have encountered.

In large 'wet' markets, different species of wild animals are kept alive for sale of fresh meat. Here, unlike in their natural habitats, wild animals come into unusually close contact with each other and humans. These are ideal conditions for viruses to find new hosts and spread within the market. These markets can become a hot spot for zoonosis. Scientists think that a wet market in Wuhan was where the SARS-CoV-2 virus originated.

Someone visiting such a market might have been infected by SARS-CoV-2 under prevailing crowded, unhygienic conditions, not necessarily by consuming a virus-carrying bat. The virus then spread from here worldwide leading to the CoViD-19 pandemic.



Illustration: Pranjal Gupta



/indscicovid



Indian
Scientists'
Response to
COVID-19

What can we do to limit the emergence of new zoonotic diseases?

In our hyper-connected world, minimizing pandemics is a serious and complex problem that requires not only global response measures, but also a regional framework that is tuned to the specific local context. Regular monitoring of pathogens and disease in animals as well as people who come in close contact with domesticated and wild animals is important. Experts also advocate strong global measures against illegal trade in wildlife.

Generally, human activities that encroach on natural habitats increases the chances of close contact with various forms of wildlife and their pathogens. The current CoViD-19 pandemic (and others in recent years) adds a significant human cost to environmental damage. In an increasingly industrial world, ecological conservation is often seen as impractical but recent zoonoses events highlight the short-sightedness of the destruction of natural habitats.



/indscicovid



Indian
Scientists'
Response to
COVID-19

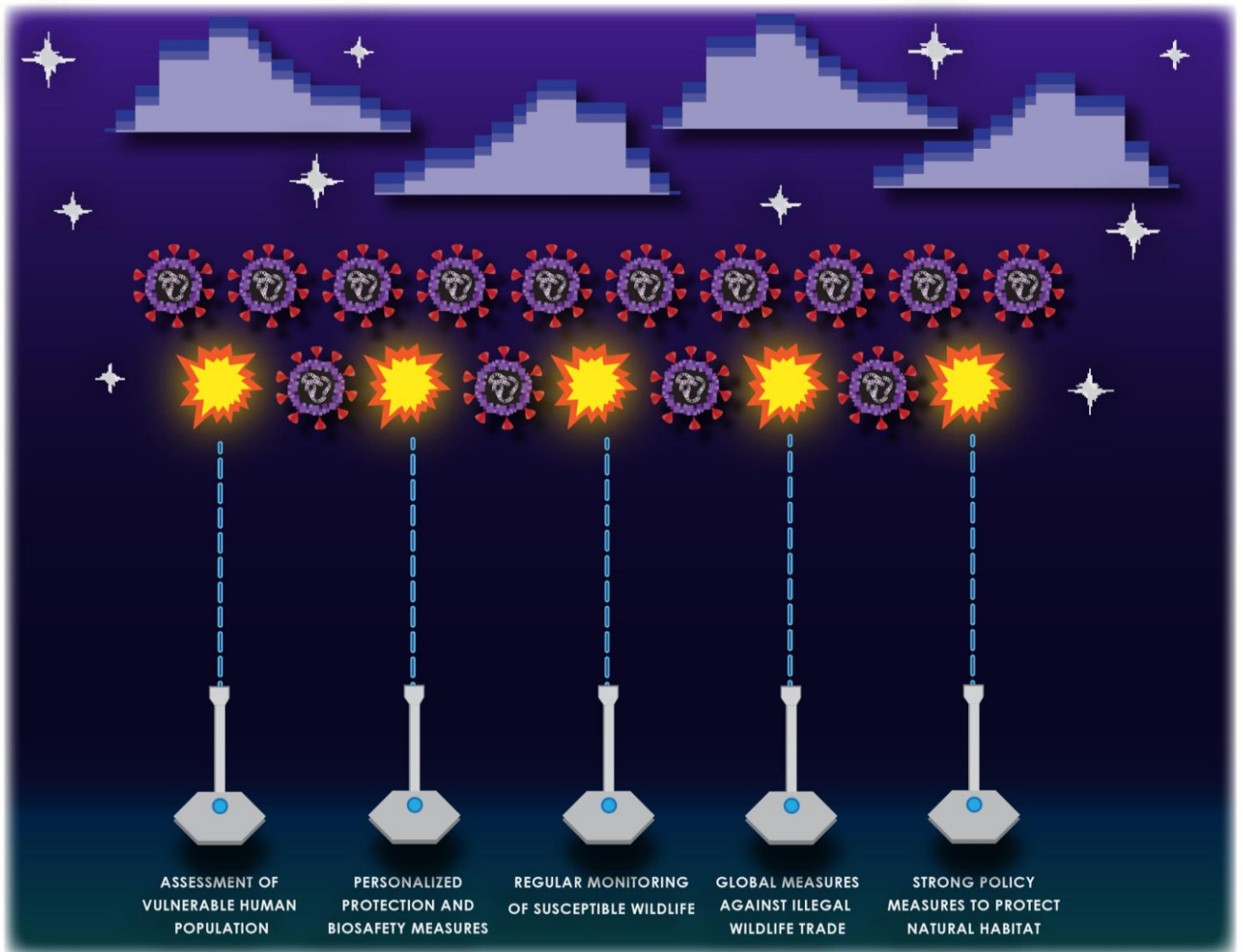


Illustration: Pranjal Gupta

Image sources:

Several components of illustrations on the given pages have been adapted from images taken from the following sources:

Page 1

1. Nature picture library; Swinny's Horeshoe bat (*Rhinolophus swinnyi*) in flight; photograph by Piotr Naskrecki. <https://www.naturepl.com/stock-photo-nature-image01589106.html>
2. <https://www.radionigeria.gov.ng/2019/09/23/fg-to-rare-sterile-tsetse-fly-to-fight-trypanosomiasis/> (Tsetse fly)
3. <https://www.stickpng.com/es/img/animales/pangolines/pangolin-adulto> (Pangolin)
4. <https://www.shutterstock.com/image-photo/black-labrador-retriever-isolated-on-white-149909621>; stock photo ID: 149909621 (image of dog)
5. https://www.123rf.com/photo_45570350_wood-mse-looking-up-in-front-of-a-white-background.html; Copyright: Isselee Eric Philippe; (Image of Wood mouse)
6. http://clipart-library.com/clip-art/358-3580819_human-body-png-download-human-body.htm (Image of man)
7. <https://pixnio.com/science/microscopy-images/ebola-hemorrhagic-fever-virus/ebola-hemorrhagic-fever-ebola-hf-is-a-severe-often-fatal-disease-in-humans-and-nonhuman-primates-2> (Image of Ebola virus)
8. <https://www.scientificanimations.com/wiki-images/> (Image of Rabies virus)
9. Wolburg, Hartwig, et al. "Late stage infection in sleeping sickness." PLoS One 7.3 (2012): e34304. (Image of Trypanosoma)

Page 7 (Clockwise from top)

1. <https://www.britishecologicalsociety.org/applied-ecology-in-times-of-covid-19/> (By Dr. Prof. Martin Nunez, British Ecological Society).
2. <https://www.theguardian.com/commentisfree/2019/jul/28/the-guardian-view-on-amazon-deforestation-europe-must-act-to-prevent-disaster> (Photograph by Felipe Werneck)
3. <https://elearning.unn.edu.ng/school.php?id=2>
4. <https://www.pennlive.com/life/2020/02/does-owning-a-dog-make-you-hot.html> (Photograph by Michael L. Baird)
5. https://commons.wikimedia.org/wiki/File:Hunt_on_hunting_farm.jpg (uploaded by Hp.Baumeler)
6. <https://www.flickr.com/photos/137886262@N06/33888596210>



/indscicovid



Indian
Scientists'
Response to
COVID-19