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Bat Hunts and Disease Outbreaks

Traditional Bat Hunting in Nagaland

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Natural hosts of some of the most deadly emerging viruses such as Ebola, bats are harvested in an annual ritual by a Naga Tribe in Nagaland. This practice, endangering both public health and biodiversity, can lead to the emergence of novel infectious diseases. A concerted and multipronged effort will have to made by governments, especially in developing countries, where the contact between wildlife and humans is more intense, to prevent, contain and respond to the emerging zoonotic diseases.

Of late, the world has witnessed an increase in the number of emerging infectious diseases (Jones et al 2008). The ongoing Ebola virus outbreak, which began in early 2014 in West Africa (Liberia, Sierra Leone, Guinea and Mali), and the swine flu (H1N1) outbreak in India in 2009 and then again in early 2015 are some well-known examples. Such EID events are dominated by zoonosis (infections that occur in both humans and animals), and a majority of these originate in wildlife (Jones et al 2008). For example, the origin of the ongoing Ebola virus outbreak may be linked to bats (Saéz et al 2015). History is replete with such examples.

During the late 1990s, the Hendra virus emerged in Australia among horses and humans, and it is thought to have originated from fruit bats (Plowright et al 2011). Moving across the Indian Ocean, a close relative of the Hendra virus, the Nipah virus emerged in Malaysia (1998), Bangladesh (2001) and India (2002). This virus killed dozens of date palm sap farmers. As sensationalised in recent books and movies, a number of such infectious diseases have originated from wild animals, many of whom live in close proximity to humans. In fact, around two-thirds of these emerging human infectious disease events are zoonotic, of which around 70% originate in wildlife (Jones et al 2008).

Why are infectious zoonotic diseases popping out from their niche more frequently than ever before? This is a pressing question that needs to be addressed, both for the sake of animal conservation in our biodiversity rich country and humans, since a large population lives in close contact with nature.

Bats and Viruses

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It is interesting that a majority of the diseases originate in wild animals. Such EIDs may be transmitted directly from wildlife to people, or indirectly through intermediate domestic animals and fomites (for example, hospital equipment like catheters, stethoscopes etc). One such important mammalian host of these diseases is the bat. Bats are remarkable mammals found in every continent except Antarctica. They occur in varied habitats from deserts to mountains, oceanic islands to tropical forests, large cities to small villages. They are amongst the most abundant mammals apart from humans and rodents and rank as one of the most species-diverse groups on this planet.

Interestingly, bats are the only mammals with the unique ability for powered flight. This ability potentially makes them one of the most potent viral disease disseminators over a large geographical area. Their extreme longevity (25 years or more) also makes them susceptible to persistent viral infections that potentially increases inter and intra species disease transmission (Calisher et al 2006). The high mutation rates of viruses makes it difficult to design efficient treatments, vaccines, and drugs. Detecting a virus is also a challenge due to its microscopic size, fragile nature, and its sneaky behaviour (for example, Rabies virus cannot be detected in its initial stage). These characteristics enable the virus to easily jump to new species and infect other animals, including humans.

Bats are increasingly recognised as rich reservoir hosts of important viruses such as Nipah and Hendra viruses, Severe Acute Respiratory Syndrome coronavirus (SARS-CoV), the Ebola and Marburg viruses, lyssaviruses (causing rabies), and many other viruses. Cases of Rabies, Ebola, Nipah, SARS-CoV and Hendra virus infections being transmitted from bats to humans have been reported from Southeast Asia, Africa and Europe in recent times; this could be due to increasing contact between humans and bats. More popular discourses such as David Quammen in *Spillover: Animal Infections and the Next Human Pandemic* and Nathan Wolfe in *Viral Storm: The Dawn of a New Pandemic Age* have described how diseases are transmitted from wildlife to humans.

The global trends in infectious diseases suggest that there is a very strong correlation between biodiversity hotspots and higher incidences of zoonotic infectious disease. India with its high population density, rich wildlife diversity (with two biodiversity hotspots) and fast shrinking forest cover provides a favourable environment for disease transmission from wildlife to humans. There have been several studies on bats and EIDs in our neighbouring countries, but there is very poor systematic information in India. For example, recent studies in Bangladesh on bats have identified antibodies for Ebola, while lyssavirus have been detected in the Phillipines. Studies on different species of bats in China and Thailand have given important insights into zoonotic diversity of viruses in this region. All this appears to indicate that bats are deadly disease carriers.

While bats are reservoirs for many viruses, they are also of tremendous economic importance to humans. Fruit bats are known to be prolific pollinators for many economically important plants such as banana, mango, date, fig, peach, cashew, durian etc. Bats are also

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known as efficient pest controlers in agricultural fields. A study in the Winter Garden of South-central Texas, United States, states that the economic value of the pest control service provided by a single species of bats to cotton production ranges from 2-29% of the $6 million value of the cotton crop in region (Boyles et al 2011). Apart from these direct effects, they also provide various critical ecosystem functions, providing services with seed dispersal thereby aiding reforestation activities.

There are various factors why infectious agents from wildlife jump over to humans causing illness and death. One of the significant causes are factors that bring wildlife and humans in close contact with each other. One such important human-wildlife interface is bush meat hunting; this combined with various other factors such as a rapidly growing human population, unsustainable natural resource consumption, biodiversity loss and habitat fragmentation have increasingly pushed wildlife and humans in close contact with each other, resulting in increased incidence of disease spillover and outbreaks during recent years.

Such factors have increasingly exposed us and our domesticated animals to viruses that earlier lacked such numerous opportunities for viral spillover. As we rapidly alter natural landscapes, converting them into farmland or other development projects, we alter habitats, changing the interaction between wildlife and humans. Bushmeat hunting provides one of the most intimate contacts between humans and wildlife, providing ample opportunities for the virus to jump over to humans. Very high bushmeat hunting has been documented in West Africa (David S 1998), which might have been the reason for high occurrence of zoonotic diseases there (Wolfe et al 2005). Though there have been very few such studies in India, one study shows high quantity of bushmeat consumption in Northeast India (Hilaluddin 2005).

Bushmeat hunters are exposed to lethal viruses, as they cut open the animal and are directly exposed to body fluids such as blood, saliva, urine and faeces. One of best known examples for disease spillover from wildlife to humans is acquired immunodeficiency syndrome (AIDS), which is thought to have jumped to humans from non-human primates through bushmeat in Africa. The SARS outbreak of 2002 is known to have originated from a wet market in China, where live wild animals are regularly slaughtered and kept in close contact with each other and humans. Other infections which are thought to have originated from wildlife include Ebola virus, Nipah virus, West Nile virus, SARS-CoV; a large number of these viruses have also been detected in bats.

Bat Harvesting Festival in Nagaland: Endangering Health and Biodiversity?

The Longpfurii Yimchungii, a Naga sub-tribe, living in Mimi village in Nagaland, participate in a unique, annual bat harvesting festival in mid-October. The village is situated along the Indo-Myanmar border and comprises around 200 households, mainly occupied by 3 clans namely Bomrr, Whourr and Mer.

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Bomrr clan leaders from different villages celebrating a festival of get together just before annual the bat harvest. The Bomrr clan is spread across 9 villages, including some living in Myanmar. As far as their oral memory goes, this clan has been traditionally harvesting cave dwelling bats annually for 7 generations which is approximately about 150 to 200 years old.

Bomrrs were the first clan in Mimi village to claim ownership of these caves, and thus, even till date, only this clan claims to hold the right to conduct this annual bat harvest festival. This tradition holds immense significance for the Bomrrs, as they traditionally believe in the medicinal value of bats. They believe that bat consumption can cure ailments such as diarrhoea, body pain, as well as increase virility.

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Thousands of killed bats lying on the floor on the first day of harvest at the bigger cave called known as lapkhun by the Bomrr. They burnt firewood to suffocate the bats. Bats which tried to escape were smashed to death in the entrance with sticks.

During this festival, the intensity of contact between bats and human is tremendous. Within two days, they harvest between 7,000 to 25,000 bats. Bat species commonly harvested here are *Rousettus leschnaultii* (Leschenault's Rousette), *Hipposideros armiger* (Great Himalayan Leaf-nosed Bat), and *Eonycteris spelaea* (Cave Nectar Bat). Of these species, *Leschenault's Rousette* and *Eonycteris spelaea* (the Cave Nectar Bat) have previously been identified from studies in China to harbour Hendra virus and Nipah virus. A recent study in Bangladesh has also reported Ebola virus antibodies in *Rousettus leschnaultii* individuals.

In Mimi, no previous studies have looked at diseases in bats or humans. However, village elders recollect that in the late 1970's, there was a major outbreak of a mysterious disease in the village that claimed more than 80 lives (~10% of the population) within a short span of time. This caused the villagers to migrate to new areas, resulting in the spread-out of the village population. This could be the tip of an ice berg. Even today there are unofficial reports of sporadic disease outbreaks.

Many of the bat hunters got bitten by bats posing a high risk of disease transmission in case the bat which they bit them harbour deadly virus.

Due to the remoteness of the region and lack of proper health care facilities, disease outbreaks are underreported in this region. This festival in Nagaland is just one illustration of the many traditional practices that bring a large number of humans and wildlife in close contact with each other.

So should we crack down heavily on the Bomrr? But coming down on the Bomrr alone will

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not solve the larger problem of hunting and infectious diseases. That can only be solved with awareness and education programmes, more access to other protein sources, and better access to health care.

Cave to plate within few hour of harvest. Each clan members get equal share of bats. They do not consume the entire catch in one or two meals but were roasted and preserved (for medicinal purpose) till the next harvesting season.

Are we Prepared for any Future Pandemic?

The swine flu (H1N1) outbreak in India early 2015 and the Japanese Encephalitis outbreak in Northeast India in 2014 shows how un-prepared we are in responding to infectious diseases. Professor Peter Piot, who first reported Ebola virus, has said in an interview "An outbreak in Europe or North America would quickly be brought under control. I am more worried about many people from India who work in trade or industry in West Africa". Several studies have been conducted in our neighbouring countries such as China, Thailand, Bangladesh, and the Philippines, which have confirmed the presence of various infectious viral pathogens from bats, but there is a dearth of credible reports from India.

This is not due to the lack of infectious pathogens in Indian bats, but probably is a reflection

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of sparse data and the absence of systematic surveillance studies. Such studies should ideally involve multi-disciplinary approaches involving elements of veterinary science, wildlife ecology, conservation medicine, human medicine and public health, as embodied in the One Health Initiative.

India is vulnerable to the threat of EIDs, considering the high human-wildlife interface (providing opportunities for zoonotic diseases), few wildlife disease surveillance mechanisms, and almost non-existent human disease surveillance in remote populations where such outbreaks can occur. Added to this, is the present healthcare services scenario in India with very few special care units, a handful of trained healthcare workers for any speciality discipline, and a high population density that can potentially facilitate an outbreak. Given these circumstances, dealing with highly infectious diseases like Ebola viral disease that has no specific drug for cure/ treatment/prevention till now will be extremely challenging.

Public Health policy Situation in India with Respect to EIDs

In order to deal with the increasing occurrence of emerging diseases and the complexity of human-wildlife interaction in disease transmission, international organisations such as the World Health Organisation (WHO), Centre for Disease Control (CDC), National Institute of Health (NIH), the United States Department of Agriculture (USDA), and the US National Environmental Health Association (NEHA) have all come together to form the One Health Initiative. This is a global project for "expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals and the environment". This initiative aims to use an interdisciplinary approach to understand emerging infectious diseases from wild animal reservoirs by combining the principles of human and veterinary medicine, ecology, microbiology, epidemiology, and molecular biology.

Although India is a signatory to the One Health Initiative, effective implementation has not taken place so far. The National Health Policy in India does not meet the rising challenge of EIDs, given its preoccupation with many other health needs. EIDs do not figure in the current National Health Policy (2002)—there is no mention of these either on the website or in the policy document.

To be better prepared, we should have national and regional epidemiological surveillance laboratories in biodiversity hotspots. As an emerging world power, India should also strive to be a leader in public health and wildlife health to deal with the threat of emerging infectious diseases.

Conclusion

With human population coming increasingly in contact with wildlife, the incidence of infectious diseases is likely to increase in the near future. The recent outbreaks of Ebola, Nipah, Severe Acute Respiratory Syndrome (SARS) and the highly pathogenic avian

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influenza (HPAI) virus have had a significant impact on human health and economy.

Northeast India is a part of the Eastern-Himalayan and the Indo-Myanmar Hotspot. The rich biodiversity in the region combined with high levels of hunting and deforestation increases the contact between domestic animals, wildlife and humans. This potent mix of high biodiversity and the intense human interaction with wildlife can lead to the emergence of novel infectious diseases.

Given all this, the government should invest more in healthcare infrastructure in disease outbreak-prone areas and make healthcare accessible to people residing in these remote regions. Drastic measures are also imperative on part of both healthcare services and conservation programs to make a collective effort to mitigate the threat to humans and wildlife.

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