



Bat World Sanctuary

Bats and COVID-19

Presenter's Guide

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Bats and COVID-19

Introduction

This presenter's guide and the companion PowerPoint presentation are appropriate for use by teachers and civic groups, as well as bat rehabilitators, who wish to give educational presentations about bats to a mixed audience. The content is appropriate for children in grade 3 and up.

Bats and COVID-19

There has been a lot of hysteria globally about bats and their role in the COVID-19 pandemic of 2020-2021. People have panicked, afraid to be anywhere near bats for fear they will be infected with SARS-CoV2, the causative virus for COVID-19. In Peru, citizens destroyed several bat colonies, despite the fact that there is no evidence that South American bat species are a reservoir for the virus. In North America, research involving bats, and bat rehabilitation, were suspended out of fear that bats might either be infected and contract COVID-19 or become new reservoirs for SARS-CoV2. Thus far, there is no evidence substantiating this risk. There is nothing to suggest or support the idea that the virus can be transmitted directly from bats to humans or from humans to bats.

The prevailing theory, as of late December 2020, is that the virus originated with a species of horseshoe bat that is commonly found in China. However, genetic studies suggest that the virus mutated between 40 and 70 years ago and adapted itself to a new reservoir host. The presumed "ground zero" point of transmission to the first human patient was a live market (aka "wet market") in Wuhan, China. These markets are, in some respects, similar to the farmers' markets of the U.S, but with the addition of live domestic, exotic, and wild animals which are housed in close proximity to one another. Despite their best efforts, researchers have as yet been unable to identify what species may have become the new reservoir host, with or without developing illness, after exposure to urine, feces, or other bodily fluids or tissues from the original host species. Over time, the virus mutated again within the new intermediate reservoir, ultimately becoming able to infect humans. With no natural immunity to the virus, a global pandemic was born.

Separating Fact From Fiction

- Fact: Bats harbor a number of viruses
 - All living things have a "microbiome" – viruses and bacteria that play an important role in how our bodies function
- Fiction: Bats transmit viruses directly to humans
 - Bats are often represented as directly infecting humans with lethal viruses, but in reality this is rarely the case
- Fact: One or more other, unrelated species are involved in virus transmission

- Virtually every incidence of new viruses affecting humans involves the original reservoir host and at least one intermediate host
- Fiction: North American bats carry SARS-CoV2
 - North American bats are reservoirs for a number of coronaviruses
- Fact: Human contact with wildlife increases our risk of exposure to new viruses
 - SARS, MERS, Nipah virus, Hendra virus, Ebola, and HIV, and other viruses, have entered the human population through our interaction with wildlife – poaching, trapping for the exotic pet trade, and hunting for bush meat
- Fiction: Wild animals are to blame for human viral infections
 - We blame what we do not understand or respect
- Fact: Wild animals do not seek out contact with humans
 - Under normal circumstances, wild animals avoid human contact. If they are threatened or starving, they may approach humans as a perceived threat or food source

Where Did SARS-CoV2 Come From?

As of December, 2020, the prevailing opinion among public health researchers is that the SARS-CoV2 virus, which causes COVID-19, most likely originated in the Asian, or rufous, horseshoe bat. These bats are relatively common in China, Viet Nam, Nepal, and India, and are classified as a species of least concern by the International Union for Conservation of Nature (IUCN). This species is also considered to be the likely reservoir for the SARS (*Severe Acute Respiratory Syndrome*)-related coronavirus. These bats, and other bat species, are often found at “live” markets (aka “wet market”) throughout much of Asia, along with a wide variety of other live wild and domestic animals. The animals in these markets are housed in close proximity to one another, but are not typically segregated by species. Often, they are housed in wire cages and stacked on top of one another, allowing urine, feces, and other bodily fluids to drop from higher cages down into lower cages.

Based on genetic studies, it is believed that the horseshoe bat variant of SARS-CoV2 mutated between 40 and 70 years ago, enabling it to jump to another species. This is not uncommon in viral transmission, and most of the zoonotic viruses that affect humans move in this way.

There is a possibility (as yet unconfirmed) that the intermediate reservoir for SARS-CoV2 is the pangolin, also sometimes called the ‘scaly anteater’. There are eight species of pangolins, with four being found in Asia and the other four in sub-Saharan Africa. These animals are heavily poached and trafficked for their meat and their scales, which are used in Chinese traditional medicine. Consequently, all eight species are listed as vulnerable, endangered, or critically endangered by the IUCN. Genetic studies indicate a 92% match between the SARS-like coronaviruses found in pangolins and SARS-CoV2.

How Does SARS-CoV2 Infect Humans?

SARS-CoV2, which causes the human illness COVID-19, utilizes a unique “spike protein” which attaches to a specific ACE-2 receptor in human cells. Once the virus has invaded human cells, it begins to replicate and spread to other cells within the body. Our bodies interpret the presence of SARS-CoV2 as a foreign element, and our immune system mounts a defense. SARS-CoV2 is properly considered a zoonotic viral disease, having originated in one or more animal species. When zoonotic viruses infect humans, this is

termed a “spillover” event. As we continue to interact and interfere with nature and wild animals, the incidence of these kinds of spillover events will continue.

Understanding “Spillover Events”

A ‘spillover event’ occurs when a viral disease is transmitted from one species to another, different species and begins to spread. Approximately two thirds of current human viral infections are zoonotic, having originated in animals. The most common zoonotic infection in humans is influenza.

Direct transmission of a virus from the primary reservoir host to humans is rare. In most direct transmission cases, the resulting infection is self-limited, with no human-to-human spread. Examples of direct transmission spillover infections include rabies, anthrax, and histoplasmosis. Some zoonotic infections must mutate within the human body in order to create a new reservoir, enabling infected individuals to transmit the virus to others. HIV is a zoonotic disease which has mutated in humans, making it transmissible to others.

Other Spillover Events

Nipah Virus

Nipah virus disease was first identified in 1988 during an outbreak in Malaysia, and the causative pathogen was isolated and identified in 1999. The natural reservoir for this virus is fruit bats, and infection commonly results from consuming raw date palm sap (a delicacy in Malaysia), which is contaminated with bat urine and feces. Domestic pigs are a secondary reservoir. There is no vaccine or specific treatment for Nipah virus, and the mortality rate among infected patients is between 50 and 75%. The best prevention is to avoid exposure to bats, sick pigs, and sick people; pasteurization of the raw date palm sap is also recommended.

Zika Virus

Zika virus was first identified in 1947, and one or more species of monkeys is considered to be the natural reservoir. The disease is primarily transmitted to humans by mosquitoes, with sexual intercourse and possibly blood transfusions being considered likely secondary routes of infection. Pregnant women who contract Zika virus can spread the infection to the baby. Infants born with Zika often have a condition called microcephaly, or a smaller than normal head. There is no vaccine for Zika, and no treatment for infants with Zika-related microcephaly. Prevention, in the form of mosquito repellents and elimination of standing or stagnant water, remains the best option.

Hendra Virus

Hendra virus was first isolated during an outbreak in Australia in 1994, with a second outbreak occurring in the Phillippines. Fruit bats are the primary wildlife reservoir, and horses are the most common intermediate reservoir. Domestic animals such as horses and pigs most likely become infected by consuming fruit or grass that is contaminated with infected bat urine and feces. As with most zoonotic spillover events, neither horses nor pigs are native to Australia. Following the two outbreaks and after the virus had been isolated in a laboratory, approximately 128 bat rehabilitators in Australia were tested for evidence of current or prior infection, which validates the theory that an intermediate reservoir is required for transmission. To date, there have been seven (7) human cases of Hendra virus, and a

vaccine for horses has been developed which is highly effective. The two most recent outbreaks of Hendra virus in 2011 and 2013 appear to be related to an increased level of nutritional stress among the bats as well as relocation of bat populations.

Ebola

Ebola virus was first identified in 1976 during two outbreaks, one in South Sudan and the other in Democratic Republic of the Congo. There are five known variants of Ebola, four of which affect humans. Several wildlife species, including bats and primates, are considered primary reservoirs for Ebola. The virus is spread through direct contact with body fluids and tissues of reservoir animals and infected humans. A virulent hemorrhagic viral disease, Ebola has a human mortality rate of between 25 and 90%. Wearing proper protective equipment and limiting exposure to infected patients, not reusing hypodermic needles and other PPE, safe burial or cremation of deceased Ebola patients, and careful handling and thorough cooking of bush meat are the best methods of prevention.

Other Spillover Events

- Yellow Fever
 - Originated in Africa
 - Spillover from nonhuman primates to humans via mosquitoes
 - First documented outbreaks in the Caribbean in the mid-1600s
- West Nile Virus
 - Originated in Africa
 - Spillover from birds to humans and other species via mosquito
 - Related to Zika, Yellow Fever, and Dengue
- Malaria
 - Originated in Africa
 - Caused by the *Plasmodium* parasite
 - Transmitted from reservoir species to humans by mosquitoes
- Lyme Disease
 - Caused by *Borrelia* bacterium
 - *Borrelia* was present in North American forests 60,000 years ago
 - Transmission cycle is ground squirrels > ticks > deer
 - Human infection results from tick bites

All of these spillover events have elements in common. There are billions of different virus and bacteria strains occurring in wildlife and humans. Wild animals are primary reservoirs for most viruses and many disease-causing bacteria and parasites. Human contact with wildlife increases the risk of spillover events, as we continue to venture into more remote areas of the Earth.

Bats, COVID-19, and Bat Rehabilitation

Several research projects have been initiated in the U.S. to determine whether North American bats may be susceptible to SARS-CoV2 or COVID-19, either to develop disease or become new reservoirs for the virus. While North American bats, like all mammal species, are host to a variety of coronaviruses, there is no evidence thus far (as of December 2020) that North American bats are susceptible.

There are several hundred variants of coronaviruses which occur throughout the animal kingdom; these have been classified in four different subgroups: alpha, beta, gamma, and delta.

At the beginning of the 2020 outbreak in the U.S. and Canada, many states and provinces prohibited bat rehabilitators from accepting any new cases or releasing any bats that were in care at that time.

Alternative handling of cases was proposed as:

1. If a citizen found an orphaned bat pup, they should place it in a tree so the mother bat could come and retrieve it
2. Citizens could take bats found on the ground to their local Animal Control
3. Bats found on the ground should be left alone
4. Citizens could contact their state wildlife agency for guidance

Unfortunately, there are a number of issues with these proposed solutions.

First, mother bats, like most other wild animals, will look for lost offspring in the last place they had them. If the pup is separated from its mother on the ground, she will not look for it in a tree. The pup will be abandoned and starve to death without intervention by a trained rehabilitator.

Second, local Animal Control agencies were significantly impacted by the COVID-19 pandemic, with reduced staff due to furloughs and illness, limited operating hours, and increased surrender of domestic pets as people feared contracting the virus from their cats and dogs. Since, in addition to these new burdens, most Animal Control officers are not trained or licensed to handle wildlife, they would defer intake cases to knowledgeable wildlife rehabilitators.

Third, the public were unwilling to leave orphaned, ill, or injured animals alone to “let nature take its course”. As a result, untrained, unlicensed, and unvaccinated individuals were attempting to care for a very fragile rabies vector species – which increased the potential for rabies exposures. Additionally, because bats require specialized care, these cases virtually always resulted in the death of the bats.

Finally, despite guidance from state wildlife agencies for rehabilitators to cease taking in bats for care, in many cases those same agencies referred the public to rehabilitators when contacted about bats found on the ground. This resulted in a great deal of frustration, as well as increased risk of rabies exposure, when rehabilitators turned new bat intakes away and citizens took measures into their own hands.

Some domestic and wildlife species, such as cats (both domestic and wild), black-footed ferrets, and mink, have contracted COVID-19 from humans (reverse zoonosis or zoonanthroposis), but have not been found to transmit the virus to humans. In these cases, all of the affected animals were in captivity and were exposed to the virus by asymptomatic individuals.

Of the hundreds of coronavirus variants, seven are known to affect humans, with four causing mild illness, and the other three, SARS, MERS, and SARS-CoV2 causing more severe illness. There are no documented cases of bats being infected with SARS-CoV2 or developing COVID-19.

As of late fall 2020, some states have lifted these restrictions, with the proviso that rehabilitators follow strict quarantine protocols for new intakes and use PPE (especially gloves and masks) when handling bats. Field research involving bats was also suspended in early 2020, and in some states has been resumed with proper PPE and guidance for minimizing handling to achieve research objectives.

Are Bats Really to Blame for COVID-19?

Although bats are natural reservoirs for a number of viral pathogens, including SARS-CoV2, they are not responsible for the spillover of SARS-CoV2 to humans. SARS-CoV2 is an airborne viral pathogen, and is most likely shed in urine or feces by bats and any intermediate hosts. Direct exposure to infected body fluids and tissues, either through inhalation or contact with blood or mucous membranes, is the likely route of transmission, although this has not yet been confirmed by medical research.

Viruses 101

- **Virus Definition** A **virus** is a chain of nucleic acids (DNA or RNA) which lives in a host cell, uses parts of the cellular machinery to reproduce, and releases the replicated nucleic acid chains to infect more cells. A **virus** is often housed in a protein coat or protein envelope, a protective covering which allows the **virus** to survive between hosts.

- <https://biologydictionary.net/virus/>

Technically, a virus is not considered to be alive, since its function is to enter a host cell and replicate. Most often, viruses are responsible for transmission of other microbes between host and receiver, or between cells. They are an important part of our microbiome (the collection of bacteria and viruses that naturally occur in our bodies), and without them, our bodies would not function properly.

Understanding the Human Microbiome

Our bodies are made up of cells, which are composed of proteins, lipids, water, minerals, and a host of bacteria and viruses. These elements combine to form bones, organs, skin, and blood. We are only beginning to understand the essential role that the billions of viruses and bacteria we harbor play in our health.

Most of the viruses and bacteria in our bodies do not cause disease, but do affect how our bodies work. Without them, we cannot digest food, heal from wounds, or fight off disease. Every organism on the planet has its own unique microbiome – in fact, each human has a unique microbiome, different from everyone else, and research suggests we take our microbiome with us when we move to a new home or even stay in a hotel.

Viruses and bacteria can cause disease when introduced to a new host, as the host immune system (also dependent upon viruses and bacteria) detects a foreign presence and mounts a response. The most common symptoms include fever, headache, nausea, and inflammation. We experience similar symptoms when we receive a vaccination against a viral disease (i.e. influenza, measles, and tetanus/diphtheria/pertussis), because our bodies identify the vaccine as a foreign presence and develop an immune response.

Lessons Learned

So what have we learned, or failed to learn, from the COVID-19 pandemic? Surely, we have learned a great deal about this specific virus and how it may affect humans. We have learned how to produce vaccines in a remarkably short time in response to this disease. We have learned (or re-learned) about basic sanitation and health.

Unfortunately, we have failed to learn a fundamental lesson about how we interact with the world around us. According to the ancient Greek poet Hesiod (*Works and Days ca. 700 BC*), when Prometheus stole fire from heaven, Zeus, the king of the gods, took vengeance by presenting Pandora to Prometheus' brother Epimetheus. Pandora opened a jar left in her care which contained sickness, death and many other unspecified evils which were then released into the world. Though she rushed to close the container, only one thing was left behind – usually translated as Hope. Through our desire to explore new places and learn new things, or perhaps through our arrogance in claiming the unspoiled places of earth as our own, time and again, we open Pandora's Box, expecting to find cookies.

How Do We Prevent the Next Pandemic?

Unless and until we develop a more profound respect for nature, and come to understand how interdependent all species, including humans, are on one another, there will be a “next pandemic”. Science tells us that much of the natural world remains hidden behind a veil of secrecy, and we must begin to ask ourselves seriously, not whether we can explore, own, or exploit another species or place, but whether we should interfere and put our own stamp upon them. We must learn to leave wild animals and wild places as we find them, untouched by our presence. Only when we find a way to accept the natural world as natural, and not ours to consume, will we be able to prevent the next pandemic.

*This is an opportunity to explore additional myths/misconceptions or answer questions from the audience. We recommend reading other resource materials, including www.batworld.org, *The Essential Bat* (Rugroden and Lollar, Bat World Sanctuary) and *Spillover* (Quammen) prior to presenting this program. If there are questions you are unable to answer, write them down along with your guest's email address, and contact Bat World. You can contact your guest and provide an answer.*