Chapter 8

Deadly Date Palm Juice

Every culture has its own customs, recreational activities, crafts, and cuisine. In this viral encounter, a local delicacy becomes contaminated with a new and deadly virus that emerged from Malaysia. Finding the reservoir that harbors this pathogen was an epidemiological challenge.

Fred Fischer earned his medical degree in internal medicine, specializing in the diagnosis and treatment of infectious diseases, about 15 years ago. It was always his dream to work for Doctors Without Borders/**Médecins Sans Frontières** (MSF). MSF is a humanitarian organization that brings quality medical care to people whose survival is threatened by violence, neglect, or a catastrophe primarily due to armed conflict, epidemics, malnutrition, exclusion from health care, or natural disasters. The organization sets up refugee camps and field hospitals in 60 countries depending upon the situation and needs.

Dr. Fischer learned about the MSF through one of his colleagues at the Centers for Disease Control and Prevention (CDC). He had been a member of the MSF for over a year and was waiting for a call to action. One day in early January, he was sitting in his office researching about a patient suffering from a mysterious case of **encephalitis** when he got a call from the MSF.

"Can you be in Bangladesh next week?" said Dr. Hossain from MSF headquarters. "Are your vaccinations up-to-date?"

"I sure can!" replied Dr. Fischer enthusiastically. "My vaccinations to travel there are current. I've even had a yellow fever vaccine and Japanese encephalitis vaccine recently."

"Perfect. Remember, although this is one of the coolest months of the year, you'll still need sunscreen."

"I will bring doxycycline (anti-malarial) medication and insect repellent with me too," replied Dr. Fischer.

"The lodging facilities will have insecticide-treated bed nets," said Dr. Hossain. "I'd also suggest you bring some anti-diarrheal over-the-counter medicine."

"What is the situation there?" continued Dr. Fischer.

"People are dying after experiencing high fevers, seizures, and headaches," said Dr. Hossain. "We could really use your infectious disease expertise."

"It sounds like an encephalitis-like illness," pondered Dr. Fischer.

"Yes, you are correct, said Dr. Hossain. "There is an epidemiological investigation under way to determine the risk factors associated with this illness."

A week later, Dr. Fischer was standing in Zia International Airport with a team of doctors and scientists waiting for transportation to Dhaka Hospital where they would be briefed on the situation. Three hours later, they were listening to a presentation given by Dr. Hossain.

"Right now 11 out of 12 people presenting with symptoms have died from encephalitis in the Tangail district. To give you a brief overview on the living situation in that region, the average literacy rate is 30%. About half of the people are involved in agricultural activities, and most of the cases of encephalitis we've seen are farmers. The main agricultural products consist of rice, potato, jute, sugarcane, sesame, linseed, wheat, mustard seed, and pulse, as well as fruit products such as mangos, jackfruit, bananas, litchis, pineapples and dates. We are quite concerned because there is now an outbreak in a neighboring region with about 40 cases. We think some of these cases may be occurring by human to human transmission."

"Have you screened blood samples yet for any of the known infectious agents that cause encephalitis?" interjected Dr. Fischer.

"Yes, we have," continued Dr. Hossain. "It is possible that the farmers are suffering from a viral infection. As you know, there are a number of viruses, including herpesviruses, flaviviruses, and polioviruses that can cause encephalitis. What we're dealing with here appears similar to the Nipah virus, which you may recall caused fatal encephalitis among pig farmers near the town of Ipoh, Malaysia in October 1998. The

following February, farmers were dying of a similar encephalitic illness south of the first outbreak in Bukeit Pelandok. At first, we thought the pig farmers and their families in this area had Japanese encephalitis. It was not until March of 1999 that we identified several patients from both areas had been infected with the Nipah virus. "During the 1998–1999 Malaysian outbreaks, we used serology to discover that the Nipah virus produces clinical disease in people, pigs, dogs, and cats, and it can infect horses, sheep, chickens, and bats."

"So, why are we here if we know what is making these people sick?" an American scientist interjected.

"The difference between the Malaysian Nipah virus outbreak and this one is that the sick and dying farmers are not pig farmers," continued Dr. Hossain. "We are beginning to suspect that the common denominator in all of these new cases is that the fresh date palm juice and dates they are consuming are contaminated. This is prime date palm sap collection season, after all. So we have devised a strategy to address the situation from a variety of angles. Our group will be divided into three teams. One team will provide medical care for patients already in our care. Another team will be working throughout the villages, searching for more cases. If more cases are found, the patients must receive supportive care and be put in isolation. The last team will be involved in testing patient serum for antibodies against the Nipah virus and in the field investigating the date palm sap collection process. This team will also be responsible for identifying other potential reservoirs of the Nipah virus causing these outbreaks and alerting local inhabitants to avoid consuming date products until the outbreak has been controlled."

Dr. Fischer was assigned to the third team, whose task it was to identify potential Nipah virus reservoirs. He was ecstatic to finally get out in the field. The next day he teamed with an Indian scientist, Dr. Nahar, and a local translator to investigate the date palm sap collection process. Very little information is available about the harvesting of sap from palm trees. They began in-depth interviews with the date palm sap collectors, also called *gachhis,* all working in one area that had 12 date palm trees.

They observed a bare-footed *gachhi* climbing up a date palm tree. A rope was wrapped around his waist, fastening his legs to the tree to aid in climbing and to avoid accidents. He was carrying a basket tied to the rope, containing

a knife, a sickle, and hollow bamboo sticks. A pitcher was also hung on the rope. The *gachhi* cleaned the tree's surface with the sickle, then used his knife to create a V-shaped cut into the tree. He inserted a thin hollow bamboo stick into the V-shaped cut. An earthen pot was placed under the outer end of the bamboo stick, collecting the sap dripping from the tree. Then the *gachhi* secured netting over the shaved part of the tree and the collection jar (**Figure 4**).

Drs. Fischer and Nahar were fascinated by the agility of the ***gachhi.*** He made the collection process look effortless. After observing the date palm trees, it appeared that the sap was collected from the opposite side of the previous year's cut. The *gachhi* quickly climbed down the date palm tree. The translator approached him and explained the recent outbreaks of encephalitis that may be tied to the process of collecting the sap and asked if he would be willing help them determine the exact cause. The *gachhi* was willing to answer their questions.

"What's the cloth netting for?" asked Dr. Fischer.

Figure 4. Gachhi collecting date palm juice. (Drawn by Brian Ledwell.)

The translator questioned the *gachhi,* and he responded with intensity and strong gesturing. He was very animated about something.

"The *gachhi* says that the bees and hornets get into the sap, which reduces its value. The cloth or bamboo netting is used to keep the bugs out. He says that birds, dogs, foxes, and bats drink the sap occasionally and spoil it with urine and feces. The sap becomes cloudy and smelly, and they can't sell it for a good price. This time of year, sap collection is their livelihood. They make molasses from the sap, as well as using it as a sweetener in traditional cakes and desserts. And often the sap is eaten raw," continued the translator. "Anyway, as I was saying, the birds and animals can spoil the sap and can also break the collection pitchers. So he is trying hard to prevent the pests from spoiling the date palm juice so that it can be sold at a higher price. Besides netting, *gachhis* also use thorns and branches to keep the animals out of the sap, or they narrow the mouth of the pots. Some *gachhis* even add lime to the collection pots and the cuts in the trees to help keep the sap clear."

"It looks like there could be several pests that contaminate the sap with Nipah virus and other microbes when they feed on the sap," said Dr. Nahar. "I wonder if the *gachhis* also taste the sap themselves; that could be how they are getting sick," verified Dr. Nahar. "Perhaps this gentleman will allow us to take some sap samples? Then tomorrow we can team up with the ecologists to trap target animals for testing," continued Dr. Nahar.

For the next few days, with the help of a local translator, the ecologists, along with Drs. Fischer and Nahar trapped bats and other animals who frequented the sap pots. Since Nipah virus is classified as a biosafety level-4 (BSL-4) pathogen, the entire team wore protective clothing such as impermeable gloves, masks, goggles, and boots during their fieldwork. They collected blood, urine, and saliva samples from the animals and swabbed harvesting tools used for sap collection and various batches of sap. Samples were sent to a laboratory for testing.

Two weeks later, Dr. Fischer was back in his practice, chatting on the phone with Dr. Nahar. "All of the fruit bat blood samples were seropositive for Nipah virus. The virus was isolated by cell culture and confirmed with polymerase chain reaction (PCR) assays," said Dr. Nahar.

"We really need to create a vaccine against Nipah virus," said Dr. Fischer. "Right now all we can do is intensive supportive care to treat the symptoms."

"The mortality rate can be as high as 92%!" said Dr. Nahar.

"The outbreaks appear to be seasonal, coinciding with sap collection, as we had proposed," added Dr. Fischer.

"The *gachhis* in this Nipah-belt will continue to be exposed to the bats carrying the virus during the harvesting of the date palm sap," said Dr. Nahar. "We need to work with the *gachhis* in developing effective means of keeping the bats away from the date palm trees and themselves."

"It will be important for us to work with the locals to address this problem, especially until a vaccine can be developed," replied Dr. Fischer.

"Yes, and we'll have to learn and understand the local beliefs and practices of the *gachhis*," said Dr. Nahar. "Sap collection is their livelihood, so instead of trying to make them change their ways, we'll have to help them devise ways of collecting the sap more safely."

"I would love to travel to Bangladesh during the winter season to assist the locals with sap collection methods!" said Dr. Fischer. "If I work at my practice every day here in the United States, I'll go batty!"

Update

Since Nipah virus was first discovered in 1999 during an outbreak among pig farmers in Malaysia, there have been 14 more outbreaks, all in South Asia. Efforts are underway to decrease bat access to date palm sap. Freshly collected date palm juice should also be boiled, and the dates thoroughly washed and peeled before they are eaten.

Questions to Consider

1. Define encephalitis. List other viruses that cause encephalitis.
2. Nipah virus is closely related to Hendra virus. Research Hendra virus. What illness does it cause? What hosts does it infect? Where do Hendra virus infections occur?
3. Research on Nipah virus is performed in a BSL-4 laboratory. What is a BSL-4 laboratory?

4. Besides Nipah virus, what other viruses can fruit bats carry and transmit to humans?
5. What changes in recent ecological changes have occurred that have resulted in the fruit bats increasingly coming into contact with humans and domesticated animals?
6. Hendra and Nipah viruses are closely related paramyxoviruses. What are the molecular characteristics of paramyxoviruses?

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Internet Resources

Doctors Without Borders//Médecins Sans Frontières, http://doctorswithoutborders.org

About Doctors Without Borders on YouTube, http://www.youtube.com/watch?v=73zMcdGfXGE&feature=related

Hendra and Nipah Viruses, CDC Special Pathogens Branch, http://www.cdc.gov/ncidod/dvrd/spb/mnpages/dispages/nipah.htm

Traveler's Health CDC home page, http://wwwn.cdc.gov/travel/destinations/list.aspx

WHO Nipah fact sheet, http://www.who.int/mediacentre/factsheets/fs262/en/