

OVERVIEW

In this activity, you will be exploring cases of Nipah virus (NiV) infection as an epidemiologist would, by collecting evidence and making calculations and predictions, based on scientific data.

NiV infection is a newly emerging zoonosis, a disease that can be transmitted from animals to humans. NiV infection in humans causes highly variable symptoms, ranging from an asymptomatic infection to fatal encephalitis, an inflammation of the brain. A vaccine for NiV does not exist, and the primary treatment for humans is limited to intensive supportive care.

Do you have what it takes to be an epidemiologist?

PROCEDURE

1. Prior to watching the film, complete Parts 1-3 of the worksheet below and read the questions in Part 4.
2. Watch the film and complete the answers in Part 4 about the film.
3. Complete Part 5 of the worksheet.

MATERIALS

- Four-function calculator
- Background reading
- Access to the internet

PART 1: LOOKING FOR PATTERNS AND MAKING PREDICTIONS

Clusters of Nipah virus infections were detected at different locations in Malaysia from September 1998 through May 1999. One area of Malaysia that was studied extensively during this time was the Port Dickson district, which is located in the state of Negeri Sembilan on the west coast of peninsular Malaysia. Epidemiologists recognized a higher prevalence of Nipah infection among pig farmers in this area. In one study, they decided to collect data from people living and working on farms in Port Dickson in order to understand the source of the infection. They collected the data from two groups:

- 1) Patients: individuals with encephalitis and evidence of Nipah infection from lab studies, and
- 2) Controls: individuals who did not have any evidence of disease and came from farms that had some cases of Nipah virus infection but no reports of encephalitis.

(Source: Umesh D. Parashar et al., *J. Infect. Dis.* 2000; 181:1755-1759.)

Table 1: Occupations* and living arrangements for people in this study.

Variable	Patients (<i>n</i> = 97)	Controls (<i>n</i> = 147)
Pig Farmer/Owner	86	142
Housewife	3	1
Student	9	10
Lived on a pig farm	72	113
Worked on a pig farm	91	147

*Occupations were not mutually exclusive.

Table 2: Percentage of people in this study who reported the presence of illness among other animals on farm.

Variable	Patients	Controls
Dogs	87%	76%
Cats	64%	62%
Rats	80%	77%
Chickens	78%	73%
Bats	19%	19%

Table 3: Percentage of people in this study who reported an increase in sick/dying animals on the farm.

Variable	Patients	Controls
Pigs	59%	24%
Dogs	25%	8%
Cats	12%	9%
Rats	9%	5%
Chickens	11%	2%
Bats	0%	0%

- Using the data above, make a prediction about the source of the Nipah virus outbreak in Port Dickson, Malaysia. Summarize the data that support your prediction.
- What actions might you take to prevent further spread of this disease?
- Which animal species in this study would you test for Nipah virus antibodies? Why?
- Using the data above, which animal species was least affected by Nipah virus infection? Explain your answer using the data. Can you think of a reason why this might be?

PART 2: READING

Read the background reading provided to gain a better understanding of epidemiology and the necessary vocabulary and calculations to complete this part of the activity.

PART 3: PRACTICING CALCULATIONS AND MAKING CLAIMS

As Nipah virus spread in Malaysia, 265 patients were diagnosed with encephalitis and 105 people died. An additional 110 individuals were found to have antibodies to Nipah virus but did not have any clinical symptoms. Of those infected, 224 were from the Port Dickson district of Negeri Sembilan. Port Dickson has a population of about 97,800. The R_0 of Nipah virus is estimated to be 0.48.

1. Calculate the following values for the Nipah infection in Port Dickson, Malaysia:
 - a. Incidence
Report as: ____ cases/ ____ population/ ____ months = incidence
 - b. Prevalence ____ %
 - c. Morbidity ____ %
 - d. Mortality ____ %
 - e. Case-fatality ratio ____ %
2. Using the R_0 value provided in the paragraph above, make a claim about whether this cluster will become an epidemic.

PART 4: NIPAH VIRUS RESERVOIR

Watch the 9-minute *Scientists at Work* video “Virus Hunter: Monitoring Nipah Virus in Bat Populations.” <http://www.hhmi.org/biointeractive/virus-hunter-monitoring-nipah-virus-bat-populations> This video focuses on a Nipah outbreak that occurred in Bangladesh in 2004. In the video, Dr. Jon Epstein, an epidemiologist, tracks the transmission of the virus from bat populations to humans. Using the information you learned in the film, answer the questions below.

1. What human behavior was the cause of the Nipah virus outbreak in Bangladesh? How did scientists determine this?
2. Scientists determined that bats are a natural reservoir for Nipah virus.
 - a. In your own words, explain what a reservoir animal is.
 - b. What evidence suggested bats were the reservoir?

3. Which of the following methods is Dr. Epstein using to monitor Nipah virus in bat populations in the video?
 - a. Monitoring symptoms
 - b. Sequencing viral genomes
 - c. Detecting antibodies to specific viral peptides in the individual's blood
 - d. All of the above
 - e. Both b and c
4. How can monitoring the bat population in this way help with human health?

PART 5: PUTTING IT ALL TOGETHER

1. Bats are natural reservoirs for Nipah virus and do not die from the infection. Knowing this information, would it be more valuable to report data for the incidence or prevalence of Nipah virus in bats? Explain why you selected one calculation over the other.
2. Why would you need to calculate morbidity and mortality in humans but not bats? In your answer, show that you understand the definition of each of these terms.
3. Looking back at the data provided from the Malaysia outbreak of 1998-1999, what evidence suggests that the bats, not the pigs, may have been the original source of the virus?
4. Explain why killing the pigs stopped the outbreak, even though the original source of infection was the bats.
5. Write a succinct statement (encompassing information from the entire activity) informing the World Health Organization about Nipah virus and how it spreads, and provide recommendations for how to control it.