



INTRODUCTION

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

Nipah virus infection is a newly emerging zoonosis, a disease that can be transmitted from animals to humans. This infection in humans causes highly variable symptoms, ranging from an asymptomatic infection to fatal encephalitis, an inflammation of the brain. A vaccine for Nipah virus 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. Complete Parts 1–3 below and read the questions in Part 4.
2. Watch the video [Virus Hunter: Monitoring Nipah Virus in Bat Populations](#).
3. Complete Parts 4 and 5.

MATERIALS

- access to the video
- “Student Reading” handout
- calculator

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
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

Table 1. Occupations* and living arrangements for people in the Port Dickson study

Variable	Patients (n = 97)	Controls (n = 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.

Source: D. Umesh et al. “Case-Control Study of Risk Factors for Human Infection with a New Zoonotic Paramyxovirus, Nipah Virus, during a 1998–1999 Outbreak of Severe Encephalitis in Malaysia.” *The Journal of Infectious Diseases* 181, 5 (2000): 1755–1759.

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

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

Table 3. Percentage of infected people in this study who reported an increase in sick/dying animals on their 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 in Table 1, 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?
- Based on 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 information in the “Student Reading” handout to gain a better understanding of epidemiology and the necessary vocabulary and calculations to complete the rest of the activity.

PART 3: Practicing Calculations and Making Claims

As Nipah virus spread from September 1998 through May 1999 in Malaysia, **265** patients were diagnosed with encephalitis, and **105** of these patients 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 Port Dickson, which has a population of about **97,800** people.

- Using this information and the calculations described in the “Student Reading” handout, calculate the following values for this Nipah outbreak:
 - Incidence** in Port Dickson, Malaysia: ____ new cases/____ people in the population/____ months
 - Prevalence** in Port Dickson, Malaysia: _____%
 - Morbidity** nationwide for Malaysia: _____%
 - Mortality** nationwide for Malaysia: _____%
 - Case fatality ratio** nationwide for Malaysia: _____%
- The R_0 of Nipah virus is estimated to be **0.48**. Based on this information, make a claim about whether the outbreak in Malaysia is likely to have become an epidemic.

PART 4: Nipah Virus Reservoir

Watch the video [Virus Hunter: Monitoring Nipah Virus in 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.

- What human behavior was the cause of the Nipah virus outbreak in Bangladesh? How did scientists determine this?
- Scientists determined that bats are a natural reservoir for Nipah virus in Bangladesh.
 - In your own words, explain what a reservoir animal is.
 - What evidence suggested bats were the reservoir for Nipah virus?
- Which of the following methods, as described in the video and reading, is used to monitor Nipah virus in bat populations? Select all that apply:
 - monitoring symptoms
 - sequencing viral genomes
 - detecting antibodies to specific viral peptides in an individual’s blood
- How can monitoring bat populations 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 (assuming that you also report the total number of bats in the population)? Explain your choice.
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 in Part 1 on 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 pigs may have stopped the outbreak (as described in the “Student Reading”), even if the original source of infection was bats.
5. Write a succinct statement (encompassing information from the entire activity) informing the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) about Nipah virus and how it spreads and provide recommendations for how to control it.