

West Nile Virus Strikes Again

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This lesson is designed for a junior or senior level high school biology course and emphasizes the history of the West Nile virus (WNV) event in the U.S. This lesson highlights the issues associated with disease spread and prevention. Students will work to develop a prevention plan for an American Indian reservation that is experiencing a new occurrence of West Nile virus infection, while taking into consideration the cultural and environmental implications relevant to this population. To successfully complete these activities, the students should have some knowledge of enzyme-linked immunosorbent assay (ELISA), polymerase chain reaction (PCR), and gel electrophoresis.

Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention (CDC).

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Summary

This lesson is designed for a junior or senior level high school biology course and emphasizes the history of the West Nile virus (WNV) event in the U.S. This lesson highlights the issues associated with disease spread and prevention. Students will work to develop a prevention plan for an American Indian reservation that is experiencing a new occurrence of West Nile virus infection, while taking into consideration the cultural and environmental implications relevant to this population. To successfully complete these activities, the students should have some knowledge of Enzyme-Linked Immunosorbent Assay (ELISA), Polymerase Chain Reaction (PCR), and gel electrophoresis.

Learning Outcomes

- The student will be able to explain the life cycle of the West Nile virus, symptoms of infection, at risk populations, therapies, and prevention strategies by exploring a fact sheet about WNV.
- The student will be able to analyze laboratory data collected from a WNV-active site and make appropriate interpretations.
- The students will understand the complexities of balancing an outbreak with a unique culture and environmental implications.

Materials

1. West Nile Virus Maps PowerPoint.
2. Print one personal copy of Introduction Discussion Questions.
3. Photocopy of article Five Common Myths about West Nile Virus – one per student.
4. Photocopy of West Nile Virus Exploratory Activity worksheet – one per student.
5. Photocopy of the American Indian Reservation Profile – one per student.
6. Photocopy Enzyme-Linked Immunosorbent Assay (ELISA) Results – one per group of 3-4 students.
7. Photocopy of Polymerase Chain Reaction (PCR) Results Following Gel Electrophoresis – one per group of 3-4 students.
8. Photocopy of West Nile Virus Occurrence PowerPoint Presentation – one per student.
9. Photocopy of West Nile Virus Occurrence PowerPoint Presentation Rubric – one per student.
10. Classroom projector and screen.
11. Access to computers, Internet and a presentation program similar to Microsoft PowerPoint.

Total Duration

3 hours, 30 minutes

Procedures

Teacher Preparation

Step 1, the teacher should prepare photocopies of all handouts. Photocopies need to be made of the following:

- Five Common Myths about West Nile Virus
- West Nile Virus Exploratory Activity for the Introduction (one per student of each handout).

Additionally, the teacher should have a personal copy of Introduction Discussion Questions.

Step 2 requires the following:

- American Indian Reservation Profile,
- Enzyme-linked immunosorbent assay (ELISA) results, and
- Polymerase chain reaction (PCR) results following gel electrophoresis (one per group of 3-4 students for each set of results).

Step 3 requires the following:

West Nile Virus Occurrence PowerPoint Presentation, and
West Nile Virus Occurrence PowerPoint Presentation Rubric (one per student for each handout).

For the Introduction, the teacher should test run the West Nile Virus Maps PowerPoint, have ready a computer, projector and screen. For Step 2, organize all photocopies. For step 3, prepare all photocopies and have ready access to computers and a presentation program. Have ready a projector, a screen and a computer that can play the presentations for Step 3.

This lesson plan should be taught after students have become familiar with the epidemiology terms, ELISA, PCR and gel electrophoresis. For additional information on these topics, visit the Web resources included below. Refer to the supplemental document Epidemiology Terms for definitions of epidemiologic terms relevant to this lesson.

Web Resources

Title: Introduction to ELISA Activity

URL: <http://www.biology.arizona.edu/IMMUNOLOGY/activities/elisa/main.html>

Description: This website is part of the Biology Project from the University of Arizona and provides an overview of enzyme-linked immunosorbent assays.

Title: Polymerase Chain Reaction

URL: <http://www.dnalc.org/ddnalc/resources/pcr.html>

Description: This website from the Dolan DNA Learning Center provides a PCR animation and a brief description of the process.

Title: Agarose Gel Electrophoresis of DNA

URL: <http://arbl.cvmbs.colostate.edu/hbooks/genetics/biotech/gels/agardna.html>

Description: This website from Colorado State University provides an overview of gel electrophoresis, pictures of gels and gel results, and an animation of the process.

Supplemental Document

Title: Epidemiology Terms

Description: This document highlights epidemiologic terminology mentioned in the lesson. Familiarity with these terms will facilitate students' completion of the lesson.

Introduction

Step 1 (Duration: 45 minutes)

At the beginning of this lesson, show the presentation entitled: WNV Maps. Inform the class that they are viewing the spread of a disease, but do not share with them the disease being represented.

Following the presentation, begin a discussion with the class by using the Introduction Discussion Questions. You may need to share the clues given if students have difficulty determining the identity of the disease being represented. The Introduction Discussion Questions Answer Key contains answers to the discussion questions. If students have not identified the disease after all clues are revealed, identify the disease as West Nile virus (WNV).

After the class is aware that the occurrence represented in the presentation is WNV, have the class brainstorm what they know about the virus. Once the class has generated a list, go through each item and write fact or fiction. Sample responses and answers are included in West Nile Virus Brainstorm Answer Key.

After the discussion, hand out the article Five Common Myths about West Nile Virus and read it aloud as a class. Invite the class to share things they learned. At the end of the class, assign the homework West Nile Virus (WNV) Exploratory Activity to be collected the following class day. The West Nile Virus (WNV) Exploratory Activity Answer Key contains answers to the questions.

Web Resources

Title: West Nile Virus Statistics, Surveillance, and Control

URL: <http://www.cdc.gov/ncidod/dvbid/westnile/surv&control.htm>

Description: This CDC website provides maps showing the spread of WNV across the U.S. from 1999 to 2006.

Title: West Nile Virus Questions and Answers

URL: <http://www.cdc.gov/ncidod/dvbid/westnile/q&a.htm>

Description: This is CDC website includes questions and answers commonly asked about West Nile virus. The West Nile Virus Q&A Website is the resource for the homework assigned following the Introduction, West Nile Virus Exploratory Activity.

Supplemental Documents

Title: WNV Maps

Description: This is a PowerPoint presentation showing the incidence of severe WNV in humans from the time it was first identified in New York in 1999 to 2006.

Title: Introduction Discussion Questions

Description: These questions are to be used to stimulate discussion about the spread of West Nile virus within the human population across the U.S.

Title: Introduction Discussion Questions Answer Key

Description: This sheet provides some answers that students may provide during the discussion.

Title: West Nile Virus Brainstorm Answer Key

Description: This sheet provides possible responses to the brainstorming questions.

Title: Five Common Myths about West Nile Virus

Description: This is an article by CDC about real and fictional information related to West Nile virus infection and prevention.

Title: West Nile Virus (WNV) Exploratory Activity

Description: This homework assignment for students utilizes CDC fact pages about West Nile virus, including information about transmission, prevention and treatment.

Title: West Nile Virus (WNV) Exploratory Activity Answer Key

Description: This sheet provides answers to the questions asked in the West Nile Virus (WNV) Exploratory Activity.

Step 2 (Duration: 1 hour)

Now that the students are aware of the breadth of WNV in America and have background information about the virus, infection, risk, and prevention, students will work together to make recommendations concerning a fictionalized increase in activity of WNV in a specific community. The teacher will organize the students into groups of 3-4 and distribute one American Indian Reservation Profile document to each student.

As a class, read the handout up to Questions for Discussion Part I. Additionally, hand out copies of Enzyme-Linked Immunosorbent Assay (ELISA) Results and Polymerase Chain Reaction (PCR) Results Following Gel Electrophoresis. At this time, each group should work together to develop responses to the questions by using the lab results and the information provided in the first part of the reading. One member from each group should then present the group's findings to the class.

As a class, read aloud the remainder of the handout American Indian Reservation Profile. Following this, each group will work together to develop responses to the questions. One member from each group will then present the group's findings to the class.

Web Resources

Title: Introduction to ELISA Activity

URL: <http://www.biology.arizona.edu/IMMUNOLOGY/activities/elisa/main.html>

Description: This website is part of the Biology Project from the University of Arizona and provides an overview of enzyme-linked immunosorbent assays.

Title: Polymerase Chain Reaction

URL: <http://www.dnalc.org/ddnalc/resources/pcr.html>

Description: This website from the Dolan DNA Learning Center provides a PCR animation and a brief description of the process.

Title: Agarose Gel Electrophoresis of DNA

URL: <http://arbl.cvmb.colostate.edu/hbooks/genetics/biotech/gels/agardna.html>

Description: This website from Colorado State University provides an overview of gel electrophoresis, pictures of gels and gel results as well as an animation of the process.

Title: West Nile Virus Questions and Answers

URL: <http://www.cdc.gov/ncidod/dvbid/westnile/q&a.htm>

Description: This is a CDC website including questions and answers commonly asked about West Nile virus.

Supplemental Documents

Title: American Indian Reservation Profile

Description: This is a fictionalized recreation of an actual WNV occurrence and CDC case. Students read about an occurrence and analyze lab data to determine the existence of a WNV occurrence. Students are then prompted to determine the issues related to the occurrence.

Title: American Indian Reservation Profile Answer Key

Description: This document provides answers for the discussion questions posed in the American Indian Reservation Profile.

Title: Enzyme-Linked Immunosorbent Assay (ELISA) Results

Description: This document provides laboratory data from the patients to determine if they have a WNV infection.

Title: Polymerase Chain Reaction (PCR) Results Following Gel Electrophoresis

Description: This document provides laboratory data from the mosquitoes collected at the sight of the occurrence to determine if they are carrying WNV.

Step 3 (Duration: 1 hour)

To assess students' knowledge about WNV spread and prevention, and to gauge their ability to manage an occurrence of WNV while being sensitive to a unique culture, students will work in groups to develop a plan for preventing further WNV activity on the American Indian reservation. Additionally, they will design an educational campaign to promote WNV prevention in the community on a long term basis.

Hand out the West Nile Virus Occurrence PowerPoint Presentation activity. Review the activity with the class. Each team should work together to respond to the questions and develop a short PowerPoint presentation that addresses the questions posed. Each team will be developing their PowerPoint for a different audience and will need to tailor their material appropriately.

Supplemental Documents

Title: West Nile Virus Occurrence PowerPoint Presentation

Description: This is the assessment activity for this lesson and describes the PowerPoint presentation that each group needs to develop.

Title: West Nile Virus Occurrence PowerPoint Presentation Rubric

Description: This is the rubric used to grade the PowerPoint presentation.

Conclusion (Duration: 45 minutes)

The students will present their PowerPoint presentations. Use the West Nile Virus Occurrence PowerPoint Presentation Rubric to assess their presentations.

Supplemental Document

Title: West Nile Virus Occurrence PowerPoint Presentation Rubric

Description: This is the rubric used to grade the PowerPoint presentation.

Assessment

The knowledge each student has gained following the introduction and Step 1 will be assessed using the worksheet West Nile Virus (WNV) Exploratory Activity. End knowledge will be determined using the West Nile Virus Occurrence PowerPoint Presentation.

Modifications

Extensions

Students could

- Survey their neighborhoods for mosquito breeding grounds and provide educational material at their town hall and library about how to prevent WNV infection.
- Collect their state data about bird and human cases of WNV from their state health department and then graph the results.
- Conduct research into WNV vaccine trials.
- Develop a WNV fashion show where students display appropriate attire for repelling mosquitoes and showcase various mosquito repellents.

Web Resources

Title: West Nile Virus Questions and Answers

URL: <http://www.cdc.gov/ncidod/dvbid/westnile/q&a.htm>

Description: This CDC website includes questions and answers commonly asked about West Nile virus.

Title: Links to State and Local Government West Nile Virus Web Sites.

URL: http://www.cdc.gov/ncidod/dvbid/westnile/city_states.htm

Description: This CDC website provides links to the home pages for the Department of Health and Human Services (DHHS) for each state. Using this site, students can locate their state DHHS.

Other Modifications

For more advanced students, this activity can involve a laboratory component where students run sample ELISAs, PCR, and gel electrophoresis of simulated samples to determine if an occurrence exists on the Indian reservation.

For lower level classes, the students can be informed that there is an occurrence of WNV on the Indian reservation, instead of analyzing the lab results and determining for themselves.

Education Standards

National Science Education Standards

LIFE SCIENCE, CONTENT STANDARD C

As a result of their activities in grades 9-12, all students should develop understanding of

- The cell
- Molecular basis of heredity
- Biological evolution
- Interdependence of organisms
- Matter, energy, and organization
- Behavior of organisms

SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES, CONTENT STANDARD F

As a result of their activities in grades 9-12, all students should develop understanding of

- Personal and community health
- Population growth
- Natural resources
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

HISTORY AND NATURE OF SCIENCE, CONTENT STANDARD G

As a result of their activities in grades 9-12, all students should develop understanding of

- Science as a human endeavor
- Nature of scientific knowledge
- Historical perspectives

Epidemiology Terms

West Nile Virus Strikes Again
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Below are a few public health terms and definitions that will aid students' successful completion of this lesson.

Endemic Disease – The constant presence of a disease or infectious agent within a given geographic area or population group. [2]

Epidemic – The occurrence of more cases of disease than expected in a given area or among a specific group of people over a particular period of time. [2]

Etiology – The study of the cause of diseases. [1]

Incidence Rate – A measure of the frequency with which an event, such as a new case of illness, occurs in a population over a period of time. The denominator is the population at risk; the numerator is the number of new cases occurring during a given time period. [2]

Vector – An animate intermediary in the indirect transmission of an agent that carries the agent from reservoir to a susceptible host. [2]

References

1. Centers for Disease Control and Prevention. ATSDR Glossary of Terms [online]. [cited 2007 June 20]. Available from URL: <http://www.atsdr.cdc.gov/glossary.html>
2. Centers for Disease Control and Prevention. Reproductive Health Glossary [online]. 2006. [cited 2007 June 20]. Available from URL: <http://www.cdc.gov/reproductivehealth/EpiGlossary/glossary.htm>

Introduction Discussion Questions

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1. What observations can you make about the spread of this disease?
2. This is a modern-day epidemic with maps showing the spread from 1999-2006. Does WNV appear to be spreading throughout the U.S.?
3. How might WNV seen in this map continue to spread? How might WNV seen in these maps continue to spread?
4. How might this disease have arrived in the U.S.?
5. What disease might be represented here? Think of modern-day epidemics.

Some clues

- The disease emerged in the U.S. in the summer of 1999 (possibly earlier) and is still around today. [1]
- The viral incubation period is thought to range from 2-15 days. [2]
- The disease has its highest incidence in people over age 50 years of age. [3]
- Incidental hosts are humans and horses [4]
- The viral life cycle relies on mosquitoes and birds [4]

References

1. Centers for Disease Control and Prevention. Questions and Answers. Overview of West Nile Virus. [online]. 2004. [cited 2007 August 27]. Available from URL: <http://www.cdc.gov/ncidod/dvbid/westnile/qa/overview.htm>
2. Centers for Disease Control and Prevention. Questions and Answers. Symptoms of West Nile Virus. [online]. 2004. [cited 2007 August 27]. Available from URL: <http://www.cdc.gov/ncidod/dvbid/westnile/qa/symptoms.htm>

3. Centers for Disease Control and Prevention. West Nile Virus: What You Need to Know. [online]. 2006. [cited 2007 August 27]. Available from URL:
http://www.cdc.gov/ncidod/dvbid/westnile/wnv_factsheet.htm
4. Centers for Disease Control and Prevention. Questions and Answers. Transmission. [online]. 2004. [cited 2007 August 27]. Available from URL:
<http://www.cdc.gov/ncidod/dvbid/westnile/qa/transmission.htm>

Introduction Discussion Questions Answer Key

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1. What observations can you make about the spread of this disease?

Answers will vary but may include that the disease was first seen in 1999 in New York. It spread West across the country, and large occurrences were seen in the Midwest.

2. This is a modern day epidemic with the maps showing spread from 1999-2006. Does it appear to be spreading throughout in the U.S.?

Answers will vary but may include that based on the data, it appears WNV may be endemic to much of the mainland (48) U.S. Some areas of the U.S. are more affected than others. In 2007, Maine and the state of Washington reported no human disease cases. However, it would be valuable to see incidence maps from this past year. (Up-to-date maps, including incidence maps like these, are posted online at <http://www.cdc.gov/ncidod/dvbid/westnile/surv&control.htm>)

3. How might WNV seen in this map continue to spread? How might WNV seen in these maps continue to spread?

Answers will vary but may include that spread may occur with human travel (a viremic human returning to the U.S. and local mosquitoes becoming infected – although unlikely, given humans' typically low viremias), bird migration, or insect spread.

4. How might this disease have arrived in the U.S.?

Answers will vary but may include arrival of infected animals or mosquitoes from another country, or human travel (see above answer addressing humans).

5. What disease might be represented here?

Answers will vary but may include West Nile virus and eastern equine encephalitis.

West Nile Virus Brainstorm Answer Key

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1. What does the class know about West Nile virus?

Answers will vary but may include

- It is transmitted by mosquitoes
- Birds are hosts and may be killed by it
- Humans can become sick
- Humans can succumb to the illness
- It came from Africa, near the Nile
- Humans contract it from mosquito bites
- Children and the elderly are most likely to become ill

2. What does the class think is fact or fiction?

- It is transmitted by mosquitoes (fact) [1]
- Birds are hosts and may be killed by it (fact) [1]
- Humans can become sick (fact) [1]
- Humans can succumb to the illness (fact) [2]
- It came from Africa, near the Nile (fact) [3]
- Humans contract it from mosquito bites (fact) [1]
- Children and older persons are most likely to become ill (fiction) [4]

References

1. Centers for Disease Control and Prevention. Transmission [online]. 2003. [cited 2007 June 6]. Available from URL: <http://www.cdc.gov/ncidod/dvbid/westnile/qa/transmission.htm>
2. Centers for Disease Control and Prevention. Symptoms of West Nile Virus [online]. 2006. [cited 2007 June 6]. Available from URL: <http://www.cdc.gov/ncidod/dvbid/westnile/qa/symptoms.htm>
3. Centers for Disease Control and Prevention. Overview of West Nile Virus [online]. 2004. [cited 2007 June 7]. Available from URL: <http://www.cdc.gov/ncidod/dvbid/westnile/qa/overview.htm>
4. Centers for Disease Control and Prevention. Who's at Risk for West Nile Virus? [online]. 2003. [cited 2007 June 6]. Available from URL: http://www.cdc.gov/ncidod/dvbid/westnile/qa/who_risk.htm

Five Common Myths about West Nile Virus

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The following article is available at: <http://www.cdc.gov/ncidod/dvbid/westnile/WNVmyths.htm>

Myth #1: There's not much I can do about West Nile virus.

Truth: There is a great deal that you, personally, can do to reduce your chance of West Nile virus infection.

- Reduce the number of mosquito bites you get. Make a habit of using insect repellent with DEET when outdoors. Spray repellent on exposed skin and clothing. Get the details about safe repellent use.
- Prime mosquito-biting hours are usually dusk to dawn. Pay special attention to protection during these hours, or avoid being outdoors.
- You can reduce the number of mosquitoes around your home. Mosquitoes breed in standing water, so check your yard once a week. Get rid of containers that aren't being used, empty water from flower pots, change water in bird baths, and maintain clean gutters.
- Make sure window and door screens are in good condition. Have an older neighbor or family member? See if they need help installing or repairing screens.

Myth #2: Kids are at the most danger of getting sick from West Nile virus.

Truth: People over 50 are at the highest risk for developing severe West Nile disease.

- Relatively few children have been reported with severe West Nile Virus disease. By contrast, most of the deaths due to WNV during 2002 were among people over 50 years old. Half of those deaths were among people over 77 years old.
- It is always a good idea for children to avoid mosquito bites, but it's also important for adults — especially older adults — to take steps to avoid mosquito bites.

Myth #3: It's only people who are already in poor health who have to worry about West Nile virus.

Truth: Healthy, active older adults who spend time working and exercising outdoors have been affected by severe West Nile virus infection.

- Being over 50 is a risk factor for developing severe West Nile disease if infected with the virus. There is a risk of getting mosquito bites while leading an active life outdoors. This doesn't mean you have to stay inside — it does mean it's important to use repellent when you go outside.

Myth #4: Repellents containing DEET are not safe.

Truth: Repellents containing DEET are safe when used according to directions.

- Because DEET is so widely used, a great deal of testing has been done. When manufacturers seek registration with the U.S. Environmental Protection Agency (EPA) for products such as DEET, laboratory testing regarding both short-term and long-term health effects must be carried out.
- There are products with different strengths (percentage of DEET) available. The longer the protection you need the higher percent of DEET needed.
- Repellent with DEET can be used for both adults and children, according to directions

Myth #5: As long as my area has a mosquito control program, I don't have to worry about using repellent.

Truth: Mosquito control activities don't eliminate every mosquito, so personal protection is still important.

- Public activities, such as using products to kill mosquito larvae and adult mosquitoes, are one part of control. Personal protection, such as using repellent, keeping window screens in good condition, and control of household breeding sites are other important steps.
- Collaboration between the community, the family, and the person is needed to achieve the best prevention of West Nile virus infection.

Reference

1. Centers for Disease Control and Prevention. Five Common Myths about West Nile Virus [online]. 2006. [cited 2007 June 6]. Available from URL: <http://www.cdc.gov/ncidod/dvbid/westnile/WNVmyths.htm>

West Nile Virus (WNV) Exploratory Activity

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To complete this adventure, you will need to spend some time at the following site:
<http://www.cdc.gov/ncidod/dvbid/westnile/q&a.htm>. You will need to navigate through the Questions and Answers provided at the site.

1. West Nile Virus is transmitted by which vector?
2. What is the most common way that a human can contract WNV?
3. What are the best methods to prevent human infection by the virus?
4. What are some other, less common ways, in which WNV can spread?
5. How would you know if someone is infected with WNV? What might their symptoms be? How would you confirm the diagnosis?
6. How can WNV infections be treated?
7. Who is most likely to become severely ill with WNV?
8. Sketch the life cycle of WNV below.

9. Why is there a peak of WNV cases during August and September?

10. Why are dead birds sentinels of WNV?

11. Describe the medical severities of WNV.

12. Does a vaccine for WNV currently exist for humans? If not, are there vaccines currently under development?

13. What additional considerations need to be made with regards to prevention strategies and children?

14. What is the morbidity rate for West Nile fever?

West Nile Virus Exploratory Activity Answer Key

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1. West Nile virus is transmitted by which vector?

ANSWER: The vector for WNV is a mosquito. According to CDC, "The main route of human infection with West Nile virus is through the bite of an infected mosquito." [1]

2. What is the most common way that a human can contract WNV?

According to CDC, "The main route of human infection with West Nile virus is through the bite of an infected mosquito." [1]

3. What are the best methods to inhibit human infection by the virus?

According to CDC

- Apply insect repellent to exposed skin.
- Spray clothing with repellents.
- Wear long-sleeved shirts and long pants (when weather permits) whenever you are outdoors.
- Place mosquito netting over infant carriers when you are outdoors with infants.
- Consider staying indoors at dawn, dusk, and in the early evening — peak mosquito biting times.
- Install or repair window and door screens so that mosquitoes cannot get indoors.
- At least once or twice a week, empty water from flower pots, pet food and water dishes, birdbaths, swimming pool covers, buckets, barrels, and cans.
- Check for clogged rain gutters and clean them out.
- Remove discarded tires, and other items that could collect water.
- Be sure to check for containers or trash in places that may be hard to see, such as under bushes or under your home. [2]

4. What are some other, less common ways, in which WNV can spread?

According to CDC, "Through, blood transfusions, through infected organ transplants through the placenta, or possibly through breastfeeding." [1]

5. How would you know if someone is infected with WNV? What might their symptoms be? How would you confirm the diagnosis?

According to CDC, "Symptoms include fever, headache, tiredness, and body aches, occasionally with a skin rash (on the trunk of the body) and swollen lymph glands . . . The symptoms of severe disease (also called neuroinvasive disease, such as West Nile encephalitis or meningitis or West Nile poliomyelitis) include headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, and paralysis."

According to CDC, using the most commonly used WNV laboratory test measures antibodies that are produced very early in the infected person. These antibodies, called IgM antibodies, can be measured in blood or cerebrospinal fluid (CSF). [3]

6. How can WNV infections be treated?

According to CDC, "There is no specific treatment for West Nile virus infection. In more severe

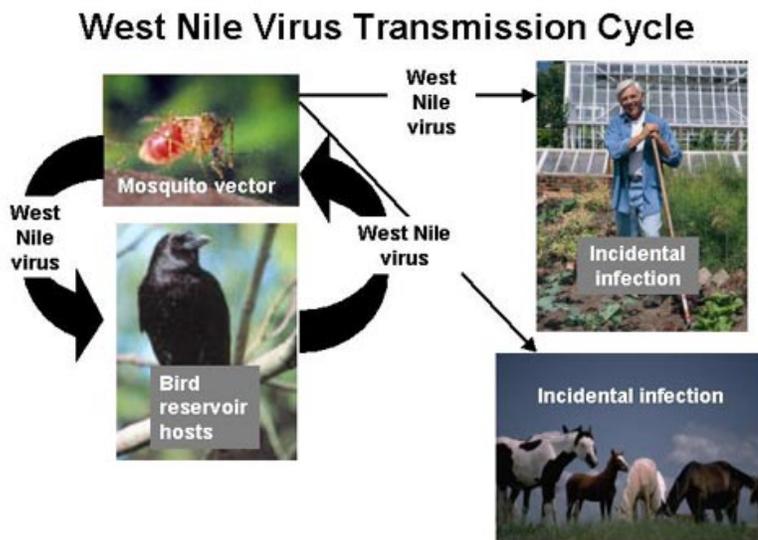
cases, intensive supportive therapy is indicated, often involving hospitalization, intravenous fluids, airway management, respiratory support (ventilator), prevention of secondary infections (pneumonia, urinary tract, etc.), and good nursing care." [4]

7. Who is most likely to become ill with WNV?

According to CDC, "All residents of areas where virus activity has been identified are at risk of getting West Nile encephalitis; persons over 50 years of age have the highest risk of severe disease. It is unknown if immunocompromised persons are at increased risk for WNV disease." [5]

8. Sketch the life cycle of WNV below.

According to CDC



[1]

9. Why is there a peak of WNV cases during August and September?

Answers will vary but may include that by August and September, many birds are infected, and thus, many mosquitoes will have the virus. The likelihood of being bitten by an infected mosquito is higher.

10. How are dead birds sentinels of WNV?

According to CDC, birds are part of the viral life cycle and can succumb to the infection. When dead birds are commonly found in an area, this may be a sign that WNV is in the area. These birds are often collected and tested to determine if WNV is the cause of death. [1]

11. Describe the medical severities of WNV.

According to CDC, the most severe type of disease due to a person being infected with West Nile virus is sometimes called neuroinvasive disease, because it affects a person's nervous system. Specific types of neuroinvasive disease include West Nile encephalitis, West Nile meningitis, West Nile meningoencephalitis, and West Nile poliomyelitis. Encephalitis refers to an inflammation of the brain. Meningitis is an inflammation of the membrane around the brain and the spinal cord. Meningoencephalitis refers to inflammation of the brain and the membrane surrounding it, and poliomyelitis refers to an inflammation of the spinal cord. [3]

12. Does a vaccine for WNV currently exist for humans? If not, are there vaccines currently under development?

According to CDC, "No, but several groups are working toward developing a vaccine." [2]

13. What additional considerations need to be made with regard to prevention strategies and children?

According to CDC

- Do NOT use oil of lemon eucalyptus products should on CHILDREN UNDER 3 YEARS.
- Do NOT use repellents with DEET should on infants less than 2 months old.
- Apply repellent to children by spraying it on your own hands and then rub your hands on your child. Avoid children's eyes and mouth and use it sparingly around their ears.
- Do NOT apply repellent to children's hands. (Children tend to put their hands in their mouths.)
- Do NOT allow young children to apply insect repellent to their own bodies; have an adult do it for them.
- Keep repellents out of reach of children.
- Do NOT apply repellent under clothing. If repellent is applied to clothing, wash treated clothing before wearing again. (May vary by product, check label for specific instructions.) [6]

14. What is the morbidity rate for West Nile fever?

According to CDC, "It is estimated that about 20% of people who become infected with WNV will develop West Nile fever." [3]

References

1. Centers for Disease Control and Prevention. Transmission [online]. 2003. [cited 2007 June 6]. Available from URL: <http://www.cdc.gov/ncidod/dvbid/westnile/qa/transmission.htm>
2. Centers for Disease Control and Prevention. Prevention [online]. 2007. [cited 2007 June 6]. Available from URL: <http://www.cdc.gov/ncidod/dvbid/westnile/qa/prevention.htm>
3. Centers for Disease Control and Prevention. Symptoms of West Nile Virus [online]. 2006. [cited 2007 June 6]. Available from URL: <http://www.cdc.gov/ncidod/dvbid/westnile/qa/symptoms.htm>
4. Centers for Disease Control and Prevention. Testing and Treating West Nile Virus in Humans [online]. 2003. [cited 2007 June 6]. Available from URL: http://www.cdc.gov/ncidod/dvbid/westnile/qa/testing_treating.htm
5. Centers for Disease Control and Prevention. Who's at Risk for West Nile Virus? [online]. 2003. [cited 2007 June 6]. Available from URL: http://www.cdc.gov/ncidod/dvbid/westnile/qa/who_risk.htm
6. Centers for Disease Control and Prevention. Insect Repellent Use and Safety [online]. 2005. [cited 2007 June 6]. Available from URL: http://www.cdc.gov/ncidod/dvbid/westnile/qa/insect_repellent.htm

American Indian Reservation Profile

West Nile Virus Strikes Again
Carolyn Kelley and June Teisan, CDC's 2007 Science Ambassador Program

Note: This is a recreation of an actual CDC case. The location of the site has been kept anonymous and data presented are fictional.

September

You are working as part of a lab team for the Centers for Disease Control and Prevention (CDC). You specialize in ELISA and PCR technologies. One of your colleagues, an epidemiologist, has recently visited a small American Indian reservation in the high plains of the western U.S. A local doctor contacted CDC after seeing 22 patients with the same symptoms: fever, chills, headache, and fatigue. Six of the patients are experiencing nausea and one has developed a rash. Twenty of the patients are ranchers and farmers; the other two cases are older patients. Additionally, a significant number of dead birds have been seen locally. The local doctor states that she has never seen this many cases of such an illness.

Based on the symptoms and the time of year, the epidemiologist is hypothesizing that the community is experiencing an increase in West Nile virus activity. The CDC is invited to visit the community, speak with the doctor and patients, and collect samples. You are flown there to collect samples. When you arrived at the scene, you collected serum samples from the patients and spent the evening trapping mosquitoes. You brought the samples back to the lab where you conducted ELISA, looking for IgM specific for West Nile virus in the patients' serum. Additionally, you prepped the mosquitoes and amplified for a specific West Nile viral gene using PCR, analyzing your results using gel electrophoresis. You have the results in front of you now (refer to Enzyme-Linked Immunosorbent Assay (ELISA) Results and Polymerase Chain Reaction (PCR) Results Following Gel Electrophoresis).

Questions for Discussion Part I

2. Is this community experiencing an occurrence of West Nile virus?
3. Do all 22 patients have West Nile infection?
4. Should CDC be invited to assist with prevention efforts? Why?

Following analysis of laboratory data, you requested more information be sent to you about the community. The additional information is below.

The reservation you are working with is a very small community in the high plains region of Western U.S. The population is approximately 350 people with all age groups represented; the entire community is below the poverty level. The teens and adults are almost exclusively employed as cattle ranchers and alfalfa farmers. The alfalfa farmers utilize open trenches to move water from the prolific wetlands to irrigate their crops. The community's income comes from cattle sales and from renting out their land to grow alfalfa crops. The closest town is three hours away and the community spends their spare time outdoors enjoying barbeques and traditional American Indian tribal activities.

Questions for Discussion Part II

1. What issues (environmental, cultural, economic, or other) can you identify that might promote the spread of West Nile virus?
2. Who is most at risk of infection in the community?
3. Who is most likely to become symptomatic following infection?

American Indian Reservation Profile Answer Key

West Nile Virus Strikes Again
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Questions for Discussion Part I

1. Is this community experiencing an occurrence of West Nile virus?

Yes. Based on data presented in the scenario, almost 6% of the population is experiencing symptoms of West Nile infection and as the doctor noted, "she has never seen this many cases at one time." Additionally, the ELISA results are positive for West Nile infection in the patients and the mosquito samples are positive as well.

2. Do all 22 patients have West Nile infections?

Yes.

3. Should the CDC be invited to assist with prevention efforts? Why?

Answers will vary but may include

Yes, CDC should intervene. The community may not be fully equipped to handle the occurrence of the disease and bring it under control. CDC staff could work with the local authorities to educate the community about disease spread and control measures.

Questions for Discussion Part II

1. What issues (environmental, cultural, economic, or other) can you identify that might promote the spread of West Nile virus?

Answers will vary but may include

- Environmental
 - (1) Wetland conservation (which could be an ideal environment for mosquito breeding)
 - (2) Open ditch irrigation may be mosquito breeding ground
- Cultural
 - (1) The community spends a lot of time outdoors both during working hours and during leisure activities.
- Economic
 - (1) The community's livelihood depends on the outdoor activities of the ranchers and alfalfa farmers.
 - (2) As the community is impoverished and may have difficulty affording mosquito preventative measures.

2. Who is most at risk of infection in the community?

According to CDC, "All residents of areas where virus activity has been identified are at risk of getting West Nile encephalitis..." [1]

3. Who is most likely to develop severe disease following infection?

According to CDC, "All residents of areas where virus activity has been identified are at risk of getting West Nile encephalitis; persons over 50 years of age have the highest risk of severe disease. It is unknown if immunocompromised persons are at increased risk for WNV disease." [1]

References

1. Centers for Disease Control and Prevention. Who's at Risk for West Nile Virus [online]. 2003. [cited 2007 June 6]. Available from URL: http://www.cdc.gov/ncidod/dvbid/westnile/qa/who_risk.htm

Enzyme-Linked Immunosorbent Assay (ELISA) Results

West Nile Virus Strikes Again
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The following laboratory results are of the samples collected from the patients on the hypothetical American Indian reservation. WNV IgM titre was determined in the patients' serum.

ELISA Results

Sample	Days post-onset	WN Antibody Titre
Negative Control	n/a	0
Positive Control	n/a	3
Patient A	14	7
Patient B	8	12
Patient C	31	11
Patient D	7	18
Patient E	5	2
Patient F	5	16
Patient G	12	5
Patient H	22	3
Patient I	16	2
Patient J	2	2

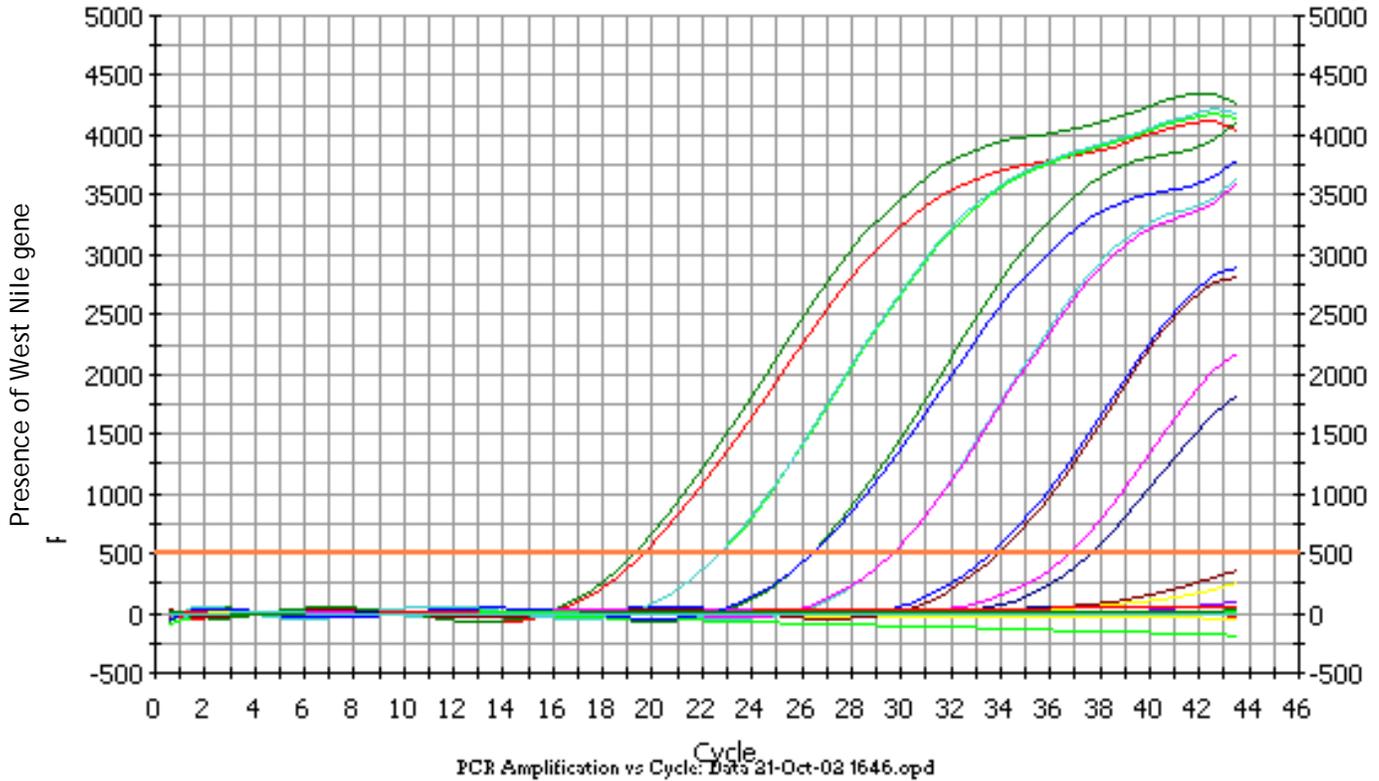
Interpretation of ELISA Results

WN=West Nile
Titre > 3 = positive
Titre < 2 = negative
Titre 2-3 = equivocal

Polymerase Chain Reaction (PCR) Results Following Gel Electrophoresis

West Nile Virus Strikes Again
Carolyn Kelley and June Teisan, CDC's 2007 Science Ambassador Program

The following laboratory results are from the mosquitoes collected on the American Indian reservation. A specific gene for WNV was amplified for using PCR technology.



PCR RESULTS

Note: each colored line indicates a different mosquito sample

Reference:

Lanciotti, R., Kerst, A., Nasci, R., Godsey, M., Mitchell, C., Savage, H., et al. Rapid Detection of West Nile Virus from Human Clinical Specimens, Field-Collected Mosquitoes, and Avian Samples by a TaqMan Reverse Transcriptase-PCR Assay. *J Clin Microbiol* 2000; 38(11): 4066-4071.

West Nile Virus Occurrence PowerPoint Presentation

West Nile Virus Strikes Again
Carolyn Kelley and June Teisan, CDC's 2007 Science Ambassador Program

Now that you have explored the issues associated with WNV activity within the American Indian reservation, it is time to make your recommendations to the various groups within the community. As a CDC representative, it is important to offer solutions to the appropriate parties to help reduce the risk of infection and increase the use of preventative measures. Your teacher will determine to which group you will be presenting. The groups are listed below.

- Tribal elders
- Ranchers and alfalfa farmers
- Children in the community
- The entire community during a town hall meeting
- Community health personnel
- Centers for Disease Control and Prevention Director

You will need to tailor your presentation to your specific audience and be sure to answer the questions posted below.

1. What is the status of the community's WNV activity?
2. What does each person need to do to prevent further spread?
3. What does the community as a whole need to do to prevent further spread?
4. What impact would prevention strategies have on
 - The environment?
 - The food chain?
 - The culture?
 - The community's livelihood?
5. What partnership(s) would you recommend to support the community's efforts at preventing further spread of the West Nile virus?
6. What is the best proposal you can make to balance all critical issues?
7. Design a short educational campaign to support your efforts.

West Nile Virus Occurrence PowerPoint Presentation Answer Key

West Nile Virus Strikes Again
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1. What is the status of the community's WNV activity?

Answers will vary, but may include the following:

- The occurrence of West Nile is serious and should be taken seriously.
- It is important that the community work to prevent further spread of the disease.
- Without taking prevention measures, this could result in further spread of disease.

2. What does each person need to do to prevent further spread?

Answers will vary, but may include the following:

- Each person needs to wear bug spray (with DEET) when outdoors, especially from dusk to dawn.
- Each person should wear protective clothing (long sleeves and pants) when appropriate.
- Each person should check to make sure that screens are intact at home.
- Each person should stay indoors more often, especially from dusk to dawn. [1]

3. What does the community as a whole need to do to prevent further spread?

Answers will vary, but may include the following:

- Seal off irrigation ditches.
- Provide education to all members of the community about West Nile virus infection and prevention.
- Find ways to help older persons and those with limited resources repair their window and door screens, and help them get insect repellent
- Monitor wet lands for mosquito larvae. (Students may propose mosquito treatments for the wetlands.)
- Monitor adult mosquito populations and seek expertise to appropriately spray the community for mosquitoes.

4. What impact would prevention strategies have on the environment, the food chain and the culture?

Answers will vary, but may include

- The environment
Mosquito treatment of the wetlands may affect the delicate balance of the ecosystem.
- The food chain
Mosquito spraying of the community or treatments of the wetlands may affect food resources and could alter the fauna of the ecosystem. However, if spraying does not occur, the drop in the crow population may increase the population of rodents. This increase in rodents may increase the variety of diseases in the area.
- The culture
The community is very family oriented and values time spent outside at barbecues and participating in traditional tribal activities. By encouraging people to stay indoors, it may impact their culture by influencing how they spend their leisure time. Additionally, if there is a lack of air conditioning indoors, it could make this option less likely.

- The community's livelihood
The community is poor and could have difficulty purchasing bug sprays, window screens, affording community mosquito spraying and wetland treatments, or sealing off the irrigation ditches. Further, the community relies on ranchers and alfalfa farmers for the majority of their livelihood. These are outdoor professions, and asking people to spend more time indoors is not feasible.

5. What sort of partnership(s) would you recommend to support the community's efforts at preventing further spread of the West Nile virus?

Recommendations for partnerships will vary, but may include the following:

- Insect repellent companies
- Pest control service companies
- Local/state departments of health

6. What is the best proposal you can make to balance all critical issues?

Answers will vary, but may include

It is imperative that the West Nile virus occurrence be brought under control while being sensitive to the needs and the means of the community. The ideal approach may be as simple as providing the community insect repellent, and encouraging its use.

7. Design a short educational campaign to support your efforts.

Answers will vary, but students may develop a proposal for a poster campaign, a short public service announcement or a helpful brochure.

Reference

1. Centers for Disease Control and Prevention. Insect Repellent Use and Safety [online]. 2005. [cited 2007 June 6]. Available from URL:
http://www.cdc.gov/ncidod/dvbid/westnile/qa/insect_repellent.htm

West Nile Virus Occurrence PowerPoint Presentation Rubric

West Nile Virus Strikes Again
Carolyn Kelley and June Teisan, CDC's 2007 Science Ambassador Program

Name: _____
Group: _____

Date: _____
Audience: _____

CATEGORY	4	3	2	1
Content Organization and Accuracy	Content is well organized using headings, titles, or lists, and all info is accurate.	Content is organized using headings, titles, or lists and all information is accurate.	Uses headings or lists, but overall organization could be better; there are 1-2 scientific errors.	Presentation is unorganized and there are more than 2 scientific errors.
Followed Guidelines	Presentation was totally appropriate for the assigned audience; tone, vocabulary, and content.	Presentation was appropriate for the audience however tone could have been more appropriate.	Presentation was appropriate for the audience however tone and/or vocabulary could have been more appropriate.	Presentation was inappropriate for the audience with regard to tone, vocabulary, and content.
Mechanics	No mistakes in grammar or spelling.	Only one mistake was noted throughout the project.	Two mistakes were noted throughout the project.	Three or more mistakes were noted throughout the project.
Attractiveness	Makes excellent use of font, color, graphics, etc. to enhance the presentation.	Makes good use of font, color, graphics, etc. to enhance the presentation.	The use of font, color, graphics, etc. could have been done more neatly.	Used minimum creativity in font, color and graphics in the presentation.
Sources	ALL source information is listed. Including where pictures came from.	Most source information is given for the presentation.	One source is missing from the presentation.	Two or more sources are not listed in the presentation.
Collaboration	Team member worked well with their group 100% of the time.	Team member worked well with their group 90% of the time.	Team member worked well with their group 80% of the time.	Team member worked well with their group less than 80% of the time.
Occurrence Recommendations	Recommendations were appropriate for the community and took into account all issues specific to the community.	Recommendations were mostly appropriate for the community and took into account all issues specific to the community.	Recommendations were mostly appropriate for the community and took into account most issues specific to the community.	Recommendations were not appropriate for the community and took into account few issues specific to the community.

Rubric adapted from: RubiStar. Available at URL: <http://rubistar.4teachers.org/index.php>