

CASE TEACHING NOTES

for

“The Unfortunate Nurse: A Case Study of Dengue Fever and Social Policy”

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INTRODUCTION / BACKGROUND

This case study introduces students to “emerging pathogens” and other concepts in parasitology, immunology, epidemiology, public policy, and science writing. Students also read a primary paper and learn about two modern techniques widely used in medical and research settings (i.e., EIA and Taqman RT-PCR). The case is suitable for biology, general education biology, cell biology, microbiology, immunology, and science and public policy courses.

Objectives

- Approach a scientific paper without fear, identifying and researching unknown terminology.
- Become familiar with the idea of nosocomial infection.
- Become familiar with the idea of emerging pathogens.
- Explore the complex virus/mosquito vector/host infection strategy of dengue virus.
- Become familiar with the following techniques: EIA (ELISA), differential cell counts, and RT-PCR.
- Explore the idea of “agenda” in science and ethics and politics in public policy-making.
- Learn to communicate information with special attention to the intended outcome and the intended audience.

CLASSROOM MANAGEMENT

The case is designed to cover three to four class meetings. To prepare for the case, students are asked to read the article “Nosocomial Acquisition of Dengue” by Dirk Wagner et al., which appeared in the October 2004 issue of *Emerging Infectious Diseases* (vol. 10, no. 10, pp. 1872–1873). The article, available online at <http://www.cdc.gov/ncidod/EID/vol10no10/03-1037.htm>, describes an incident in which a nurse in Freiburg, Germany, became infected with the dengue virus as a result of a needlestick. As part of their assignment, students are asked to circle any unfamiliar terminology in the article and to look up definitions and other information for these terms/techniques. A Resources list is provided to the students for use in their research. In addition, students are asked to pay special attention to the Figure and Table from the journal article, which will be discussed during the next class meeting.

Part I—The Unfortunate Nurse

Begin class by asking students, “Can you narrate the main idea of the paper in a few sentences?” Next, have the students share the definitions and information they collected for the terms they circled in the article. The article describes an accidental nosocomial infection of a nurse who is treating a traveler afflicted with dengue. Although the word “nosocomial” is defined in the on-line medical dictionary suggested for student use as “acquired or occurring in a hospital” and the term does appear in the title of the article, it is most commonly used for conditions acquired by patients as a result of their hospital stays rather than by hospital staff, as in this case. Ask students: “In what sense are hospitals dangerous places?”

Next, hand out the script in Part I of the case and have the students act out the parts of the Narrator, Nancy, Elaine (Dr. Ghee's nurse), and Dr. Ghee. Direct the students' attention to the first set of three questions, which help to provide a framework for a discussion of the scenario described and the incident in the article it is based on. (Answers to the questions are contained in the Answer Key.)

After discussing the first set of questions, give students the "results" of "Nancy's" blood (see the Table, reproduced from the Wagner et al. article) as well as the Figure (also from the article) containing information on the diagnostic tests performed. Ask the students to look them over and try to interpret them, using the second set of questions to help guide the students' understanding of the material. (Answers to these questions are contained in Answer Key.)

Divide the students into groups. Each group is responsible for researching various aspects of dengue, as well as some of the relevant research techniques, and preparing a PowerPoint presentation for the next class. Direct the students to the Resources list in the case, especially the CDC resource, which has numerous PowerPoint slides on multiple aspects of dengue. Students may select slides from the CDC site or prepare their own for their presentation. Presentations should be no longer than five minutes (including time for questions) and should only include three to five slides. Allow students as much as possible to pick their own topics to research, but these might include:

- Dengue life-cycle through mosquitoes.
- How the differential diagnosis is made.
- Dengue fever vs. dengue hemorrhagic fever.
- Epidemiology of this emerging infection.
- Which is the more likely source of future societal burden in the U.S.—travel or immigration?
- How an EIA works.
- How RT-PCR (reverse transcriptase-PCR) works.
- Terminology not adequately covered in the classroom discussion.

Good sites for help for those unfamiliar with EIA (ELISA) and RT-PCR include:

- PubMed Bookshelf <http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=Books>

For ELISA, I recommend Biochemistry, by J.M.Berg, J.L.Tymoczko, and L. Stryer, W.H. Freeman and Co., 2002; see Section 4.3.3, figure 4.35, in particular, available at <http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=stryer.figgrp.515>

For RT-PCR, I recommend Human Molecular Genetics, 2nd edition, by T. Strachan and A.P. Read, Garland Science, 1999, Chapter 6.

- Callahan, J.D., Wu, S.J., Dion-Schultz, A., Mangold, B.E., Peruski, L.F., Watts, D.M., et al. 2004. Development and evaluation of serotype- and group-specific fluorogenic reverse transcriptase PCR (TaqMan) assays for dengue virus. *J Clin Microbiology*. 39:4119–24. Available at <http://www.pubmedcentral.nih.gov/articlerender.fcgi?tool=pubmed&pubmedid=11682539>

If a student shows a particular interest in the TaqMan® (Applied Biosystem) technique, the above article (referenced in the Wagner et al. paper) gives a description of the particular adaptation of the TaqMan technique that was used in that case. It is not, however, necessary for the students to go into the TaqMan technique in depth, since the table in the Wagner et al. paper shows only presence or absence of virus (semi-quantitative data is not shown).

- Additionally, Applied Biosystem offers free access to an excellent document called "Essentials of Real Time PCR," available at their website: <http://docs.appliedbiosystems.com/pebi docs/00105622.pdf>.
- Medline Plus Medical Dictionary at <http://www.nlm.nih.gov/medlineplus/mplusdictionary.html>

Part II—Presentations

In the second class meeting, the student groups each present a short slide show on their assigned topics and provide a two-page handout for each class member. The slide show can be customized to emphasize natural history of the disease,

diagnosis and treatment, epidemiology, current research initiatives, or public policy. That is to say, students should come away with a comprehensive fund of facts regarding dengue. Students score the other students' talks using the Presentation Grading Rubric included in the case. After the presentations and discussion, each student individually prepares an outline telling what he/she now knows about dengue, and what he/she would still like to learn.

Part III—Dengue in Social Context / Educating Stakeholders

Students are told to read a second article before the class session in which Part III of the case is covered. The article, entitled “Texas Lifestyle Limits Transmission of Dengue Virus,” by P. Reiter et al., is publicly available on the CDC website at <http://o-www.cdc.gov.mill1.sjlibrary.org/ncidod/eid/vol9no1/02-0220.htm>. Ask students to circle any terms they don't understand and to look up definitions for these.

The discussion in class of the article can begin by asking students what terms they have circled and other items they don't understand, and asking class members to contribute their knowledge to “demystify” the article. The Reiter article brings home the idea that public policy should not be made in a vacuum. Sometimes science can show whether a concern is valid or not. Ask students if they are convinced by the arguments in the paper. If not, what further information would they like to have? Use the questions in Part III to help guide the discussion (cf. Answer Key).

Question 5 requires that the instructor provide the students with a table or figure showing the National Institute of Health's projected funding budget for various diseases for the current year. Data for 2007 is available online at <http://www.aas.org/spp/rd/07ptbi9.pdf>. Rather than include that data here, instructors wishing to use this case are directed to the NIH website to pull the most current data for use with this case study.

Students are given a homework assignment (though some instructors may wish to make this a fourth class meeting in-class activity) to design (with artwork and text) three short educational brochures on dengue—one appropriate for primary care physicians, one for recently graduated researchers and intended to encourage them to pursue research in this field, and one appropriate for laypeople who maintain homes or plan to travel into areas where dengue is endemic. Students can begin the work of planning their brochures in class, with the instructor available for consultation. (I think that's important!)

When I teach this case, I post information to my course website, including the following.

- Part I
 1. List of student-generated vocabulary words and brief definitions.
 2. Analysis of data figure and tables discussed in the paper.
- Part II
 1. The students' PowerPoint slides.
 2. Representative outlines—a few of the good ones and a few poorer ones, with helpful comments. The identity of the students is not given. Students are invited to post comments as well.
- Part III
 1. A couple of very good brochures, with the instructor's comments, as well as a couple of poorer efforts, with, hopefully, helpful comments. Again, the identity of the students is not given.

BLOCKS OF ANALYSIS

Dengue

Dengue (pronounced “deng-ee”) is a viral disease transmitted by the bite of an infected mosquito, usually *Aedes aegypti*. It is common in tropical regions, especially Southeast Asia, India, South and Central America and, importantly, Mexico. The United States Centers for Disease Control (CDC) maintains surveillance of dengue, and infections have been reported primarily in the southwestern and southeastern states of the United States. Although dengue epidemics have occurred historically in the Southwest, in recent years infections have been reported most frequently in patients who have recently traveled in Mexico. There is concern that as tourism and modern travel shrink the planet to create

a “global village,” dengue could emerge as a major health problem and societal burden. Although there have been some attempts to connect Mexican immigration with increased incidence of infection in the southwestern U.S., the epidemiological facts do not back up the proposition that recent immigrants pose a major health risk in this respect. In fact, with good mosquito control measures and public hygiene, dengue is seldom seen in the U.S. outside of Puerto Rico, where it is endemic.

Classic dengue fever, or “breakbone fever,” is not life-threatening. Patients develop high fever, severe headaches, and pain in their muscles, along with nausea and vomiting. With care, the worst of the disease passes within seven days, although some lethargy may be felt for several weeks. Palliative care and close attention to hydration comprise management of the disease. However, some patients develop dengue hemorrhagic fever (DHF), which can be fatal. DHF lasts from two to seven days and has the same symptoms as those described above; however, there is also presence of skin hemorrhages, rashes, bleeding nose and gums, and sometimes internal bleeding as capillary walls lose integrity. If enough leakage occurs, circulatory failure and systemic shock may be followed by death. There are four serotypes of dengue virus. Immunity is serotype-specific; therefore, a person may become ill with dengue four separate times despite having an adequate immune response. It is even theorized that previous infection with one serotype may increase risk of progressing from simple dengue to dengue hemorrhagic fever due to the presence of antibodies that are not helpful to clearing the newly encountered serotype, but do contribute to immunopathology, i.e., disease states resulting from hyperactivity of the immune system. Although vaccines are in development, at present there is not an effective vaccine, nor is there a reliable antidote to dengue infection. Therefore, the CDC and the World Health Organization (WHO) emphasize an integrated program, including public education, local health surveillance, palliative care, and, most important, good mosquito control.

All of the information above may be found at <http://www.cdc.gov/ncidod/dvbid/dengue/dengue-hcp.htm>.

ANSWER KEY

Answers to the questions posed in the case study are provided in a separate answer key to the case. Those answers are password-protected. To access the answers for this case, go to [the key](#). You will be prompted for a username and password. If you have not yet registered with us, you can see whether you are eligible for an account by reviewing our [password policy and then apply online](#) or write to answerkey@sciencecases.org.

ASSESSMENT

For the Part I group assignment, the entire group gets the same grade. Students should receive the Presentation Grading Rubric before planning their presentations.

Individual student assignments are generated in Parts II and III:

- Part II—outline assignment
- Part III—brochure homework assignment

I also routinely give a few points for enthusiastic classroom participation and good attendance.

RESOURCES

1. Wagner, D., de With, K., Huzly, D., Hufert, F., Weidmann, M., Breisinger, S., Eppinger, S., Kern, W.V., and Tilman, M.B. 2004. Nosocomial acquisition of dengue. *Emerging Infectious Diseases* 10(10):1872–1873; see <http://www.cdc.gov/ncidod/EID/vol10no10/03-1037.htm>.
2. Neves-Souza, P., Zeredo, E.L., Zagne, S., Valls-de-Souza, R., Reis, S., Cerqueira, D., Nogueira, R., and Kubelka, C.F. 2005. Inducible nitric oxide synthase (iNOS) expression in monocytes during acute dengue fever in patients and during in vitro infection. *BMC Infectious Diseases* 5:64; see <http://www.biomedcentral.com/1471-2334/5/64>.

3. Dengue and Dengue Hemorrhagic Fever: Information for Health Care Practitioners. <http://www.cdc.gov/ncidod/dvbid/dengue/dengue-hcp.htm>. Contains good diagrams/slides and other information about the dengue virus, the mosquito vector, and the infectious strategy of the virus.
4. Better Environmental Management for Control of Dengue, World Health Initiative. <http://www.who.int/heli/risks/vectors/denguecontrol/en/index.html>.
5. Blood Groups and Red Cell Antigens, NCBI. <http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=rbcantigen.chapter.ch1>. Good textbook article on blood and the cells it contains.
6. The White Blood Cell and Differential Count. <http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=cm.chapter.4532> In: *Clinical Methods*, 3rd ed., H. Kenneth Walker et al., Butterworths.
7. Wikipedia has a good article on white blood cells with photographs that will help you see the morphological differences that allow a trained microscopist to determine leukocyte number, lymphocyte number, neutrophil number, etc.—i.e., to make a “differential count” of white blood cells. See: http://en.wikipedia.org/wiki/White_blood_cell.
8. EpiNotes Disease Prevention and Epidemiology Newsletter. South Carolina 2006 List of Reportable Conditions. <http://www.scdhec.gov/health/disease/index.htm>. Students can look at this to get an idea of what the Reportable Disease forms look like, and where dengue sits on the list. Tell them to try to also find sites like this for other southern and southwestern states, which have large Mexican immigrant populations, and Florida, which has large populations of well-traveled retirees.
9. Reiter, P., Lathrop, S., Bunning, M., Biggerstaff, B., Singer, D., Tiwari, T. et al. 2003. Texas lifestyle limits transmission of dengue virus. *Emerging Infectious Diseases* 9(1): 86–89. Available at <http://o-www.cdc.gov.mill1.sjlibrary.org/ncidod/eid/vol9no1/02-0220.htm>.
10. Medline Plus Medical Dictionary at <http://www.nlm.nih.gov/medlineplus/mplusdictionary.html>.
11. PubMed’s Entrez BookShelf, at <http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=Books>, is a free, searchable database of on-line college and medical life science textbooks. In the search box at the top of the page, students can type in their search words (e.g., “ELISA”). Many of the books include downloadable figures, etc., that the students can use in their papers and presentations.

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