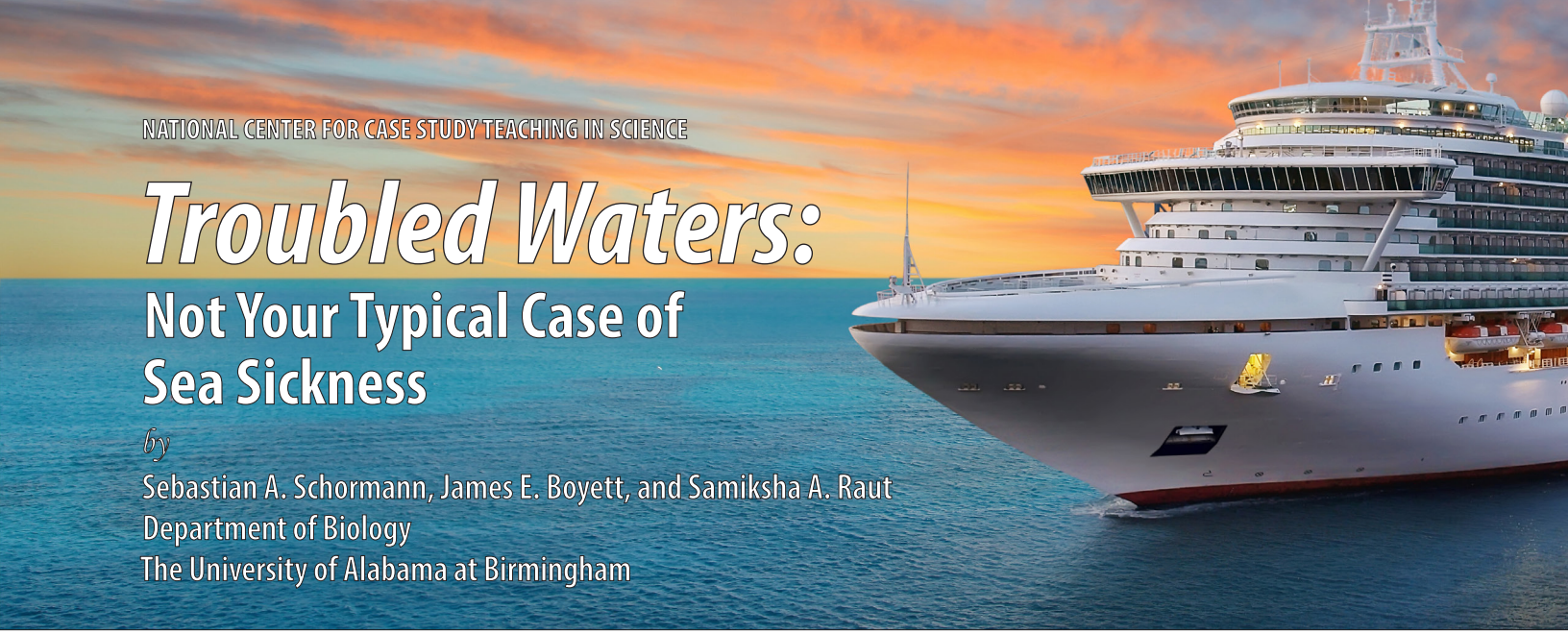

NATIONAL CENTER FOR CASE STUDY TEACHING IN SCIENCE

Troubled Waters:

Not Your Typical Case of Sea Sickness

by

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Part I – Trouble at Sea

Traveling 25 knots per hour on the open seas for the seventh day of a ten-day cruise, Michael was more concentrated on the speed of his next shuffleboard disc. Lining up his shot, Michael propelled a disc. CLACK! Exactly what he wanted. "I told you that spending time in that spa everyday makes you a better player," he grinned.

As Michael began celebrating with his friends, his chest began to tighten, and he found that he could not take in a whole breath. Michael, a lifelong asthmatic, instinctively reached for his albuterol inhaler and shot two puffs into his lungs. What followed was a coughing fit that turned his face red. "Are you okay Michael?" asked his shuffleboard competitor, Peter.

Michael had trouble getting his words out as he whimpered, "Usually ... this inhaler ... works right away."

Growing worried, Peter slapped on his friend's back a couple of times and that seemed to do the trick as Michael coughed up a ball of phlegm. Michael, having long forgotten his shuffleboard game, decided it was better for him to get out of the sea air and head back to his room in the luxury suites. Accompanied by his friend Peter, Michael made it back to his room where he drank some water and got ready for bed.

The next day, Michael woke up with a throbbing headache. "I knew I shouldn't have had that second daquiri yesterday," Michael thought to himself. As he stood up to look at his clock, his muscles felt weak and fatigued. "Please don't tell me I'm getting sick," he muttered.

With heroic effort, Michael made his way to the sick bay to meet with the cruise ship doctor. With no one in front of him in line, Michael quickly got in to see Dr. Shift, who greeted him with, "What brings you in today, Mr. Mathers?"

After Michael recounted his coughing fit, the doctor asked, "Did you notice the color of the mucus that you coughed up?"

Michael thought long and hard before finally admitting, "Sorry, doctor, I did not."

"Hmm. Did you step off at the port two days ago?" asked Dr. Shift.

"Yes, but how is that related to this?" replied Michael.

Dr. Shift took Michael's temperature and listened to his lungs. "Your breathing sounds pretty labored, definitely a discernable rattle," remarked Dr. Shift, "and your temperature is 102 degrees. We don't have the appropriate tests to confirm, nor do we know the color of your mucus, but I believe you're experiencing symptoms of acute viral bronchitis. It's been frequently observed in the region where we docked two days ago. Unfortunately, since it's likely a virus, I don't have any magic pills to give you, but I can prescribe some cough syrup if it continues to bother you."

Relieved, Michael headed back to his room, wondering what kind of shrimp he would grab from the buffet later that day.

Questions

1. Use the following resource and your textbook to describe the signs and symptoms of viral bronchitis.
   - MedlinePlus. (2021). Acute bronchitis [webpage]. National Library of Medicine (US). <https://medlineplus.gov/acutebronchitis.html>

2. Use the following resource to list a few pathogens that appear similar to viral bronchitis in terms of its signs and symptoms.
   - National Center for Immunization and Respiratory Diseases. (2020). Pneumonia [webpage]. Centers for Disease Control and Prevention. <https://www.cdc.gov/pneumonia/index.html>

3. Using your list from Question 2, what tests should Dr. Shift perform to rule out diseases other than viral bronchitis?

Part II – A Sexist Virus?

Michael did not make it to the lunch buffet that day. Instead, the nausea made it hard to hold down what little food he had left in his stomach. That night, when Michael tried to make his way back to the sick bay, he was surprised to see a long line of recognizable faces. Directly ahead of him he saw one of his buddies. "What are you doing here, Peter?" he asked.

"I'm trying to figure that out myself," replied Peter. "Last night, I started to have that same cough that you had except what I coughed up had yellow-green color with some blood in it. In fact, I could hear that same nasty cough rattling from some of the rooms next to me."

"That's weird! Maybe it's something else because at least you haven't thrown up yet!" At that moment, George, the retiree ahead of Peter with whom Michael had frequently conversed about the stock market, ran out of the line towards the trash and proceeded to lose his lunch.

The worried nurse working at the front desk ran inside to inform Dr. Shift. Immediately, Dr. Shift burst out of the room. "We do not have enough staff to handle all these patients!" Just a few minutes later, the ship's overhead communication made an emergency announcement: "Alert! Alert! The ship will be making way toward the nearest port immediately."

After docking, Michael looked outside and saw ambulances ready to transport him and his shipmates to the hospital. Taking another look at who was being evacuated, he saw George, Nicolás, Krish, Eli; these were people he had been spending time with on the cruise. As he looked around bewildered, he found Peter again. "Peter, did you notice that everyone who got sick is male?"

Questions

1. Do the new signs and symptoms match Dr. Shift's original diagnosis of viral bronchitis? If not, list some pathogens that fit the signs and symptoms

2. Why do you think that this disease may be selectively affecting males?

Part III – Mayday Received

Upon arriving at Mercy Hospital, Michael informed the doctor of his symptoms and described how his male companions exhibited the exact same symptoms. The doctor briefly examined Michael, and after taking notes of his signs, he placed orders for various lab tests. The results were as follows:

Table 1. Imaging and Diagnostics

Chest X-Ray	Pneumonia with consolidation in lower portion of both lungs
Direct Microscopy of Sputum	A Gram-negative coccobacillus
Differential White Blood Cell Count	Elevated neutrophils, no presence of bacteria in the blood
Urinary Antigen	Positive for *Legionella pneumophila*

"It would appear that you and your shipmates are positive for Legionnaire's disease," remarked the doctor.

"Like as in the Roman Legions?" asked Michael.

The doctor replied, "Haha, good guess, but not quite. It's actually named after the American Legion, where the first outbreak occurred at a meeting in 1976 in Philadelphia."

Michael asked, "Does it affect only males?"

"Well, not necessarily," replied the doctor. "In your case, however, the bacteria must have been located in a place that only males had access to. It was probably somewhere it could establish a biofilm on, such as a filter or piping."

Michael thought a moment and then asked, "What is a biofilm?"

The doctor replied, "Well, a biofilm is a layered gathering of a variety of microorganisms to help protect the bacteria inside. You see, one can expect to find biofilms from plaque sticking to one's teeth to bacteria on a slimy coating on rocks in streams to even the gunk inside a pipe that is connected to your sink." He looked at Michaels chart for a moment, and then continued. "This bacterium primarily affects those individuals who have compromised immune systems. A healthy individual may inhale the bacteria but never even show any characteristic signs of Legionellosis."

"What do you mean? I wasn't feeling sick earlier!" Michael interjected.

"True, but you do have asthma," the doctor explained. "Immune compromised doesn't mean you have another infection; it's just that you are less able to fight off infection. You know, this could also include individuals who are elderly, with any existing pre-existing conditions, or who have an infection or have smoked for a significant number of years in their lives."

Questions

1. Answer the following questions using the results from Table 1.
   a. List possible pathogens that cause pneumonia.

   b. How would you describe the shape of the bacteria found in Michael's sputum sample?

   c. What could be inferred about the functional anatomy of the bacterium when it is described as Gram negative?

d. What is a differential white blood cell count?

e. What can you conclude from the elevated neutrophils as indicated in the differential white blood cell count?

f. What does a positive antigen test indicate?

2. Using the following links and Michael's laboratory test results shown in Table 1, do you think he had Legionnaires' disease or Pontiac fever? Explain.
   - National Center for Immunization and Respiratory Diseases, Division of Bacterial Diseases. (2021). *Legionella* (Legionnaires' disease and Pontiac fever) [webpage]. Centers for Disease Control and Prevention. <https://www.cdc.gov/legionella/index.html>
   - MedlinePlus. (2021). Legionnaires' disease [webpage]. National Library of Medicine (US). <https://medlineplus.gov/legionnairesdisease.html>

3. Using your hypothesis from Question 2 in Part II, predict how the passengers would have encountered the bacterium and comment on its mode of transmission.

4. What is a biofilm?

5. Can Legionnaires' disease be classified as a "communicable disease"? Justify your answer.

Part IV – The Calming Tides

"Finally! The last of the antibiotic," Michael exclaimed.

"You act like it's been forever. How long have you been taking those things anyway?" asked Jennifer, Michael's roommate back home.

"Man, it feels like forever… It's been three whole weeks. Ugh!" explained Michael.

"At least it's over, right? And, you got two free cruises out of it," said Jennifer.

"It is, but I don't know if I ever want to go on a cruise again."

"Well if you're not going to use it, the least you could do is give them to me. Especially since you didn't even take me on the last one."

"Yeah, yeah, yeah, I know, I should have brought my microbiologist friend and then this wouldn't have happened. Maybe once the ship has been recommissioned and I can stand the smell of sun tan lotion and daiquiri again, then we can go," said Michael sheepishly.