It's All Negative: A Case Study in Antibiotic Resistance

Antibiotics are drugs used to treat bacterial infections. The use of antibiotics has had a huge impact on human health in terms of infectious disease. Unfortunately, their overuse has led to the selection of bacteria that are resistant to the antibiotics that once controlled them. Antibiotic resistance is a major public health threat. The CDC states that in 2019, there were more than 2.8 million antibiotic resistant infections in the US, resulting in as many as 35,000 deaths or more. The problem continues to grow as antibiotics are overused in both human and animal settings, and as research into new antibiotics lags behind the emergence of antibiotic resistance. The CRE (Carbapenem Resistant *Enterobacterales*) are a group of antibiotic Gram-negative bacteria that are resistant to many drugs, including the carbapenem class of antibiotics. Once very rare, these bacteria have been identified in 42 states.

Scenario part 1:

Sarah has not been feeling well and has made an appointment with her primary care physician. For the past two days, Sarah has been experiencing frequent urination and some pain and burning while urinating.

In your group, answer the following questions.

1. What disease or infection do Sarah's symptoms point to?

2. After hearing of Sarah's symptoms, what do you think the doctor's next step would be?

Scenario part 2:

Sarah's doctor decides to run a urinalysis on site and receives the following results.

Urinalysis test run	Normal range	Patient range
Color	Pale yellow to amber Clear	Yellow Slightly cloudy
pH	4.5 - 8	6.2
RBC (red blood cells)	<5	4
WBC (white blood cells)	<5	11
Bacteria	absent	+4
Leukocyte esterase	absent	Positive
Nitrites	absent	Positive

In your group, please answer the following questions:

1. Do the urinalysis results support your group's initial diagnosis?

2. Which test results supported your diagnosis, and explain what these tests are indicating?

3. What do you believe the next step will be? If a medication is part of your answer, which medications are commonly given at this point in diagnosis?

4. Which bacteria are often associated with this type of infection?

Scenario part 3:

Sarah is seeing her physician for the second time. She was diagnosed with a urinary tract infection 5 days ago and was prescribed amoxicillin. Amoxicillin does not appear to be working. A urinalysis was performed again, and her urine is still showing signs of infection. She now also has abnormal levels of RBCs in her urine, and her urine had a somewhat pale pink appearance.

1. Based on what we've been learning in class/lab, what do you believe is going on here? Why do you believe Sarah is not responding to the drug?

2. Based on what we've been learning, what do you believe the doctor will do next?

Scenario part 4:

The doctor has sent off Sarah's urine for culture to determine what bacteria is causing this infection. As a lab technician, you streak the urine sample for isolation and obtain bacterial colonies. The bacteria causing this infection is one of the bacteria from your list we've been working on in lab.

1. After doing some research, which of the bacteria from the list are good candidates for causing a uti (there may be more than one)?

2. What is your first step in identifying this bacteria? Once your group has an answer, call over the instructor to confirm and to provide the result.

3. What did the results of this test tell you? Was it expected based on your answer to #1? Does this test help you narrow down your possibilities? Which bacteria could be responsible? Explain your answer.

4. To help confirm this, what would you want to do next? Why? Once you have an answer, let your instructor know so she can give you the result?

5. What did the result tell you? Is there any other test you would like to run before drawing a preliminary conclusion? Explain your answer. Call over the instructor for results (if need be).

6. Which bacteria is causing the infection? What lines of evidence do you have for this answer?

7. Based on what we've learned, what would you want to do before prescribing another antibiotic?

Scenario part 5:

Fortunately, Sarah's doctor had already ordered a Kirby-Bauer test to determine which antibiotics would be most effective for Sarah's infection. Your instructor will hand out the results for analysis. Use a ruler to measure the zones of inhibition for the four antibiotics used on Sarah's culture. Use the Interpretation table to determine the resistance or susceptibility of the culture to each antibiotic.

1. Were any of the antibiotics effective against this bacterium? If so, which one(s)? Explain your answer?

2. What do these results tell you about this bacterium? Can your group think of what might need to be done next?

3. What is the impact of these results on the patient? How does this relate to what we have been learning in class/lab?