iCEV Medical Microbiology

Knowledge and Skill Statement	Student Expectation	Breakout	iCEV Citation			
			Narrative/Activity	Type of Citation (New Content/New Citation)	Lesson Name	New Location
(2) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:	(F) organize quantitative and qualitative data using equipment such as graphing calculator, computer software and probes, graphic organizers;	(ii) organize qualitative data using equipment	Activity	New Content	Culturing Techniques	Lab Activity- Culturing Microbes
(4) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;	(iv) develop explanations supported by models and consistent with scientific ideas	Activity	New Content	Developing a Model: Medical Microbiology	Activity- Models Explanation Infographic
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(4) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:	(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and	(i) communicate explanations individually in a variety of settings	Narrative	New Content	Professionalism in the Sciences: Medical Microbiology	Student Handout- Communication Strategies
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(7) The student is expected to perform and analyze results in the microbiology laboratory. The student is expected to:	(I) interpret and explain the role of the culture and sensitivity report provided to the clinician.	(i) interpret the role of the culture report provided to the clinician	Narrative	New Citation	Evaluating Antimicrobial Agents	Student Handout- Role of Culture & Sensitivity Reports
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Culturing Microbes

Activity Overview:
You will culture a microbe using the T-streak method and quadrant streak method.

Directions:

1. Obtain the following materials:
    - Gloves and lab coat
    - Permanent marker
    - Two media plates
    - Inoculating loop
    - Bacteria culture

2. Put on gloves and lab coat.

3. Label the bottom of each plate with your name and any other information required by your instructor.

4. Draw the T-streak pattern on the bottom of one plate and the quadrant streak method on the bottom of the other plate.

5. Answer Activity Question 1 on the following page.

6. Sterilize the inoculation loop by passing it through the Bunsen burner until the metal is orange.

6. Allow the inoculation loop to cool. Be sure it does not touch any surface.

7. Use the inoculation loop to scoop up a small amount of the bacteria sample.

8. Open the T-streak media plate just enough to access the agar. Perform a T-streak inoculation using good aseptic technique and sterilizing your loop between each streak.

9. Open the quadrant streak media plate just enough to access the agar. Perform a quadrant streak inoculation using good aseptic technique and sterilize your loop between each streak.

10. Follow your instructor's directions to place both plates in the incubator at 37ºC with the lids down.

11. Answer the remaining activity questions to record qualitative data about your cultures through observations and notes.

Culturing Microbes

Activity Questions:

1. Describe how the medium appears before the microbe is cultured.

2. Describe how the medium appears after the microbe is cultured.

3. Identify any possible contamination concerns that may have occurred during culturing.

4. Describe how the agar appears 24 hours after the microbe is cultured.

5. Describe how the agar appears 48 hours after the microbe is cultured.

6. What inferences can you make based on the data and descriptions you have compiled?

Model Explanation Infographic

Project Overview:

In groups, you will choose a medical microbiology topic and research models relevant to medical microbiology to help develop explanations of the topic based on scientific ideas, principles and theories.

Directions:

1. Your instructor will divide the class into groups of five.

2. In your group, select one of the topics from the following list:
   - Antibiotic resistance
   - Immune response to infection
   - Disease transmission
   - Vaccine development
   - Reemerging infectious diseases

3. Based on the topic selected, use the internet to research models which relate to the topic and how the model is supported by scientific ideas, principles and theories.

4. Develop an infographic which details your findings which can be printed or shared digitally to ensure it can be used in a variety of formats. The infographic should contain at least the following information:
   - name of topic chosen
   - an explanation of the topic based on at least one model found relating to the topic
   - at least two supports of the model from either accepted scientific ideas, principles or theories

5. Turn in your completed activity according to your instructor's directions.

Proposing Solutions

Proposing solutions to medical microbiology problems often involves analyzing and interpreting data collected from various sources. A basic approach to utilizing data to propose solutions can include the following processes:

Data Collection:
Gather relevant data from various sources such as research studies, clinical trials, epidemiological surveillance, patient records, and public health databases. The data may include information on microbial pathogens, host responses, treatment outcomes, resistance patterns, epidemiological trends, and diagnostic test results.

Data Analysis:
Analyze the collected data using appropriate statistical and computational methods. This may involve identifying trends, patterns, associations, and correlations within the data. Use tools such as data visualization techniques, statistical tests, and modeling approaches to gain insights from the data.

Identify Patterns & Gaps:
Look for patterns or trends in the data that may provide insights into the underlying problem. Identify gaps in knowledge or areas where the data is insufficient to fully address the problem. For example, if antibiotic resistance is a concern, analyze resistance patterns, identify the most common resistant pathogens, and assess factors contributing to resistance development.

Identify Potential Solutions:
Based on data analysis, propose potential solutions to address the identified problem. Consider evidence-based interventions, strategies, or innovations aligning with the data findings, scientific ideas, principles and theories. For example, if data analysis reveals a rise in a specific antibiotic-resistant strain, propose interventions like antibiotic management programs, development of new drugs, or infection control measures to combat the spread of the resistant strain.

Models can be used to optimize diagnostic testing strategies for infectious diseases. By incorporating test characteristics such as sensitivity or specificity and disease prevalence, models can assess the performance and cost-effectiveness of different testing approaches. This information can guide decisions on test selection, screening procedures, and resource allocation for diagnostic testing. Proposed solutions should be evaluated and validated through real-world studies and trials as well as scientific ideas, principles and theories to ensure their effectiveness and feasibility.

Consider Multidisciplinary Approaches:
Medical microbiology problems often require multidisciplinary approaches. Collaborate with experts from various fields, such as microbiologists, immunologists,

epidemiologists, clinicians, and public health professionals, to develop comprehensive solutions. Incorporate diverse perspectives and expertise to ensure the proposed solutions are well-rounded and effective.

Evaluate Feasibility & Impact:
Assess the feasibility and potential impact of the proposed solutions. Consider factors such as cost, resources, scalability, ethical implications, and the potential for implementation in real-world settings. Conduct cost-effectiveness analyses or modeling studies to evaluate the potential impact of the proposed solutions on disease outcomes or public health.

Iterative Approach:
Proposing solutions based on data is a repetitive process. Continuously gather new data, update analyses, and refine solutions based on emerging evidence and feedback. The field of medical microbiology is dynamic, and new insights may lead to further modifications or alternative solutions over time.

Remember, proposing solutions to medical microbiology problems requires a rigorous and evidence-based approach. Data analysis plays a crucial role in understanding the problem, identifying potential solutions, and informing decision-making.

Communication Strategies

Communicating scientific explanations and solutions in a variety of formats is crucial for reaching diverse audiences and effectively conveying complex information. Some of the most common formats include:

Scientific Papers:
Publishing research findings and solutions in scientific journals allows for in-depth, peer-reviewed communication within the scientific community. This format typically follows a structured format, including an abstract, introduction, methods, results, discussion, and conclusion sections. Research is typically conducted by a team and requires collaboration and review throughout the initial writing of the paper and through the official peer-review process.

Presentations:
Oral presentations, such as talks at conferences or seminars, provide an opportunity to share scientific findings, explanations and solutions with a live audience. These presentations often use slides or visual aids to support the delivery of information and may include data, graphs, and illustrations.

Posters:
Poster presentations are commonly used at conferences and scientific meetings. Posters allow for visual representation of scientific findings, explanations and solutions through a combination of text, figures, and graphs. Posters are effective for summarizing research findings and facilitating discussions with peers.

Infographics:
Infographics are visual representations that use a combination of text, icons, images, and charts to convey scientific information in a concise and engaging manner. They are useful for simplifying complex concepts, presenting data, and highlighting key findings or solutions.

Scientific Reports & Summaries:
Creating reports or summaries targeted at policymakers, stakeholders, or the general public is an effective way to communicate scientific explanations and solutions in a clear and accessible manner. These documents should include an overview of the problem, the scientific basis, and evidence supporting the proposed solutions.

Websites & Blogs:
Developing websites or blogs dedicated to scientific explanations and solutions allows for the dissemination of information to a wider audience. These platforms can include articles, case studies, FAQs, and interactive content to engage readers and provide access to scientific resources.

Videos & Animations:
Creating videos or animations can be an engaging way to communicate scientific explanations and solutions. These formats can combine visual elements, narration, and graphics to simplify complex concepts and enhance understanding.

Social Media & Podcasts:
Utilizing social media platforms and podcasts can help reach broader audiences and share scientific information in a more accessible and digestible format. These mediums allow for shorter, concise explanations, discussions, and interviews with experts.

Press Releases:
Developing press releases can effectively communicate scientific explanations and solutions to journalists and the media. These documents should highlight the significance of the research or proposed solutions and emphasize key findings in a language accessible to non-experts.

Public Talks & Outreach Events:
Engaging in public talks, workshops, or outreach events allows for direct interaction with the public and provides an opportunity to explain scientific concepts, present research findings, and discuss potential solutions to scientific problems. Often times these talks and events allow for individuals to communicate with a diverse audience and answer questions to further explain their findings, explanations and solutions.

Adapting scientific explanations and solutions to various formats ensures information is accessible, engaging, and relevant to different audiences, including scientists, policymakers, stakeholders, and the general public. It is important to tailor the content, language, and visuals to suit the specific format and target audience, promoting effective communication and understanding.

Designing Solutions

Activity Overview:

You will consider a problem or issue in the field of medical microbiology in order to design a solution for the issue.

Directions:

1. Use the internet and other resources to locate a problem or issue in the field of medical microbiology. Be sure to check in with your instructor to have your chosen issue approved and record the problem in the space provided.

2. Research and list, in the space provided, three possible solutions to the problem.

3. Choose one solution from the list and detail how the solution can be implemented. This could include sketches of models, detailed processes or precise procedures.

4. Write a description of your solution and propose how it will help solve the issue identified in step one. The description can be presented either as a document, infographic, short presentation or other format which makes sense to communicate the solution.

5. Form small groups according to your instructor's directions, and share the identified problem and possible solution.

6. Based on your group's discussion, incorporate any feedback you received from the group into your description.

7. Turn in your completed activity as directed.

Proposed Problem:

Write out the problem you are choosing to address.

Possible Solutions:

1.

2.

3.

Proposed Solution Details:

Proposed Solution Explanation:

Role of Culture & Sensitivity Reports

Culture Reports

Culture reports play a crucial role in providing valuable information to clinicians regarding the presence and characteristics of microorganisms in a patient's specimen. The report is generated by the microbiology laboratory after performing a culture test on the patient's sample, such as blood, urine, sputum, or wound swab.

Culture reports typically include the following components:

- Identification of Isolates
    - The culture report identifies the microorganisms isolated from the patient's sample. It specifies the genus and species of bacteria, fungi, or other microorganisms present. This information helps the clinician understand the specific pathogen causing the infection or the microbiota composition in certain cases.
- Quantification
    - The culture report may provide information on the number or quantity of microorganisms isolated. This quantification can help assess the severity of the infection or determine if the isolated organism is likely to be a contaminant or a true pathogen.
- Susceptibility Testing
    - In many cases, the culture report includes antimicrobial susceptibility testing results for the isolated organisms. This information guides clinicians in selecting the most appropriate antibiotic therapy by indicating which drugs are effective against the identified pathogens and which ones may be ineffective due to resistance.
- Additional Characteristics
    - Depending on the type of infection and the laboratory's capabilities, the culture report may provide additional information about the isolated organisms such as details about their growth characteristics, biochemical reactions, or other relevant traits to aid in their identification and further characterization.

Interpreting the culture report is an important step for clinicians in making informed decisions regarding patient management. The report helps guide appropriate antibiotic selection, dosing, and duration of therapy. It also aids in distinguishing between colonization and true infection, assisting in the diagnosis and subsequent treatment planning.

Clinicians need to carefully review and interpret the culture report in the context of the patient's clinical presentation, medical history and other diagnostic findings. Clinicians consider factors such as the pathogenic potential of the isolated organism, the site of infection, the patient's immune status, and local resistance patterns when making

treatment decisions.

The culture report provides a snapshot of the microorganisms present in the patient's sample at the time of testing. It may take several days for the laboratory to complete the culture and sensitivity testing, and during this time, the clinician may need to initiate empiric antibiotic therapy based on clinical judgment before receiving the final report.

Effective communication between the clinician and the microbiology laboratory is essential to ensure a clear understanding of the culture report findings and to address any questions or concerns. Collaboration between the clinician and the laboratory team facilitates optimal patient care by integrating microbiological information into the overall clinical management of the patient.

Sensitivity Reports

Sensitivity reports, also known as the antimicrobial susceptibility report or antibiotic sensitivity report, are a critical component of the laboratory culture report provided to the clinician. Sensitivity reports provide information on the susceptibility or resistance of the isolated microorganism(s) to various antibiotics. The sensitivity report plays a crucial role in guiding the clinician's decision-making regarding antibiotic therapy for the patient.

Key aspects and roles of the sensitivity report include:

- Antibiotic Susceptibility Testing
    - The sensitivity report presents the results of antimicrobial susceptibility testing conducted on isolated microorganisms. This testing involves exposing the organisms to different antibiotics to determine their response. The report indicates whether the microorganism is susceptible, intermediate, or resistant to each tested antibiotic.
- Treatment Selection
    - The sensitivity report helps clinicians choose the most effective antibiotic(s) for treating the infection. The report provides information on which antibiotics are likely to inhibit the growth of the isolated organism. Clinicians select antibiotics to which the microorganism is susceptible, as this increases the likelihood of successful treatment.
- Resistance Patterns
    - The sensitivity report reveals the resistance patterns of the microorganisms, indicating which antibiotics the organisms are resistant to. This information is crucial for avoiding ineffective antibiotic choices that may contribute to treatment failure or the development of further antibiotic resistance.
- Treatment Optimization
    - The sensitivity report assists the clinician in tailoring antibiotic therapy to the specific needs of the patient. It helps in selecting the appropriate dosage, route of administration, and duration of treatment based on the

susceptibility patterns of the isolated microorganisms. This helps optimize treatment outcomes while minimizing the risk of adverse effects and the development of resistance.

- Clinical Decision Support
  - The sensitivity report provides evidence-based information to support clinical decision-making. It enables the clinician to make informed choices regarding antibiotic therapy, considering local resistance patterns, patient factors (such as allergies or comorbidities), and the severity of the infection.
- Monitoring Resistance Trends
  - Sensitivity reports also play a role in monitoring and detecting trends in antimicrobial resistance patterns. By gathering and analyzing susceptibility data over time, healthcare facilities and public health agencies can identify emerging resistance trends and develop appropriate strategies for infection control and antimicrobial stewardship.

It is important for clinicians to review the sensitivity report in conjunction with the culture report and consider the clinical context of the patient. Factors such as the site of infection, patient characteristics, local resistance patterns, and antibiotic pharmacokinetics should be considered when interpreting the report and making treatment decisions.

Regular communication and collaboration between the clinician and the microbiology laboratory are essential to understand the sensitivity report findings, clarify any uncertainties, and ensure optimal patient care.