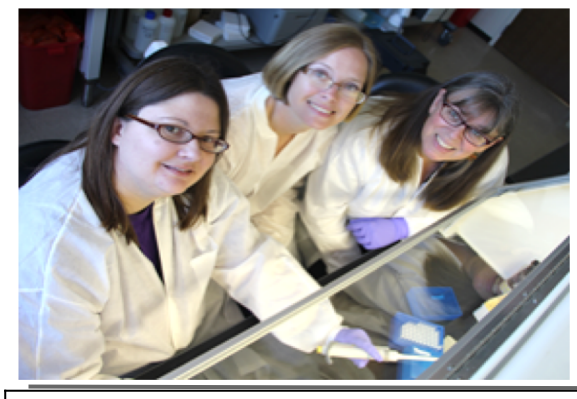
SHL Outbreak Investigation



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Part I: Overview of Business

In operation since 1904 with focus on testing for typhoid, diphtheria, rabies and TB, the State Hygienic lab continues to have a mission to protect and improve quality of life providing reliable environmental and public health information to all 99 counties in Iowa.

Today, services encompass response to and surveillance of infectious disease threats; preparedness for bioterrorism or chemical threats; environmental monitoring of waterways and drinking water; newborn and maternal screening; and educational training and outreach.

Part II: Job Specifics

Microbiology/Environmental Microbiology

- Isolate pathogens and confirmatory testing/surveillance of pathogens from patient blood, stool, urine, sputum samples; and food and water samples respectively
- Polymerase Chain Reaction (PCR)
- Pulse Field Gel Electrophoresis (PFGE)
- Maldi - TOF Mass Spectrometry
- Whole Genome Sequencing (WGS)

DNA fingerprint is sent to the PulseNet surveillance system database. Lab personnel work with epidemiologists, CDC, and others, to confirm suspected outbreaks.

Part III: Introduce the Problem

An outbreak has occurred! As CDC epidemiologists and SHL Technicians, you are tasked with identifying the source of the outbreak and determining, through PCR simulation, which additional patient might have been part of the outbreak.

To ensure early detection and identification of future outbreaks, you will examine the advances in surveillance systems and consider how best to address pathogenic mutations that result in antibiotic resistance.

Part IV: Background

Students will have completed the following:

- Pathogens & disease transmission
- Microbe Characteristics (emphasis on bacteria)
- Bacterial Gram Stain Lab
- Outbreak Research & Health Inspector Mini PBL

Resources for Activity:

Hedging your Bets - Outbreak simulation
https://www.cdc.gov/careerpaths/scienceambassador/documents/hs_hedging-your-bets-2016.pdf

Bacterial Id. - PCR & DNA Sequencing Virtual Lab
http://www.hhmi.org/biointeractive/bacterial-identification-virtual-lab

The Story of PulseNet
https://www.cdc.gov/pulsenet/index.html

Part V: Business Solution

In an outbreak, the SHL would characterize the pathogen using culturing, PCR, PFGE, and WGS. The DNA fingerprint would be submitted to PulseNet for surveillance purposes and in order to determine matches. SHL personnel would work with Epidemiologists and the CDC. If a common source is available, ex. food, the environmental microbiology lab technicians would additionally culture it to isolate the pathogen and determine if there is a match between the patient sample and the prospective source. The SHL is also part of the Food Emergency Response Network (FERN), completing surveillance food testing to ensure safe food sources.

Part VI: Student Solutions

- Identification of various positions of employment in the pipeline required to solve an outbreak problem
- Determination of a simulation outbreak source through data analysis
- Understanding of PCR, and use of simulation to identify an additional patient who may be part of the outbreak and might warrant further investigation
- Recognition of the importance of advanced means of surveillance. Questions - What are the advantages of PulseNet moving toward WGS? Why might it continue to be important to use more "traditional" methods of bacterial identification/characterization?

Follow up

- Job Description & Sharing of Outbreak "players" (Health Inspector, Lab Technicians; Epidemiologist, Doctor, CDC, Bioinformatics specialist)
- Antibiotic Resistance Lab
- CDC Antibiotic Resistance Surveillance