Group 1: Pathogen Identification and Diagnostics

Scenario

A cluster of severe, atypical respiratory infections has been reported at Atrium Health Wake Forest Baptist hospital. Initial PCR panels rule out common seasonal pathogens. The patient reports having visited a local farm market where they purchased a live chicken.

Your Role

You are responsible for taking specimens collected by the field team and identifying the pathogen causing the outbreak.

Objective: Identify the pathogen within the time and budget allotted. You have **48 hours** and a limited budget.

Diagnostics Available

Diagnostic	Description	Cost	Time
Culture	Bacterial culture	$500	2 hours
PCR	Multiplex PCR	$2,000	4 hours
EM	Electron microscopy	$5,000	8 hours
WGS	Metagenomic whole-genome sequencing	$15,000	24 hours

Questions to Answer

1. Did you identify the pathogen?
2. What kind of constraints did you operate with?
3. Did all of the specimens test positive? Why or why not?
4. Were specimens testing positive for multiple things?

Group 2: Testing Response Team

Scenario

A cluster of severe, atypical respiratory infections has been reported at Atrium Health Wake Forest Baptist hospital. Initial PCR panels rule out common seasonal pathogens. The patient reports having visited a local farm market where they purchased a live chicken.

Your Role

You are responsible for designing the testing plan for the outbreak response.

Objective: Maximize testing coverage within the budget, minimize false negatives and false positives, and limit the response time to 21 days.

Testing Options

You can select any combination of diagnostics to deploy, but you need staff to run the tests.

Diagnostic	Sensitivity	Specificity	Cost	Throughput
PCR	95%	99%	$50	∼10/hr
LAMP	85%	95%	$10	∼21/hr
RAT	70%	97%	$5	∼42/hr

Questions to Answer

1. What was the optimum configuration given your budget? How long would it take to deploy?
2. How did the assay choice impact your testing coverage, cost, and timeline?
3. What do you think the consequences of false negatives and false positives would be in a response?
4. If money were no object, how much would it cost to use all of each type of test?

Group 3: Medical Countermeasures Team

Scenario

A cluster of severe, atypical respiratory infections has been reported at Atrium Health Wake Forest Baptist hospital. Initial PCR panels rule out common seasonal pathogens. The patient reports having visited a local farm market where they purchased a live chicken.

Your Role

You must decide which therapeutics to deploy during the outbreak.

Objective: Minimize the peak number hospitalized and the total number who die from infection.

Resources Available

Vaccines:

- Cost: $10 per dose; capacity: 5,000 per day.
- Takes 14 days to arrive from the national strategic stockpile.
- Requires technicians at $10 per hour each.

Antivirals:

- Can be given to 10,000 people per day.
- Reduces symptom duration by 50%.
- Can induce selective pressure for resistance.

Questions to Answer

1. Set vaccine technicians to 0. Note the peak hospitalized and total deaths.
2. Note the day of peak infections with and without antivirals.
3. What happens to peak hospitalizations and deaths when you add antivirals? What else happens?
4. If you deploy vaccinations, what happens?
5. Explore the simulator to come up with a reasonable budget request to the mayor.
6. What would the price per vaccine need to be if you had 20 technicians to reduce peak infections by 50%?

Group 4: Animal Field Team (APHIS)

Scenario

A cluster of severe, atypical respiratory infections has been reported at Atrium Health Wake Forest Baptist hospital. Initial PCR panels rule out common seasonal pathogens. The patient reports having visited a local farm market where they purchased a live chicken.

Your Role

You represent the Animal and Plant Health Inspection Service (APHIS) and are responsible for controlling the outbreak among the animal population.

Objective: Balance culling versus vaccination (or some combination) to minimize the number of birds culled, minimize cost, and stop the spread.

Key Information

- Broilers can be sold for $5 each.
- Vaccination costs $1 per bird but takes several days per farm due to personnel limitations.
- Culling in a ring sacrifices healthy birds to prevent onward spread.
- USDA reimburses farmers $3 per sacrificed bird (net loss of $2 per bird for the farmer; $3 cost to the taxpayer).

Questions to Answer

1. What strategies were most successful in stopping the outbreak?
2. What was the lowest cost strategy overall?
3. What were some of the challenges with the different control options (vaccination, culling, cull ring size)?
4. What do you wish you could do?

Group 5: Field Epidemiology Team

Scenario

A cluster of severe, atypical respiratory infections has been reported at Atrium Health Wake Forest Baptist hospital. Initial PCR panels rule out common seasonal pathogens. The patient reports having visited a local farm market where they purchased a live chicken.

Your Role

You are responsible for conducting an epidemiological survey to map potential exposure sites and characterize the transmission chain.

Objective: Characterize the transmission chain of the pathogen.

Operational Constraints

- **Budget:** You have limited funds, staffing, and resources.
- **Time:** The outbreak clock advances with every action.
- **Decay:** Viral shedding in animals ceases over time. Environmental RNA degrades rapidly. Act quickly.

Your Mission

1. Open the interactive HTML simulator.
2. Conduct an epidemiological survey to map potential exposure sites.
3. Balance your budget to collect virological samples across locations.
4. Generate the phylogenetic tree to visualize the transmission chain.
5. Download the FASTA sequences and calculate your genetic distance matrix using the Jukes–Cantor model: $d = -\frac{3}{4} \ln\left(1 - \frac{4}{3}p\right)$

Questions to Answer

1. What was the most cost-effective strategy for finding exposure sites?
2. What was the least cost-effective strategy?
3. What were some of the challenges with the different survey options?
4. How would we use this information during this outbreak and beyond?