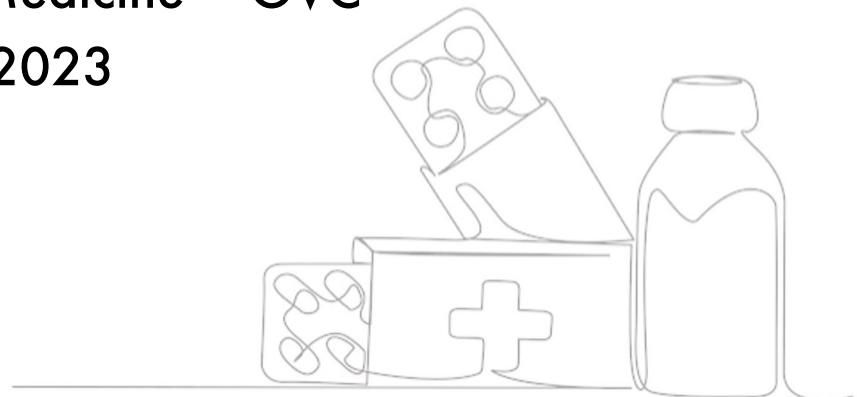
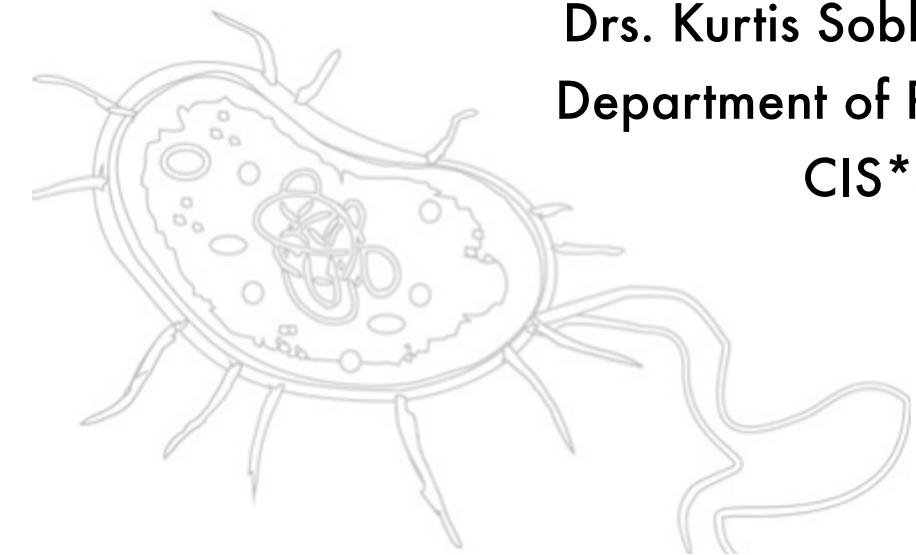


Antimicrobial Resistance (AMR)

Drs. Kurtis Sobkowich & Theresa Bernardo

Department of Population Medicine – OVC

CIS*4020 - Fall 2023





Kurtis Sobkowich



Dan Gillis



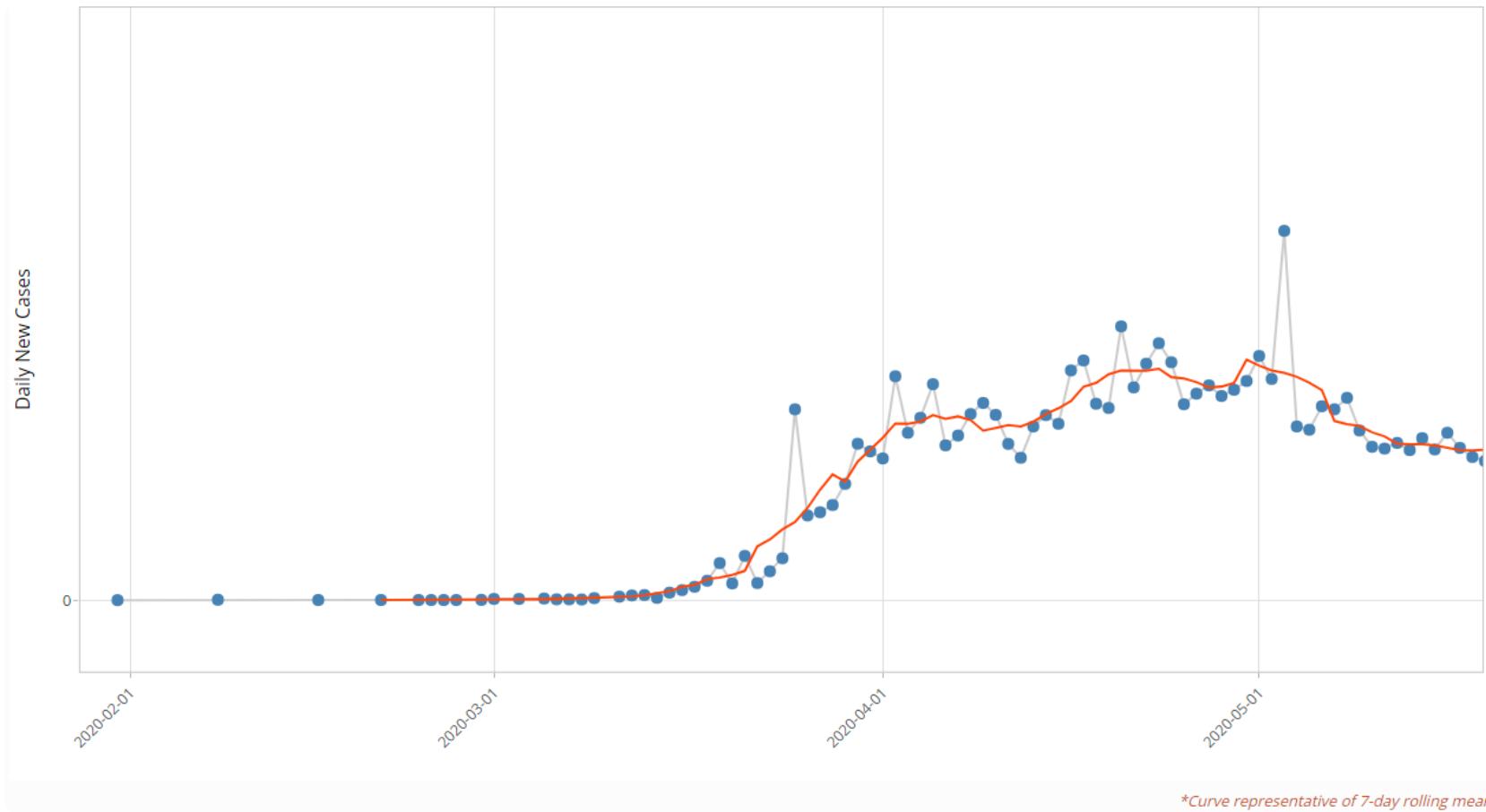
Theresa Bernardo



Areas in Canada with cases of COVID-19 as of March 13, 2020, 2:30 pm

Province, territory or other	Number of confirmed cases	Number of probable cases
British Columbia	53	0
Alberta	23	0
Saskatchewan	0	1
Manitoba	1	2
Ontario	79	0
Quebec	17	0
New Brunswick	1	0
Repatriated travellers	2	0
Total cases	176	3

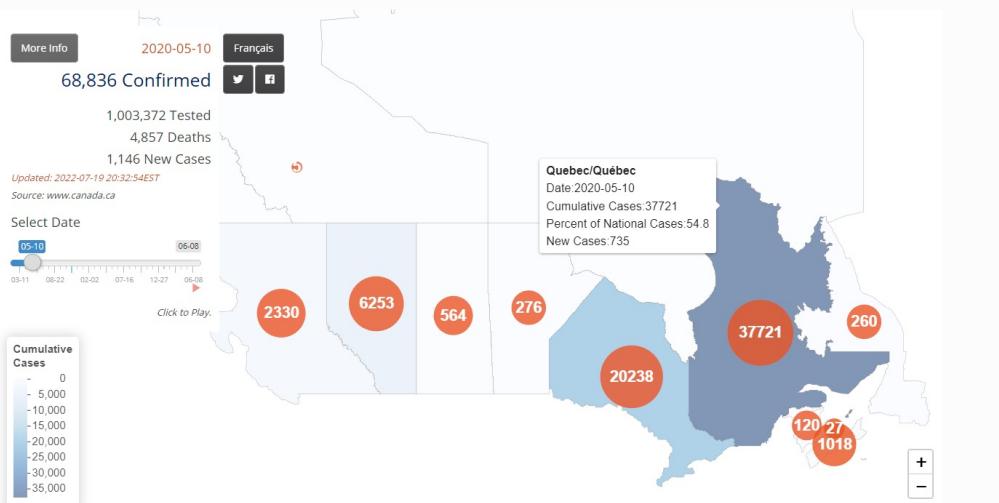
Canadian Epidemic Curve



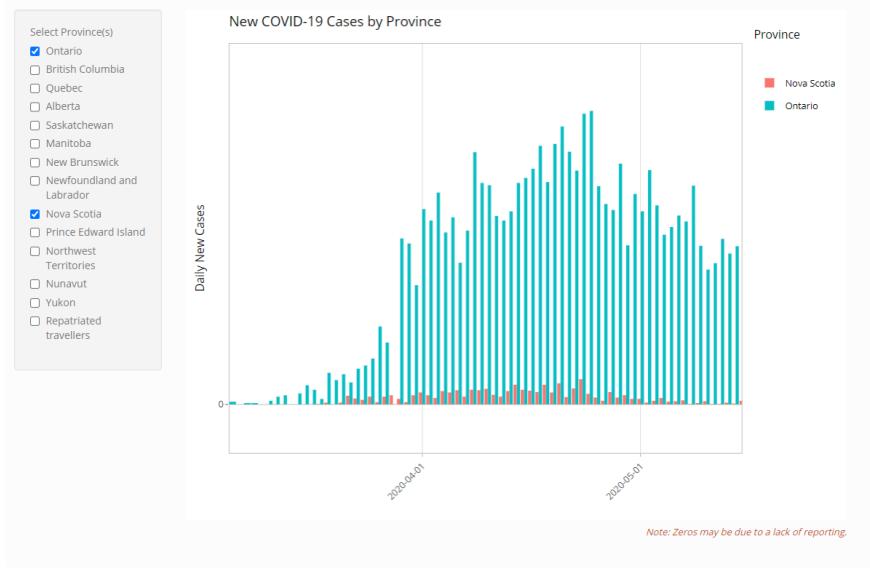


Monitoring COVID-19 in Canada

Monitoring COVID-19 in Canada | Map | Daily New Cases | Cumulative Cases | Mortality | Statistics | Data | About



Monitoring COVID-19 in Canada | Map | **Daily New Cases** | Cumulative Cases | Mortality | Statistics | Data | About

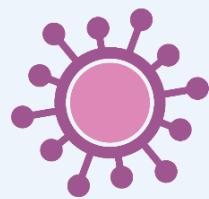




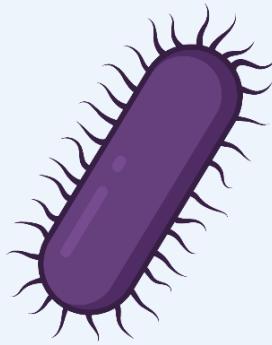
Introduction to AMR

(Anti-Microbial Resistance)

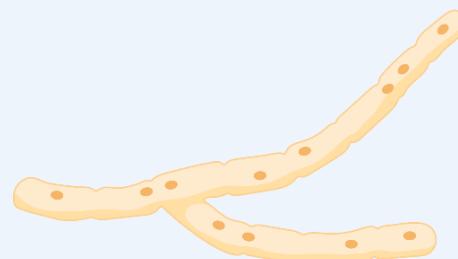
Microbes (micro-organisms)



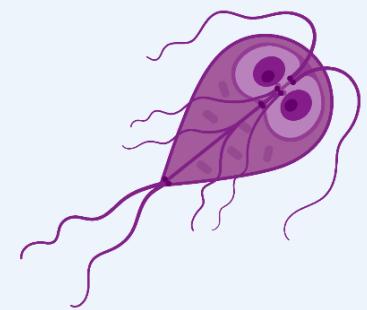
Virus



Bacteria

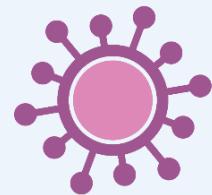


Fungus

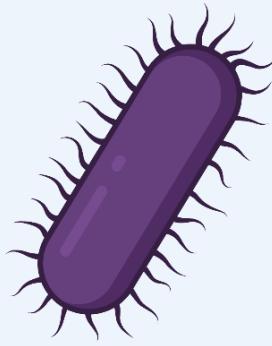


Parasite

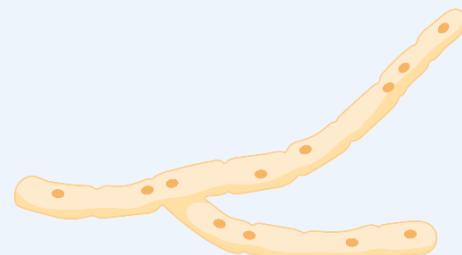
Antimicrobials



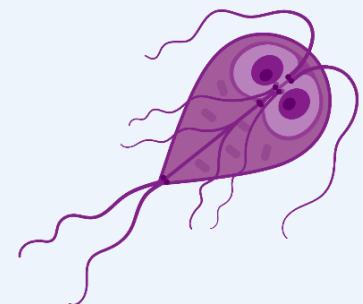
Virus



Bacteria



Fungus



Parasite

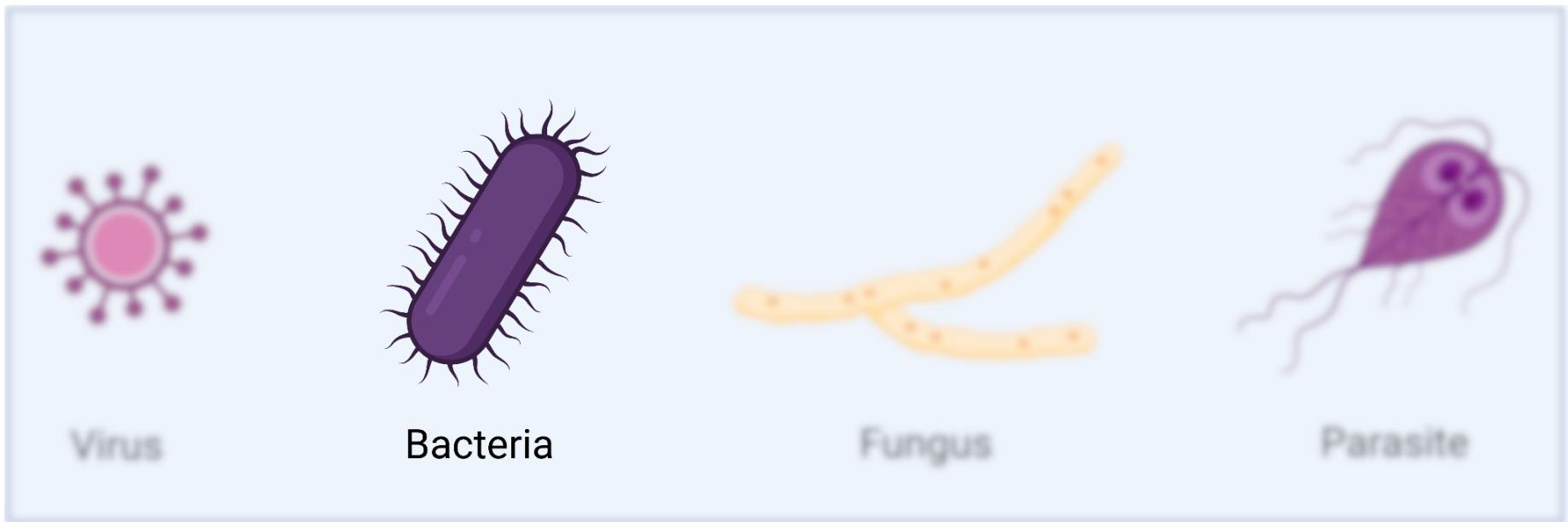
Antivirals

Antibiotics

Antifungals

Antiparasitics

Antimicrobials



Antivirals

Antibiotics

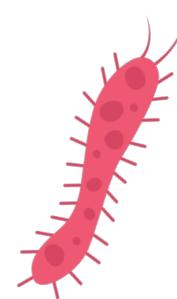
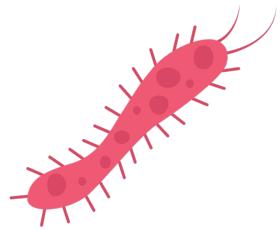
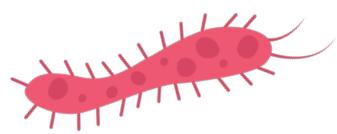
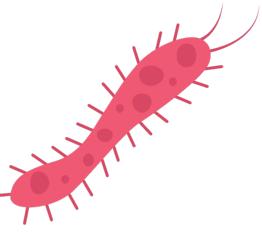
Antifungals

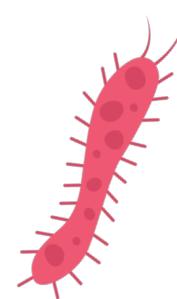
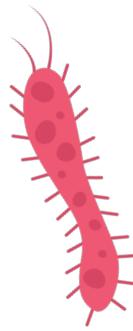
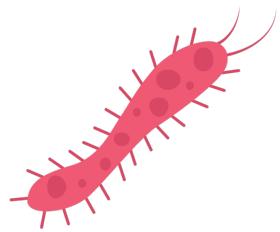
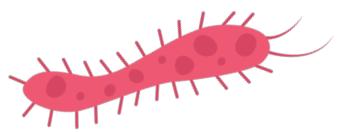
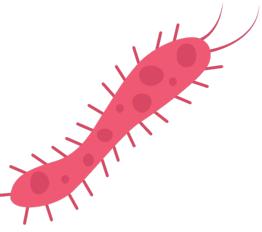
Antiparasitics

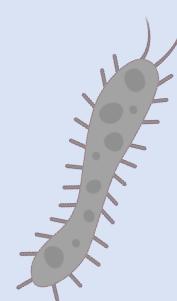
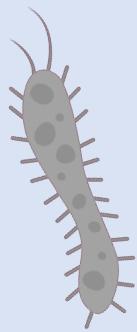
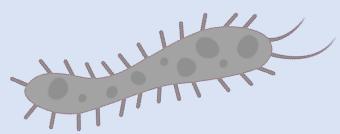
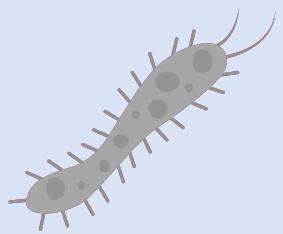
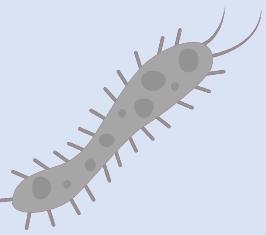


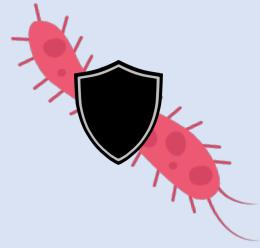
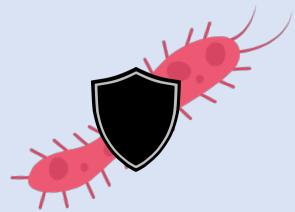
Antimicrobial Resistance (AMR)

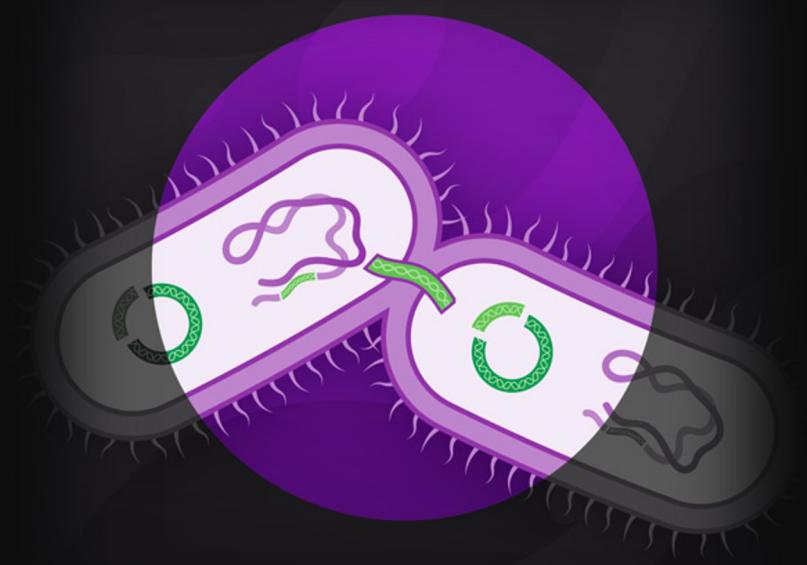
- Antibiotics work by either preventing bacteria from multiplying or by triggering cell death
- Over time, bacteria develop mutations that neutralize or evade the effects of antibiotics
- When antibiotics are used, it creates an environment where only the bacteria with these adaptations can survive and reproduce
- Bacteria can spread these adaptations to their offspring and to neighboring bacteria

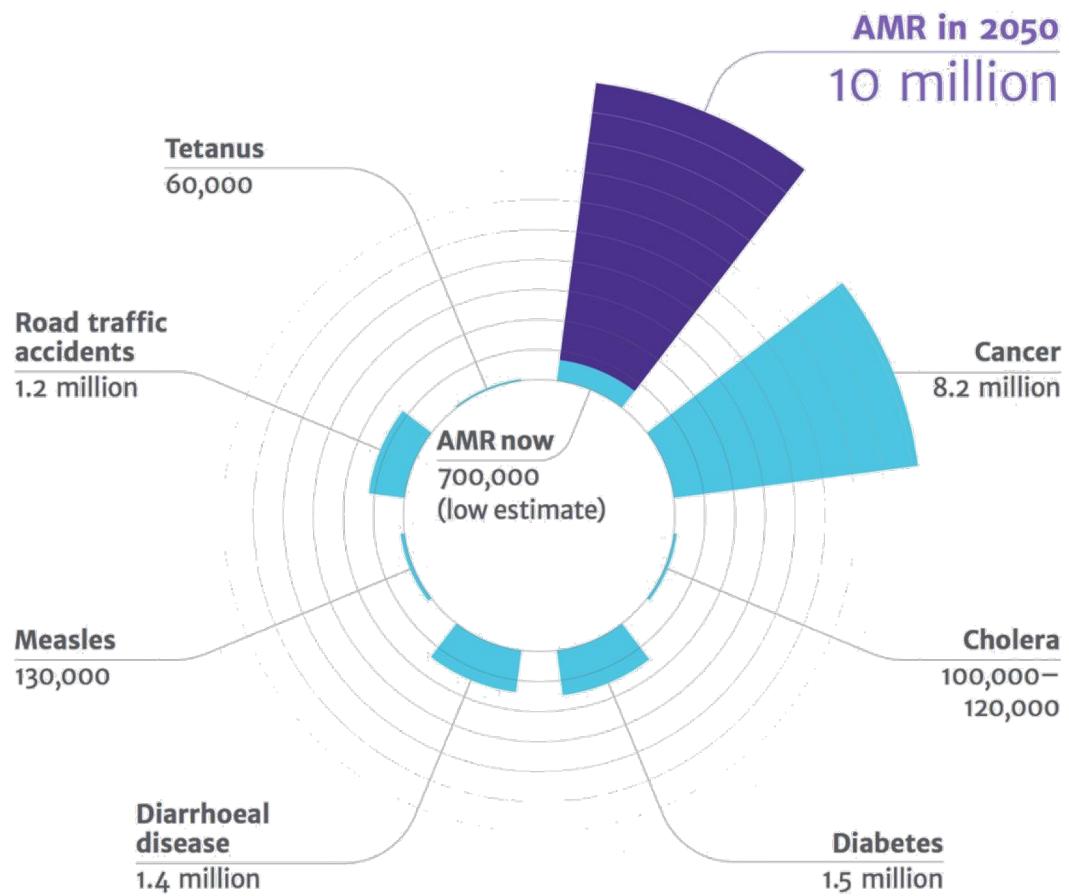


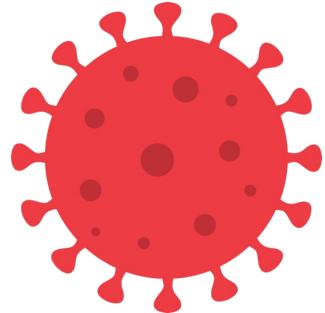




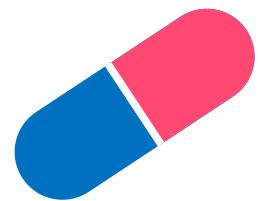








COVID-19 deaths



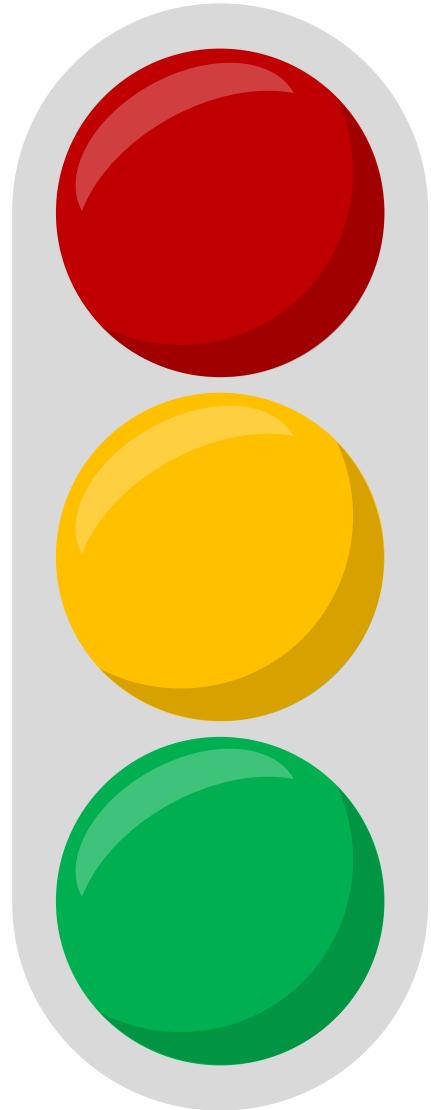
AMR deaths

5 million in 2020
3.5 million in 2021

4.9 million annually (indirect)
1.27 million annually (direct)

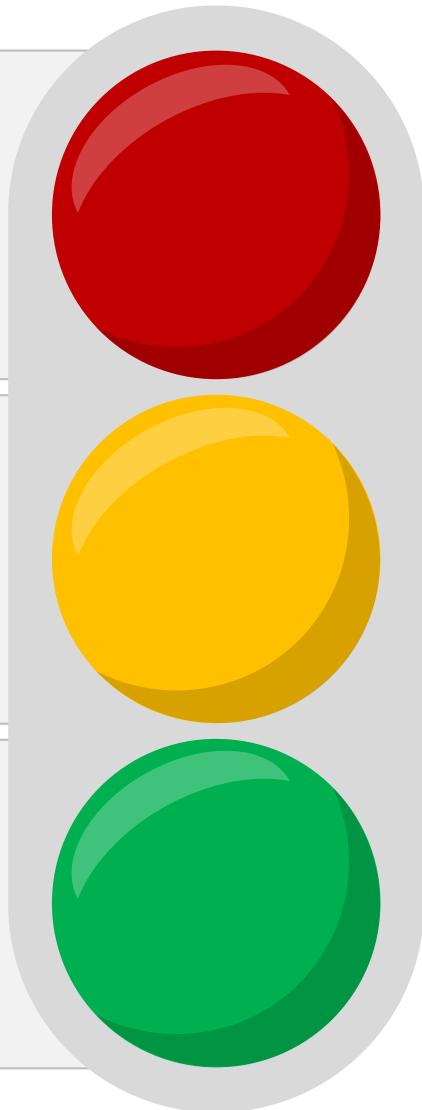
... a slow-moving pandemic.

Tiered approach to antimicrobial stewardship



Tier
3

- Should only be used in rare situations where there is confirmed or strongly suspected resistance to drugs of the other tiers.
- Drugs of 'Last Resort'



Tier
2

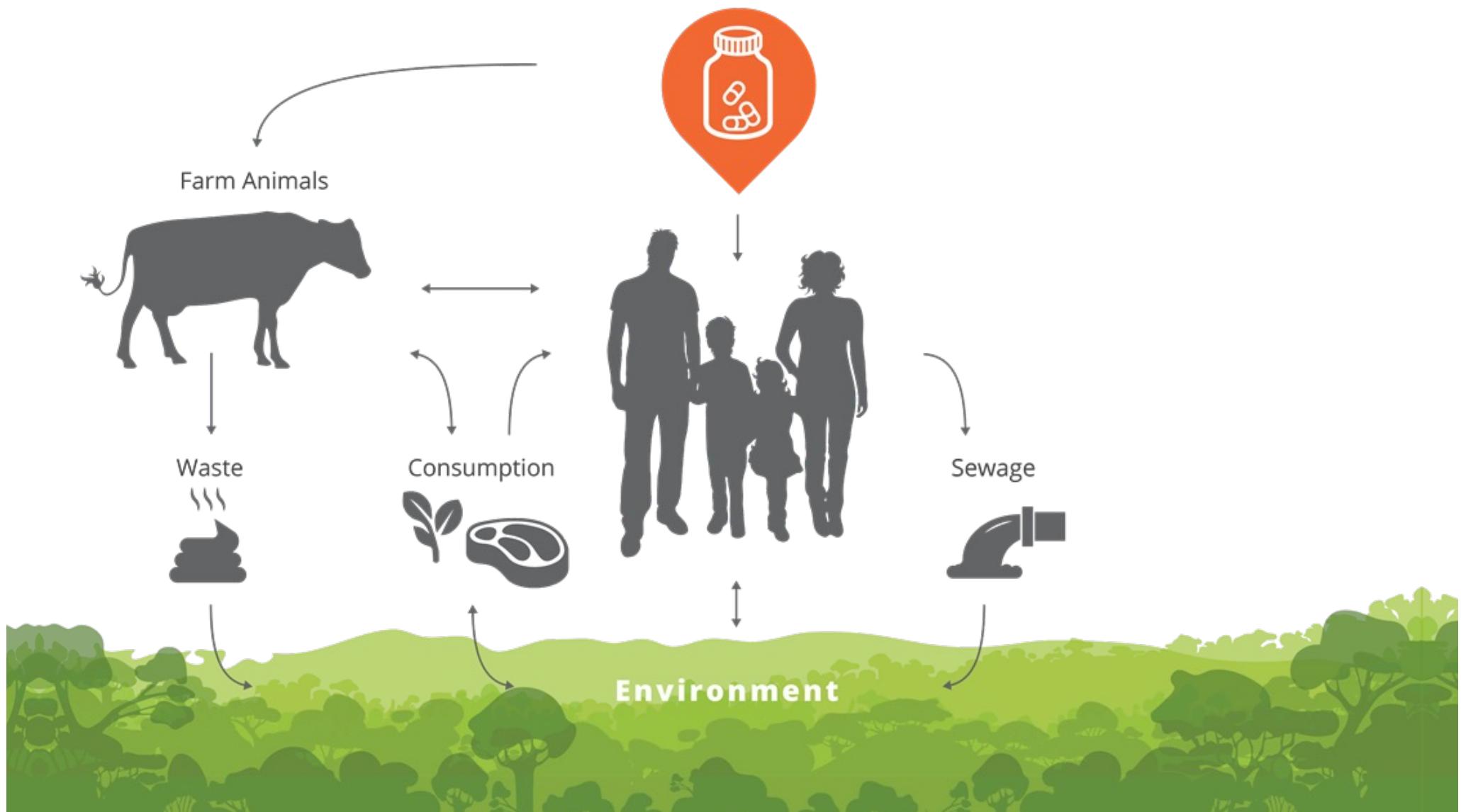
- Use should be supported by bacterial susceptibility testing.
- To be used with caution to avoid the development of further resistance.
- 'Second-line'

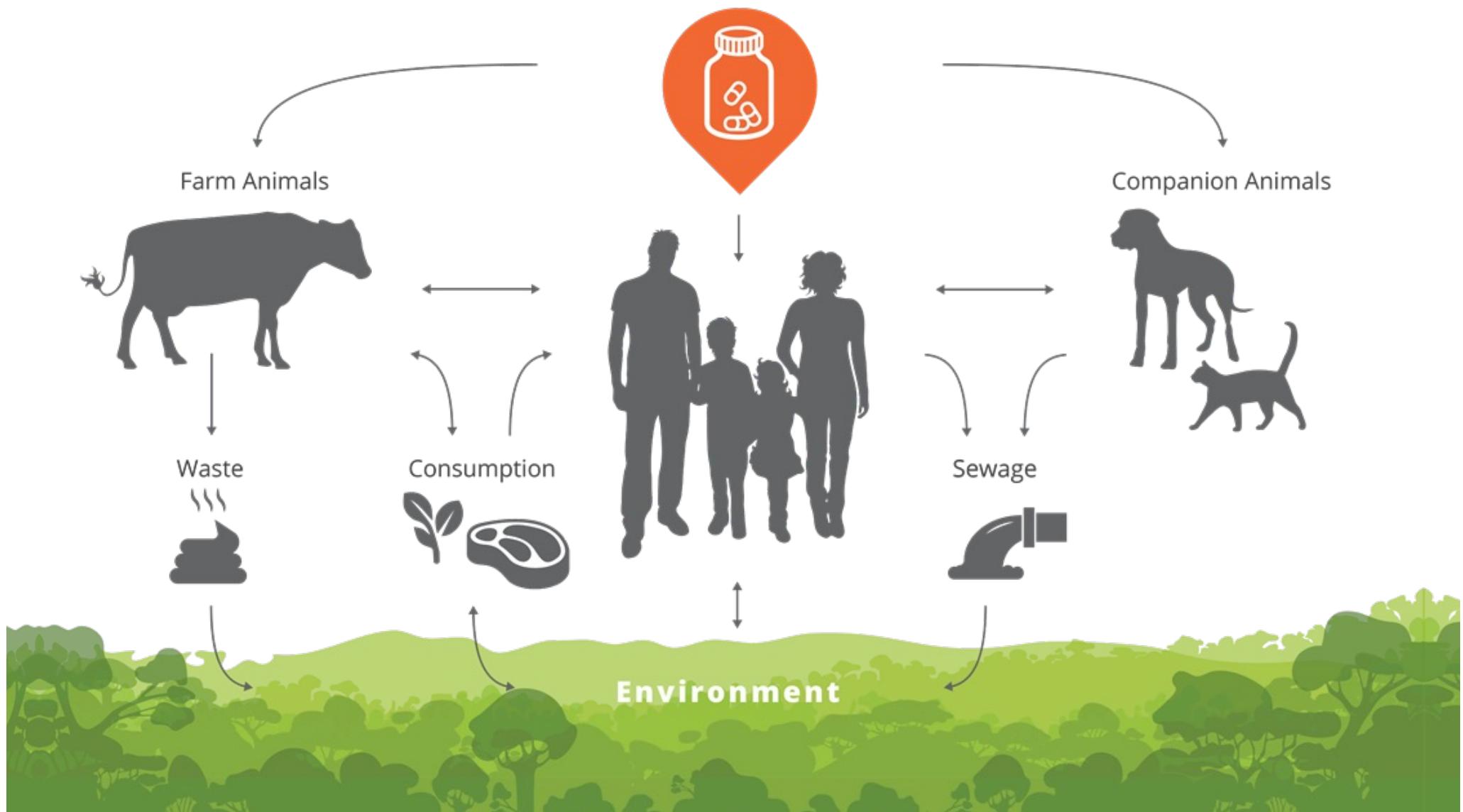
Tier
1

- Antibiotics that can be used to treat a range of common infections.
- 'First-line' of defence

'One Health' Approach to AMR







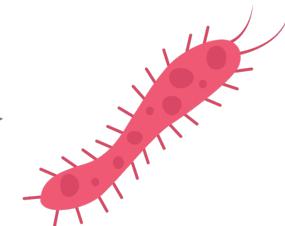
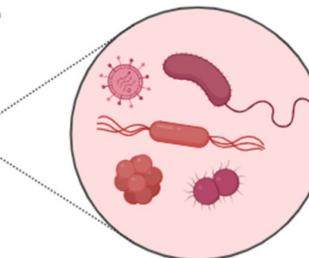
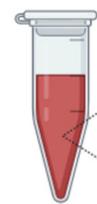


How do we test for AMR?

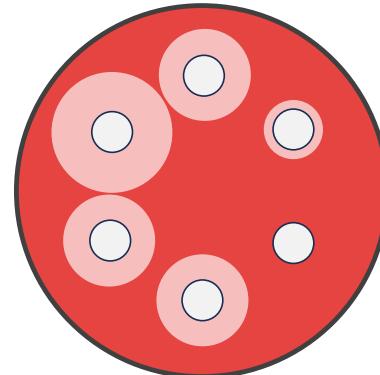
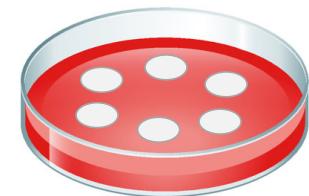
Veterinarian



Lab



Isolate and identify pathogen



Monitor to see which antibiotics eliminate bacteria

Tracheal aspirate: *Pseudomonas aeruginosa*

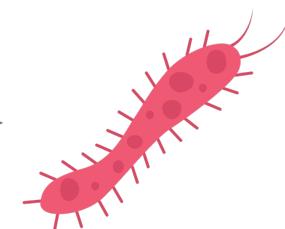
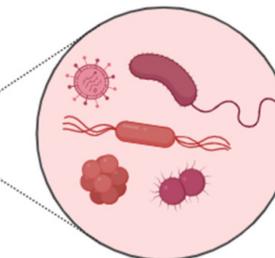
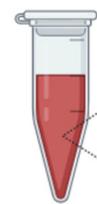
Antibiotic	Interpretation
Aztreonam	S
Ceftriaxone	R
Cefepime	S
Ciprofloxacin	I
Gentamicin	S
Meropenem	S
Piperacillin/Tazobactam	S

Add bacteria to plate, with disks of various antibiotics

Veterinarian

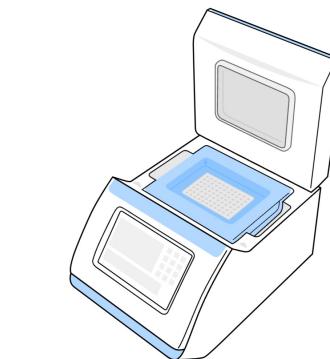


Lab

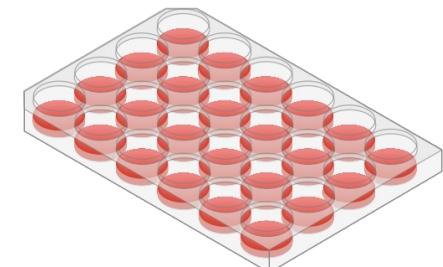


Isolate and identify pathogen

Tracheal aspirate: <i>Pseudomonas aeruginosa</i>	
Antibiotic	Interpretation
Aztreonam	S
Ceftriaxone	R
Cefepime	S
Ciprofloxacin	I
Gentamicin	S
Meropenem	S
Piperacillin/Tazobactam	S



Monitor for growth



Add isolated bacteria to specific concentrations of antibiotics

The data

The data

- Years: 2019-2022
- Geography: New York State
- Species: Cats and Dogs
- Number of observations:
 - 111,969 test panels (rows)
 - 2,180,713 individual susceptibility test

The data

Patient information					Infection information				Susceptibility test results			
id	State	County	Age	Species	Site	Source	Panel	Bacteria	A1	B1	B2	C1
273	New York	Bronx	10	Canine	...	Urine	Aero. Culture	<i>E. Coli</i>	R	S	S	I

S: Susceptible

R: Resistant

I: Intermediate

TF: To Follow

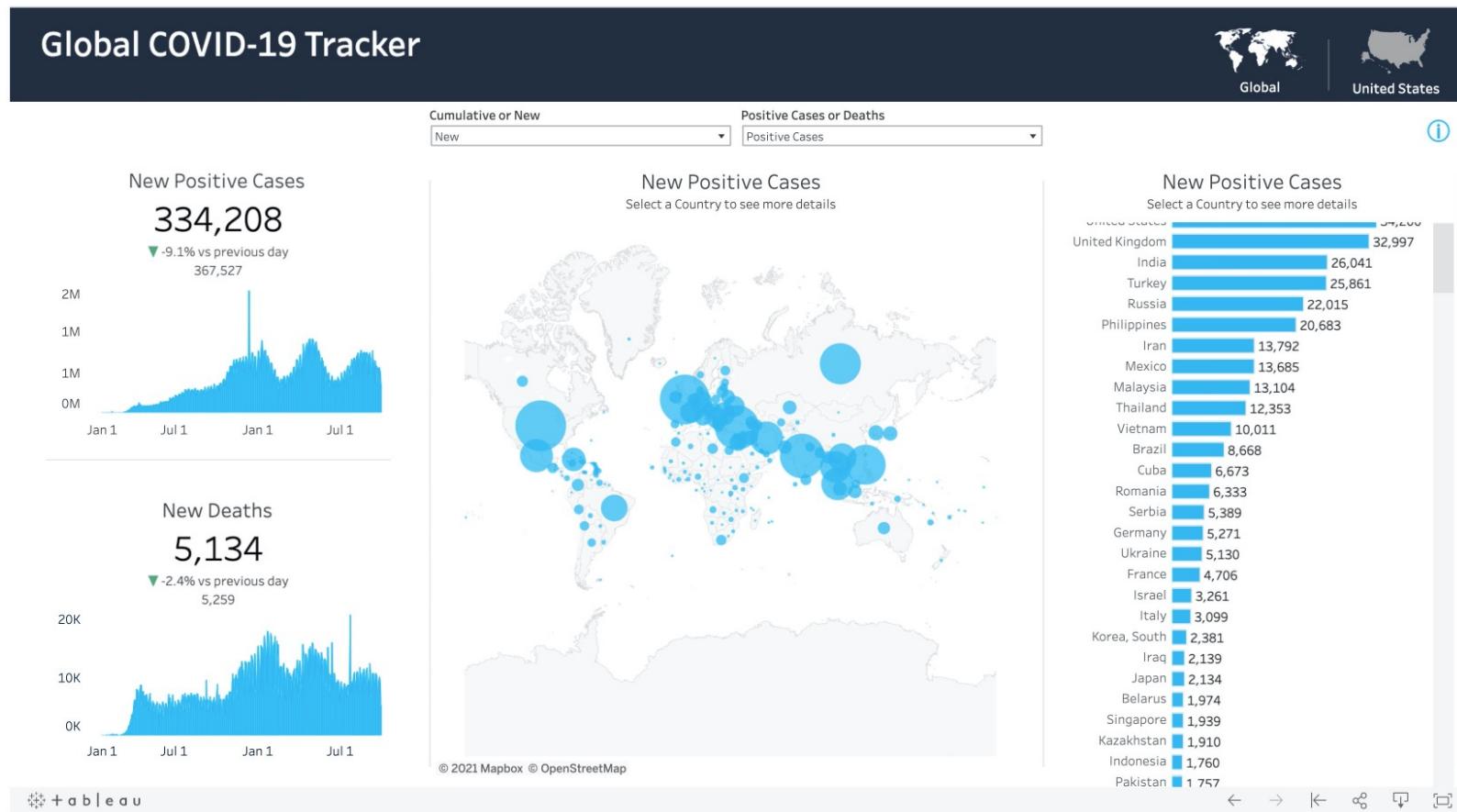
N/I: Not interpretable

The challenge

The challenge

- Antimicrobial susceptibility testing is the best option for effective treatment and preventing further resistance (\$\$\$)
- Vets are likely making antibiotic treatment decisions based on:
 - What has worked for them in the past
 - Recommendations from senior vets
 - Antimicrobial stewardship guidelines
- Can we provide vets a tool based on previous susceptibility tests to make data-driven decisions for AB treatment?

Dashboards



The scenario...

- A dog comes in with an unidentified bladder infection
- The veterinarian is aware of the AMR crisis and advocates for susceptibility testing before prescribing
- The client is not able to afford testing but also does not want to leave without treatment for her dog
- The veterinarian decides that the next best thing is to check which antibiotics are showing resistance to common bacteria found in canine bladder infections in her specific location
- She is returned with a list of antibiotics and the percentage of times they have been observed as being resistant based on the data and makes her prescription decision based on this information.

Possible features

- Location specific
- Time specific
 - (e.g., Some pathogens are more common in summer months)
- Infection site specific (urinary, blood, ear, etc.)
- Species specific (canine vs feline)
- Predict the pathogen
- Present which drugs are likely to be effective based on the data
 - Considering the tiered approach to antibiotics (first-line, last-resort, etc.)

Additional Resources

- Government of Canada 
- <https://www.canada.ca/en/public-health/services/antibiotic-antimicrobial-resistance.html>
- Centers for Disease Control and Prevention (CDC) 
- <https://www.cdc.gov/drugresistance/about.html>
- World Health Organization (WHO) 
- <https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance>