One Health

Alana Sterkel, PhD, D(ABMM), SM(ASCP)^{CM}

Associate Director, CDD, Wisconsin State Laboratory of Hygiene

Assistant Professor, DPLM, SMPH, University of Wisconsin- Madison

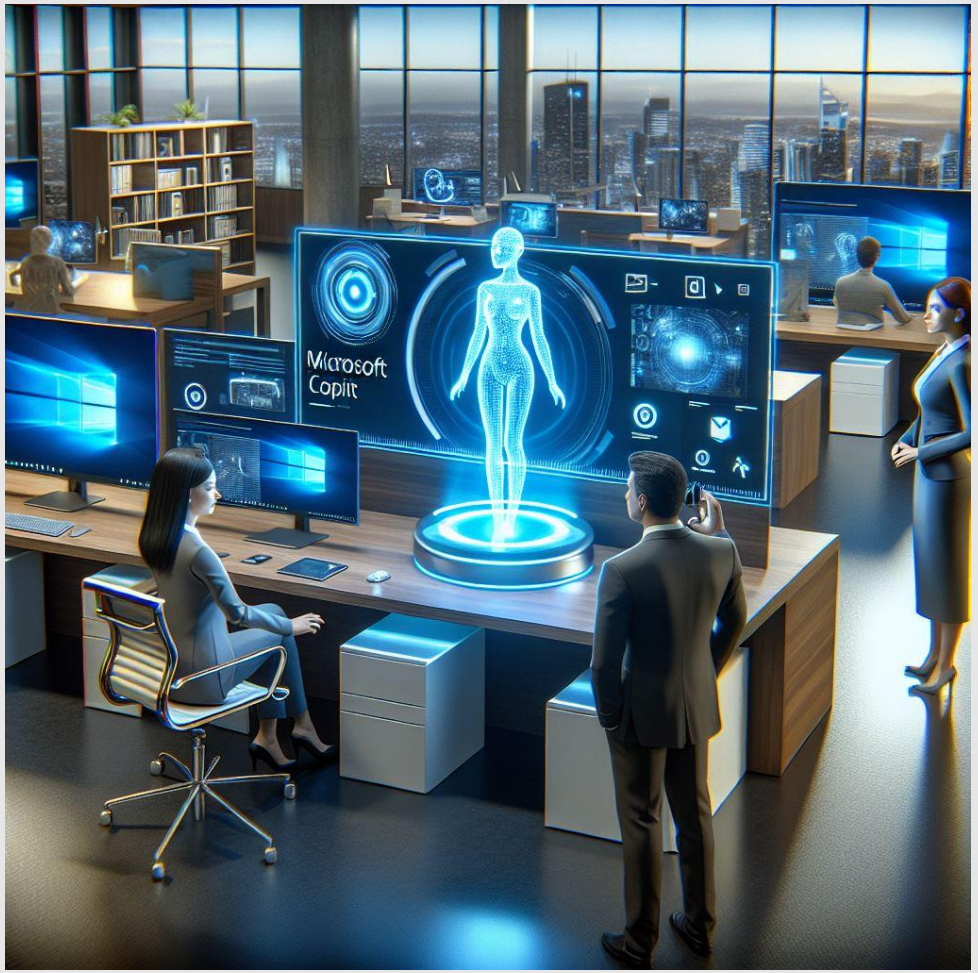
Wisconsin State Laboratory of Hygiene
UNIVERSITY OF WISCONSIN–MADISON

Disclosures

No conflicts of interest to report

I did use AI to make many of these images.

Warning, some animals are not anatomically accurate



Copilot selfie

One Health

The health of people is connected to the health of animals and our shared environment.

Outline

- Understanding One Health
- Benefits of One Health Approach
- Case Studies
- Strategies for Implementing One Health Principles

Understanding One Health

Definition

One Health is a collaborative, multisectoral, and transdisciplinary approach — working at the local, regional, national, and global levels — with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment.

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Zoonotic diseases

- More than 60% of known infectious diseases in humans are zoonotic

- Approximately 75% of new or emerging infectious diseases in humans originate from animals

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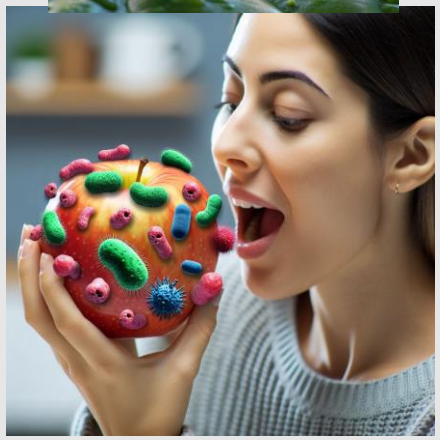
https://www.cdc.gov/one-health/about/about-zoonotic-diseases.html

Routes of Infection

- **Direct contact:** saliva, blood, urine, mucous, feces, or other body fluids of an infected animal. Examples include petting or touching animals, and bites or scratches.
- **Indirect contact:** Objects or surfaces that have been contaminated. Examples include aquarium tank water, pet habitats, chicken coops, barns, plants, and soil, as well as pet food and water dishes.
- **Vector-borne:** Being bitten by a tick, or an insect like a mosquito or a flea.
- **Foodborne:** Unpasteurized (raw) milk, undercooked meat or eggs, or raw fruits and vegetables that are contaminated with feces from an infected animal.
- **Waterborne:** Drinking or coming in contact with water that has been contaminated with feces from an infected animal.



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One Health Timeline

1821: The term "zoonoses" is first used to describe diseases that can be transmitted from animals to humans.

2004: The Wildlife Conservation Society hosts a conference that leads to the "**Manhattan Principles**," which outline the One Health approach.

2008: The One Health Initiative Task Force is established by the American Veterinary Medical Association.

2010: The CDC, FAO, WHO, and OIE publish the "Tripartite Concept Note," promoting a unified approach to managing health risks at the human-animal-ecosystem interface.

2011: The first International One Health Congress is held in Melbourne, Australia.

2012: The Global Risk Forum sponsors the first One Health Summit in Davos, Switzerland.

2013: The second International One Health Congress is held in conjunction with the Prince Mahidol Award Conference.

2016: The One Health Commission and the One Health Initiative team up to promote **One Health Day** on November 3rd each year.

2020: The COVID-19 pandemic highlights the importance of the One Health approach in managing zoonotic diseases.

Benefits of a One Health Approach

- Preventing Zoonotic Diseases
- Improving Food Safety and Security
- Combating Antimicrobial Resistance
- Enhancing Global Health Security
- Protecting Biodiversity and Conservation
- Managing Vector-Borne Diseases
- Addressing Environmental Contamination

Coronaviruses

COVID pandemic started in Wuhan market animals after all, suggests latest study

The finding comes from a reanalysis of genomic data.

By Smriti Mallapaty

MERS from Camels

- Middle East Respiratory Syndrome
- Dromadary camels
- 35.5% Mortality
- Aerosol transmission
  - Camels spit and sneeze
  - Person to person
- Fully cook camel meat, don’t kiss camels, don’t drink unpasteurized camel milk or camel urine

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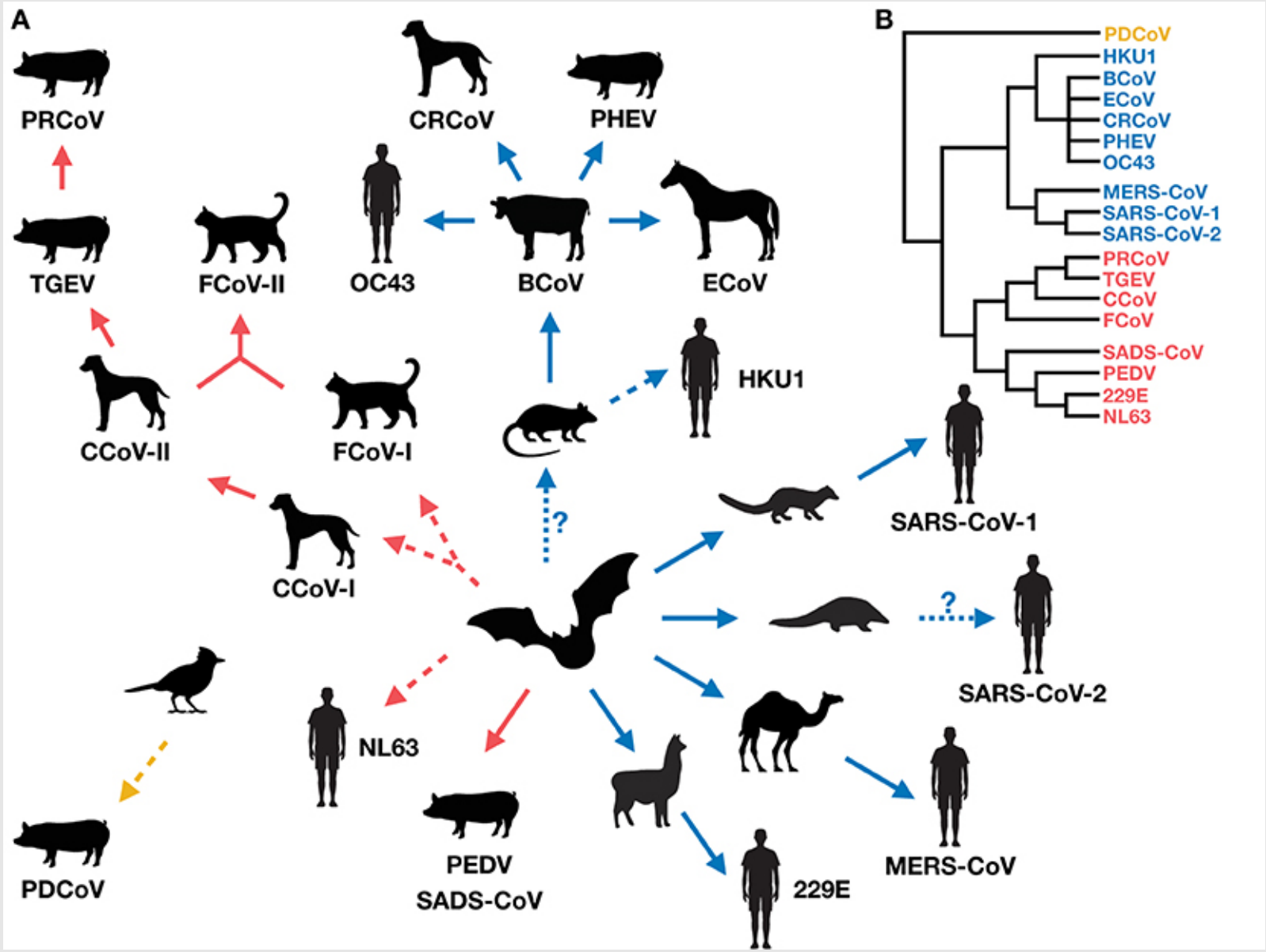
https://www.who.int/news-room/fact-sheets/detail/middle-east-respiratory-syndrome-coronavirus-(mers-cov)

Complicated Transmission Chains



https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2021.717941/full

Cases

Case- Puppies!

- A child is diagnosed with a *Campylobacter* infection.
- It disseminates causing a blood stream infection.
- Empiric therapy is not working.
- AST discovers the strain is fully drug resistant.
- The isolate is submitted to the public health lab for additional characterization.
- The case is linked to several others in the region and later to cases in other states.
- The Epidemiological investigation identifies something in common between the infected persons, recent contact with puppies

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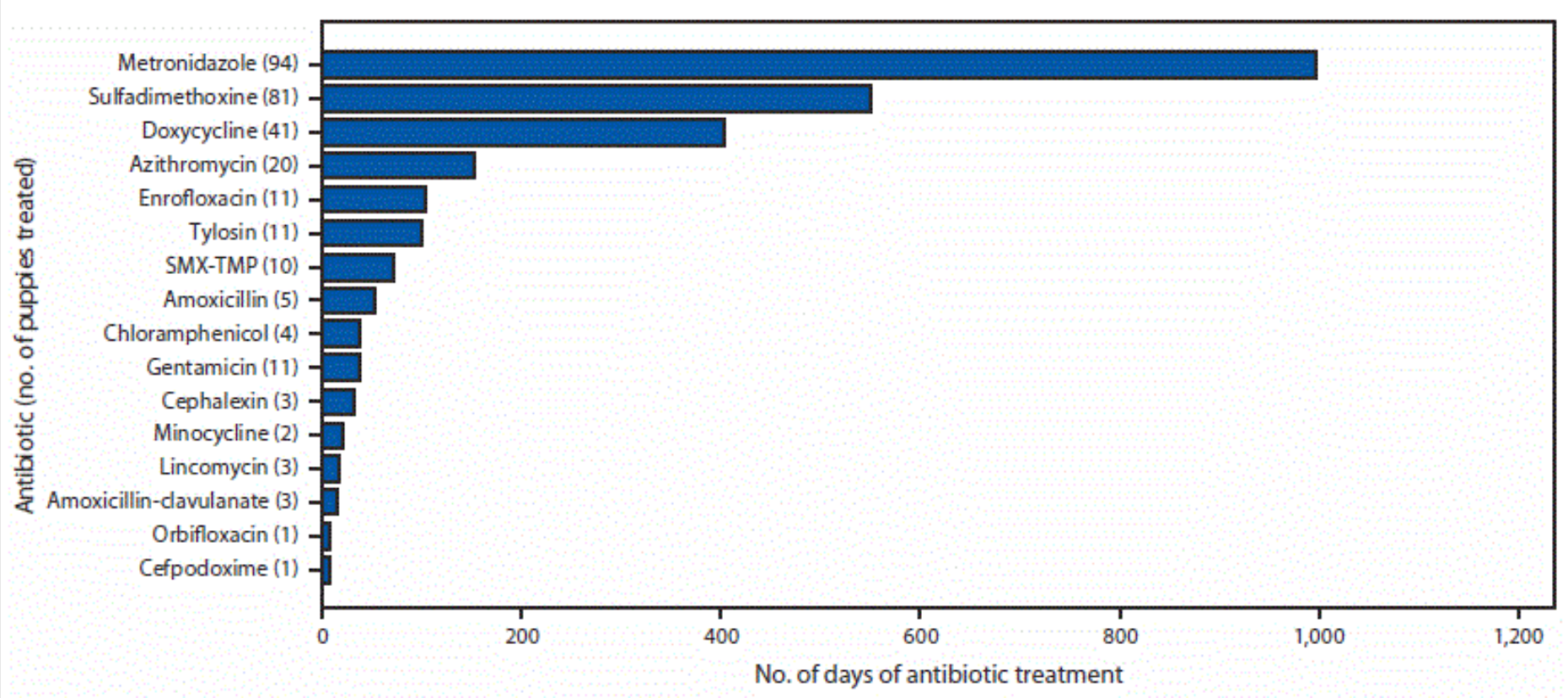
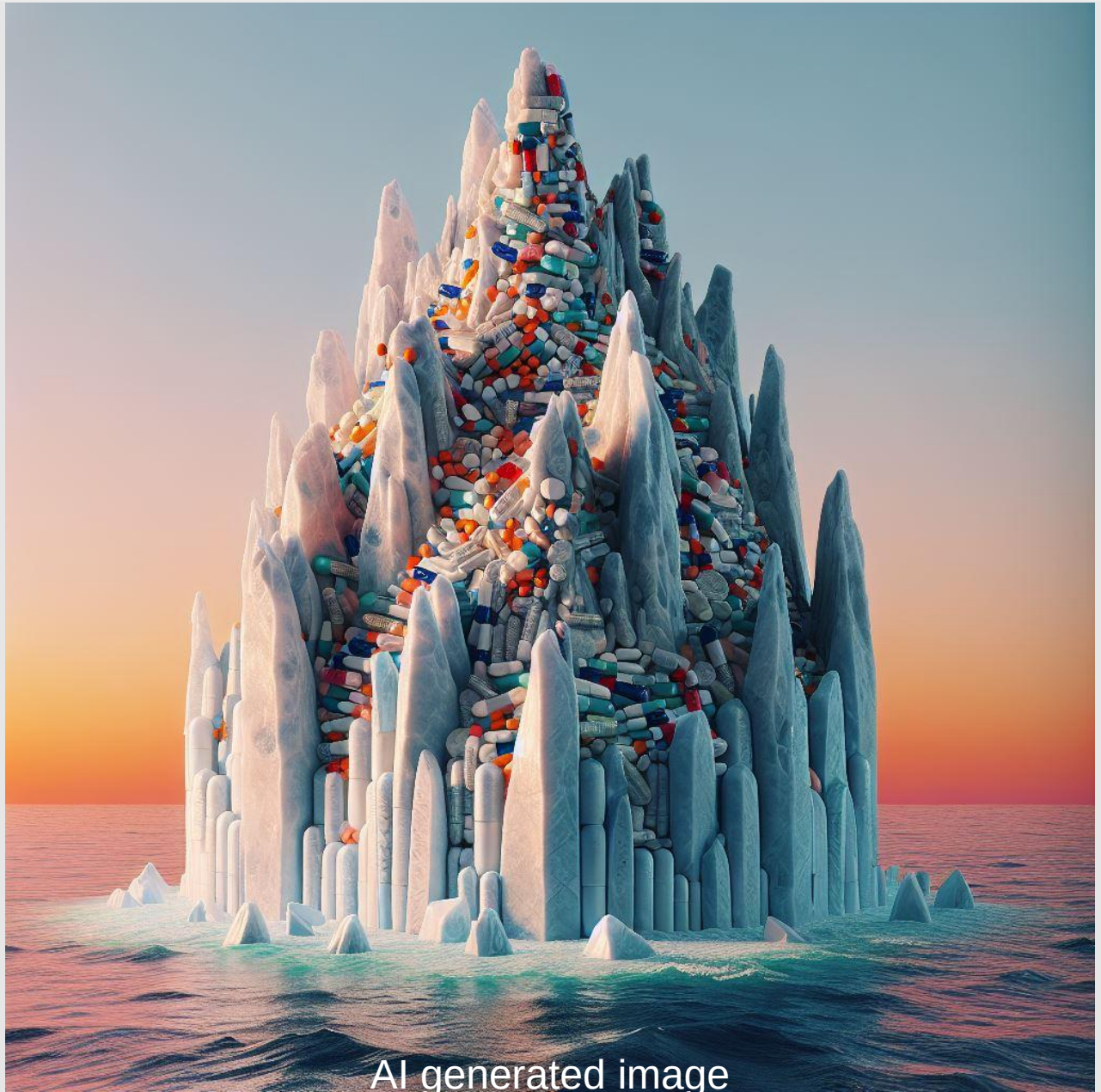
Case- Impact

- Nationally, 118 persons, including 29 pet store employees, in 18 states were identified. In total, six pet store companies were linked to the outbreak.
- Outbreak isolates were resistant to all antibiotics commonly used to treat *Campylobacter* infections, including macrolides and quinolones.



https://www.cdc.gov/mmwr/volumes/67/wr/mm6737a3.htm#F1_down

Antimicrobial Resistance



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CAUSES OF ANTIBIOTIC RESISTANCE

HANDLE ANTIBIOTICS WITH CARE

Antibiotic resistance happens when bacteria change and become resistant to the antibiotics used to treat the infections they cause.

Over-prescribing of antibiotics

Patients not finishing their treatment

Over-use of antibiotics in livestock and fish farming

Poor infection control in hospitals and clinics

Lack of hygiene and poor sanitation

Lack of new antibiotics being developed

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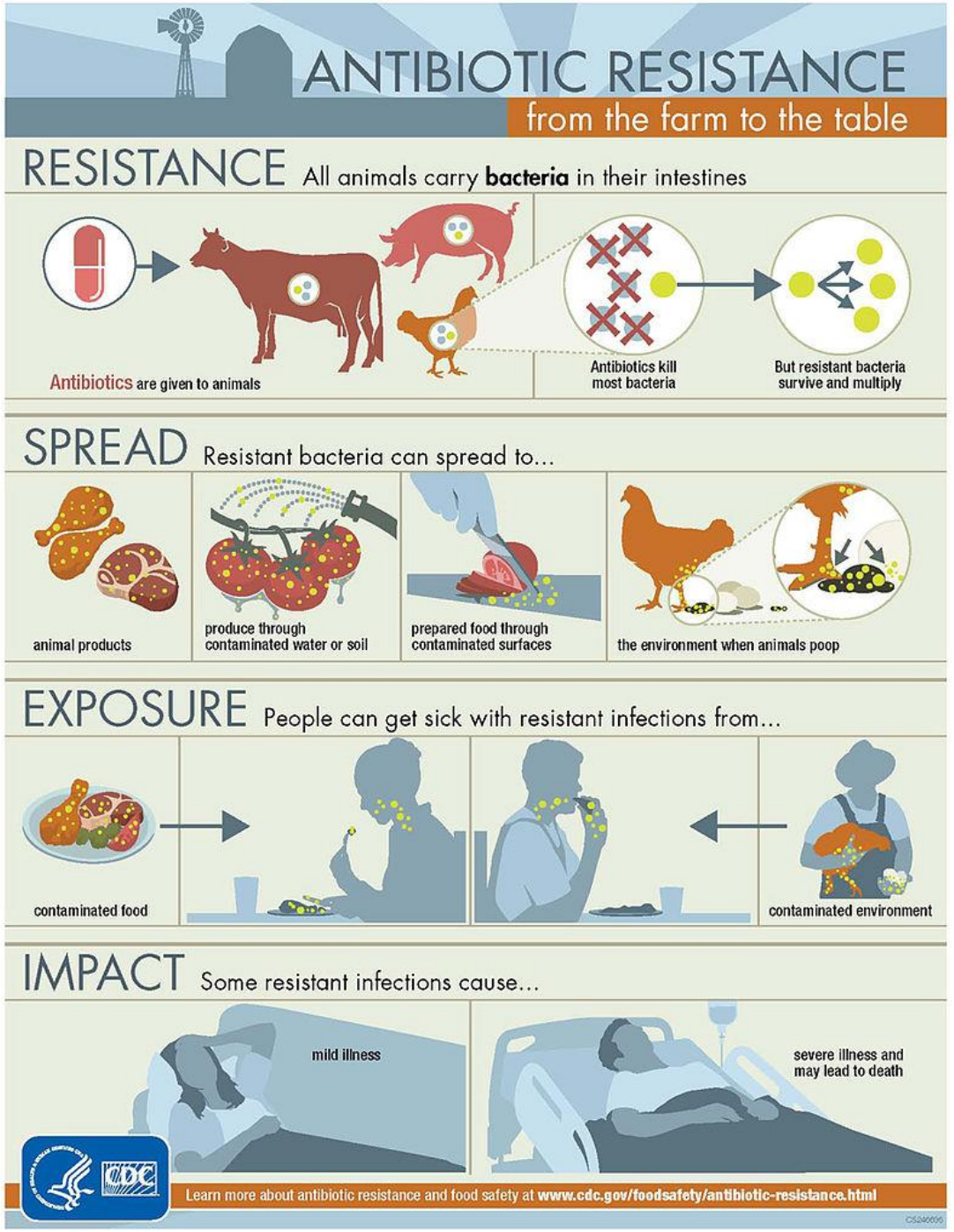
www.who.int/drugresistance

#AntibioticResistance

World Health Organization


ANTIBIOTIC RESISTANCE
from the farm to the table
RESISTANCE All animals carry bacteria in their intestines
Antibiotics are given to animals
Antibiotics kill most bacteria
But resistant bacteria survive and multiply
SPREAD Resistant bacteria can spread to...
animal products
produce through contaminated water or soil
prepared food through contaminated surfaces
the environment when animals poop
EXPOSURE People can get sick with resistant infections from...
contaminated food
contaminated environment
IMPACT Some resistant infections cause...
mild illness
severe illness and may lead to death
Learn more about antibiotic resistance and food safety at www.cdc.gov/foodsafety/antibiotic-resistance.html

Antibiotic Pollution

- High concentrations in wastewater
- Can result in drug resistance within environmental microbes
- These can spread to humans and animals from fishing

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https://www.sciencedirect.com/science/article/pii/S2666911024000042#:~:text=This%20has%20led%20to%20large,trigger%20the%20development%20of%20AMR.

Tulips in the Netherlands

- The Netherlands are widely known for their vast fields of tulips.
- “Tulip Mania” in the 1600 is a key point in the history of the country
- Vast sales of flowers and bulbs are a significant market in their economy
- When the tulip “bubble” burst is caused a great depresssion

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Antibiotics in Agriculture

- The tulips are sensitive to disease and can be wiped out by molds like *Botrytis tulipae*, *Trichoderma viride*, and *Aspergillus fumigatus*

- To protect the highly profitable tulips from fungal diseases the tulip fields are routinely sprayed with azole antifungals

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Killer Tulips

- As a result from extensive use of antifungals, as many as 18% of tulips imported from the Netherlands contain azole resistant *Aspergillus*.

- These strains can cause difficult to treat infections in vulnerable populations.

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Antibiotics in Livestock

- Livestock fed steady, low doses of antibiotics grow much larger than other animals, meaning more pounds of meat per animal
- “Pharming animals” became common practice as farmers competed against each other
- This resulted in widespread antibiotic resistance in microbes throughout the farm and surrounding community

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What Happens on the Farm Doesn’t Stay on the Farm

- Drug resistant bacteria can be found at neighboring farms
- In one case, spread was traced to a feed store shared by many farmers
- Can lead to infections with drug resistant organisms
- Ingestion of non-pathogens can also result in genetic recombination with pathogens in our guts.

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The Solution

- Use of antibiotics in feed was banned in the UK in 2006, however in 2017, 73% of antibiotics sold globally were used in animal feed
- Stopping now would significantly reduce meat production in resource limited countries.

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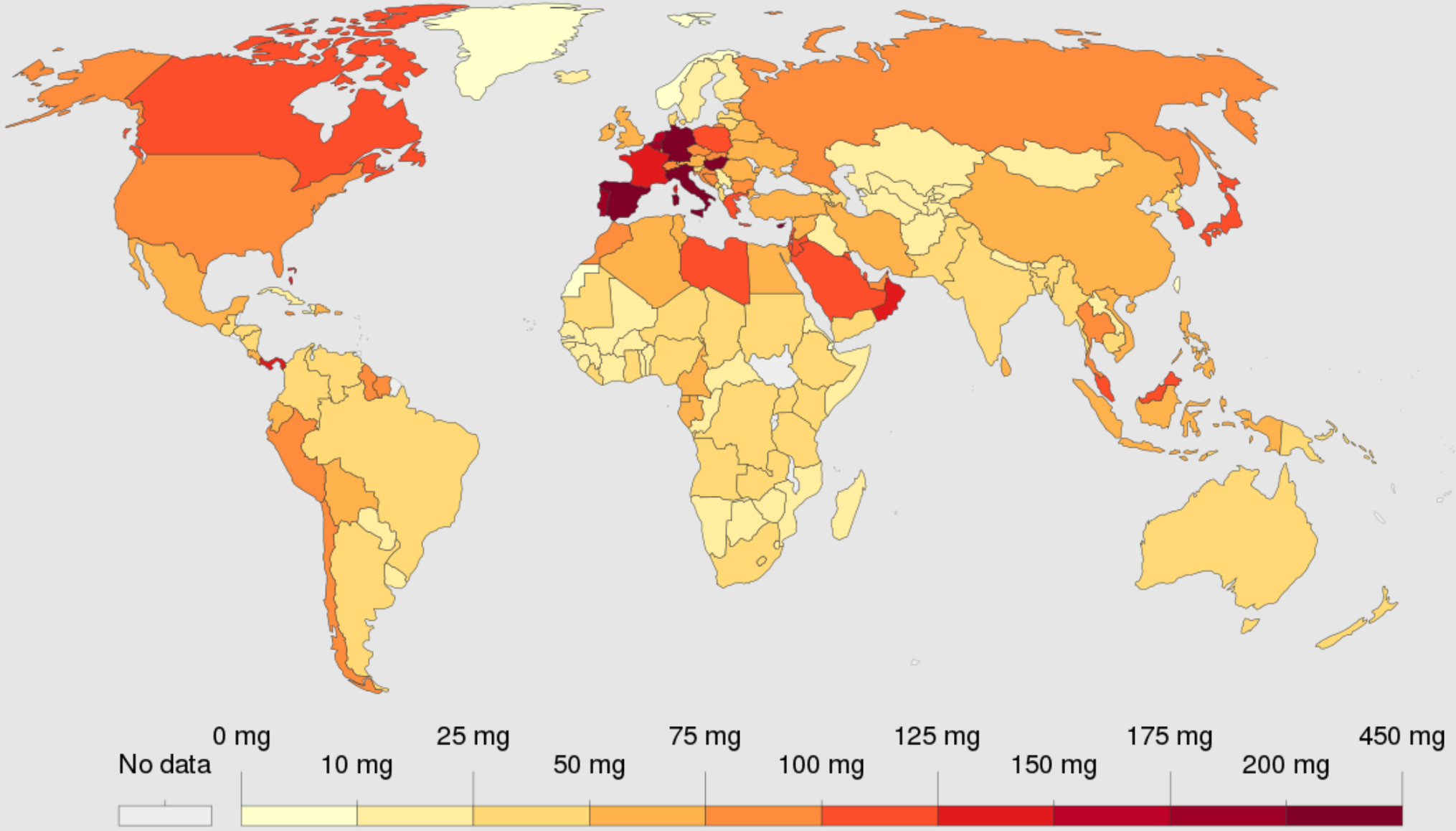
Antibiotic use in Livestock, 2010



Source: European Medicines Agency, European Surveillance of Veterinary Antimicrobial Consumption (2017) & Van Boeckel et al. (2015)

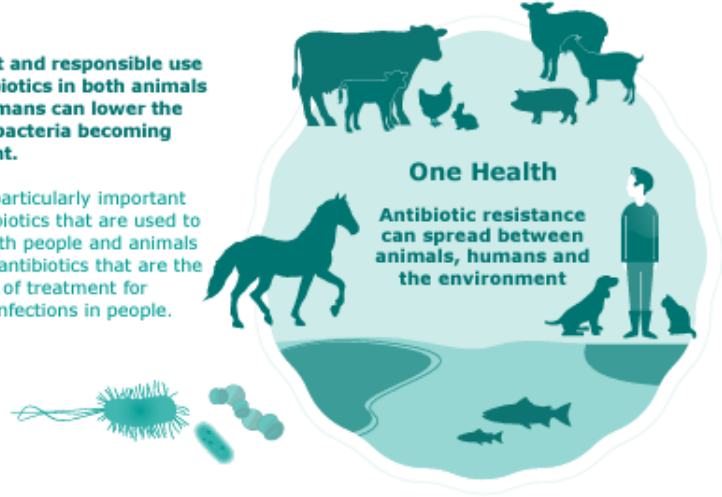
Interim Solution

- An interim solution is to not use antibiotics used to treat human infections.
- The WHO published a revised list in 2019 of “Critically Important Antimicrobials for Human Medicine”
  - The intent that it be used "as a reference to help formulate and prioritize risk assessment and risk management strategies for containing antimicrobial resistance due to human and non-human antimicrobial use to help preserve the effectiveness of currently available antimicrobials

Critically Important Antimicrobials for Human Medicine

Prudent and responsible use of antibiotics in both animals and humans can lower the risk of bacteria becoming resistant.

This is particularly important for antibiotics that are used to treat both people and animals and for antibiotics that are the last line of treatment for critical infections in people.



The Antimicrobial Advice Ad Hoc Expert Group (AMEG) has categorised antibiotics based on the potential consequences to public health of increased antimicrobial resistance when used in animals and the need for their use in veterinary medicine.

The categorisation is intended as a tool to support decision-making by veterinarians on which antibiotic to use.

Veterinarians are encouraged to check the AMEG categorisation before prescribing any antibiotic for animals in their care. The AMEG categorisation does not replace treatment guidelines, which also need to take account of other factors such as supporting information in the Summary of Product Characteristics for available medicines, constraints around use in food-producing species, regional variations in diseases and antibiotic resistance, and national prescribing policies.

Category A
Avoid

- antibiotics in this category are not authorised as veterinary medicines in the EU
- should not be used in food-producing animals
- may be given to companion animals under exceptional circumstances

Category B
Restrict

- antibiotics in this category are critically important in human medicine and use in animals should be restricted to mitigate the risk to public health
- should be considered only when there are no antibiotics in Categories C or D that could be clinically effective
- use should be based on antimicrobial susceptibility testing, wherever possible

Category C
Caution

- for antibiotics in this category there are alternatives in human medicine
- for some veterinary indications, there are no alternatives belonging to Category D
- should be considered only when there are no antibiotics in Category D that could be clinically effective

Category D
Prudence

- should be used as first line treatments, whenever possible
- as always, should be used prudently, only when medically needed

For antibiotics in all categories

- unnecessary use, overly long treatment periods, and under-dosing should be avoided
- group treatment should be restricted to situations where individual treatment is not feasible
- check out the European Commission's guideline on prudent use of antibiotics in animals: https://bit.ly/2s7LUF2

https://www.ema.europa.eu/en/documents/report/infographic-categorisation-antibiotics-use-animals-prudent-and-responsible-use_en.pdf

More Cases

Case- For the Birds

- A man goes to the hospital with severe diarrhea
- Clinical testing identifies *Salmonella*
- Public health testing further identifies the bacteria as *Salmonella typhimurium*
- Serotyping links his case with an ongoing outbreak.

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Case- For the Birds

- The State Epidemiological investigation identifies an exposure link between the infected individuals- contact with wild birds
- CDC, veterinary, and public health partners send out messaging to alert the public and health care systems
- The outbreak was eventually connected back to specific bird feeders
- Cleanout of the feeders stopped the outbreak

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Case- Rabid Raccoon

- A 9 year old boy is bitten by a raccoon
- An astute physician takes no chances and immediately vaccinates the boy for rabies.
- The child still get’s sick and passes away
- There is an outcry from the community to prevent this from happening again

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Solution 1-Education

- Teach kids to avoid raccoons

- Relies solely on human behavior, can reduce risks but may not prevent all future cases

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Solution 2- Eradicate the source

- Kill all raccoons in the area to destroy the rabid animal and prevent future infections

- Does not rely on changing human behavior.
- May eradicate the source of the bite
- Does not remove risk from other animal types (bats, skunks, foxes, etc.)

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Solution 2- Unintended consequences

Without raccoons in the area other pests become a problem

- Disruption to the ecosystem
- Disruption in seed dispersal
- Increase in rodent population
- Rise in insect populations

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Solution 3- The One Health Approach

- Drop oral vaccine bait in the surrounding area to vaccinate raccoons and other animals that can carry rabies
  - Fish and vanilla flavored
- Dropped by plane in rural areas or by hand in more urban areas (i.e. near trash cans, the location where the bite occurred)
- OK if other animals eat it!

Solution 3- Benefits

- Does not rely solely on changing human behavior
- Reduces risk of transmission of rabies during the next animal encounter.
- Protects wildlife instead of killing them
- Better supports our ecosystem and minimizes our negative impact

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Case- Rift Valley Fever

- In 1997 an outbreak in East Africa infected 90,000 people, killing 500.
- Many animals also died causing economic difficulties for the people who relied on them for milk, meat, and trade.

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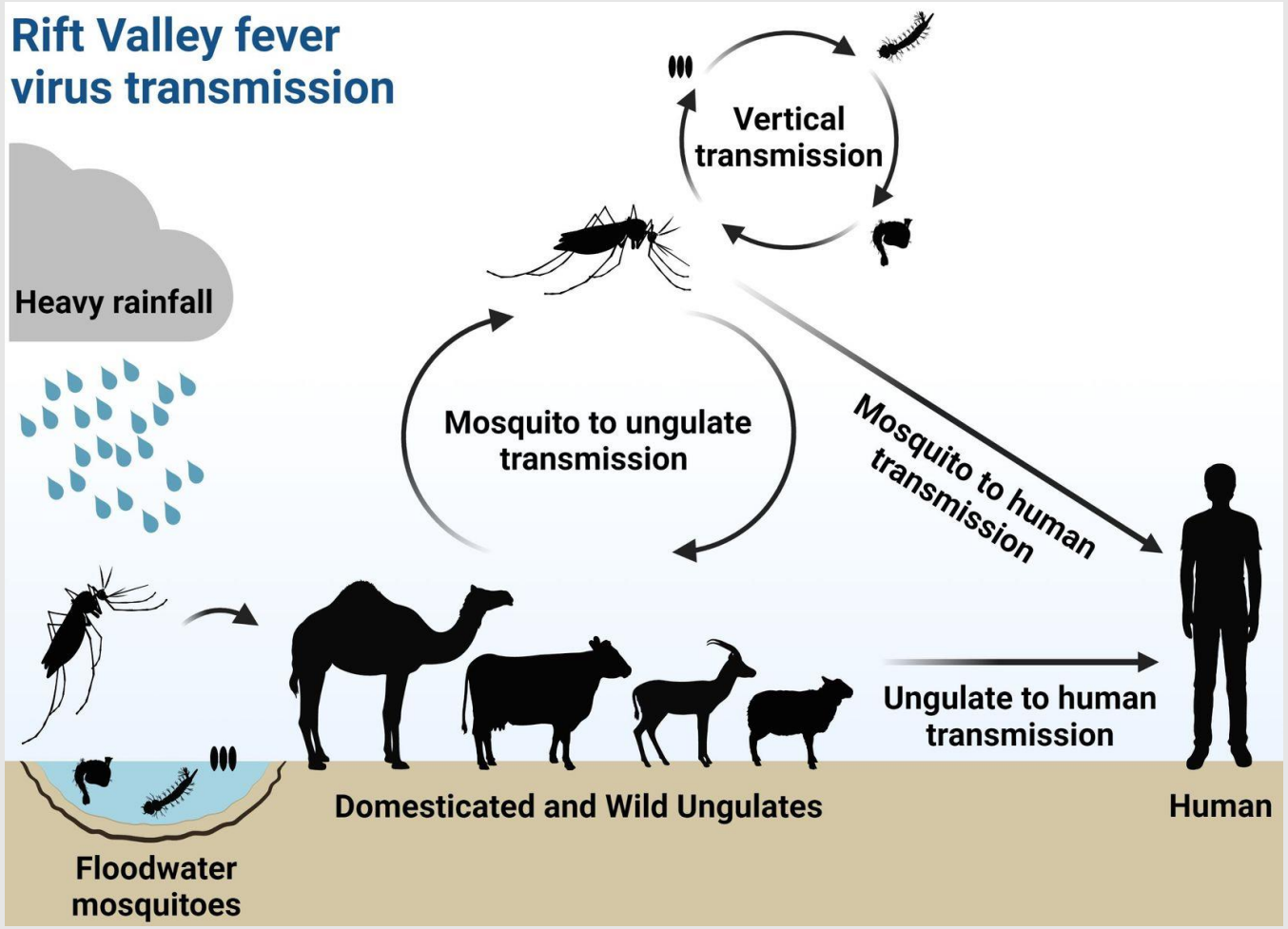
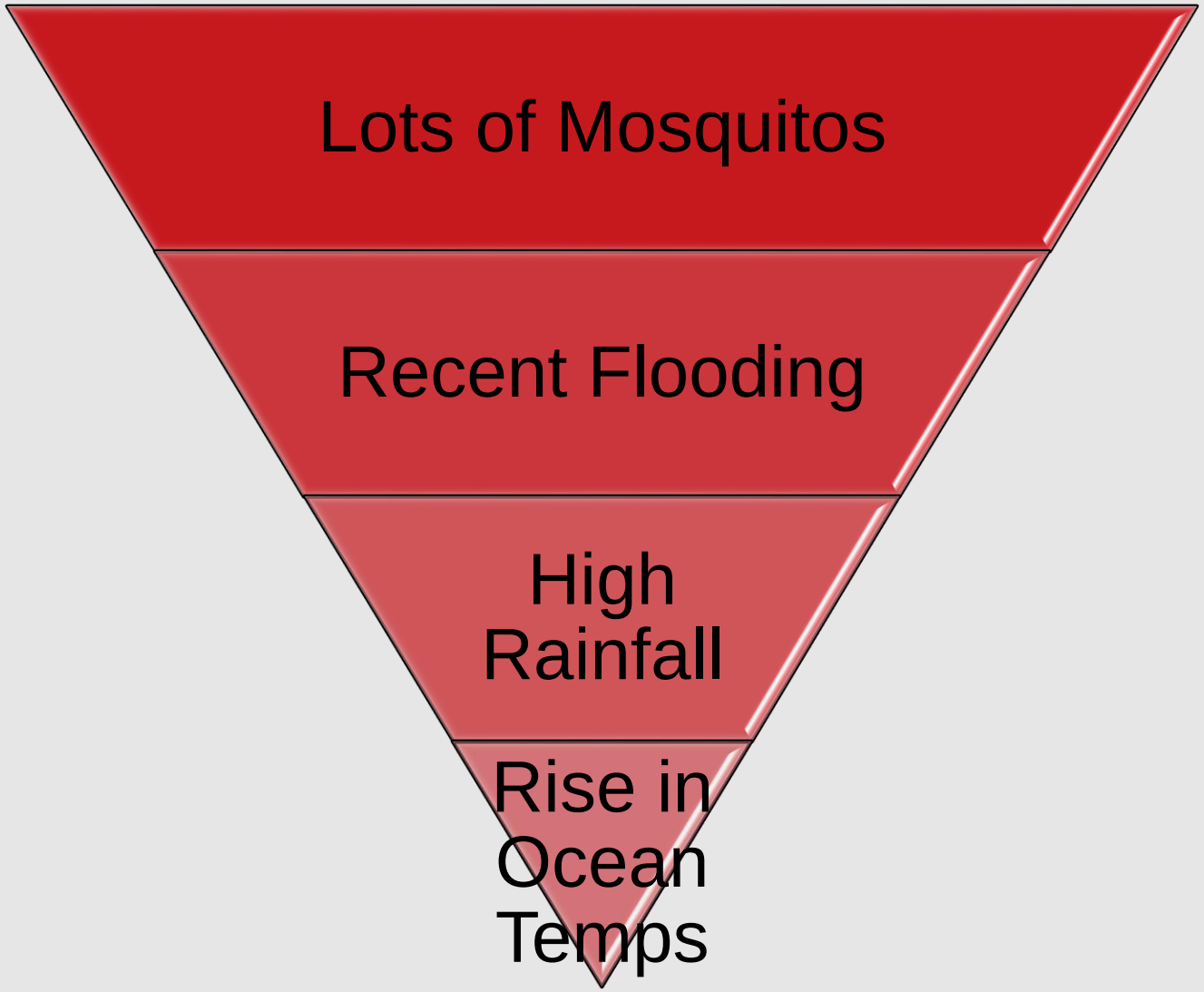
Rift Valley Fever

- Transmitted by mosquitos
- Humans are also infected through direct contact with infected animals.
- A wide range of animals can be infected and act as a reservoir for the virus.
- Most people are asymptomatic, severe disease can include encephalitis, blindness, hemorrhagic fever, and death
- Also kills animals and almost all pregnant animals miscarry when infected.



https://edis.ifas.ufl.edu/publication/IN1403

The Cause



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The Solution

- Currently no vaccine for humans
- Mosquito eradication is difficult because eggs can survive for years
- An inexpensive animal vaccine with no observable side effects is now being used to reduce the animal reservoir.
  - This protects economic interests and reduces human infections
- NASA now monitors changes in ocean temperature to predict weather patterns and outbreaks.

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Strategies for Implementing One Health Principles

Sentinel Surveillance

- Using animals as an early alert for dangerous environments

- Canary in the coalmine was an early warning of carbon monoxide build up in coalmines. If the highly sensitive canary passed out, everyone had to get out.

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Routine testing of Sentinel Species

- Sentinel Chickens are routinely tested for mosquito born diseases like West Nile, EEE, and St. Louis Encephalitis
- They can tolerate infections with little to no symptoms, but will develop antibodies if infected.
- This provides early detection and geographical awareness
- Can lead to mosquito control efforts in those areas
- Can support public health guidance
- Can aid in diagnosis of patients

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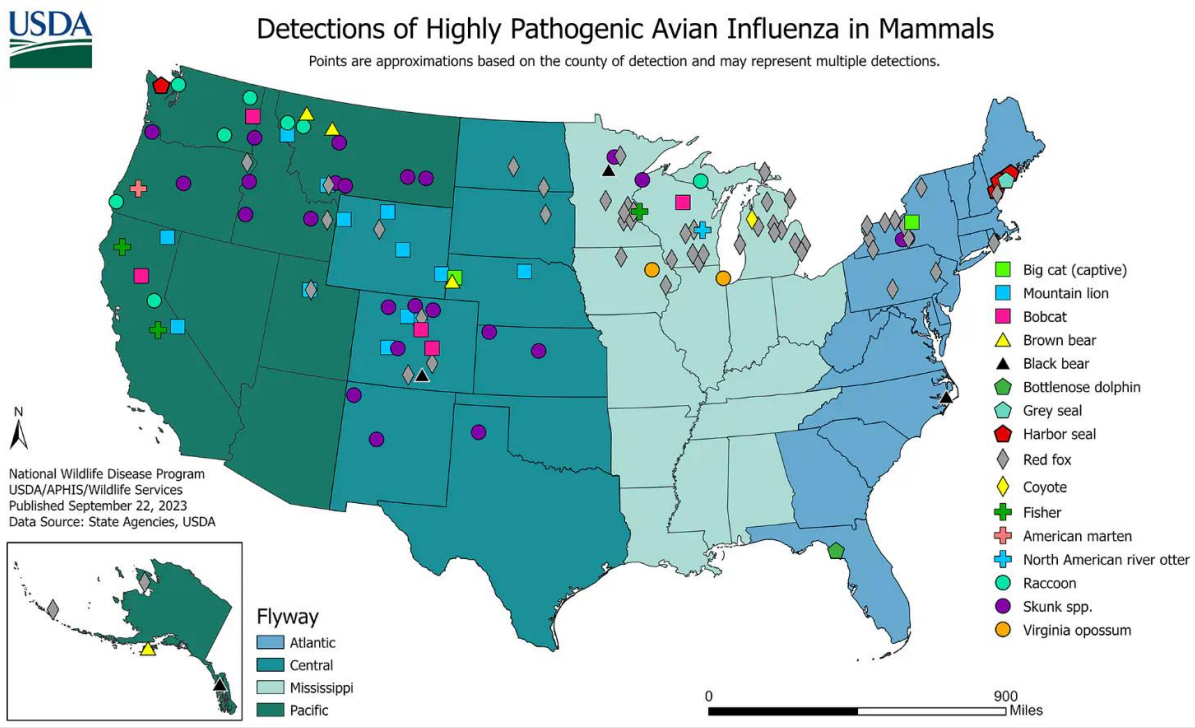
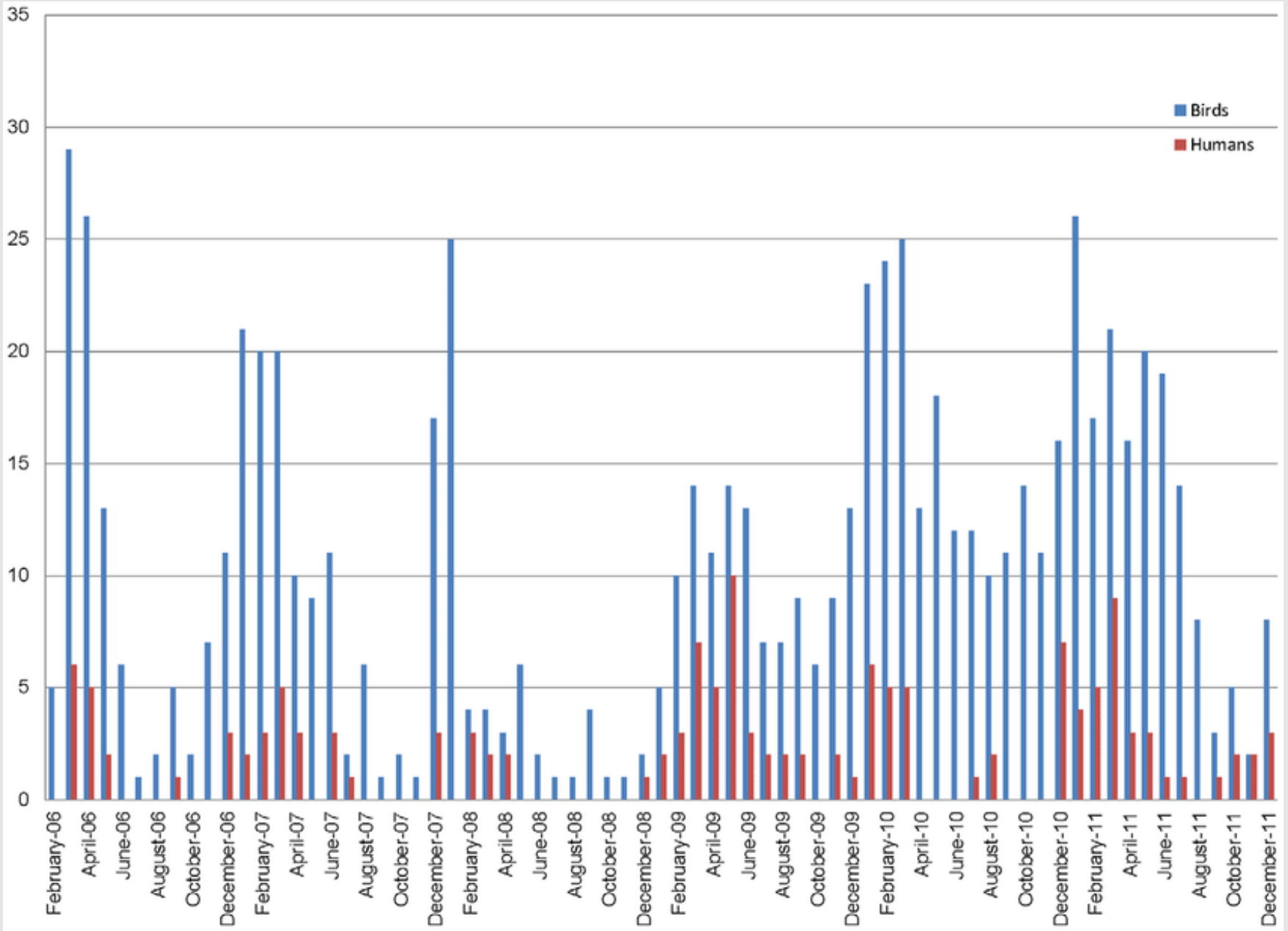
Wild animal surveillance for Influenza

- The USDA APHIS captures and tests wild birds to monitor for the spread of high pathogenicity avian influenza



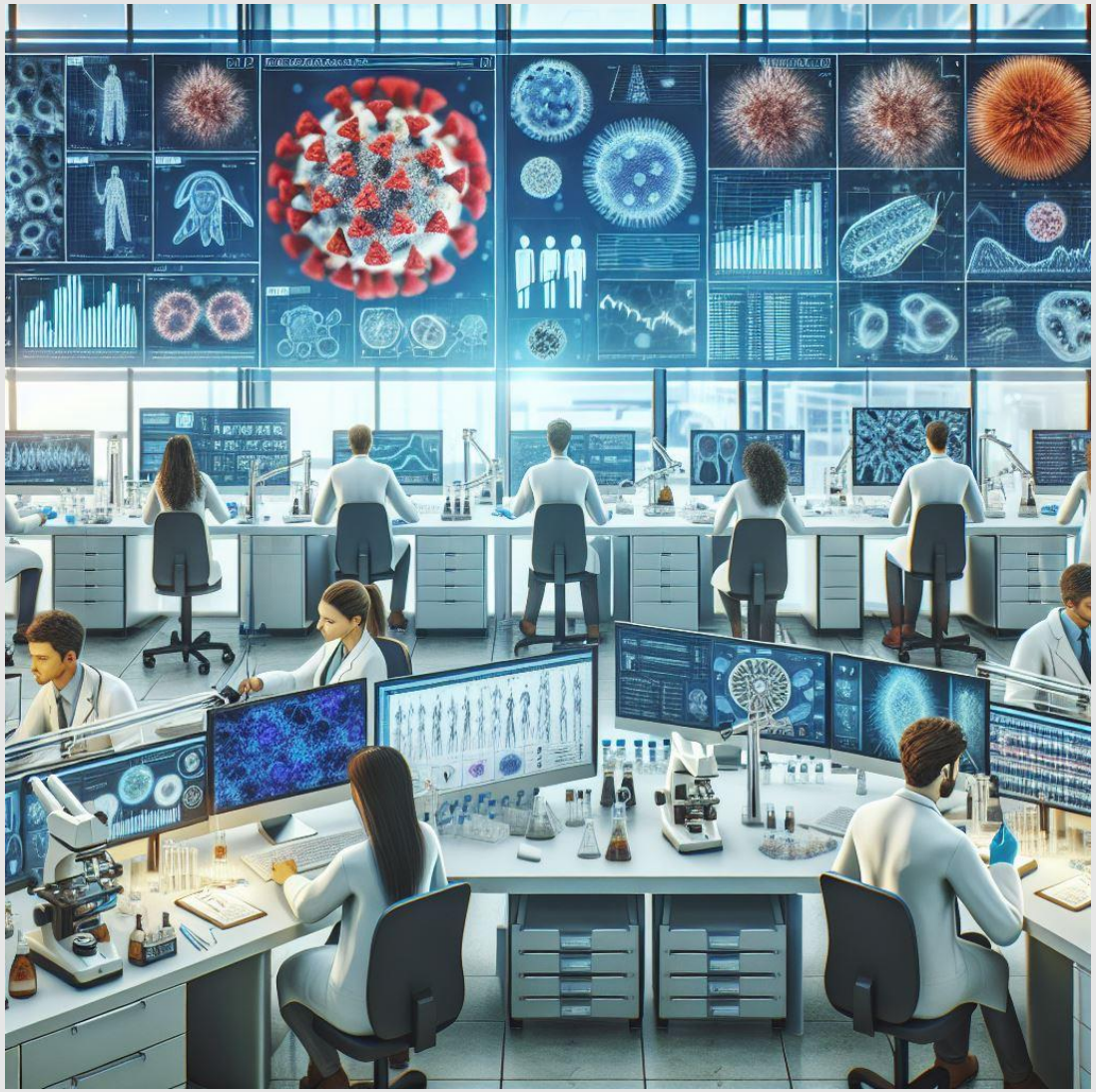
https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/wild-birds

H5N1 in Birds and Humans in Egypt



Surveillance of both human and animal infectious diseases

By monitoring both human and animal populations, these systems can identify emerging zoonotic diseases (diseases that can be transmitted from animals to humans) before they spread widely



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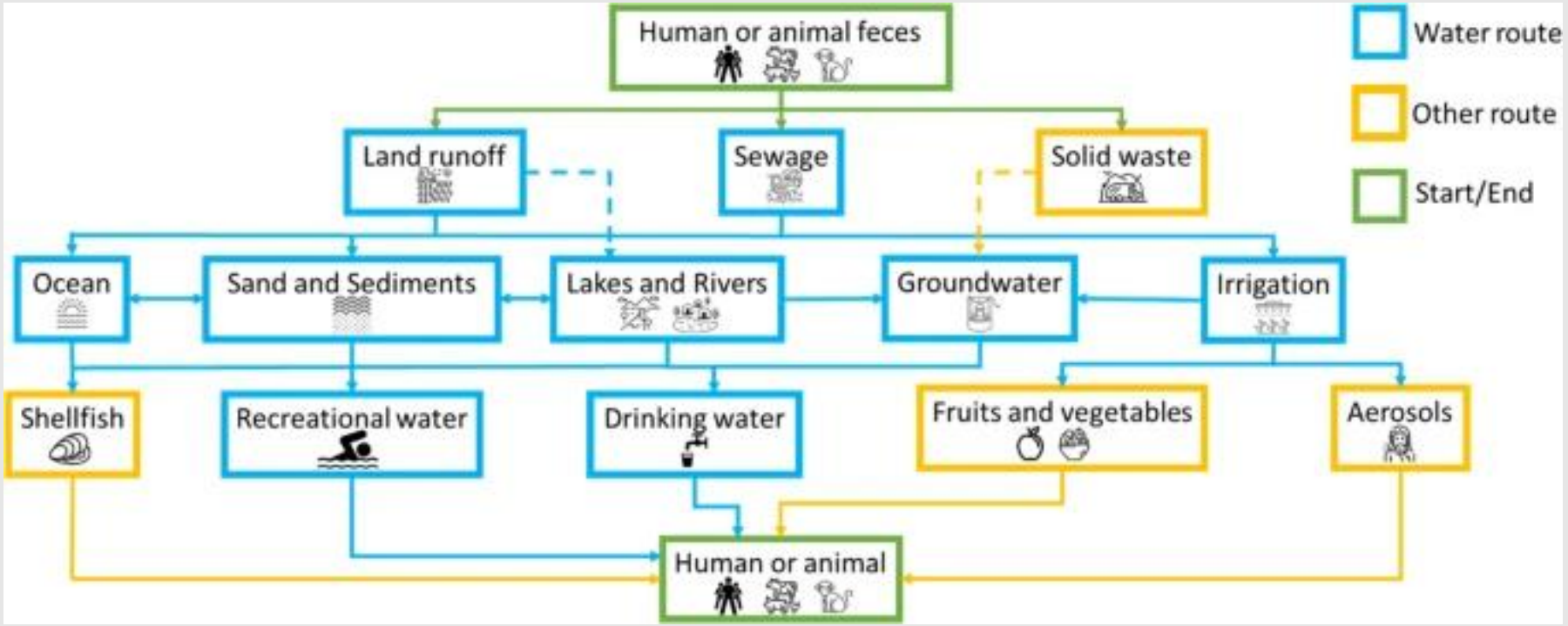
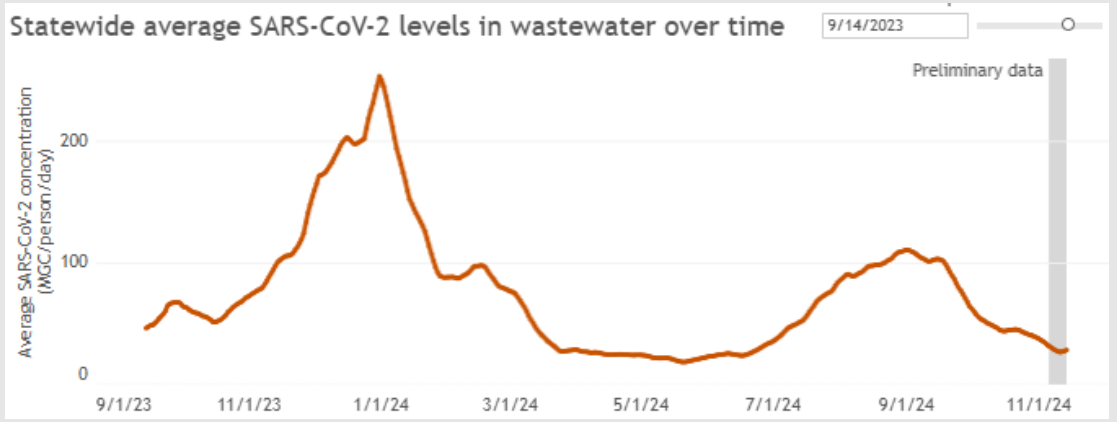
Wastewater Surveillance

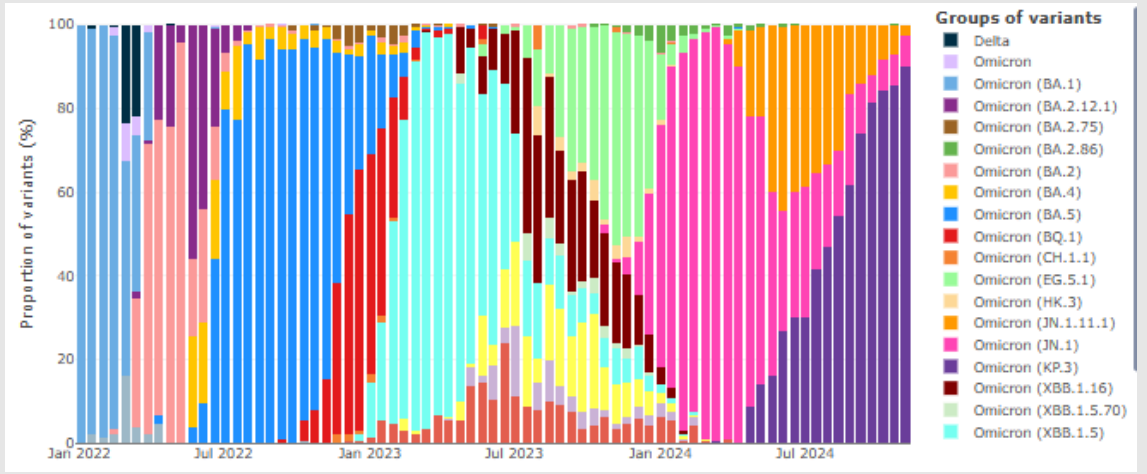


- Wastewater is comprised on human waste, animal waste, and environmental runoff.
- Monitoring for disease prevalence provides a more holistic view
- Tracing “up the line” can pinpoint the source

How Wastewater is being used

- Monitor for prevalence
  - Matches well with clinical data for many diseases
  - Could help monitor spread of emerging pathogens
  - Limited use for diseases lost in a diaper
- Monitor for strains changes
  - Can be used to detect a variant of concern
  - Could be used to inform on vaccine strain choices





https://www.dhs.wisconsin.gov/covid-19/wastewater.htm#wastewater
https://dataportal.slh.wisc.edu/sc2-ww-dashboard

Other uses for Wastewater surveillance

- Monitor for rare vaccine preventable diseases
  - Hepatitis A, Measles, Mumps, Rubella, H. flu, N. meningitidis
  - Could result in a vaccine campaign to control the spread

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Vaccinating high risk groups

- Hepatitis A infections can go undiagnosed for months
- This virus is shed in the stool and spread by the fecal oral route.
- During that time there can be significant spread particularly if the infected person is a food handler or live in a homeless community
- With only 10-30 cases of Hep A per year in Wisconsin, early detection along with localized vaccination campaigns could reduce the impact of outbreaks

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One Health in Action

- **The One Health Zoonotic Disease Prioritization (OHZDP) Workshop**: Organized by the CDC, USDA, and DOI, this workshop brings together experts from various sectors to prioritize zoonotic diseases of national concern. The goal is to enhance collaboration and develop strategies to address these diseases effectively
- **National Antimicrobial Resistance Monitoring System (NARMS)**: This collaboration involves the FDA, CDC, USDA, and the U.S. Environmental Protection Agency. NARMS monitors antimicrobial resistance in bacteria from humans, retail meats, and food animals, providing critical data to inform public health actions
- **Global Health Security Agenda (GHSA)**: The GHSA is an international effort that includes multiple countries and organizations working together to strengthen global health security. It focuses on preventing, detecting, and responding to infectious disease threats through a One Health approach
- **PREDICT Project**: Part of the USAID Emerging Pandemic Threats program, PREDICT aims to identify and monitor pathogens that can spill over from wildlife to humans. It involves collaboration between wildlife biologists, veterinarians, and public health experts to detect and respond to emerging zoonotic diseases

Manhattan Principles

1. Recognize the link between human, animal, and wildlife health, and the threat diseases pose to people, food supplies, economies, and biodiversity.
2. Understand that land and water use decisions impact health and disease patterns.
3. Include wildlife health in global disease prevention and control efforts.
4. Acknowledge that human health programs can aid conservation.
5. Develop holistic approaches to disease prevention and control, considering species interconnections.
6. Integrate biodiversity conservation and human needs in disease threat solutions.
7. Regulate wildlife trade to protect populations and reduce disease risks.
8. Limit wildlife culling for disease control to scientifically justified cases.
9. Invest in global health infrastructure for better disease surveillance and response.
10. Foster collaborations among governments, communities, and sectors for health and conservation.
11. Support global wildlife health surveillance networks for early disease warning.
12. Educate and raise awareness about the health-ecosystem relationship for a healthier planet.

https://www.oneworldonehealth.org/sept2004/owoh_sept04.html

What Labs Can Do

- **Enhancing Workforce Training**: Providing continuous education and training for laboratory personnel in areas such as molecular diagnostics, bioinformatics, and biosafety. This helps maintain a skilled workforce capable of handling complex One Health challenges
- **Promoting Data Sharing and Collaboration**: Establishing robust data-sharing mechanisms and fostering collaboration between human health, veterinary, and environmental laboratories. This can be facilitated through integrated surveillance systems and platforms that allow for real-time data exchange
- **Expanding Genomic Surveillance**: Utilizing advanced genomic technologies like whole-genome sequencing (WGS) to monitor and track pathogens. This helps in understanding the genetic diversity of pathogens, detecting antimicrobial resistance, and identifying emerging threats
- **Participating in Global Networks**: Engaging in international laboratory networks and initiatives to share knowledge, resources, and best practices. This enhances global surveillance efforts and ensures a coordinated response to health threats
- **Improving Biosafety and Biosecurity**: Strengthening biosafety and biosecurity measures to prevent laboratory-acquired infections and ensure safe handling of high-risk pathogens. This includes regular risk assessments and implementation of safety protocols

Closing Remarks

Recognizing and responding to infectious disease with a one Health approach will result in:

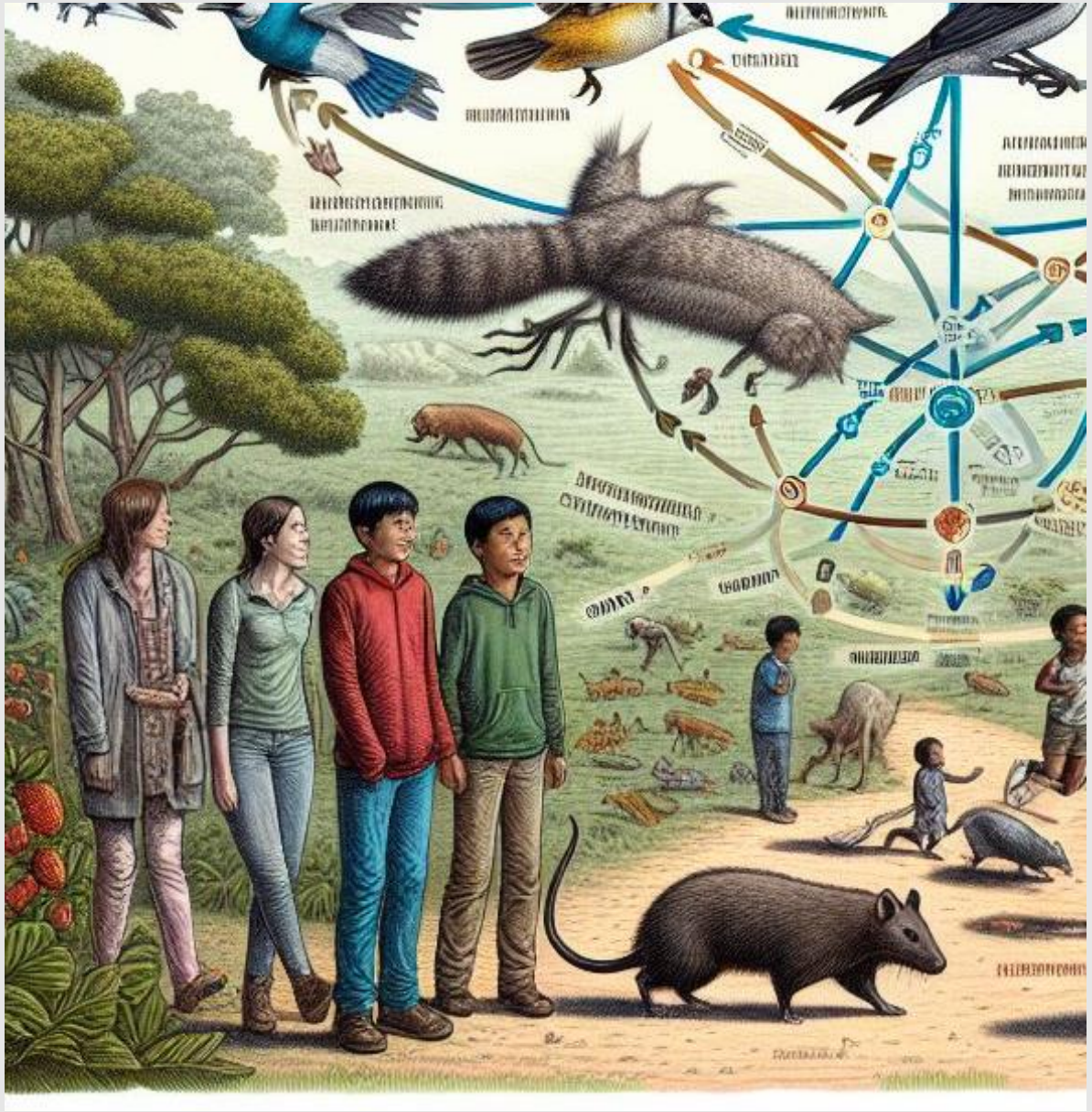
- Improved disease prevention, control, and treatment
- Enhanced health outcomes for humans and animals
- Sustainable ecosystem management

One Health Day

Resources

- WHO- https://www.who.int/europe/initiatives/one-health
- CDC- https://www.cdc.gov/one-health/about/
- USDA- https://www.usda.gov/topics/animals/one-health
- World Org. for Animal Health- https://www.woah.org/en/what-we-do/global-initiatives/one-health/
- Food and Agriculture Organization- https://www.fao.org/one-health/en
- One Health Initiative- https://onehealthinitiative.com/
- One Health Commission- https://www.onehealthcommission.org/

AI Candid Camera

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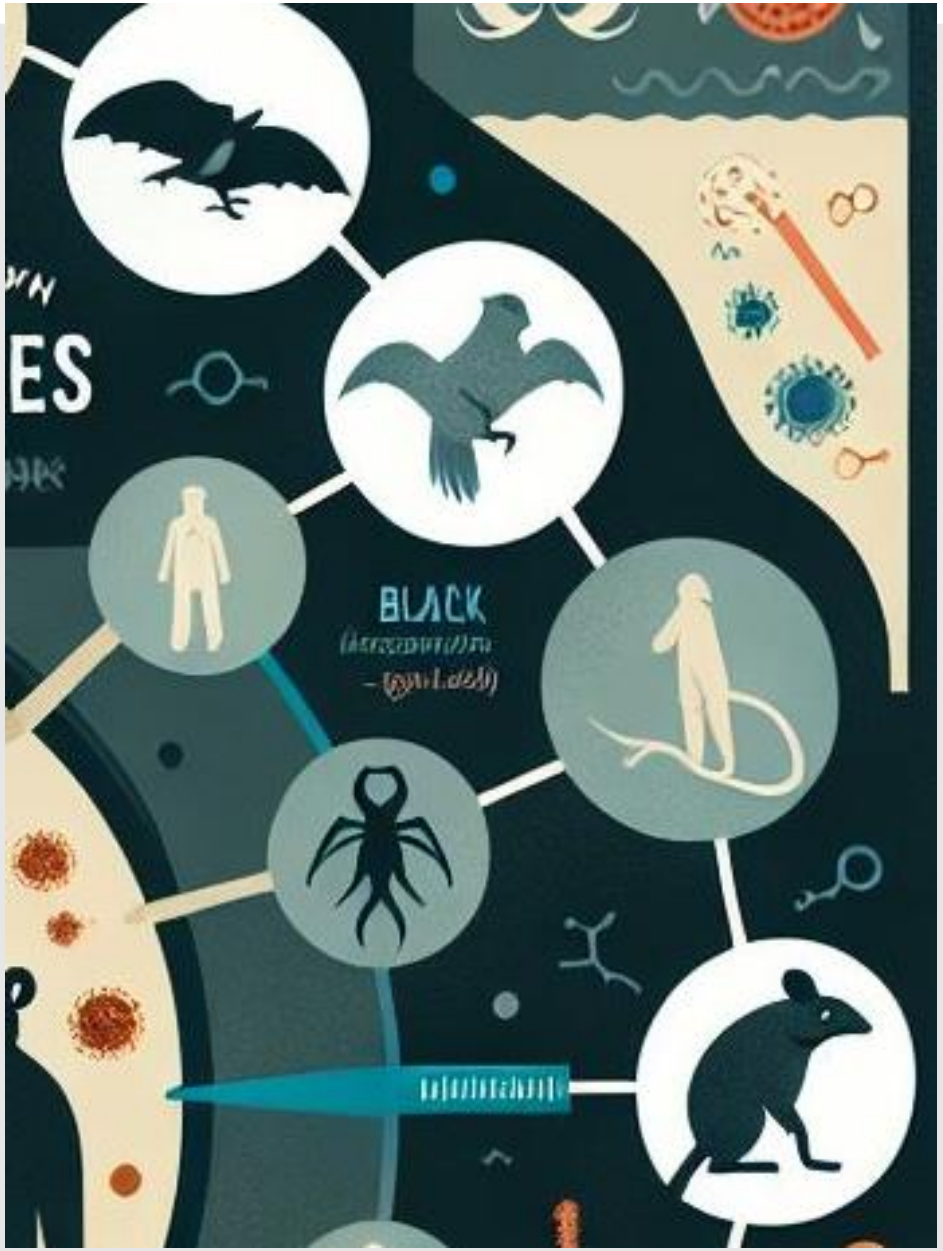
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Questions?