

The background is a promotional poster for 'CowPots'. At the top, the word 'COWPOTS' is written in large, yellow, stylized letters. Below it, the slogan 'The pots you plant!' is written in a green, cursive font. To the right, there is a red flower-shaped graphic with the text 'Odor Free!' in yellow. In the center, a blue oval contains the main title of the slide. Below the oval, there is a grey box containing the presenter's name and affiliation. At the bottom left, there is a logo for the University of Maryland and the Department of Environmental Science & Technology. The bottom right corner has the text 'Pots lants' and '3.11'.

Antibiotics Resistance, Manure Technologies, and Value-Added Treatment

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Presentation Overview

- Value-Added Products
 - Bedding, Compost and Digestate Products
 - Nutrient Extraction after Digestion
- Antibiotics in Agriculture
- Antibiotic Resistance (AR) and AR Policy
- Antibiotic Resistance and Manure Treatment

Bedding for on-Farm Use

- Solid Separation after digestion. Solids can be:
 - Used directly as bedding (or sold to other farms)
 - Composted and used on fields or sold
 - Partially dried (air injection) and used as bedding

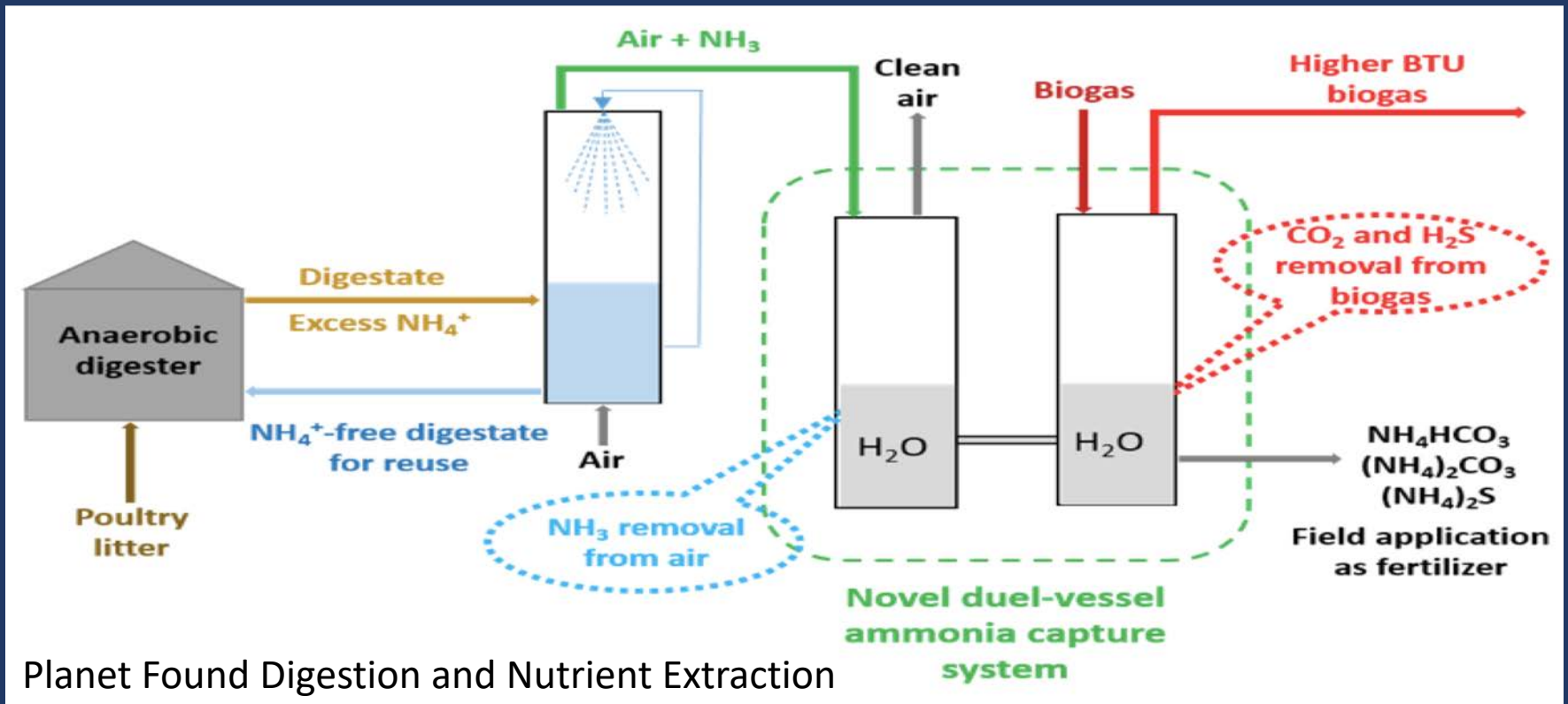


- Our prior analyses of small-scale digesters (250 cows or less) showed the use of digested solids for bedding generated the highest revenue (\$100 per cow per year), followed by biogas use for electrical generation (\$47 to \$70 per cow per year) and CO₂ credits (\$7 per cow per year). (Klavon et al., 2013)



DC Water Class A Biosolids Bloom Product

Nutrient Extraction Post-Digestion



- Ammonium scrubber drives NH_3 from the digester effluent into an ammonia-rich solution, which can be transportable fertilizer.
- Solid presses and nutrient extraction takes nutrients from a solid matrix (poultry litter) into a concentrated form, with reusable water produced after nutrient removal.

What are other value-added benefits?

- Are there other value-added benefits?
 - Pathogen reduction
 - Odor reduction
 - GHG reductions (and \$\$ on the carbon market)
- Does anaerobic digestion reduce other contaminants?
 - Nutrients are not reduced by much in the digester (settled and some bacterial uptake), but nutrients are transformed.
 - What about Antibiotic destruction?
 - Is caffeine, estrogens, and personal care products reduced in wastewater treatment plant digesters?
 - Nanoparticles?

Informed Consent

- You are being asked to participate in a research study. The purpose of this study is to understand perceptions of antibiotic use for livestock.
- You are being asked to volunteer because you are a stakeholder with an interest in antibiotic policy. You are free to withdraw at any time.
- You will be asked to answer questions about agriculture, animal health, farm management, antibiotic regulations, decision making, and use. This survey should take about five minutes to complete.

Informed Consent

- We do not ask or identify any individuals who plan to participate in this survey.
- You must be of 18 years or older to participate in this survey.
- There are no known risks involved in completing the survey. There are no tangible benefits for completing the survey.
- Participation is entirely voluntary; you may at any time withdraw from participation
- All data obtained will be anonymous. Your data will not be shared with any other parties under any circumstance.

Informed Consent

- This study has been reviewed and approved by the UMBC Institutional Review Board (IRB). A representative of that Board, from the Office of Research Protections and Compliance, is available to discuss the review process or my rights as a research participant. Contact information of the Office is (410) 455-2737 or compliance@umbc.edu.
- The PI for this study is David Lansing
 - email: dlansing@umbc.edu
 - Phone: 410-455-2971

Survey: Antibiotic usage and antibiotic resistance knowledge and perceptions

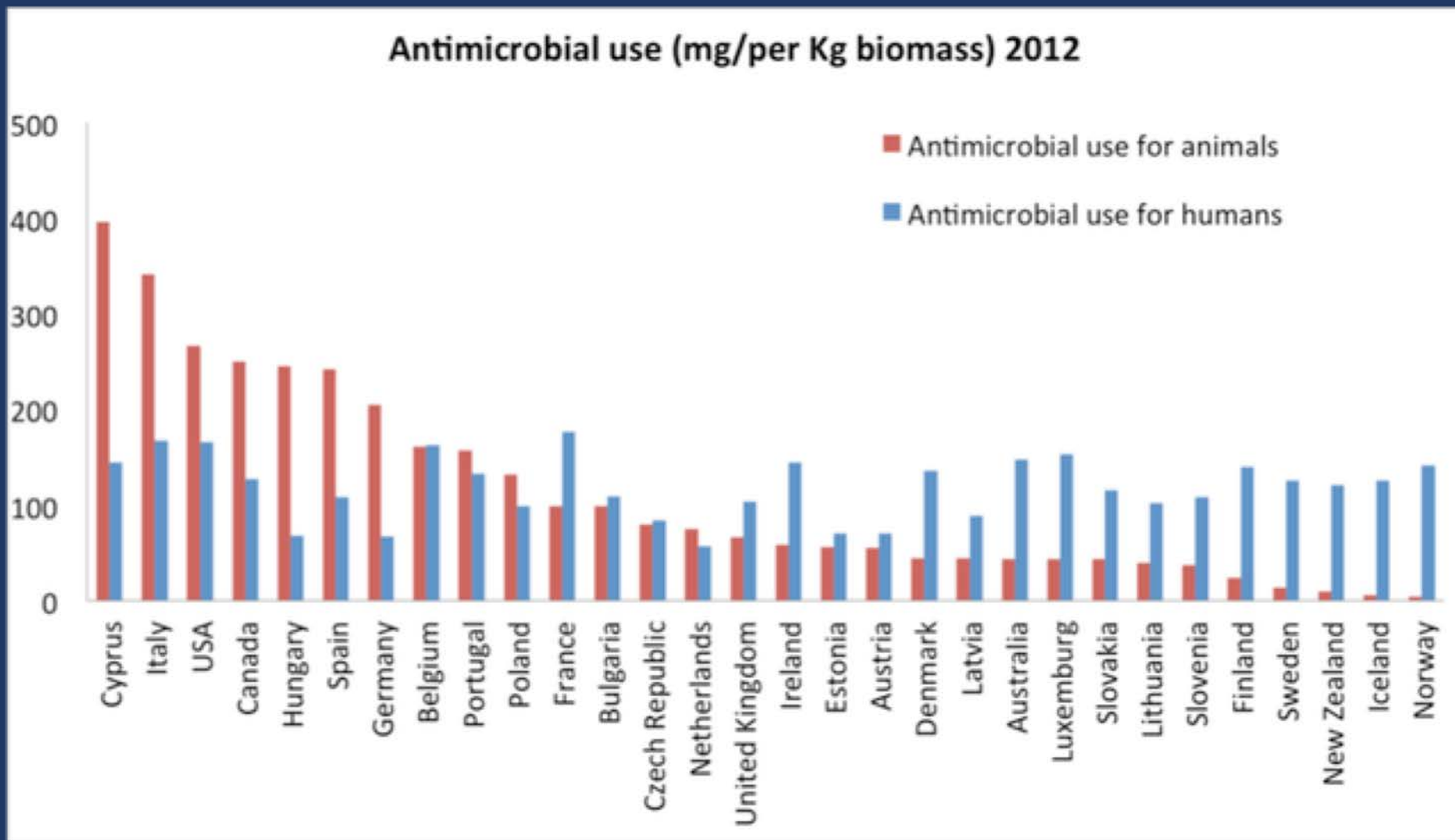
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- Please take out your phones and answer the questions found at the following link:

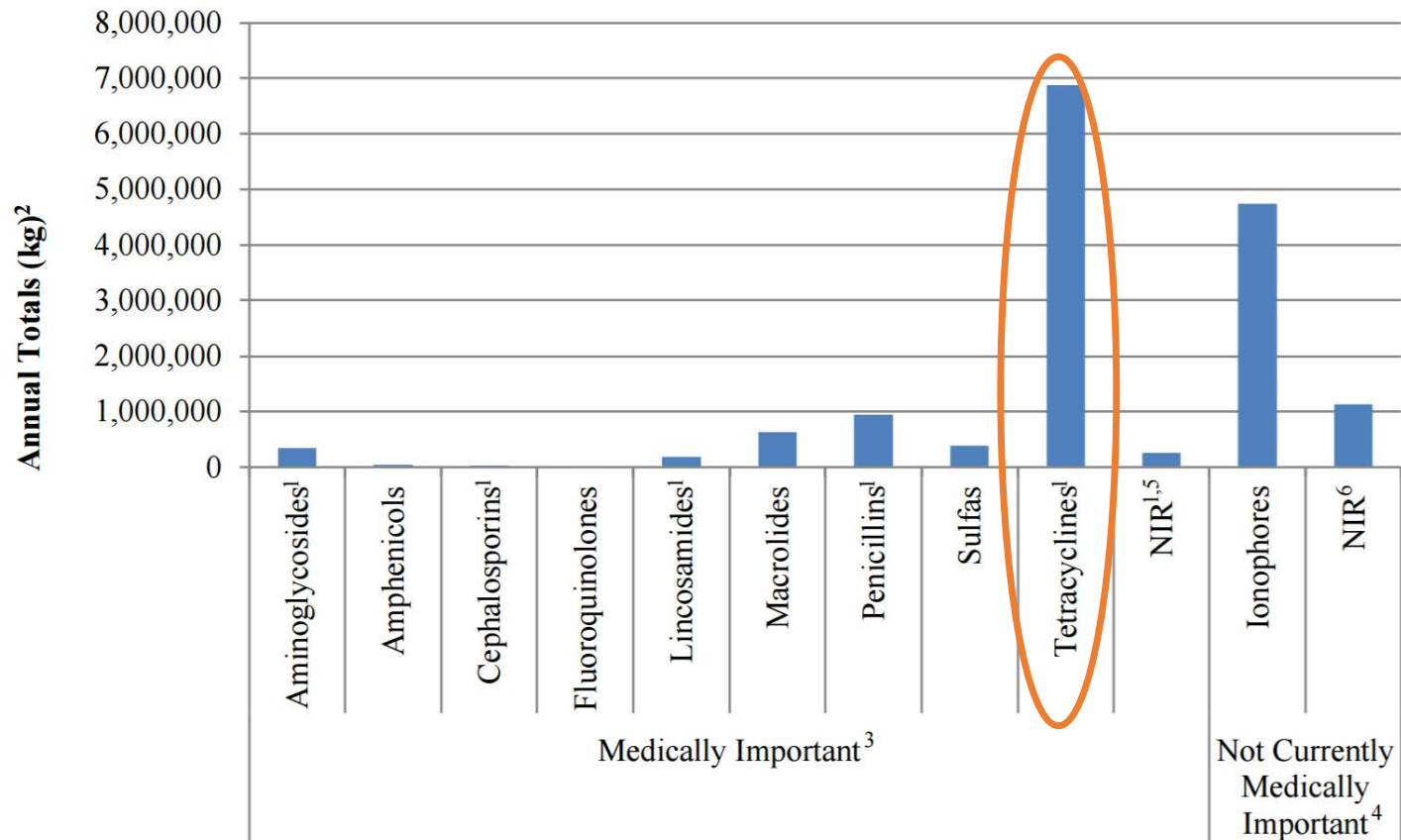


Antibiotic Use: Humans and Animals



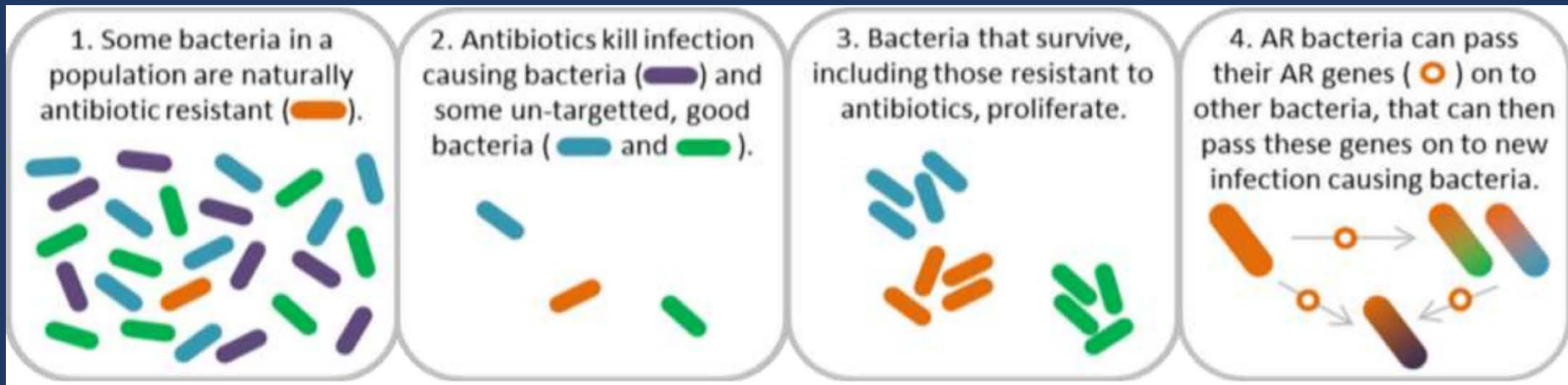
Antibiotic Usage in Animal Husbandry

ANTIMICROBIAL DRUGS APPROVED FOR USE IN FOOD-PRODUCING ANIMALS¹
ACTIVELY MARKETED IN 2015
DOMESTIC SALES AND DISTRIBUTION DATA
REPORTED BY MEDICAL IMPORTANCE AND DRUG CLASS

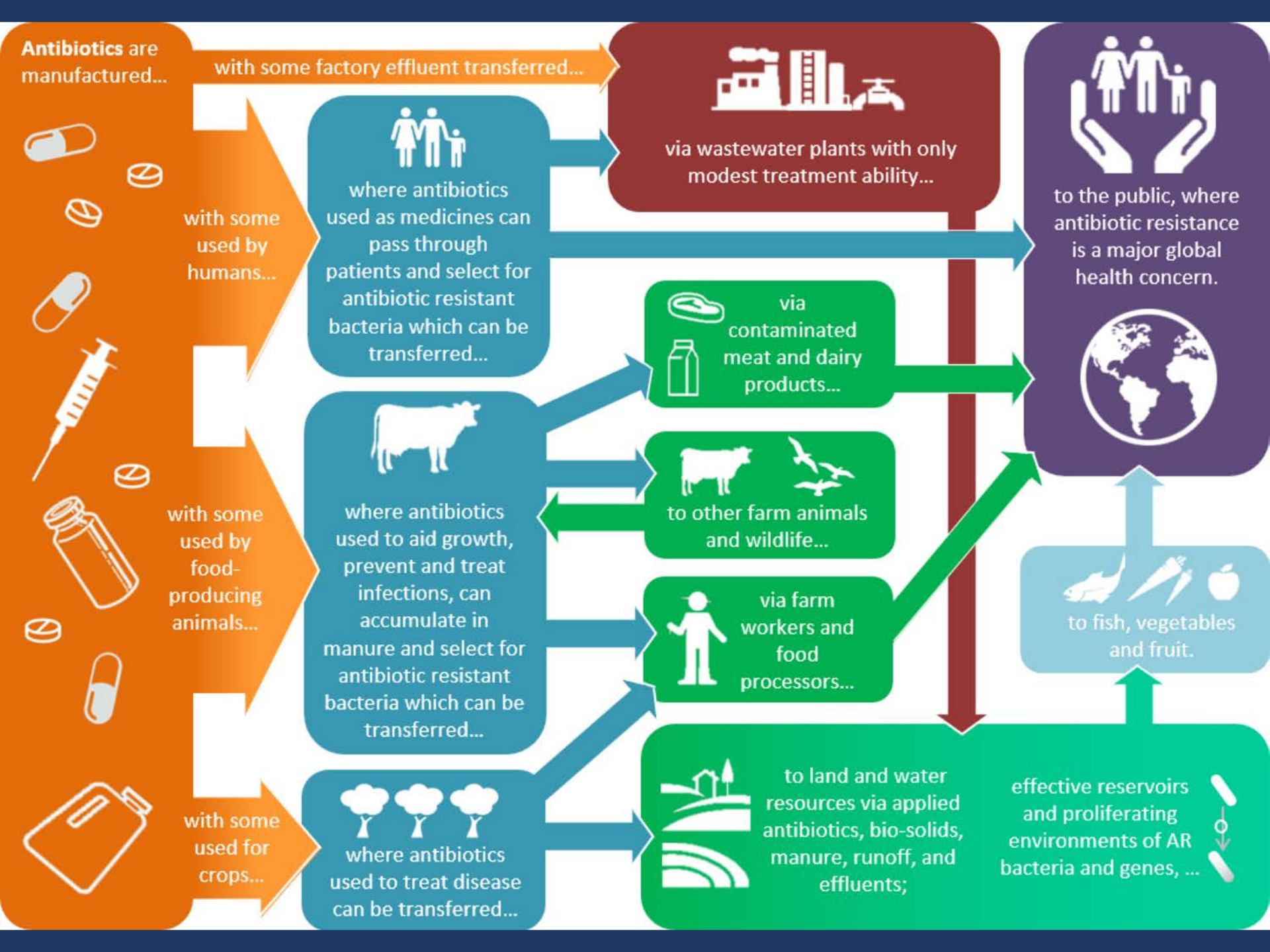


Pathways of Antibiotic Resistance (AR)

- Why do we care? Antibiotic resistance (AR) can cause administered antibiotics to be ineffective in disease control.



- Where/how does this happen?
 - Horizontal gene transfer can pass antibiotic resistant genes (ARG) from resistance bacteria (ARB) to other bacteria in soil/water/manure/guts. Once ARG is acquired, these unrelated bacteria will gain AR and can then pass ARG on to their offspring or to other unrelated bacteria.



Survey: Perception of policy regulations on antibiotic administration

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Veterinary Feed Directive (VFD)

- 1996: Animal Drug Availability Act (ADAA)
 - Created category of Veterinary Feed Directive Drugs
- 2013: Guidance For Industry #209
 - Eliminates feed and water use of medically important antimicrobials for production purposes
- 2015: GFI #213
 - Process and timeline for implementing #209
- VFD Final Rule
 - December 2016: Full Implementation of GFI #213

Veterinary Feed Directive – Jan 2017

- Cannot use medically important antibiotics for production purposes
- Must obtain a VFR from a veterinarian to use antibiotics
 - Producer must be in context of a Veterinarian Client Patient Relationship (VCPR)
 - VCPR defined by states
 - Responsibility for animal health; knowledge of animal; available for follow up

VFR Impacts on Farms

- Potential for Financial Impact
 - Complete ban would reduce profits by \$1,400 per hog house
 - No determinative studies yet
- Early Qualitative Studies
 - Hog and Beef Cattle Producers (Lee Schultz, Iowa State)
 - few complaints about the VFD process, paperwork etc.
 - Dairy Producers (Kelsey O'Shea, Cornell):
 - Increased capital investments
 - Different barn design; more monitoring technology
 - Less availability of in-feed antibiotics: Feed mills often out of stock

State Antibiotic Laws

- Maryland: Keeping Antibiotic Effective Act
- California: SB27
 - Both took effect in 2018
 - California's seen as more stringent
 - Key difference: Preventative Use
- Poultry Industry (i.e. Purdue) has gone antibiotic free ahead of industrial regulations

Survey: Perception of the role of anaerobic digestion in antibiotic mitigation

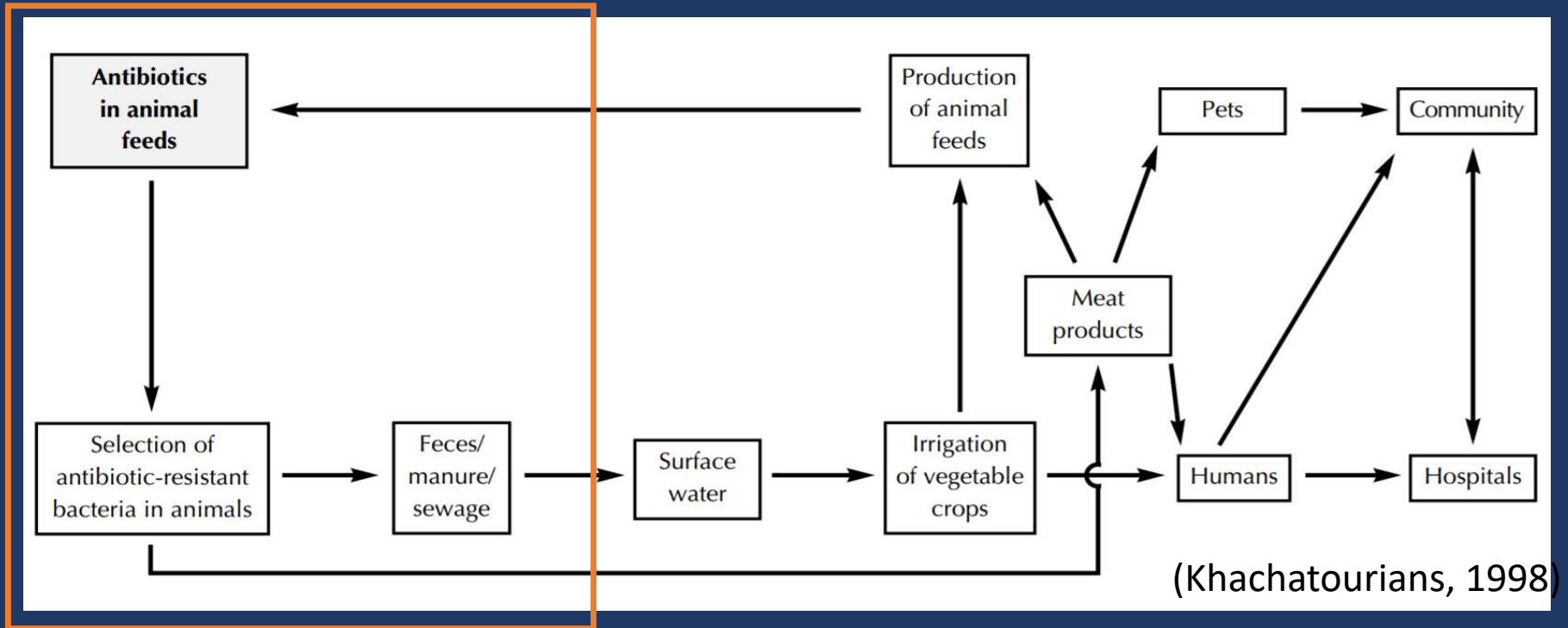
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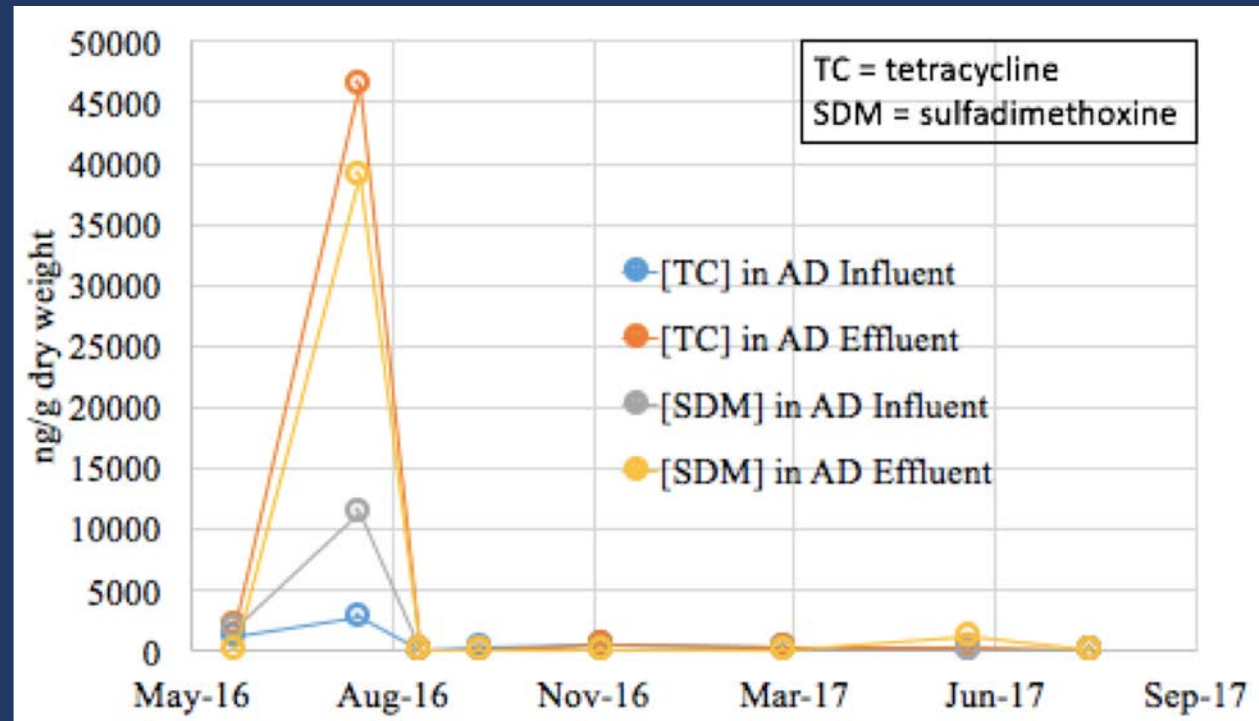
Pathways of Antibiotic Resistance (AR): Influence of Manure



- Manure management varies greatly: composting, solid-liquid separation, digestion, lagoon storage, packed bedding.
- Some farms have physical separation of sick cows and separation of milk supply, but manure may not be separated.

Prior Research: Fate of antimicrobials in Digesters

- Antibiotics residuals in digesters are often close to zero, but can spike with animal treatments.
- With various retention times throughout the manure treatment process, it difficult to show treatment effect.



- Our lab studies of antibiotic spikes showed 100% reduction of SDM in digesters, but inconsistent (0-80%) removal of TC, likely due to the highly sportive nature of TC.
- Lab extraction of antibiotics is more difficult in digester influent compared to effluent.

New studies:

- Effect of temperature and thermal hydrolysis prior to digestion on ARG and antibiotics for both wastewater and dairy manure.



Pulper

- Influent solids 15 to 18.5 %TS
- Preheated to 140-210° F with recycle steam
- Mixing pumps

Reactors

- Batch process
- Heated to 302-356° F -160 C
- 87psi
- ~ 30 minute detention time

Flash Tank

- Depressurization destroys cell walls
- Cools down to 158-239° F
- 8-12 %TS to digesters >



*Thermal Hydrolysis
FOR CLASS A*

