Antimicrobial Resistance & Animals

JOHNS HOPKINS
BLOOMBERG SCHOOL
of PUBLIC HEALTH

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Land Acknowledgement

We humbly acknowledge that our universities are located on the traditional and contemporary homelands of indigenous peoples. As we gather from places across the country and globe, we honor and recognize indigenous people of our homelands.

Together, we acknowledge the history of genocide and ongoing systemic inequities while respecting treaties made on this territory as a step towards reconciliation and strengthening relationships with indigenous peoples. We give thanks to the past, present and future stewards of this land and respect all tribal nation's sovereignty and right to self-determination. We aim to hold ourselves and the university community accountable to tribal nations.

Snapshot

- Case study 1: AMR & One Health
  - MDR-MRSA in a Household (companion animal)
- Case study 2: Food systems, policy & AMR
  - California Senate Bill 422
  - ARES project

AMR: antimicrobial resistance
MDR: multi-drug resistant
MRSA: methicillin-resistant *Staphylococcus aureus*

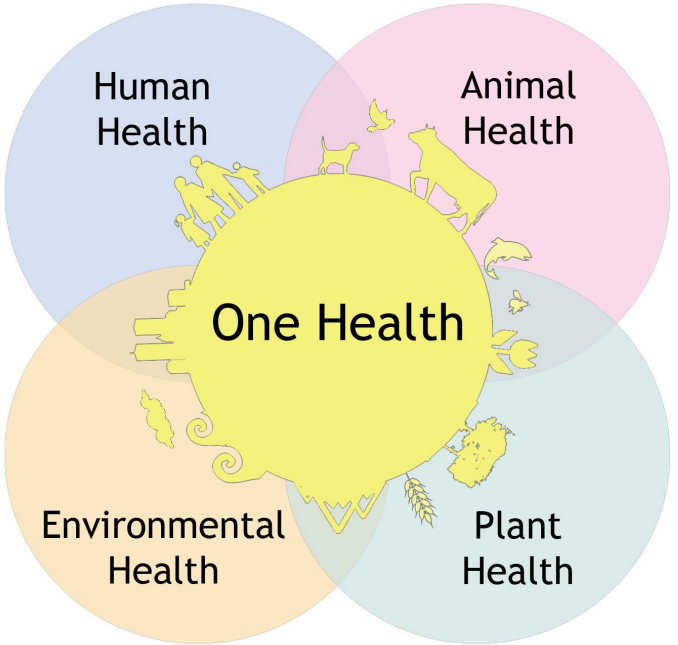
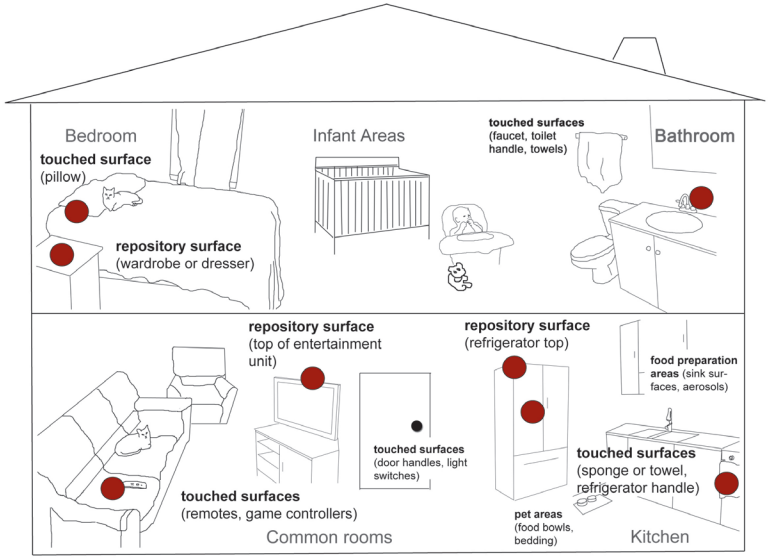


Image: M. Davis

Case Study 1: MRSA in Households

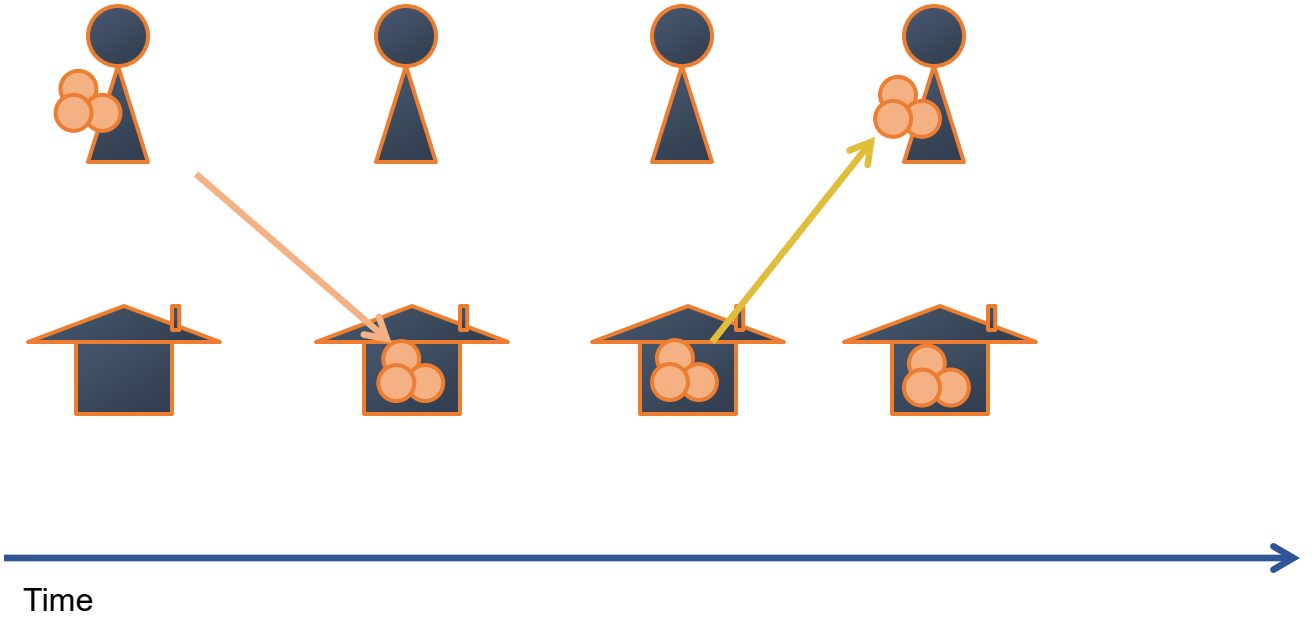
Methicillin-resistant *S. aureus* in homes

- *S. aureus* colonizes a third of the U.S. population
  - Colonization is a risk factor for later infection
  - Methicillin-resistant *S. aureus* (MRSA) associated with worse outcomes
- Home contamination rates range from 40 – 100% (reservoir)



Davis *et al.*, The role of the household in transmission of methicillin-resistant *S. aureus* and other staphylococci. *The Lancet Infectious Diseases* 2012

S. aureus colonization & the home environment



MRSA contamination in homes of people with recent infxn

Bedroom spaces

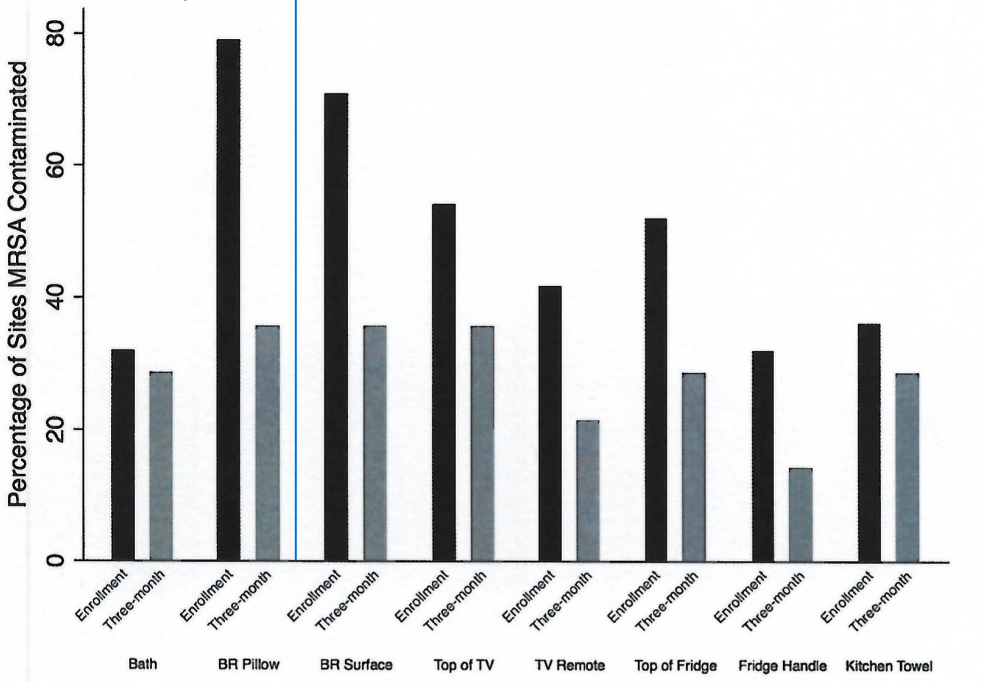


FIG 1 Percentage of sites contaminated with MRSA at the enrollment visit (baseline) and the 3-month visit. Samples were collected from eight standardized locations in the common room, kitchen, and bedroom (BR) of each household.

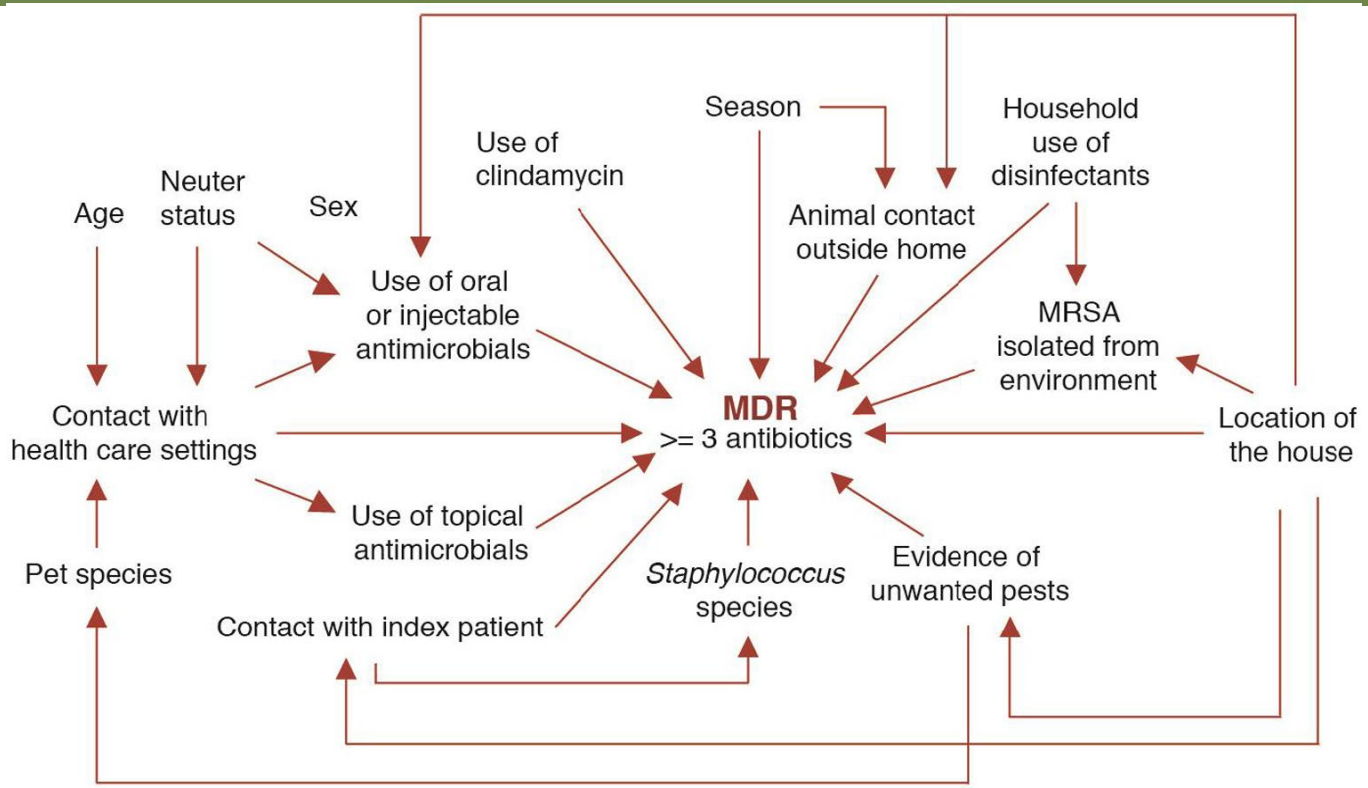
Jonathan Shahbazian

Risk factors for
multidrug resistance (MDR):

- Human or pet use of antimicrobial drugs
- Use of disinfectants on EPA list of MRSA-cidal products
- Rural residence

Shahbazian JH, Hahn PD, Ludwig S, Ferguson J, Baron P, Christ A, Spicer K, Tolomeo P, Torrie AM, Bilker WB, Cluzet VC, Hu B, Julian K, Nachamkin I, Rankin SC, Morris DO, Lautenbach E, and **Davis MF**. Multidrug and mupirocin resistance in environmental methicillin-resistant *Staphylococcus aureus* (MRSA) collected from the homes of people diagnosed with a community-onset (CO-) MRSA infection. *Applied and Environmental Microbiology* 2017, 83(22):e01369-17.

Pet MDR Outcomes



Dr.Cusi Ferradas

Ferradas, C., Cotter, C., Shahbazian, J. H., et al.(2022). Risk factors for antimicrobial resistance among Staphylococcus isolated from pets living with a patient diagnosed with methicillin-resistant *Staphylococcus aureus* infection. Zoonoses and Public Health, 00, 1– 10. https://doi.org/10.1111/zph.12946

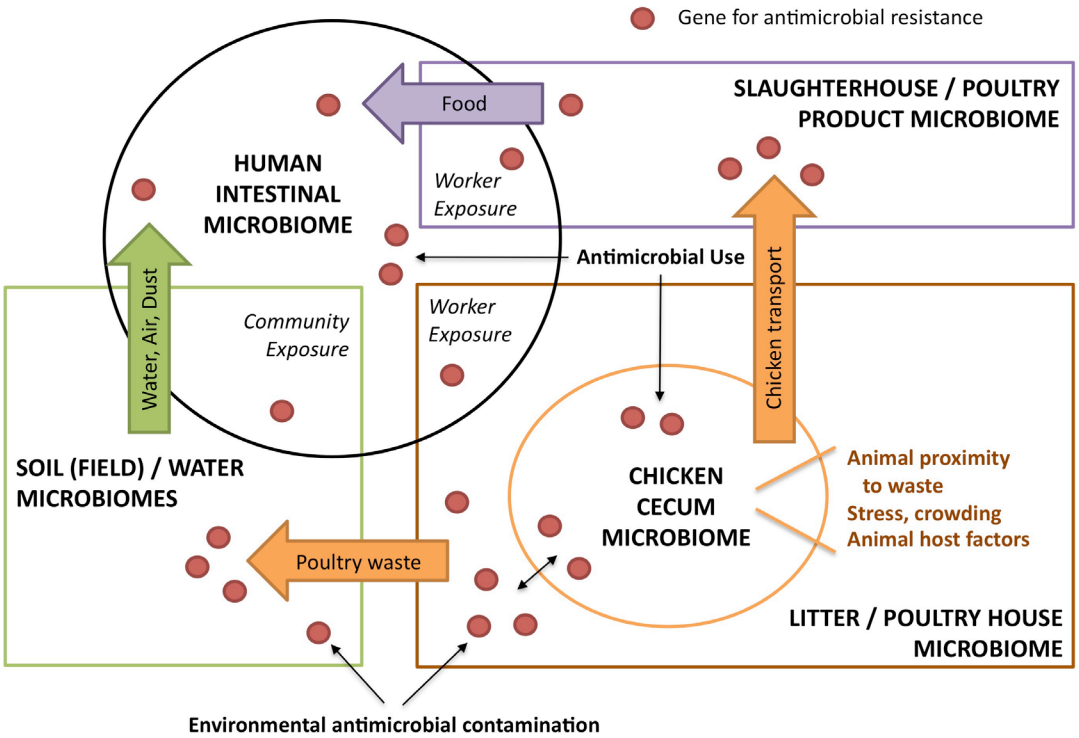
Pet Outcomes: MRSA in pets and the environment

House ID	Sample	Pet species	N of MRSA positive / Total N in the house	spa type	MDR	fox	amk	e	cip	gm	cc	sxt	tet	Concordant (N)*	Total N of antimicrobials tested*	Percent concordance
A	Pet	Dog	1/5	t334	Yes									8	11	73%
	Environment	-	-	t216	-											
B	Pet	Cat	1/1	t008	Yes									10	11	91%
	Environment	-	-	t008	-											
C	Pet	Cat 1	2/2	t008	Yes									9	11	82%
		Cat 2		t008	Yes											
	Environment	-	-	t008	-											
D	Pet	Cat 1	2/13	t008	Yes									11	11	100%
		Cat 2		t008	Yes											
	Environment	-	-	t008	-											
E	Pet	Dog	1/1	t12500	Yes									10	11	91%
	Environment	-	-	t12500	-											
F	Pet	Dog	1/1	t216	No									9	11	82%
	Environment	-	-	t216	-											
G	Pet	Dog	1/1	t216	No									9	11	82%
		Cat	1/1	t216	No											
	Environment	-	-	t216	-											
H	Pet	Dog	1/1	t121	Yes									10	11	91%
	Environment	-	-	t121	-											

Ferradas, C., Cotter, C., Shahbazian, J. H., et al.(2022). Risk factors for antimicrobial resistance among Staphylococcus isolated from pets living with a patient diagnosed with methicillin-resistant *Staphylococcus aureus* infection. Zoonoses and Public Health, 00, 1– 10. https://doi.org/10.1111/zph.12946

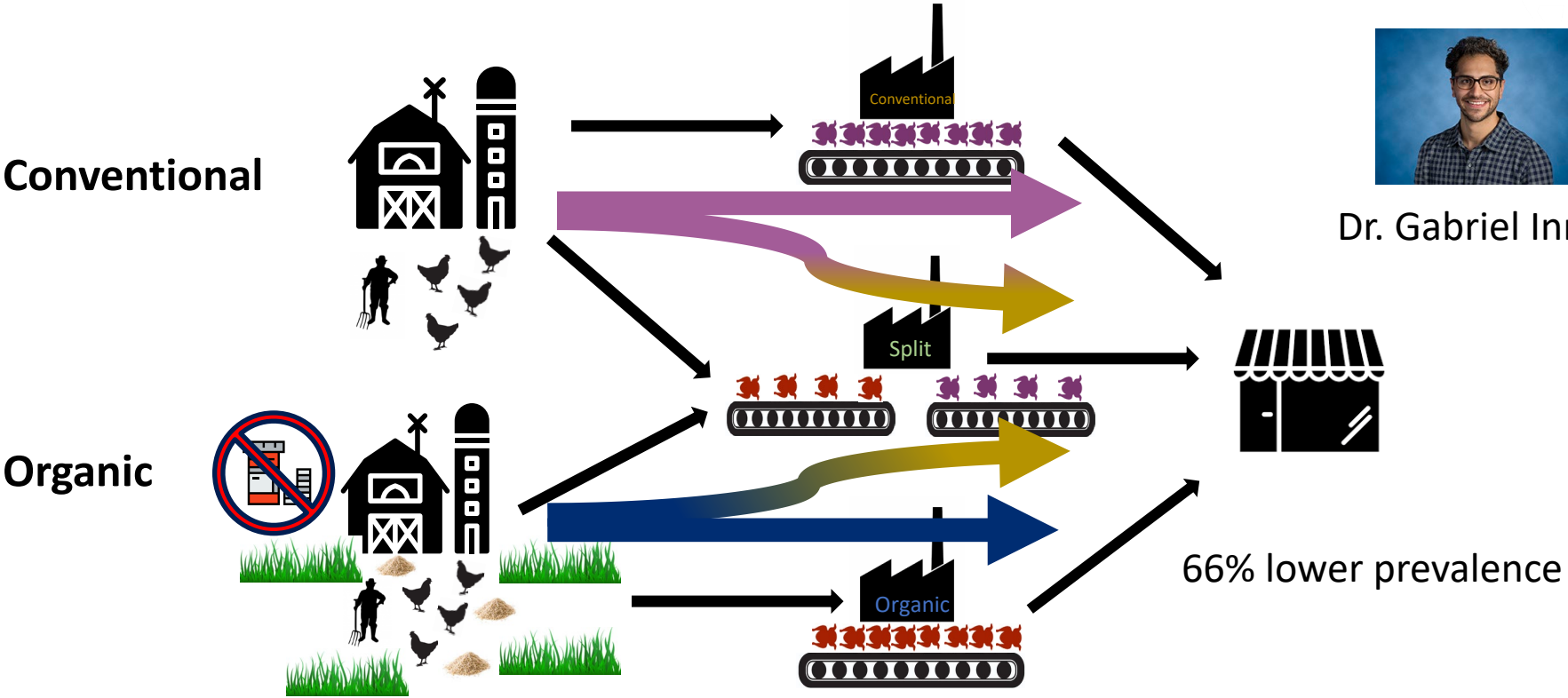
Case Study 2: Food, Policy & AMR

Pathways for resistant bacteria & resistance genes: food systems



Davis, M. F., Price, L. B., Liu, C. M., & Silbergeld, E. K. (2011). An ecological perspective on U.S. industrial poultry production: the role of anthropogenic ecosystems on the emergence of drug-resistant bacteria from agricultural environments. Current opinion in microbiology, 1–7. Elsevier Ltd. doi:10.1016/j.mib.2011.04.003

Organic meats had lower MDR contamination in NARMS



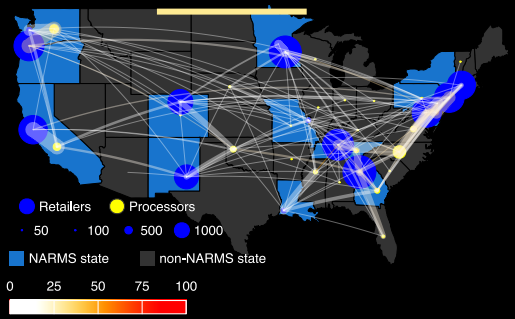
Dr. Gabriel Innes

Innes EHP 2021

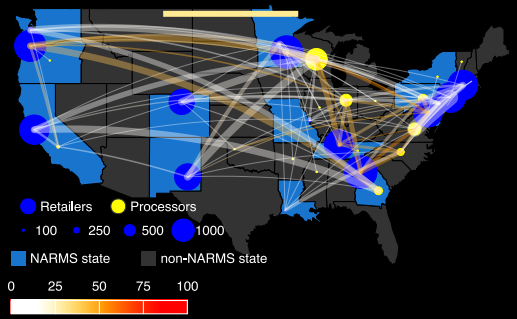
Meats that traveled longer distances had higher MDR bacterial contamination in NARMS

Dr. Gabriel Innes

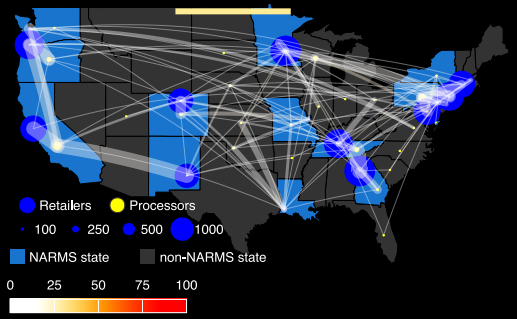
Movement of Total Chicken Breasts from NARMS, 2012-2014



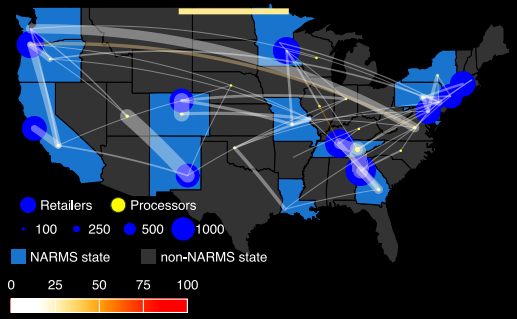
Movement of Total Ground Turkey from NARMS, 2012-2014



Movement of Total Ground Beef from NARMS, 2012-2014



Movement of Total Pork Chops from NARMS, 2012-2014



Innes Sci Rep 2023

Policy that governs production practices

Senate Bill No. 27

CHAPTER 758

An act to add Chapter 4.5 (commencing with Section 14400) to Division 7 of the Food and Agricultural Code, relating to livestock.

[Approved by Governor October 10, 2015. Filed with Secretary of State October 10, 2015.]

LEGISLATIVE COUNSEL'S DIGEST

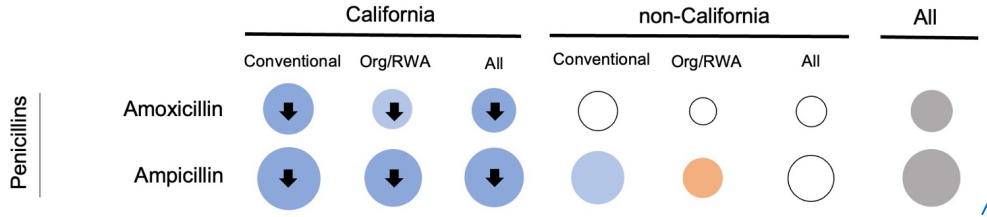
SB 27, Hill. Livestock: use of antimicrobial drugs.

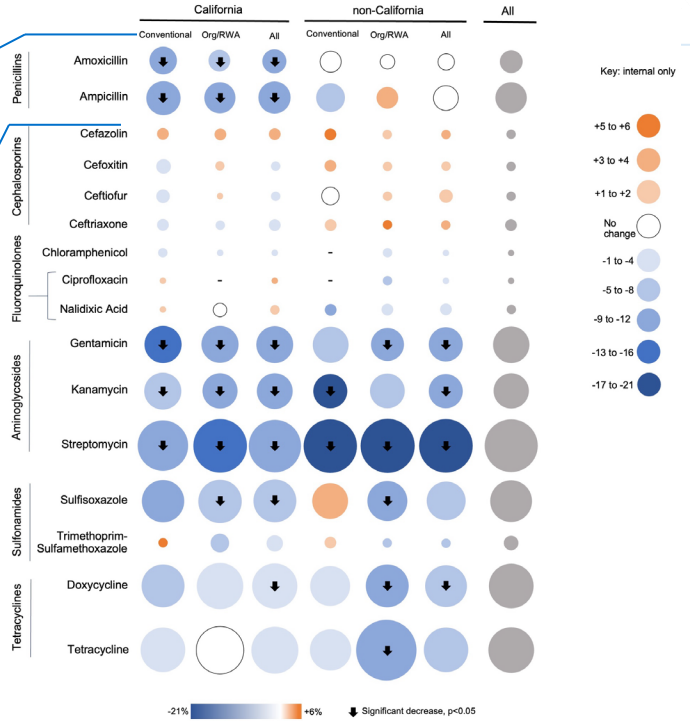
Retail meat AMR

Annual median % change in resistance in retail chicken *E. coli*

	CA chicken	Non-CA chicken	Interaction P-value
Penicillins			
Amox-Clav	-1.8%	-0.6%	0.09
Ampicillin	-4.3%	0.8%	**0.007**

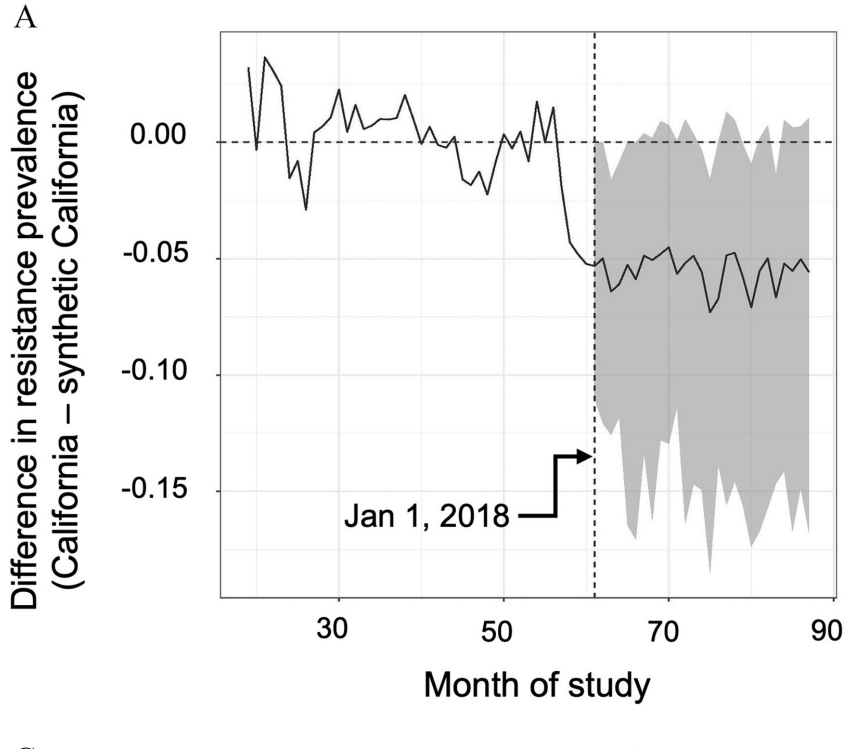
Retail meat AMR





Human UTI *E. coli*

- Synthetic control analysis
- Extended-spectrum cephalosporins



Unintended consequences

"I think often it's just a lack of understanding of the industry and a lack of understanding of the practices of ranchers, but also an increasing problem that I'm recognizing is the tendency to view any given regulation in a vacuum... Regulatory agencies have a great way of silo-ing themselves into what they think is important."

- Beef Producer

Q&A | Discussion

About This Presentation

Produced by the Center for Teaching and Learning at the Johns Hopkins Bloomberg School of Public Health.