

Vive la Resistance: The Impact of Antibiotic Use in US Livestock on Emerging Antibiotic Resistance

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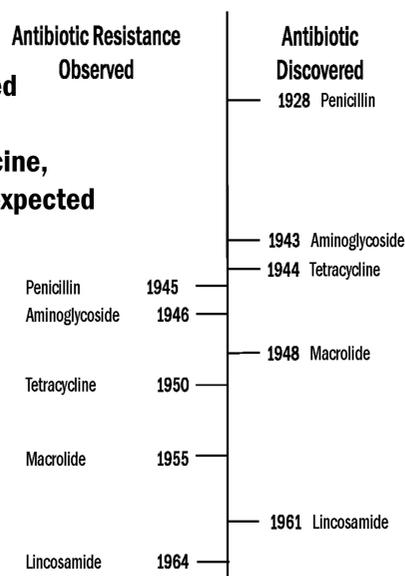
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INTRODUCTION

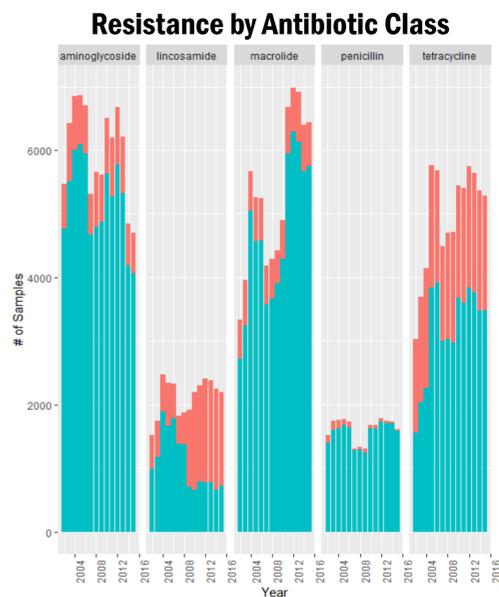
History of Antibiotics

Antibiotics are acknowledged as one of the greatest discoveries of modern medicine, and have helped to extend expected lifespans.

Over the past three decades the number of new antibiotics developed and approved for use has decreased, leaving fewer options for treating resistant bacteria.

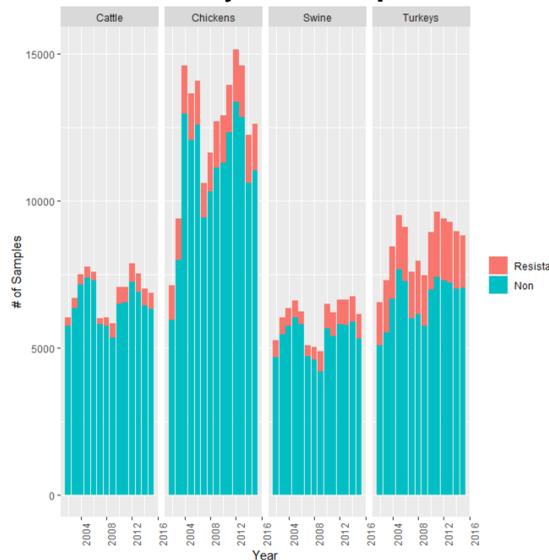


RESULTS



Lincosamide resistance has **increased** and other classes remain constant.

Resistance by Livestock Species



Poultry have **higher** incidence of resistance.

METHODS

We obtained data on US livestock inventory, retail meat antibiotic resistant testing and antibiotic sales was obtained from USDA, FDA and CDC reports. Pathogens studied were: *C.coli*, *C.jejuni*, *E.faecalis*, *E.faecium*, *E.hirae*, *E.other*, *E.coli*, and *Salmonella*. Host species studied were: Cattle, Swine, Chicken and Turkey. Antibiotics were separated into classes: Tetracyclines, Penicillins, Macrolides, Lincosamides and Aminoglycosides. The state based data had highest sampling from Maryland, Georgia, Oregon and Tennessee. Data was collected from 2000-2016. We merged these data sets to visualize patterns. We tested for increased resistance as a function of time, livestock group, bacterial pathogen, and antibiotic group using generalized additive models (GAMs, mgcv package, R.) We weighted GAMs by the number of samples tested.

Macrolides	Tetracyclines	Penicillins	Aminoglycosides	Lincosamides
<ul style="list-style-type: none"> Azithromycin Erythromycin Tylosin Tellithromycin 	<ul style="list-style-type: none"> Doxycycline Tetracycline Tigecycline 	<ul style="list-style-type: none"> Amoxicillin-Clavulanic Acid Ampicillin Penicillin Piperacillin-tazobactam 	<ul style="list-style-type: none"> Kanamycin Streptomycin 	<ul style="list-style-type: none"> Clindamycin Lincomycin

CONCLUSION

- Turkeys have a higher rate of antibiotic resistance, likely due to how they are grown.
- Tetracyclines have maintained high resistance
- Lincosamide resistance has rapidly increased within recent years

FUTURE DIRECTIONS

Utilization of antibiotic resistance surveillance programs such as NARMS (National Antimicrobial Resistance Monitoring System) and GLASS (Global Antimicrobial Resistance Surveillance System) will allow for better analysis of antibiotic resistance and use. Analysis of data from actual livestock operations, rather than purely retail, may provide greater insights. Studying environmental pollution and other methods of transfer of resistant pathogens would also provide a better idea of the impacts CAFOs have on human health.

ACKNOWLEDGEMENTS

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Industrial Agriculture

Within the past century farming has become increasingly industrialized and vertically integrated.

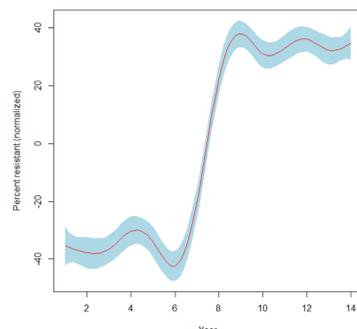
Concentrated Animal Feeding Operations (CAFOs) in which animals are raised in high density confined environments, where injury and infections are more likely to occur, are now the standard model followed of the livestock industry.

Low dose antibiotics are given to livestock to prevent disease and promote growth which is recognized as a major cause of antibiotic resistance.

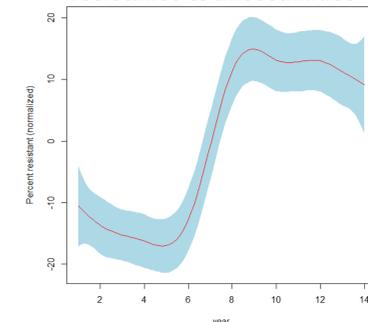


Image provided by the Utah Animal Rights Coalition

Enterococcus faecalis resistance to lincosamides



Enterococcus faecium resistance to lincosamides



Lincosamides had a **steep** increase in resistance.

Turkey and Chicken were **positively associated** with the intercept.

Antibiotic Resistance Crisis

In recent years, the evolution of antibiotic resistance has become a crisis, with new multidrug resistant pathogens emerging. As a result, governments are beginning to pass legislation reducing use of antibiotics in agriculture when not medically necessary.



More Information?