



Antimicrobial resistance in food animals in Asia - can it be reversed?

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ASIA PACIFIC VETERINARY INFORMATION SERVICES

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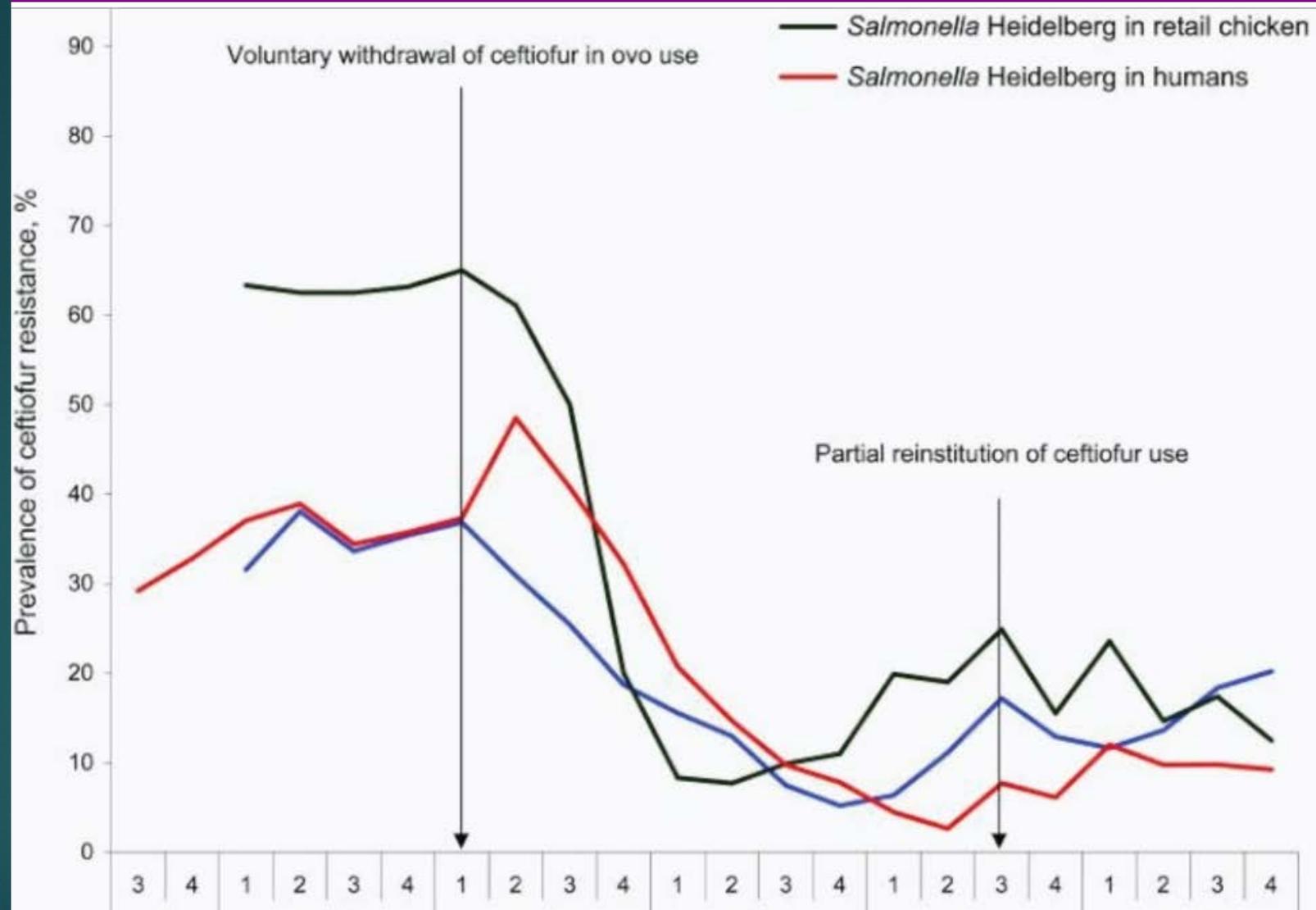
To what extent can AMR in Asian food animals be reversed?

- ▶ Probably not enough even if AMR plans are implemented
- ▶ Will examine some evidence
- ▶ Lessons from a previous global health crisis
- ▶ Finish by considering some alternatives
- ▶ Not addressing relative contribution of farmed animals to AMR in humans

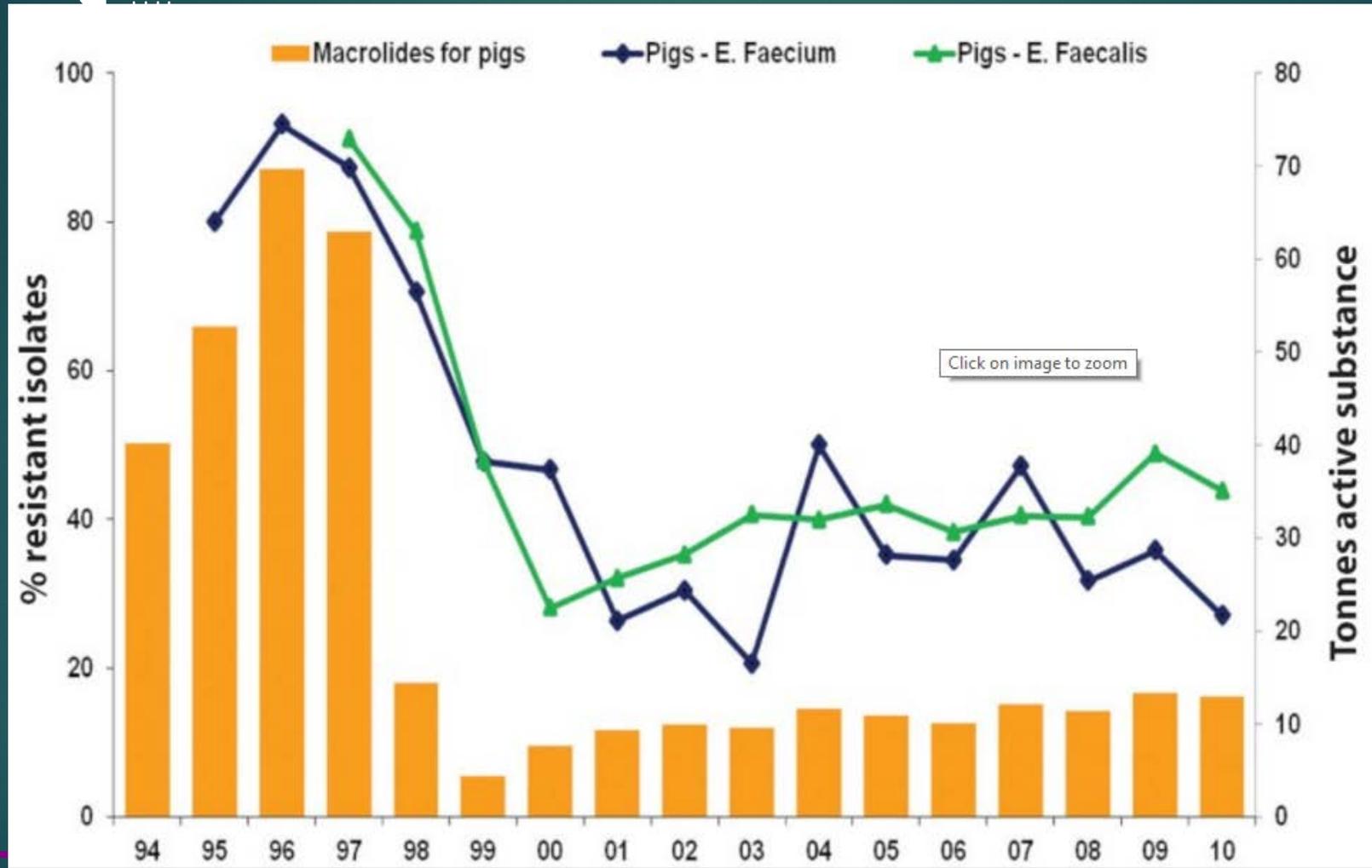
AM stewardship will reduce resistance or will it?

- ▶ Some examples where reduced use improved AMR dramatically
- ▶ Mainly from high income countries

Example 1 – effect of changes to practices - ceftiofur in chicks



Example 2. Macrolides in pigs and erythromycin resistance - Denmark



.... but not in all cases

- ▶ Resistance still present to many AMs even in places with good control
- ▶ More likely to reduce resistance to newer AMs (e.g. quinolones)
- ▶ Selection pressures will persist, including co-selection
- ▶ Resistance does not always produce fitness cost for bacteria
- ▶ Starting from a much higher base in Asia
- ▶ Stewardship will likely stop AMR in animals from



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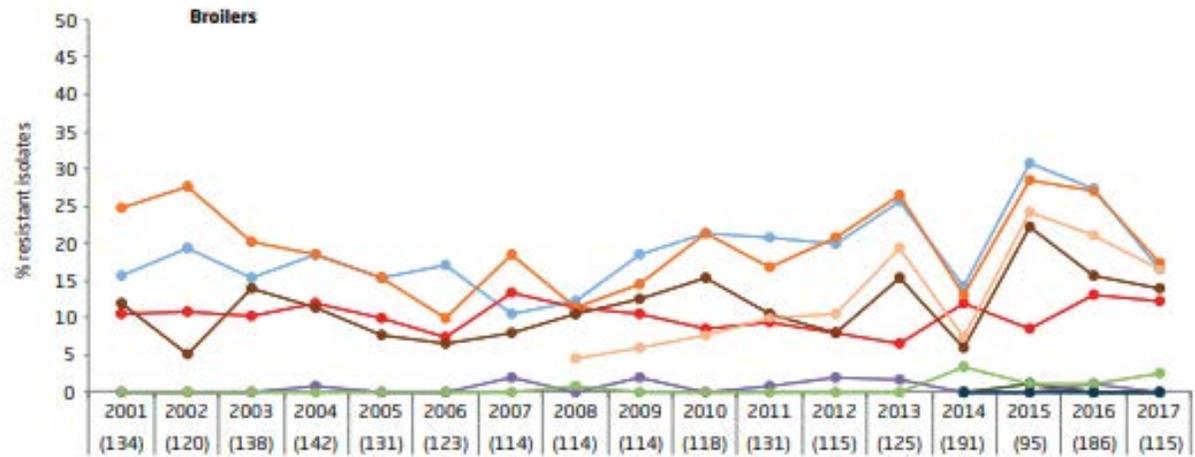
Widely Used Benzalkonium Chloride Disinfectants Can Promote Antibiotic Resistance

Minjee Kim, Michael R. Weigand, Seungdae Oh, Janet K. Hatt, Raj Krishnan, Ulas Tezel, Spyros G. Pavlostathis, Konstantinos T. Konstantinidis

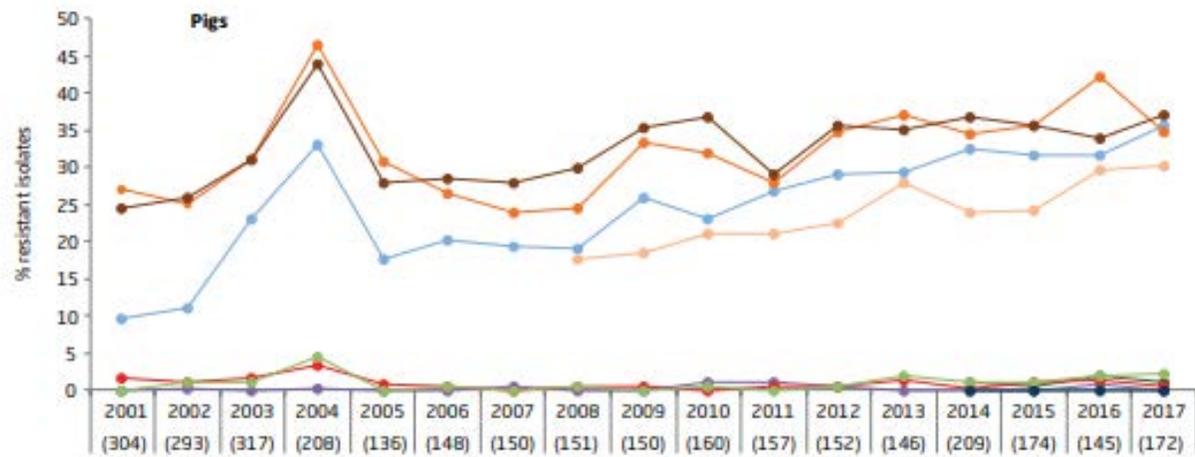
Resistance persists even in places with good control on AM use

Figure 7.2 Resistance (%) among *E. coli* from animals, Denmark

DANMAP 2017



Older AMs

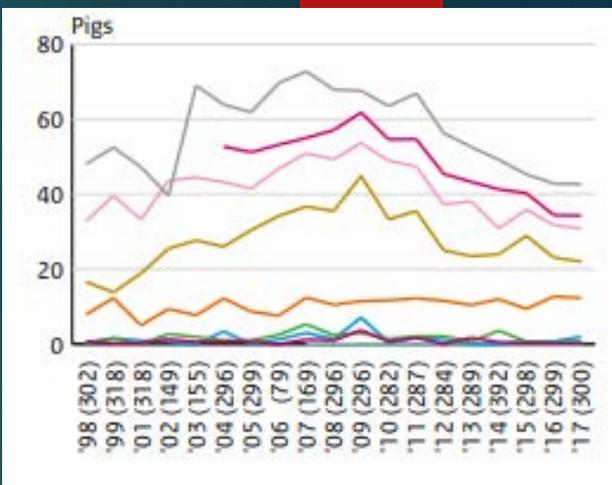


Older AMs

Quantitative assessment of antimicrobial resistance in livestock during the course of a nationwide antimicrobial use reduction in the Netherlands

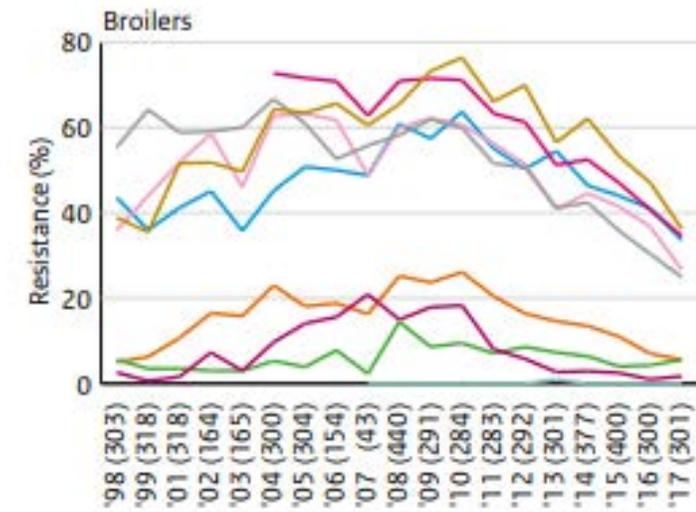
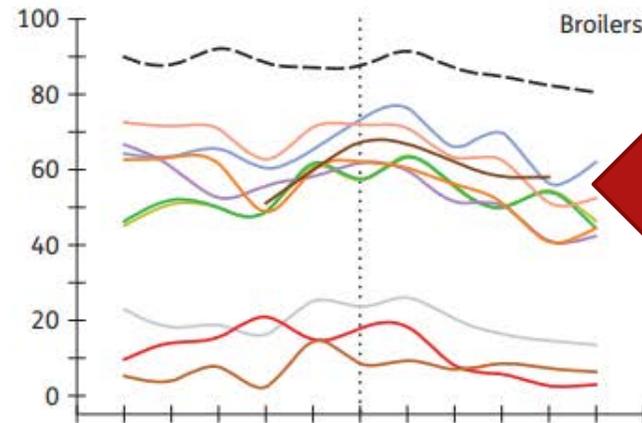
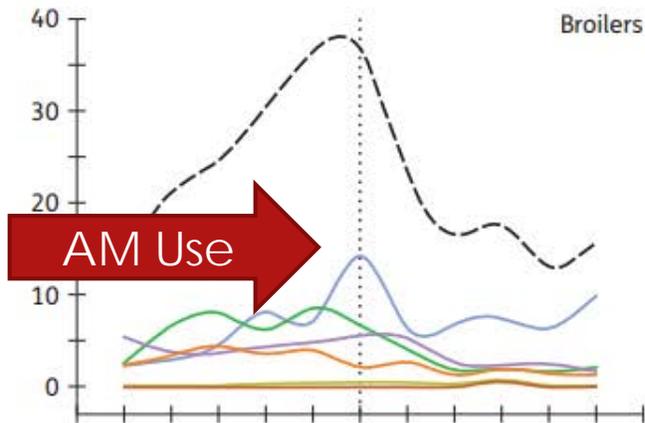
Alejandro Dorado-García^{1,2*}, Dik J. Mevius^{2,3}, José J. H. Jacobs^{1,4}, Inge M. Van Geijlswijk^{4,5}, Johan W. Mouton^{4,6}, Jaap A. Wagenaar^{2–4} and Dick J. Heederik^{1,4}

¹Division of Environmental Epidemiology, Institute for Risk Assessment Sciences, Utrecht University, Utrecht, The Netherlands



Antimicrobial use and resistant *E. coli* in livestock production

JAC

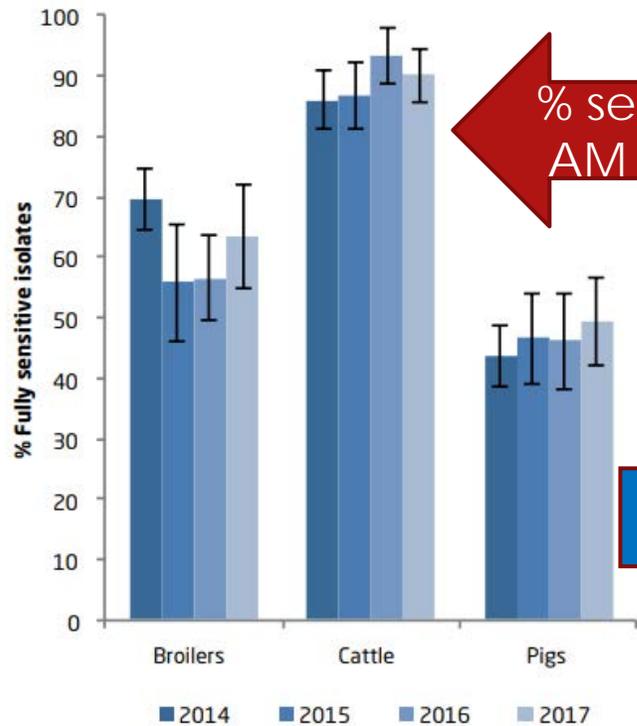


MARAN 2018

AM use in chickens in parts of Asia now low but resistance is persisting

Proportion fully susceptible *E.coli* - Denmark and Netherlands

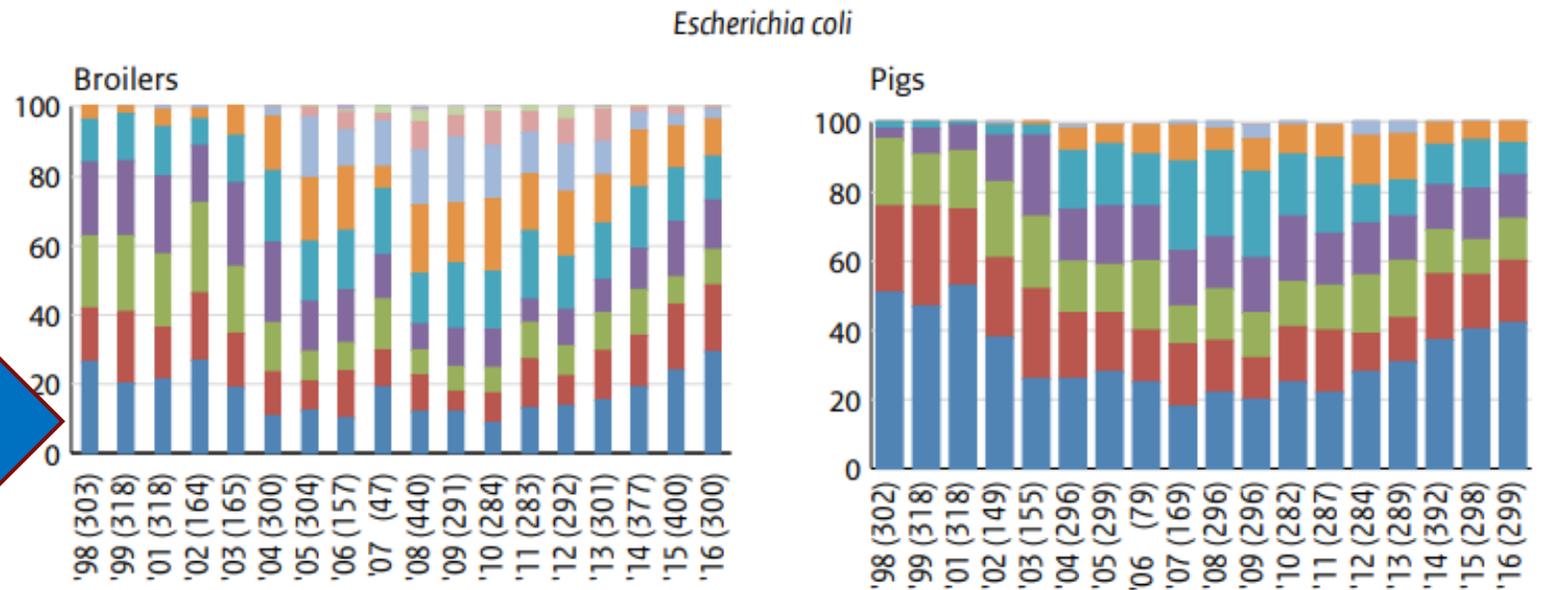
Figure 7.3 Proportion of fully susceptible *Escherichia coli* isolates from broilers, cattle and pigs, Denmark DANMAP 2017



% sens to all AM classes

% sens to all classes

Figure Eco02 Resistance (%) to 0-9 antimicrobial classes among *E. coli* strains from broilers, slaughter pigs, veal calves and dairy cattle in the Netherlands from 1998-2016.



Mainland China – higher base level



Veterinary Microbiology

Volume 203, May 2017, Pages 49-55

Veterinary
Microbiology

Surveillance of antimicrobial resistance among *Escherichia coli* from chicken and swine, China, 2008–2015

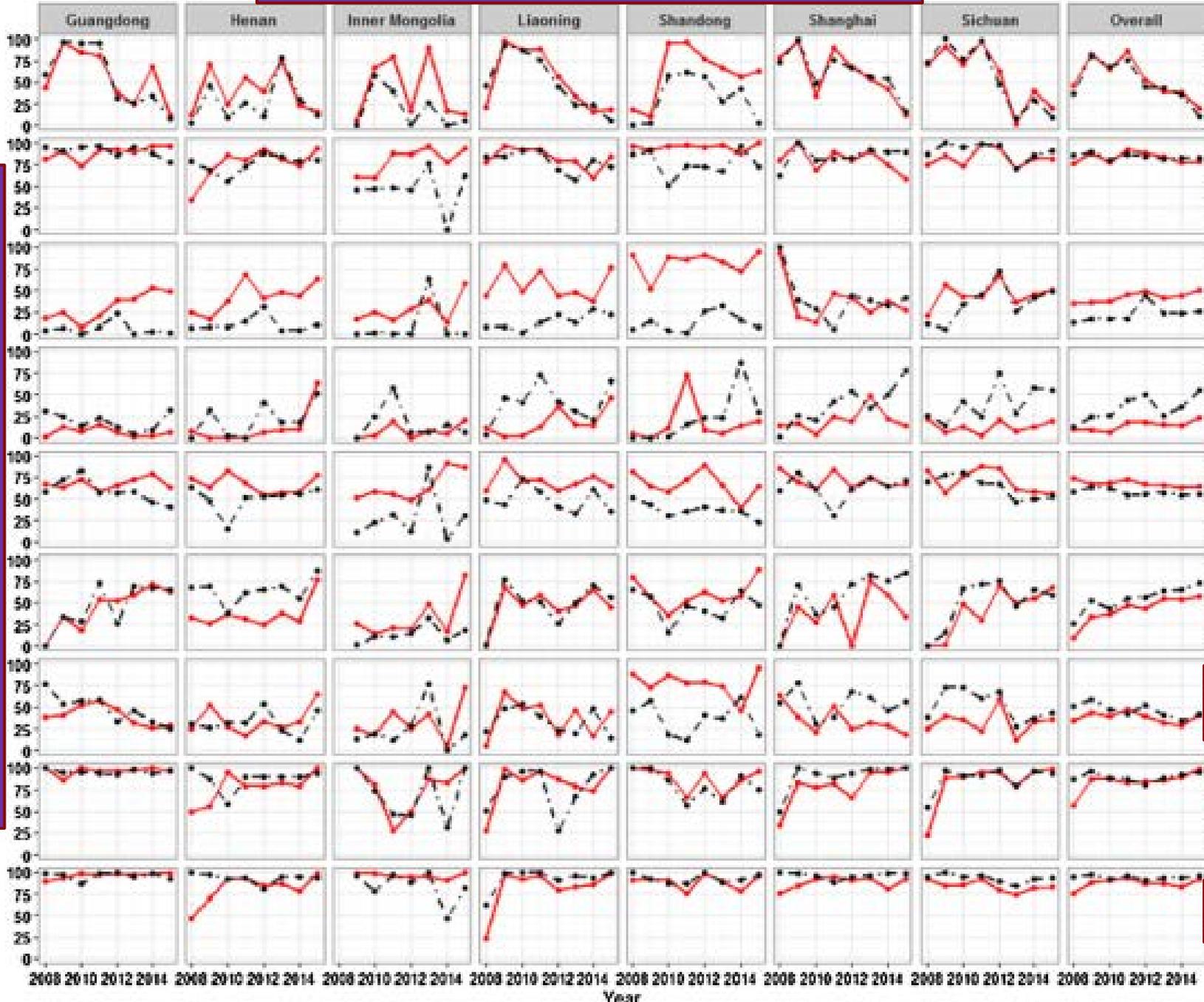
Peng Zhang ^{a, 1}, Zhangqi Shen ^{a, 1}, Chunping Zhang ^b, Li Song ^b, Bing Wang ^c, Jun Shang ^d, Xiuying Yue ^e, Zhina Qu ^f, Xinnan Li ^g, Liqin Wu ^h, Yongjun Zheng ⁱ, Anand Aditya ^c, Yang Wang ^a, Shixin Xu ^b  ,
Congming Wu ^a  

- ▶ High levels of resistance to multiple AM classes
- ▶ Very few isolates pan-sensitive

Individual Provinces

Overall

Antimicrobial resistance %



Amox/Clav

Ampicillin

Ceftriaxone

Colistin

Enrofloxacin

Florfenicol

Gentamicin

Sulfonamide

Tetracycline

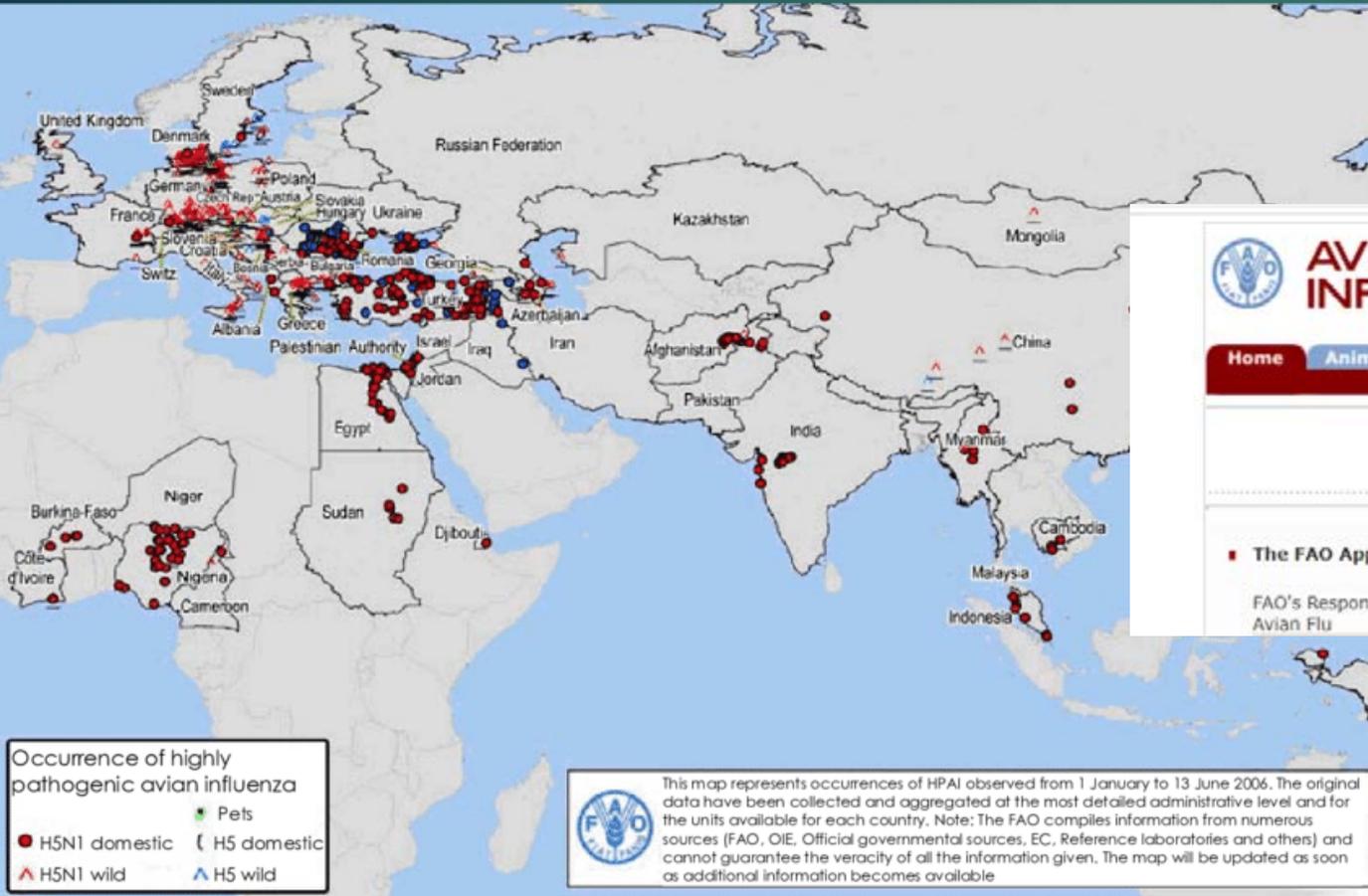
Zhang et al 2017

Commensal *E.coli* China

2008-15

% resistant

Lessons not learned from 2006 avian influenza/pandemic threat





AVIAN INFLUENZA

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AVIAN INFLUENZA: A GLOBAL ANIMAL HEALTH CRISIS WITH PROFOUND CHALLENGES TO SCIENCE AND SOCIETY

■ **The FAO Approach**

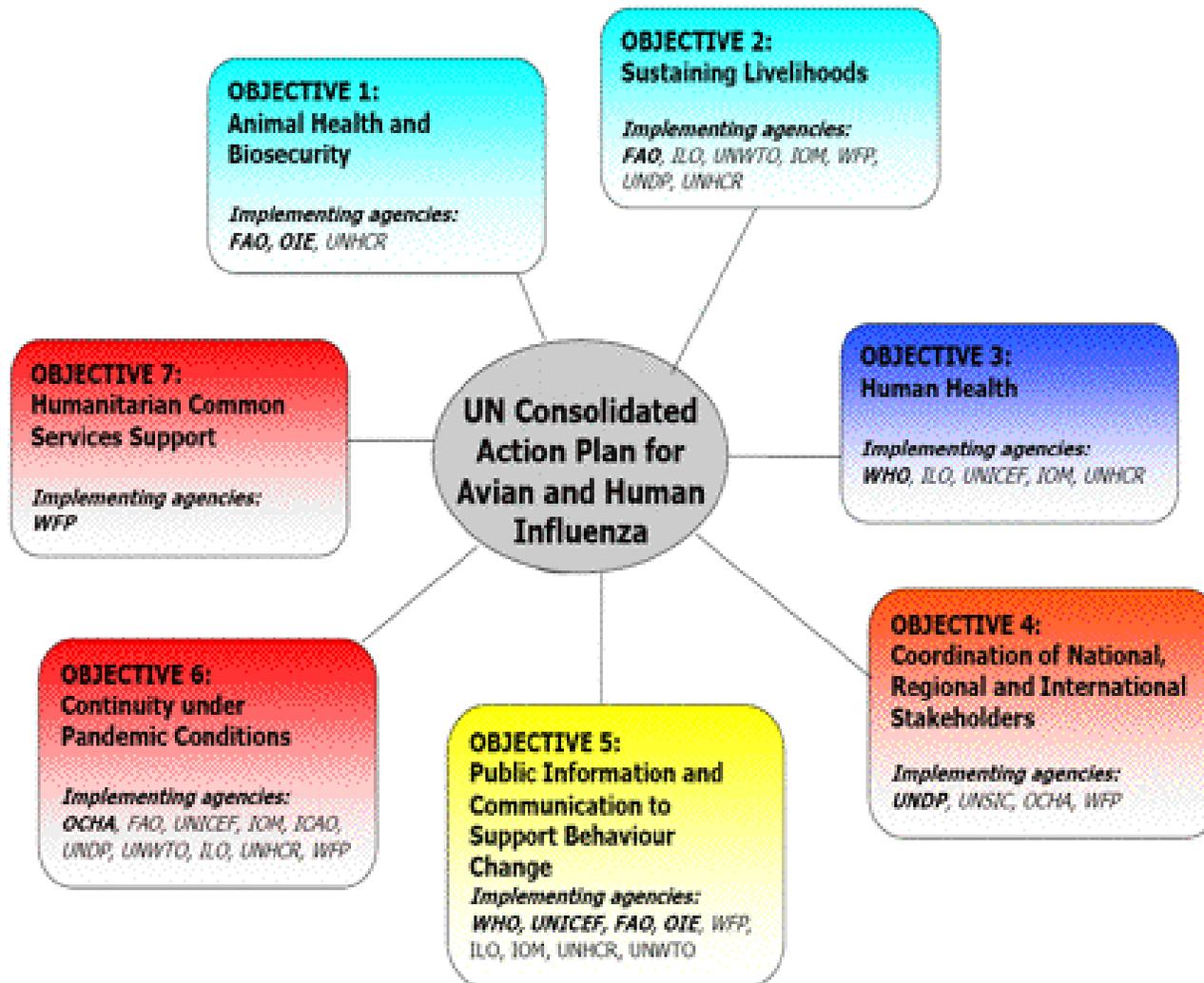
FAO's Response to Avian Flu

Samuel C. Jutzi, Director, Animal Production and Health Division
Joseph Domenech, Head, Animal Health Service and Chief Veterinary Officer
FAO, Rome, Italy
August 2006

Les influ

"Avian influenza threatens the entire world. It knows no borders. It is our collective responsibility to ensure that all countries – rich and poor – are protected and prepared. The United Nations family will do all it can to help ensure that this happens."

- Kofi Annan, former UN Secretary-General



strains in poultry

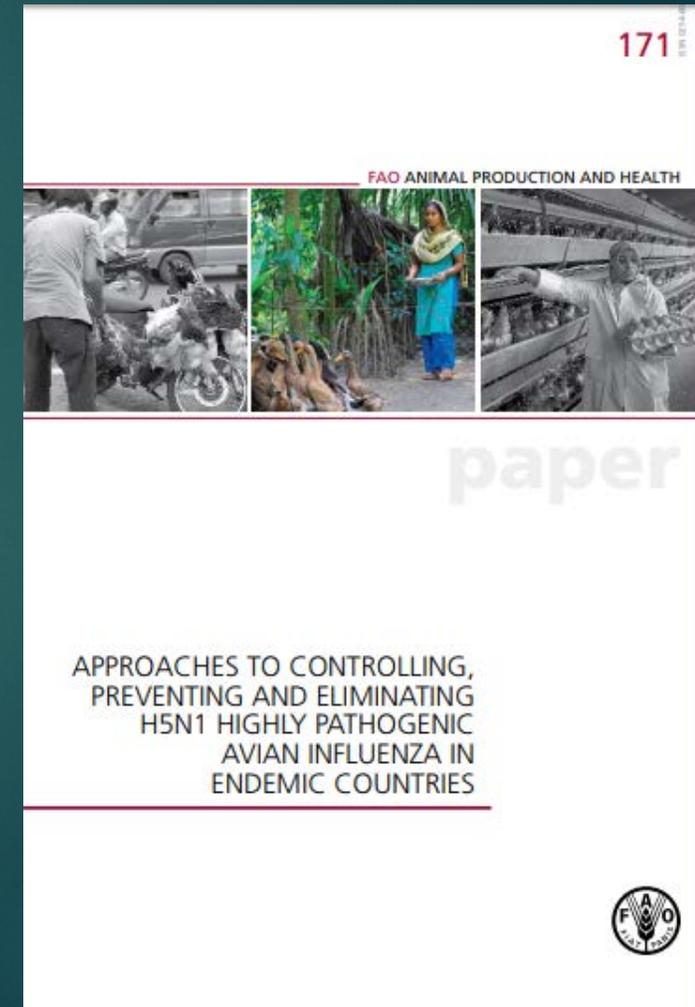
Lessons not learned from avian influenza/pandemic threat

- ▶ Some focus on wrong areas
- ▶ Due to misconception that virus could be eliminated from low and low-middle income countries
- ▶ Communications – raised awareness with limited changes in practices
- ▶ Donor fatigue



Factors that support avian influenza endemicity also apply to AMR

- ▶ Complex, poorly biosecure production and marketing chains
- ▶ Inadequate veterinary services and weak enforcement capacity - incremental change since 2006
- ▶ Problem not being resolved so need to devote more resources to alternatives (universal influenza vaccines for humans was recommended for avian influenza)



What about improved biosecurity?

- ▶ Yes, in some instances
- ▶ Limits to what can be done
- ▶ Cost vs benefits
- ▶ Vaccines help to control some diseases
- ▶ Complicated by antigenic variation/new strains



Farm location and biosecurity



Map

Google

What are our expectations for levels of AMR in food animals?

- ▶ Livestock farming to make minimal contributions to environmental and human AMR
- ▶ Not assessing whether plans will achieve this, even if adopted
- ▶ Most will only result in incremental improvements
- ▶ Especially in low to middle income countries
- ▶ Focus on the outcomes – not (just) the measurable outputs



MONITORING GLOBAL PROGRESS ON ADDRESSING ANTIMICROBIAL RESISTANCE

Analysis report of the second round of results
of AMR country self-assessment survey
2018



AMs will still be needed in livestock in Asia

- ▶ AM-free production will only be possible on a small number of farms
- ▶ Ban on critical AMs as growth promoters a good first step but only if enforced
- ▶ Need to understand why critical AMs are being used for treatment and prevention ... and where possible replace/find alternative approaches
- ▶ Explore other ways to stop resistant bacteria from getting out of farms



What else can we do?

- ▶ Find critical points in production system
- ▶ Take action to minimise spread of resistance - biocontainment
- ▶ Animals leaving farms
- ▶ Livestock waste



Animals leaving farms

- ▶ Can we somehow out-compete resistant bacteria in the period just prior to slaughter?
- ▶ Method must be safe and not involve antimicrobials
- ▶ Build on developing knowledge of microbiome manipulation



The screenshot shows the top portion of a web page from Frontiers in Microbiology. The header includes the Frontiers logo and the journal title "frontiers in Microbiology" next to the section "Infectious Diseases". A navigation bar contains links for "SECTION", "ABOUT", "ARTICLES", "RESEARCH TOPICS", "FOR AUTHORS", and "EDITORIAL BOARD". Below the navigation bar, there is a breadcrumb trail "< Articles" and a note: "THIS ARTICLE IS PART OF THE RESEARCH TOPIC Engineering Microbes for Therapy". The main content area identifies the article as a "REVIEW ARTICLE" published in "Front. Microbiol." on "19 June 2018" with the DOI "https://doi.org/10.3389/fmicb.2018.01328". The title of the article is "Standardized Preparation for Fecal Microbiota Transplantation in Pigs". The authors listed at the bottom are Jun Hui, Linnli Chen, Yimei Tang, Chunlin Xie, Baoyang Xu, and Min.

Livestock waste

- ▶ Biochar for composted solid waste?
- ▶ Filtration of treated liquid waste?
- ▶ Other cost-effective measures?



Science of The Total Environment

Volume 649, 1 February 2019, Pages 902-908



Turning pig manure into biochar can effectively mitigate antibiotic resistance genes as organic fertilizer

Xue Zhou ^{a, b}, Min Qiao ^{a, b}, Jian-Qiang Su ^c, Yin Wang ^c, Zhi-Hong Cao ^d, Wang-Da Cheng ^e, Yong-Guan Zhu ^{a, c}



Journal of Environmental Management

Volume 231, 1 February 2019, Pages 439-445



Short communication

High removal efficiency of antibiotic resistance genes in swine wastewater via nanofiltration and reverse osmosis processes

Lihua Lan ^a, Xianwang Kong ^a, Haoxiang Sun ^b, Changwei Li ^a, Dezhao Liu ^a

Conclusions

- ▶ AM stewardship important but may not provide the gains expected
- ▶ High probability that, in 10 years, levels of AMR in Asian farm animals will be similar to today
- ▶ Might see some improvement in resistance to high priority critically important AMs in richer countries
- ▶ Progress will require investment in alternative approaches, but so far limited
- ▶ Identify ways to prevent AMR organisms/genes from leaving farms – “biocontainment”
- ▶ Mitigation vs adaptation