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

LES SIMS

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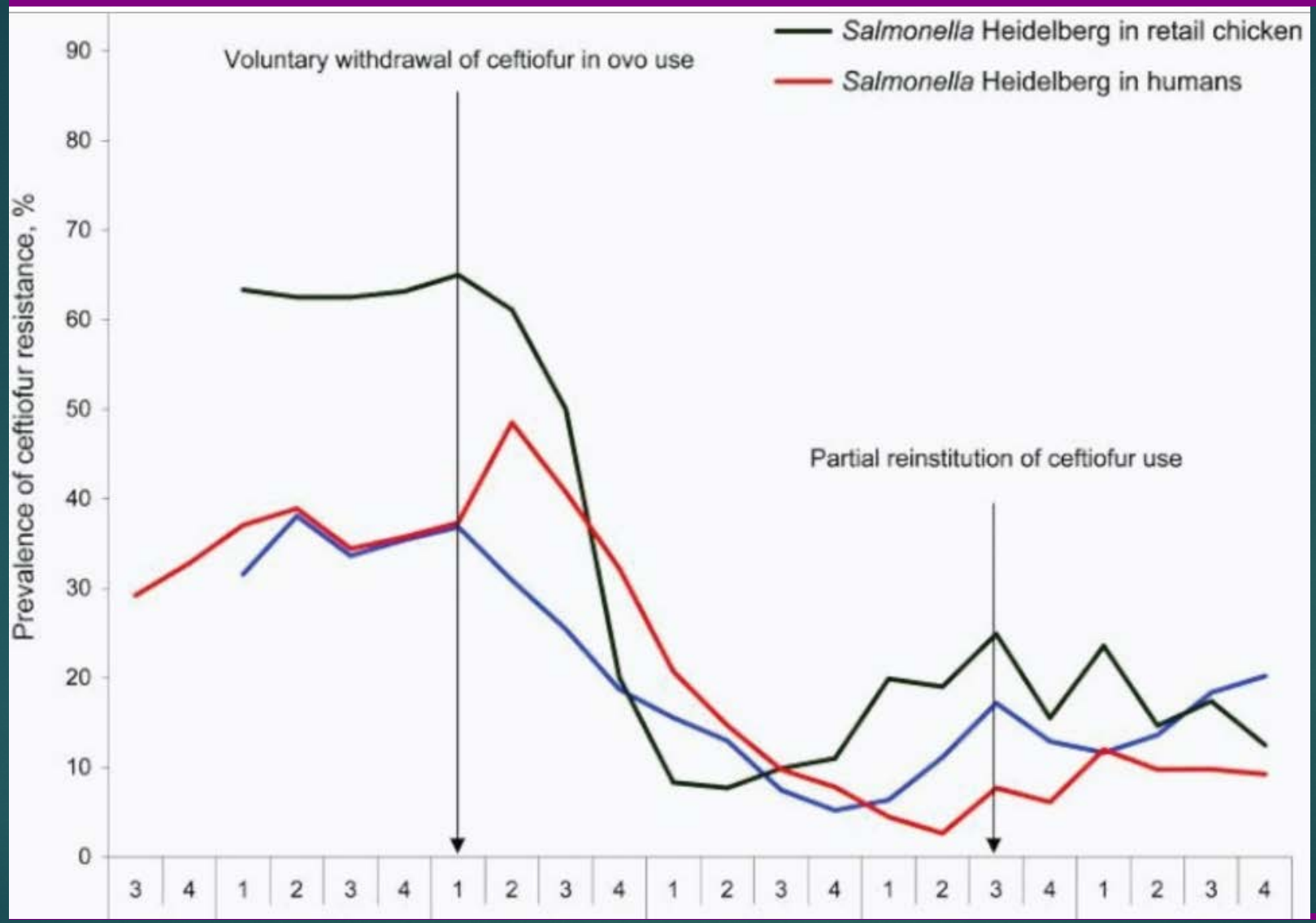
To what extent can AMR in Asian food animals be reversed?

- 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

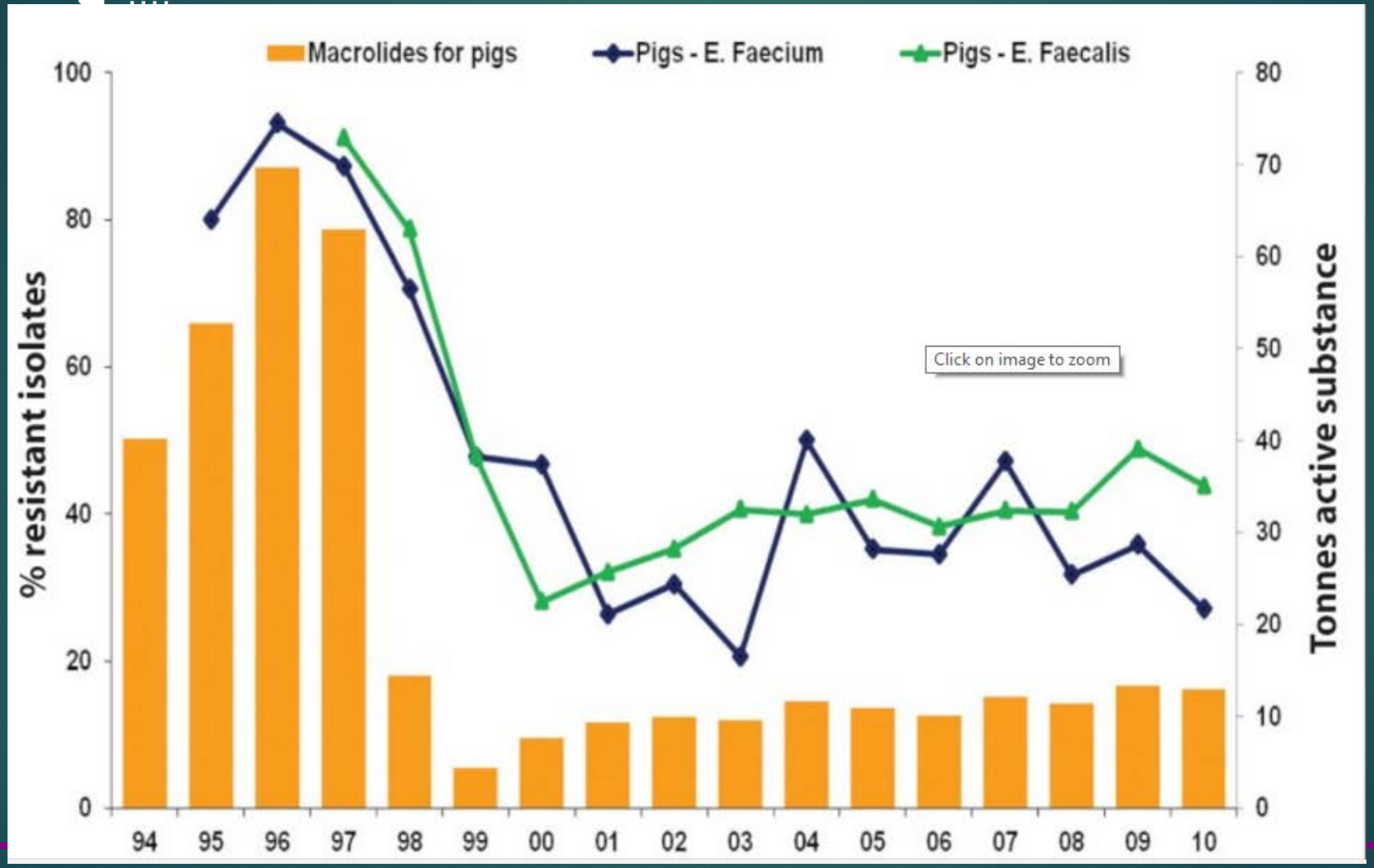
Example 1 – effect of changes to practices - ceftiofur in chicks



Source Wegener 2012 based on Dutil et al 2010

Example 2. Macrolides in pigs and erythromycin resistance - Denmark

- ....

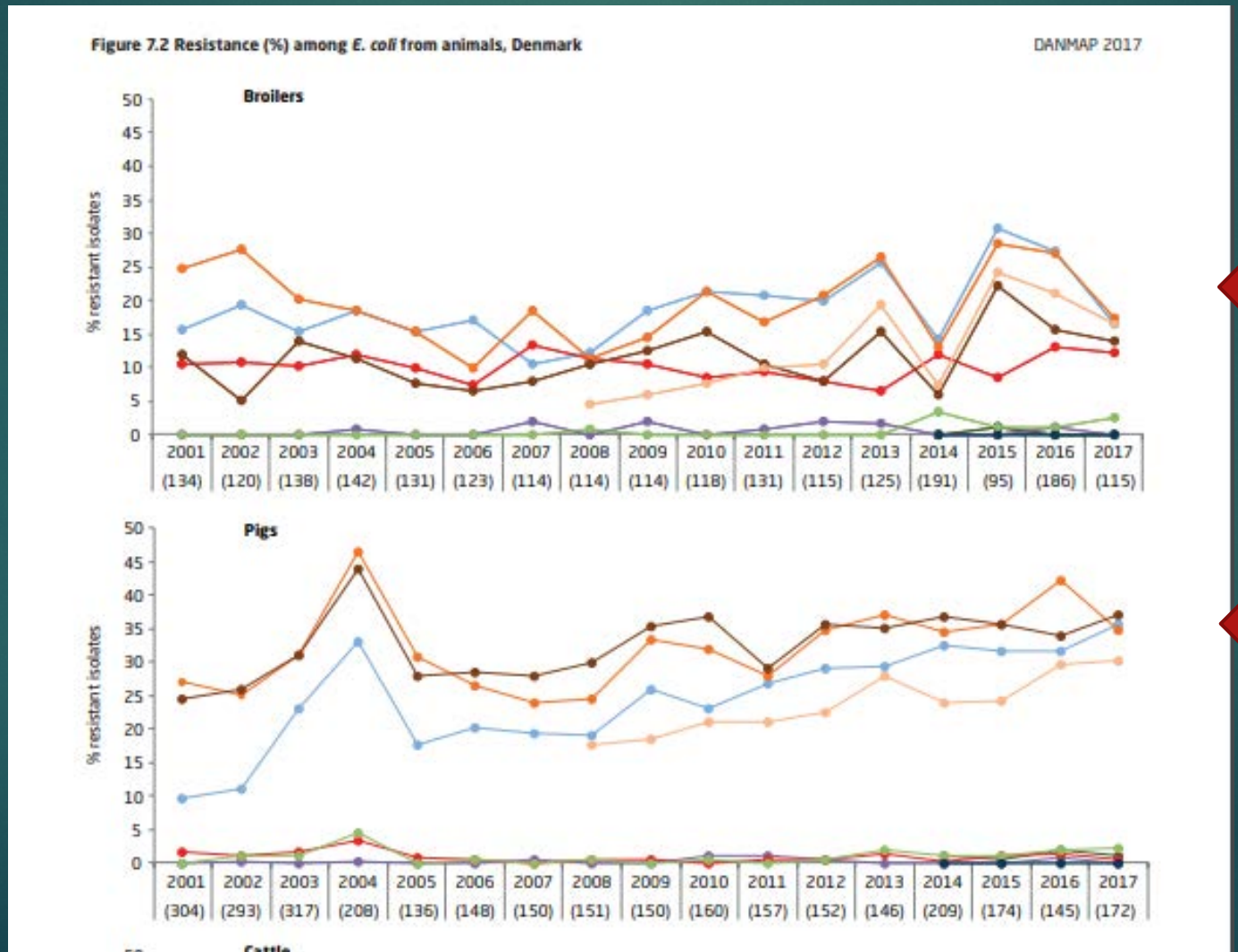


Danmap 2010

.... 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 fro

Resistance persists even in places with good control on AM use



Older AMs

Older AMs

DANMAP 2017

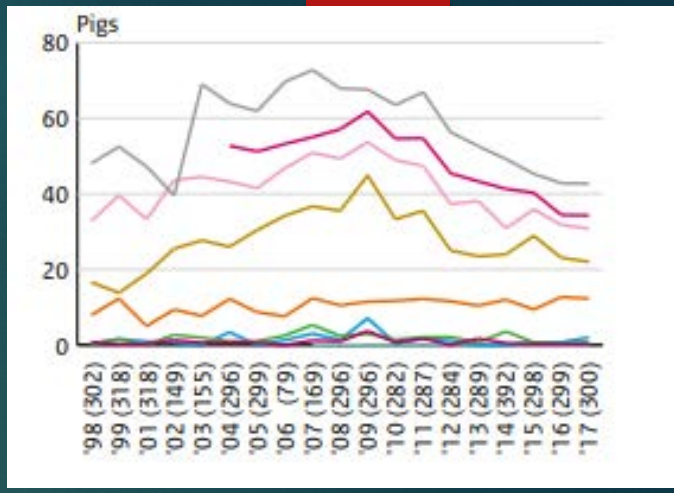
J Antimicrob Chemother 2016; **71**: 3607–3619
doi:10.1093/jac/dkw308 Advance Access publication 1 September 2016

Journal of Antimicrobial Chemotherapy

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

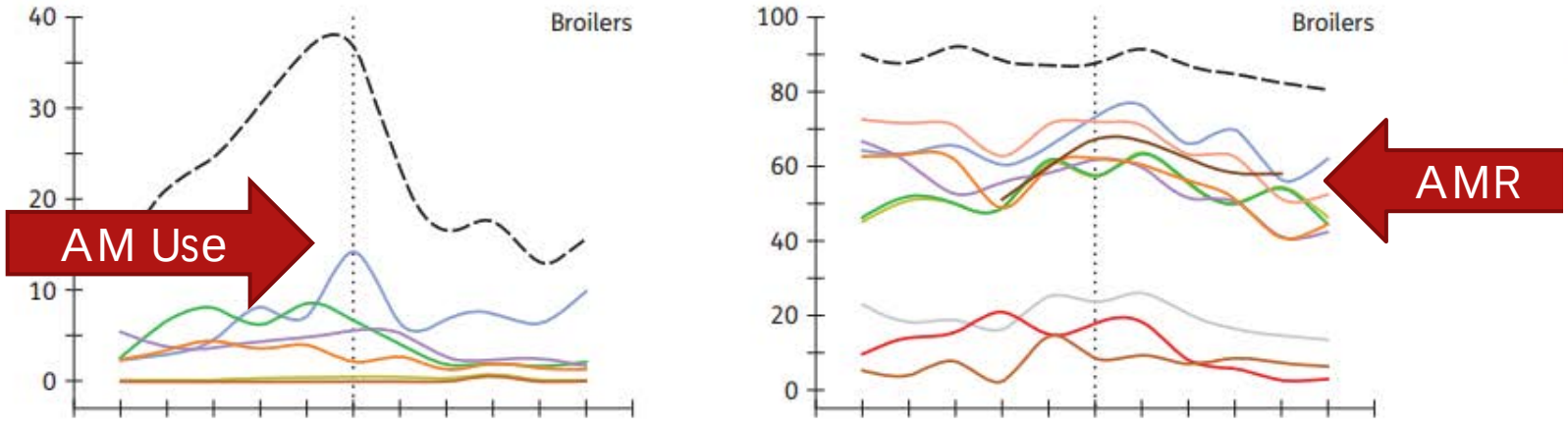
Alejandro Dorado-García[1,2]*, Dik J. Mevius[2,3], José J. H. Jacobs[1,4], Inge M. Van Geijlswijk[4,5], Johan W. Mouton[4,6], Jaap A. Wagenaar[2–4] and Dick J. Heederik[1,4]

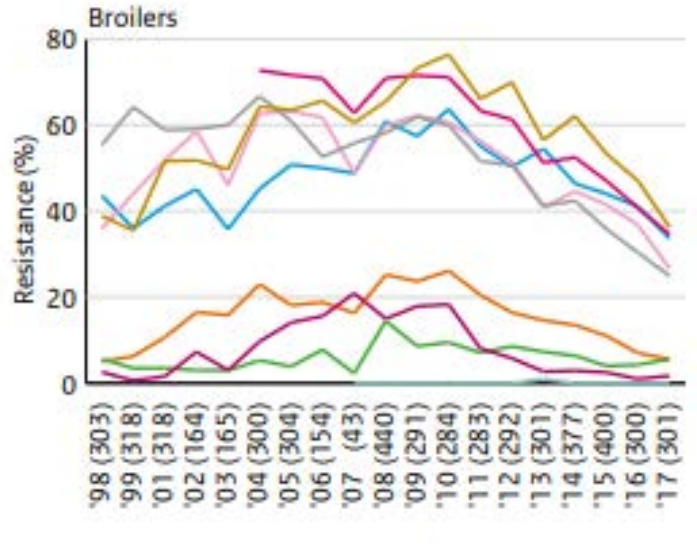
[1]Division of Environmental Epidemiology, Institute for Risk Assessment Sciences, Utrecht University, Utrecht, The Netherlands;



JAC

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



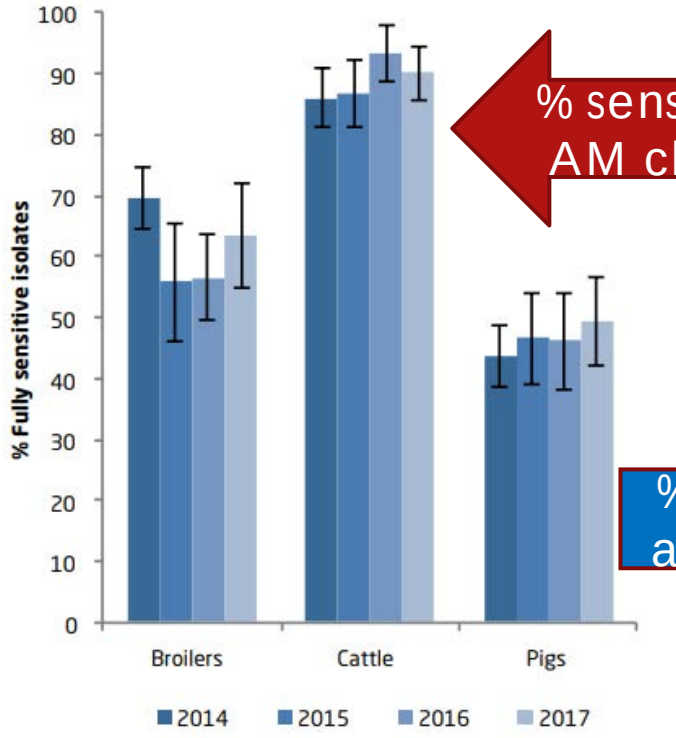


MARAN 2018

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

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

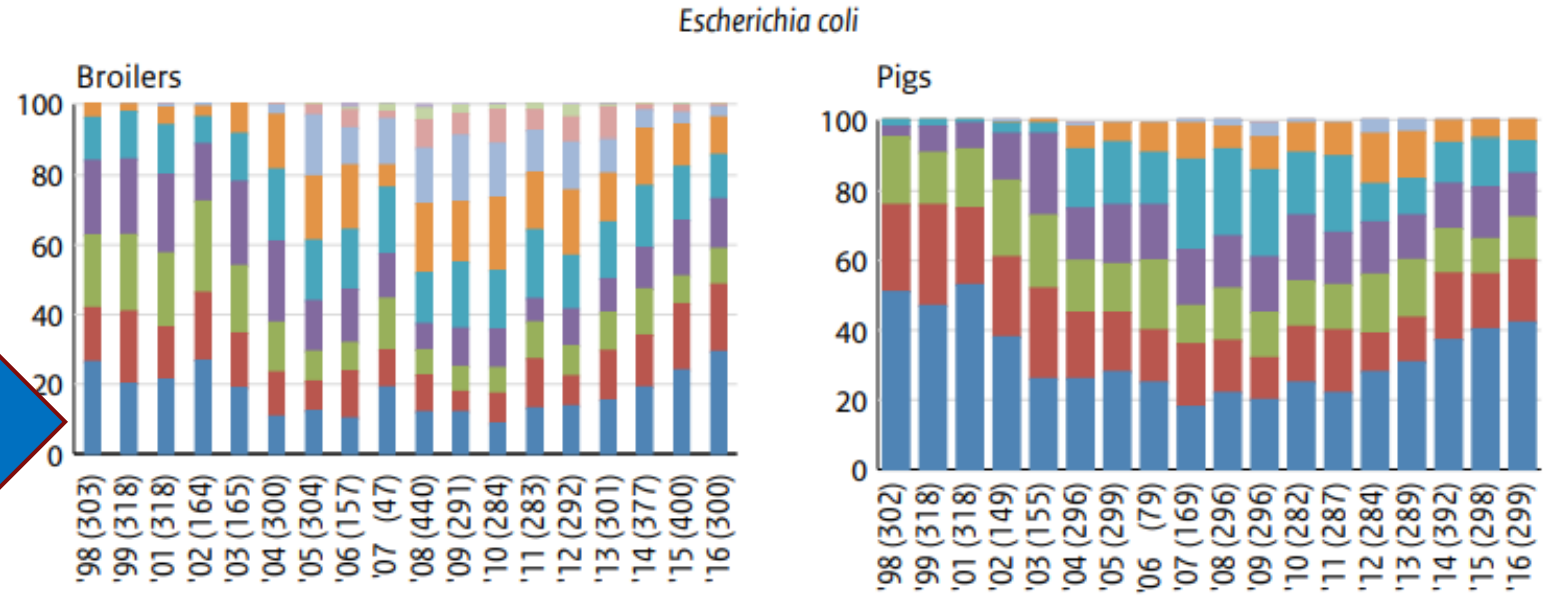
Figure 7.3 Proportion of fully susceptible *Escherichia coli* isolates from broilers, cattle and pigs, Denmark DANMAP 2017



% 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.



DANMAP 2017

MARAN 2018

Mainland China – higher base level

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Veterinary Microbiology

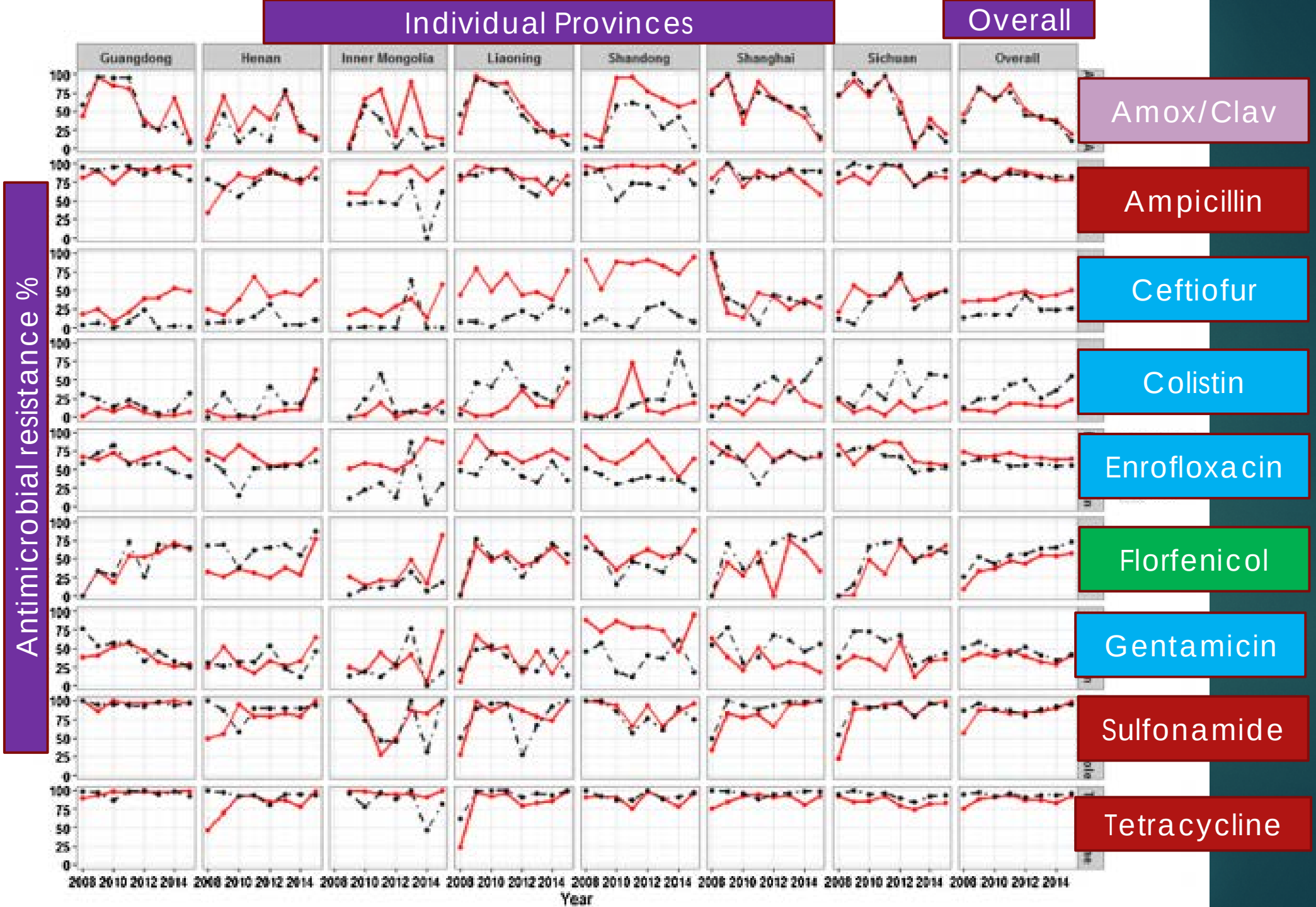
Volume 203, May 2017, Pages 49-55

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



Amox/Clav

Ampicillin

Ceftiofur

Colistin

Enrofloxacin

Florfenicol

Gentamicin

Sulfonamide

Tetracycline

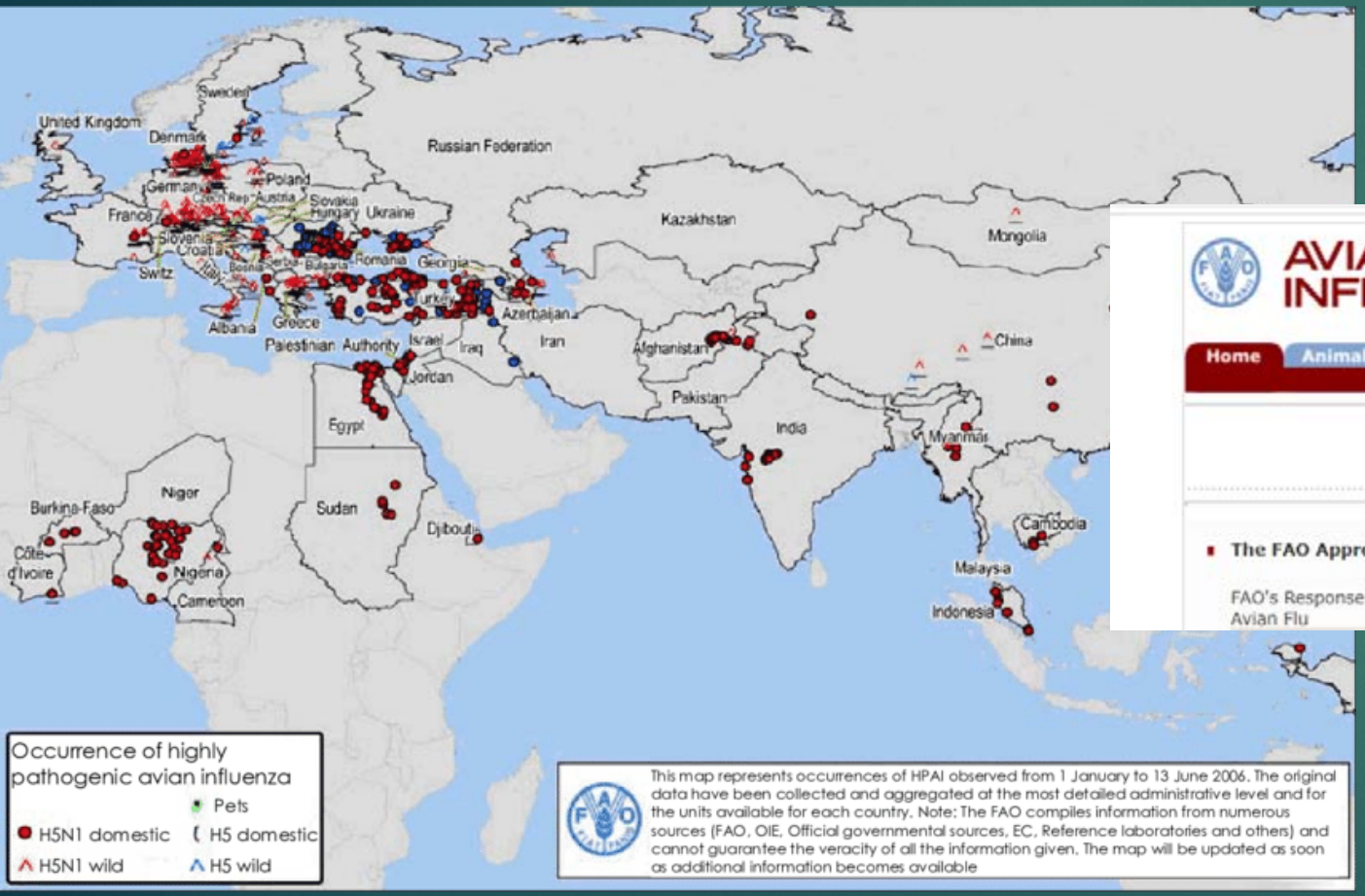
Zhang et al 2017

Commensal *E.coli* China

2008-15

% resistant

Lessons not learned from 2006 avian influenza/pandemic threat



Les
influ

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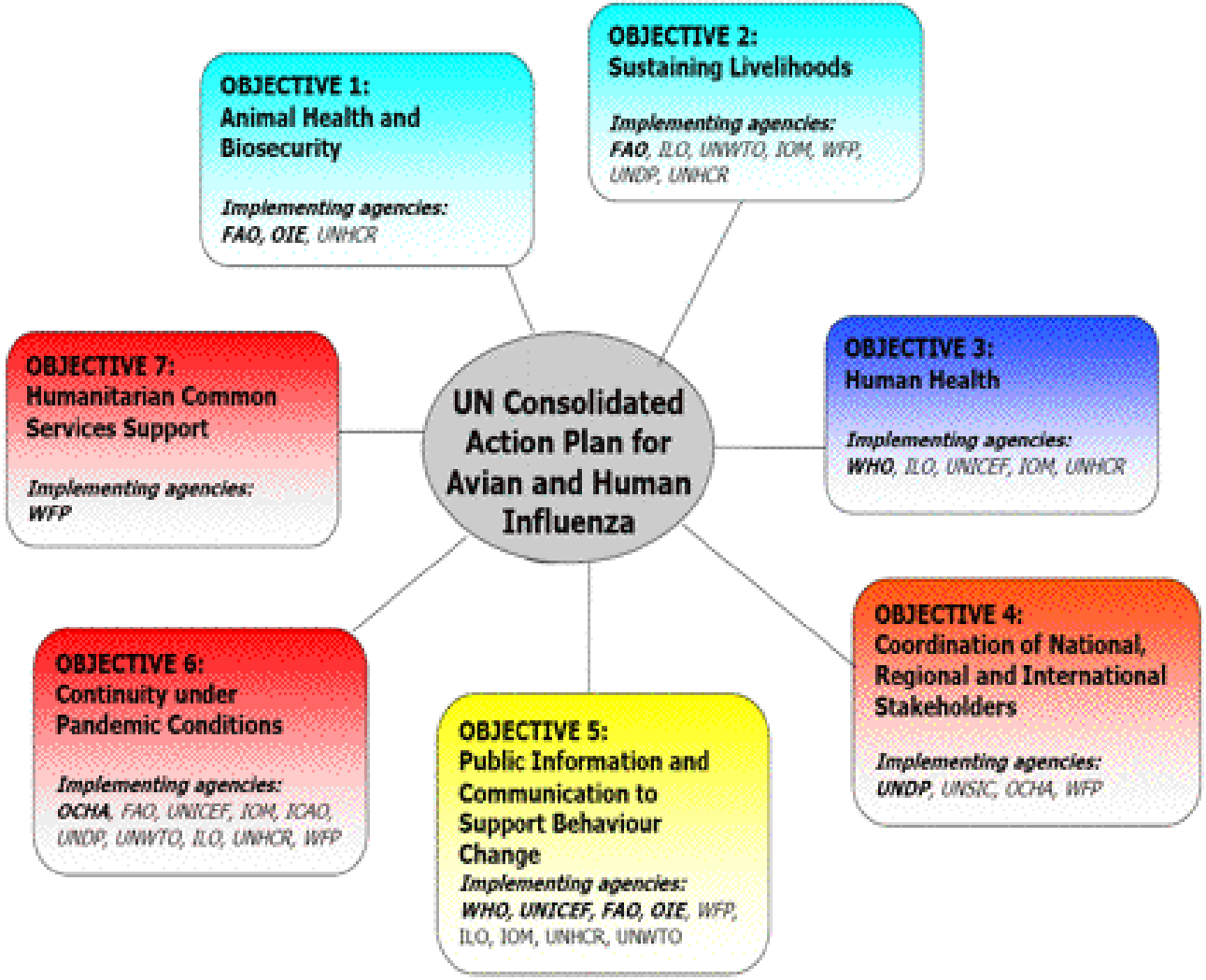
"Avian influenza threatens the entire world. It knows no borders. It is our collective responsibility to ensure that all countries – rich and poor – are protected and prepared. The United Nations family will do all it can to help ensure that this happens."

- Kofi Annan, former UN Secretary-General



strains in poultry

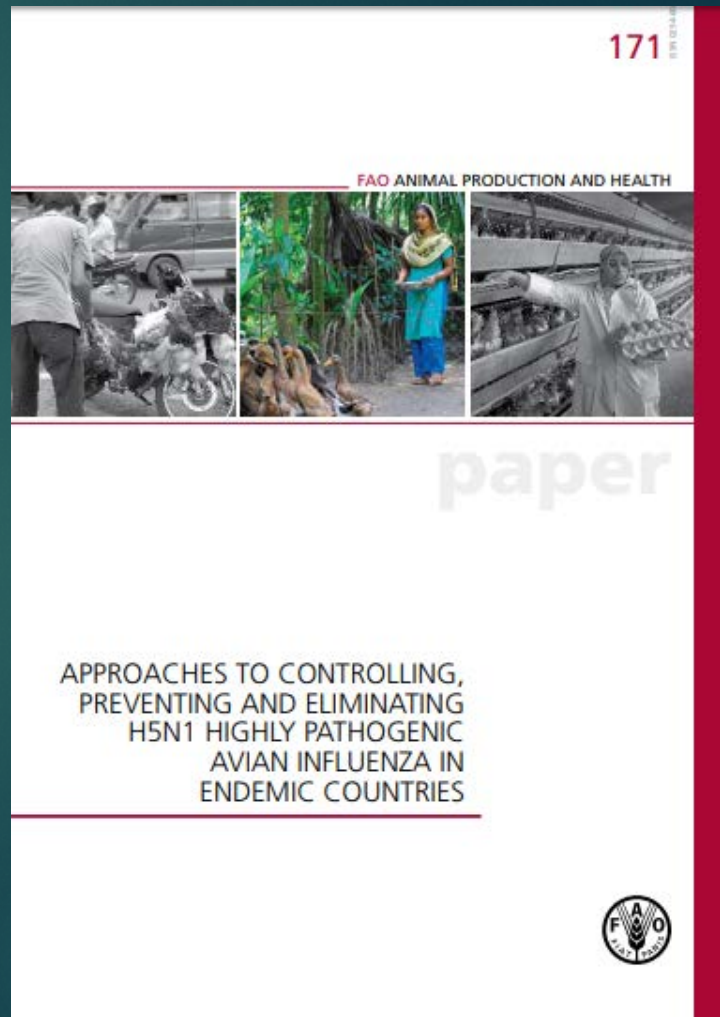
/10.1111/zph.12486

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

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

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

Livestock waste

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

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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]

ELSEVIER

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