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FOOD SYSTEMS AND ANTIMICROBIAL RESISTANCE

Making food system more robust to reduce AMR risk globally

Andrew Farlow

VOLUMES ANTIMICROBIAL USE IN FOOD-PRODUCING ANIMALS

PLOS GLOBAL PUBLIC HEALTH

Global trends in antimicrobial use in animals in 2020 and 2030

Fig 2. Antimicrobial consumption per country in 2020 and 2030. Circles are proportional to quantity of antimicrobials used. Red circles correspond to the quantity used in 2020, and outer dark red ring corresponds to the projected increase in consumption in 2030. Country boundaries were obtained from GADM (https://gadm.org/download_world40.html).

Global trends in antimicrobial use in food-producing animals: 2020 to 2030

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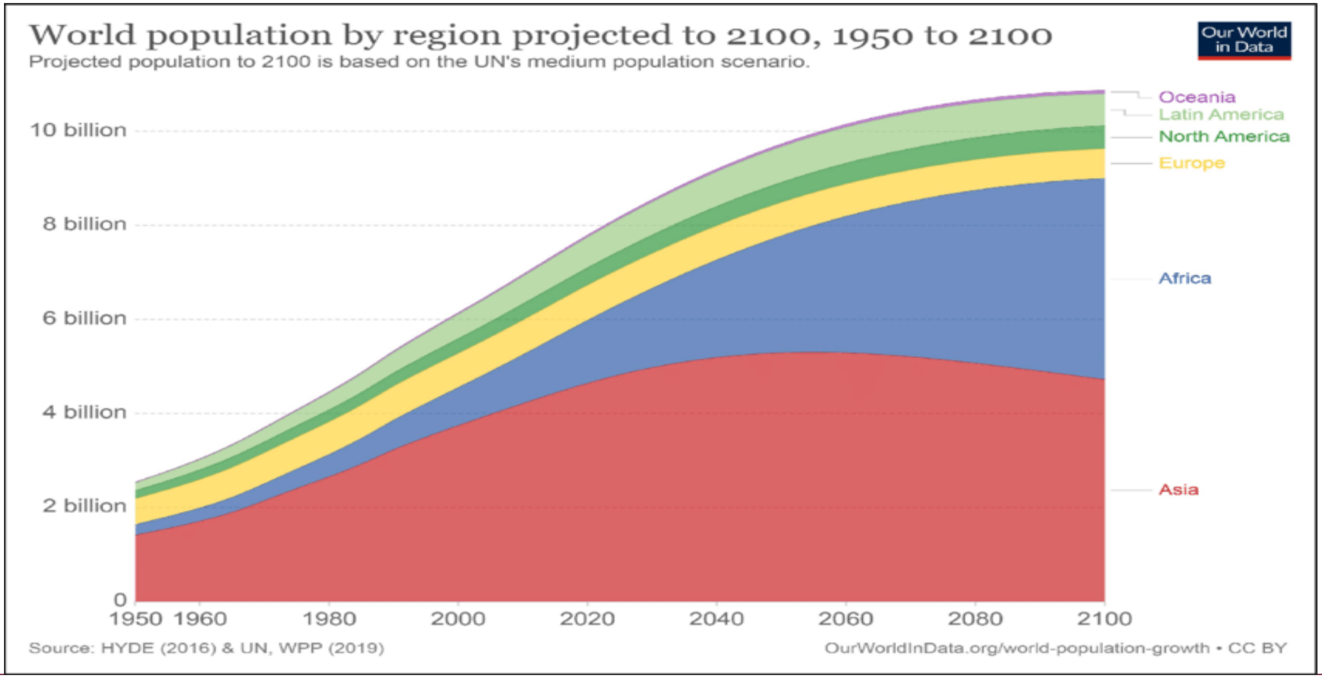
- By volume, the largest contributor to antimicrobial consumption.
- About 70-75% of all antimicrobials worldwide.
- 99,502 tonnes (95% CI 68,535–198,052) in 2020.
- Based on current trends, increase 8.0% to 107,472 tonnes (95% CI: 75,927–202,661) by 2030.
- Hotspots overwhelmingly in Asia (67%).
- <1% were in Africa.

Food Systems and Antimicrobial Resistance:

Making food systems more robust to reduce AMR risk globally

Thursday 27th and Friday 28th June 2024

Max Liebermann Haus, Berlin and online



- Global population growth.
- Life-style aspirations lead to greater meat consumption and pressure on farmers to deliver low-cost animal protein even if AMR risk.
- Global meat production grew 45% between 2000 and 2020.
- Many food production systems rely on antimicrobials as a less costly substitute for infection prevention.
- AMR risk.
- Green-house gas and climate change risks too.

LIMITATIONS IN NUMBERS

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- 42 countries report AMU data (these mostly HICs).
- China, Brazil, India, and United States in top 5 countries.
- Australia top 5, but **not reporting its data.**
- Brazil largest exporter of poultry and cattle in the world does not openly publish its AMU data.
- Not cover aquaculture, not rabbits.
- Big data gaps (sheep Vietnam).
- How do we model interventions and stewardship policies using current data base?

HOTSPOTS OF VETERINARY ANTIMICROBIAL CONSUMPTION

PLOS GLOBAL PUBLIC HEALTH   Global trends in antimicrobial use in animals in 2020 and 2030

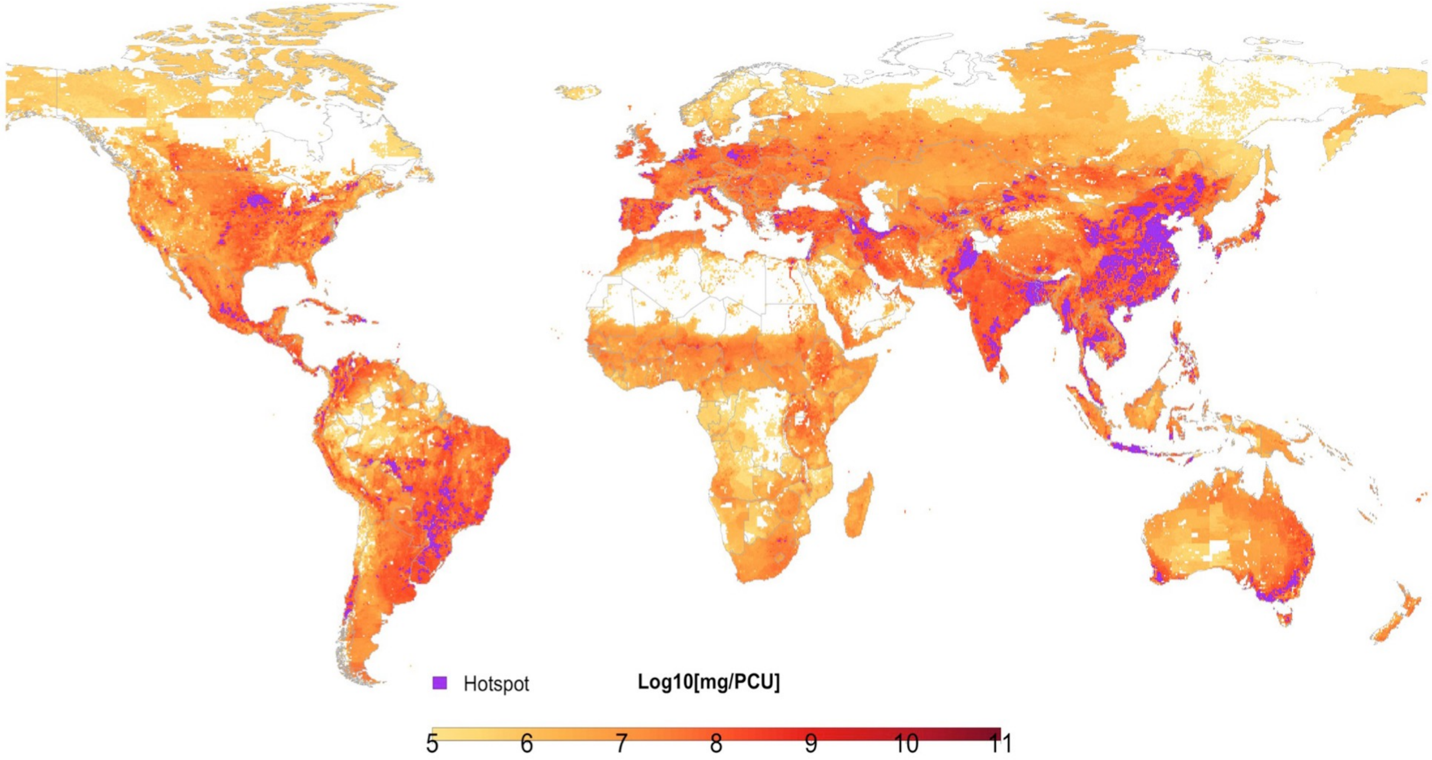
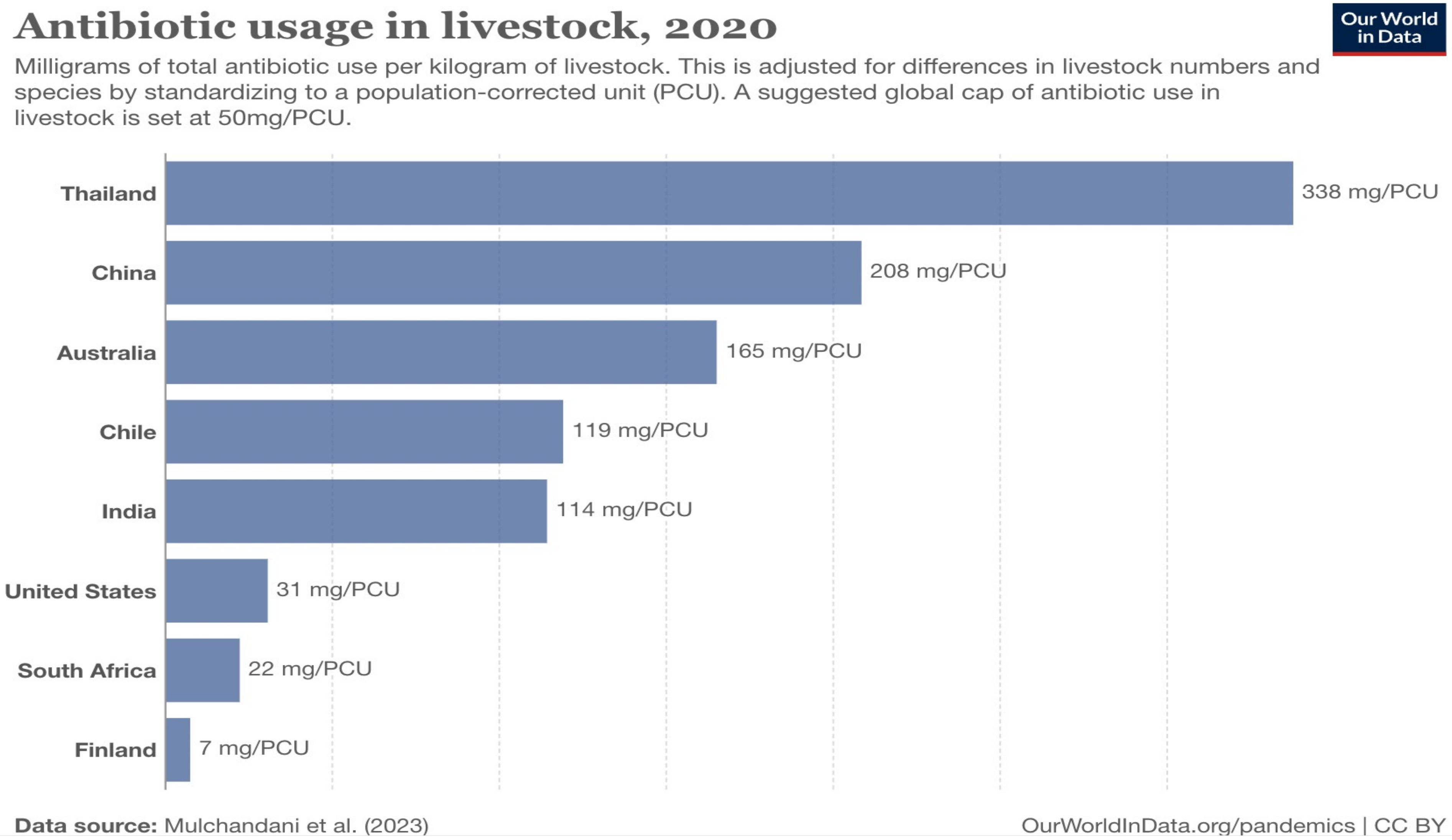


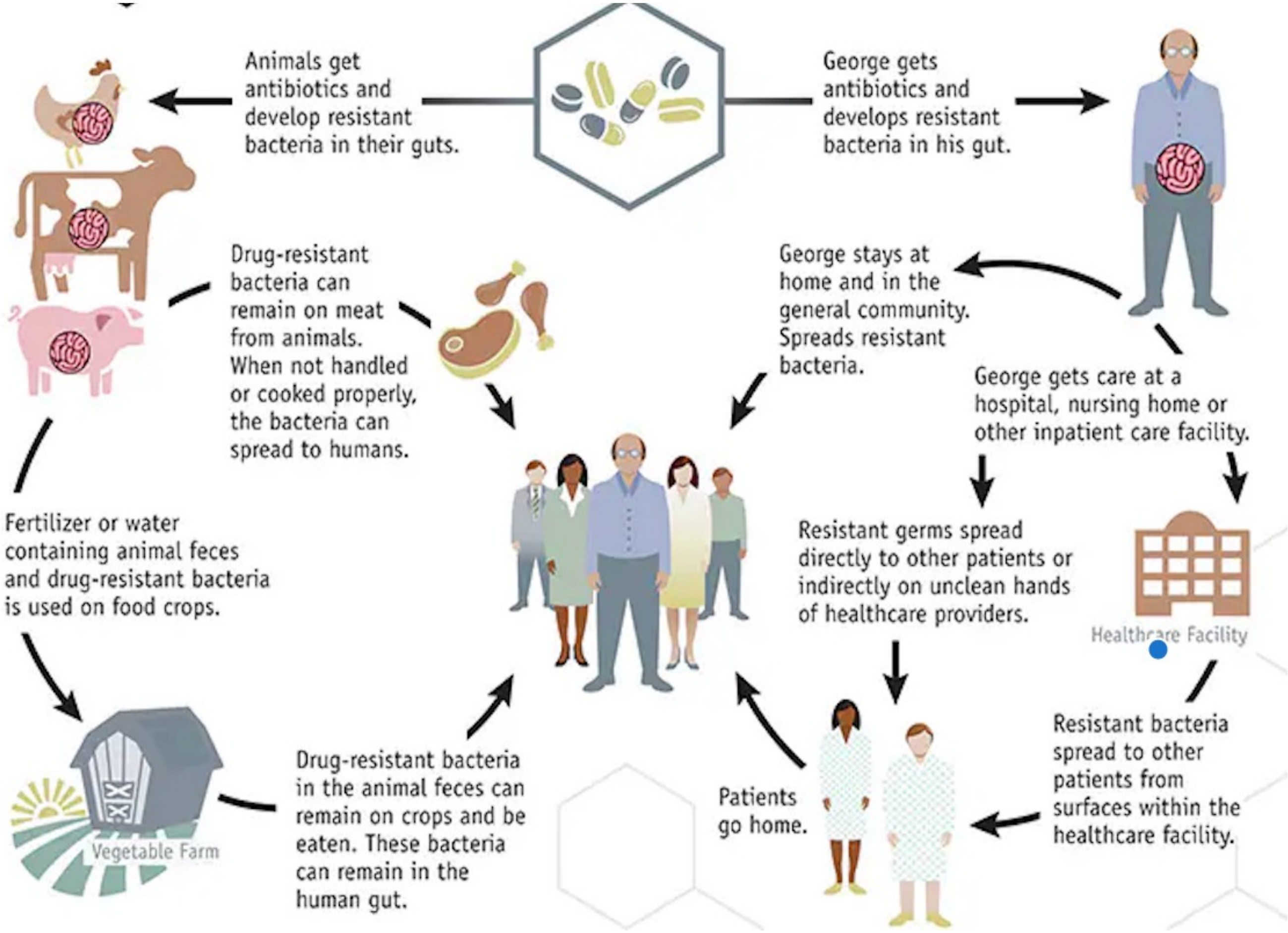
Fig 3. Global distribution of veterinary antimicrobial consumption at 10 x 10 kilometers resolution expressed in milligrams per biomass (population correction units). Purple indicates hotspot areas (top 95% percentile). Country boundaries were obtained from GADM (https://gadm.org/download_world40.html).

- Variability:
  - UK: 75% of farm antibiotics used in feed or water.
  - **Less than a quarter** given by **injections**, to treat individual animals.
  - **Sweden: less than half the farm antibiotics administered in the UK.**
  - proportion of antibiotics given via **feed or drinking** <10%.
  - **three quarters given by injection.**

PER KILO OF LIVESTOCK (MORE VARIABILITY)

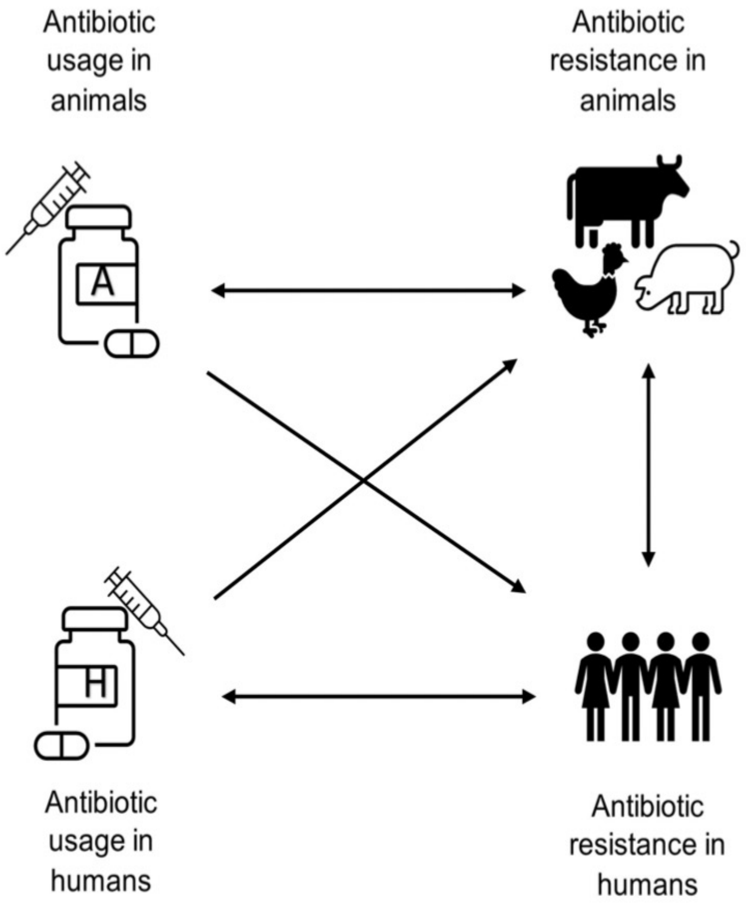


ROUTES (SYSTEMS THINKING)



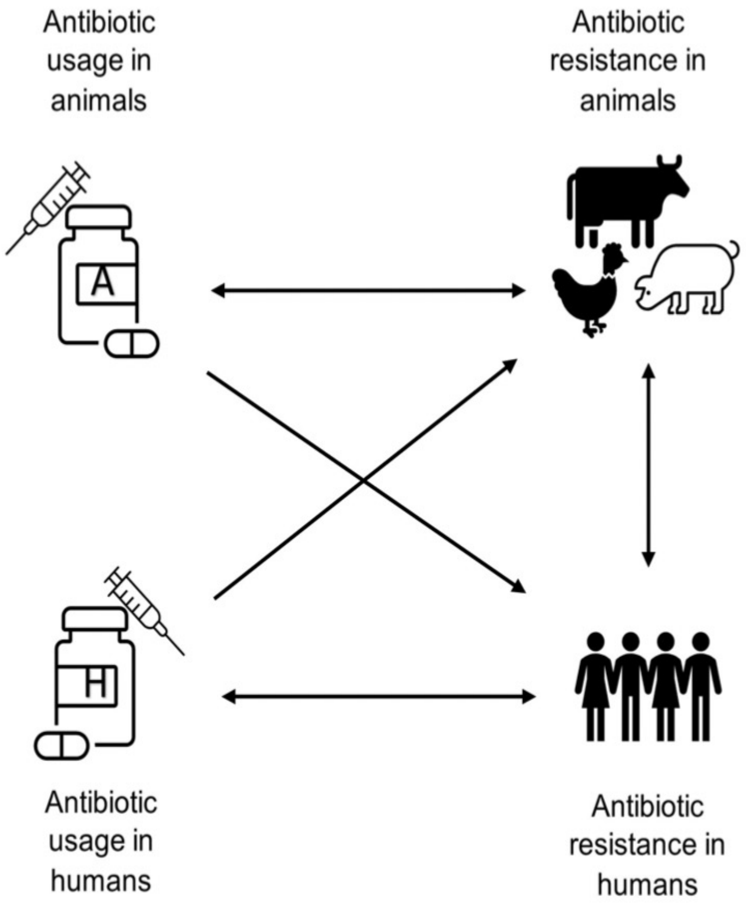
- Antibiotic use selects for antibiotic-resistant bacteria in animals, just as in humans.
- Resistant bacteria transferred to farmworkers and to the public during food preparation.
- Farm effluents
  - antibiotic residues, which can drive environmental bacterial resistance.
  - antibiotic- resistant bacteria, which contaminate the environment and can enter the food chain.

BIG KNOWLEDGE GAPS



- Animal – animal:
  - Numerous studies (mostly Europe surveillance).
  - Positive correlation AMU and development of resistance.
- Animal – human:
  - Widely presumed significant, but poorly understood.
  - Overlapping resistant bacterial lineages and resistance elements in samples from human colonisation, animals, and retailed meat.
  - Few studies explore/quantify direct pathways.
  - Quantitative and ecological extent not fully understood.

BIG KNOWLEDGE GAPS



- Human-human:
  - Numerous studies (hospitals, care homes).
  - Positive correlation AMU and AMR.
  - At ecological level, mostly cross-sectional, limited inferring of causality.
- Human-animal:
  - Next to no studies.
  - Some evidence human medicines -> resistance in environment.
  - Limited understanding of simultaneous use
  - One Health approach?
- **Relative contribution of animal AMU versus human AMU in driving AMR unknown.**
- **Much unnecessary** (prophylaxis) **animal AMU can be cut,** but how much and how to prioritise?

EVIDENCE NEEDS:

- AMU in animals highly variable geographically, by type of antimicrobial, and over time.
- Evidence on drug-pathogens combinations in animals that pose the most serious threat to human health from AMR.
- Poor understanding of constraints/incentives that shape choices, especially pressure farmers face to use antibiotics, actual and perceived risks, how to mitigate those risks, and pressures inside food supply chain.
- Socioeconomics: resistance rates and effect on health differ with countries' socioeconomics, health-care systems, patient populations, and antibiotic consumption.
- Most outcomes the result of the systems, needs multi-sectoral and cross-disciplinary systems thinking.
- Implement challenge. Just having good evidence is not enough to change behaviour.

PROJECT: MUTUALLY SUPPORTIVE COMPONENTS

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- **Bioinformatics platform – for 'food and AMR' tool development (with Sam Sheppard and others, IOI)**
  - Data on AMR **source attribution**, based on sample pathogens from food animals, abattoirs, food on the shelf, and people in hospitals.
  - **Metadata** of partners' sequence samples combined with other data (location and date, temperature, heat stress, air quality, health, household finances, socioeconomic status), cost data sets, and economic modelling will allow exploration of how interventions, and their costs, will impact different groups and help assess likely acceptability/uptake at local=granular level.
- **Economic & epidemiological model development (with many others?!):**
  - Risk mapping food supply chains and food system practices to identify when economic/social pressures combine with evolutionary pressures to generate the greatest risk (e.g., where profit margins are extremely small, informational asymmetries especially high, regulation especially weak, etc.).
  - Unpick incentives structures.
  - AMR impacts and mitigation costs of different food systems, test a repertoire of interventions / changes in practice at different key points.

COMPONENTS OF PROJECT/S

- **Working with farmers: Farm randomised control trials (RCTs) and mixed methods surveys (with Harriet Bartlett, Farm Trials Lead, HESTIA, Department of Biology and others)**
  - Give farmers in test group information on their antimicrobial use benchmarked against peers and an advice engine suggesting actions peers are taking which are likely to be most effective in reducing their antimicrobial use.
  - Farmers' information come from digital tools they already use to monitor their productivity but not currently their antimicrobial use.
  - Every production cycle, re-evaluate AMU, compare in both test and control groups.
  - Parallel interviews with farmers in short- and medium-term to understand their preferences and behaviours, and if and how giving them information changes this.
  - Evidence incorporated into new tools refined with farmers: user-friendly (software) tools, based on local, not overly aggregated, evidence, constantly updating., visualising for farmers 'personalised' evidence of costs, benefits, impact on AMR risk of their actions.

THANK YOU

END