Antimicrobial resistance: research by International Livestock Research Institute and partners

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Background

There is increasing consensus that resistance to antimicrobials important for human healthcare has often been generated in animals and spread to humans and has the potential to cause major harm to human health. Antimicrobial resistance (AMR) also imposes costs on the livestock sector. Most of the studies on antibiotic use and AMR come from developed countries, but developing countries are increasingly concerned about the impacts of AMR. Moreover, in a globalized world, AMR created in one country can easily spread to others.

A main finding from our case studies has been the very limited evidence on antibiotic use and antimicrobial-resistant pathogens in livestock and the implications for human and animal health. We can confidently say that most antibiotics in developing countries are administered by untrained personnel, that regulations, even when present, do not translate to practice and that antimicrobial-resistant pathogens are common in livestock and livestock products. This suggests that further evidence is needed to guide interventions to address what is potentially a problem of major significance for global health and the wellbeing of people and their livestock in poor countries.

International Livestock Research Institute (ILRI) is interested in AMR as a human health externality of intensifying livestock production in developing countries and a constraint to livestock productivity, but we are also concerned that poor farmers should have access to disease control options to safeguard the livestock assets upon which they depend.

This research strategy note summarizes some of the work we do in this area and provides some suggestions for strengthening the evidence base.

Summary of recent and current research on AMR at ILRI

ILRI has been working on different aspects of AMR for a number of years.

Antimicrobial-resistant pathogens in livestock and livestock products

Most ILRI research in developing countries has been on identifying antimicrobial residues or antimicrobial-resistant pathogens in livestock products or populations. We have conducted studies in camels in northern Kenya and in many informal food markets in Africa and Asia. These often find high levels of multi-drug resistant pathogens in livestock, even those kept in remote and isolated communities with little history of drug use.

Drug residues in livestock and livestock products

Other ILRI studies have found drug residues in milk and meat. For example, in Ghana, 36% of milk samples were contaminated with one or more of the antimicrobial drugs screened and in Kenya, 16% of beef samples were contaminated with trypanocides.

Veterinary drug use by animal health workers and farmers

Research shows that drug use is almost negligible in some communities and high in others, but generally less than in many Organisation for Economic Co-operation and Development (OECD) countries.

Work in West Africa found that rational drug-use principles could be applied to farmer use of drugs. Rational drug-use packages were identified for practitioners, community animal health workers and farmers. The farmer package was found to be most acceptable and sustainable and was tested by randomized controlled trials. These showed that information improved farmer knowledge, quality of drug use and health outcomes in animals. However, political sensitivities make it difficult for farmer-information and community animal health worker approaches to go to scale.

Epidemiology of AMR transmission

Studies of AMR in livestock and drug use by farmers do not allow understanding the dynamics or direction of AMR transmission between livestock and humans. Two UK-funded projects based in Kenya and working with a number of UK universities are looking at the molecular epidemiology of pathogens, including AMR genes, among livestock, livestock products, people and the environment.

Mapping, measuring and predicting antimicrobial use in agriculture

Relatively few estimates of antimicrobial use in livestock currently exist outside OECD countries and those that do can be broken down into (i) national sales data and (ii) case studies in single farms or regions. ILRI contributed to the first global mapping of antimicrobial use in livestock, led by Princeton University and the Center for Disease Dynamics, Economics & Policy, based on our work on mapping livestock distributions and livestock production systems. We are improving estimates of country use, through our close links with veterinary services in developing countries.

Based on our work in forecasting demand for animal-source foods and livestock sector responses to that, we are able to predict trends in antimicrobial use in livestock under different scenarios of sector development.

We developed an evidence paper for the Department for International Development on the current state of knowledge on agricultural use of antibiotics in developing countries.

Foresight to prevent AMR emergence

ILRI has a major research effort on the 'infection and treatment' method for prevention of East Coast fever. East Coast fever is one of the most important diseases in East Africa, responsible for enormous losses of animals each year. Fortunately, the disease can be prevented by injecting cattle with a mild form of the disease and antimicrobials at the same time. As this goes to scale, it would be important to look at the risk of the emergence of tetracycline resistance.
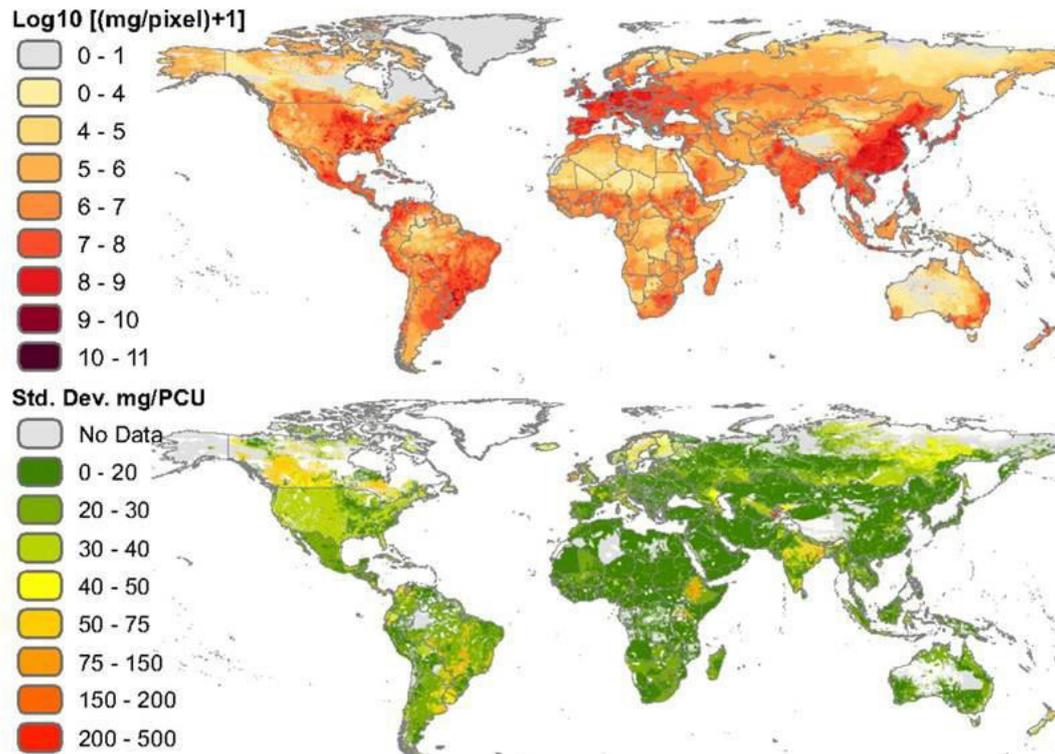

Review of Evidence on Antimicrobial Resistance and Animal Agriculture in Developing Countries

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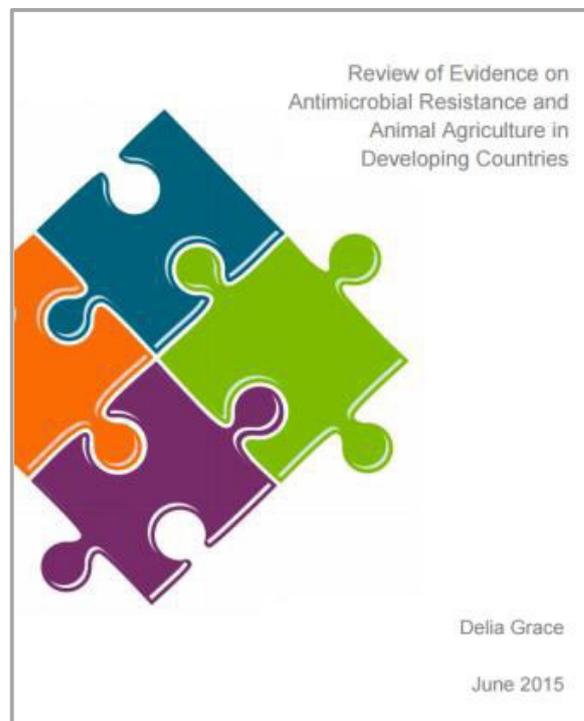
Strengthening the evidence base

There is an assumption that unregulated or indiscriminate use of antibiotics in developing-country livestock systems is contributing to AMR but the evidence how this actually occurs is relatively weak. A first step would be to conduct a comprehensive and systematic review of the use of antimicrobials in developing-country agriculture and the presence of AMR in livestock and livestock products in these regions. We are continually improving our estimates of livestock distributions and production systems, and predictive mapping on livestock intensification, as part of the Gridded Livestock of the World initiative, in collaboration with the Université libre de Bruxelles and the Food and Agriculture Organization of the United Nations. These provide the foundation for estimating antimicrobial use and trends, globally.

Areas of high uncertainty and importance where further field research is needed include:

- Antimicrobial use and AMR in different livestock systems and in different national contexts.

- The specific relationships between antimicrobial use in agriculture and human health; understanding the selection pressures and the transmission pathways for AMR genes.

- Antibiotic quality and the prevalence of fraudulent and substandard drugs.

- Effectiveness, costs and benefits of interventions to reduce drug use in developing-country agriculture and to disrupt transmission cycles for antimicrobial-resistant pathogens.

Global antimicrobial consumption in livestock in milligrams per 10 km2 pixels (Top) and average SD of estimates of milligrams per PCU (Bottom).

Log10 [(mg/pixel)+1]
- 0 - 1
- 0 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- 9 - 10
- 10 - 11

Std. Dev. mg/PCU
- No Data
- 0 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 75
- 75 - 150
- 150 - 200
- 200 - 500

Thomas P. Van Boeckel et al. PNAS 2015;112:5649-5654

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Recent publications on AMR by ILRI and partners

Chotinun, S., Rojanasthien, S., Unger, F., Tadee, P. and Patchanee, P. 2014. Prevalence and antimicrobial resistance of *Salmonella* isolated from carcasses, processing facilities and the environment surrounding small scale poultry slaughterhouses in Thailand. *Southeast Asian Journal of Tropical Medicine and Public Health* 45(6): 1392-1400. http://www.tm.mahidol.ac.th/seameo/2014-45-6-abstract/16-627110.pdf

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