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A Framework for Costing the Lowering of Antimicrobial Use in Food Animal Production

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EXECUTIVE SUMMARY

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NOTE: This briefing note represents work in progress. The authors would welcome feedback and any additional literature not identified or not covered in this review.

Johns Hopkins Center for a Livable Future

ReAct Action on Antibiotic Resistance

Executive Summary

Antimicrobial drugs play an important role in treating diseased animals, but their non-therapeutic use in food animal production undermines efforts to curb antimicrobial resistance. The quantity of antimicrobials used for food animal production is significant compared to human use and on an upward trajectory. Between 2010 and 2030, an Organization for Economic Cooperation and Development (OECD) analysis projects antimicrobial consumption in food animal production will climb by 67 percent—two-thirds of this increase coming from the larger number of food animals in production and one-third resulting from the switch to more intensive animal production systems. Non-therapeutic antimicrobial use in food animal production has largely been driven by perceived economic benefits, including greater feed efficiency and growth, decreased time to market as well as lower mortality and morbidity of food animals. This use, however, has generated significant concern due to its contribution to antimicrobial resistance.

This briefing note provides an overview of the published literature on costs associated with lowering antimicrobial use in food animal production and of switching to alternative modes of production across livestock sectors and countries. Using a structured search of the literature, 24 studies providing economic costing data on production-purpose and prophylactic antimicrobial use were identified. Only studies that included costing figures of economic effects were reviewed. Studies identified were limited to the United States and Europe, largely focused on intensive operations, and provided insight on economic impacts at the animal, farm, and market level. Considering experimental and observational data, these studies show wide variation in the economic effects of curbing non-therapeutic antimicrobials across the animal, farm, and market levels. For example, one of the more comprehensive studies across livestock sectors, a 2015 U.S. Department of Agriculture Economic Research Service (USDA/ERS) analysis, examined the impact of phasing out non-therapeutic antimicrobials in hogs and broilers as well as beef and dairy cattle. Using an assumption that such antimicrobial use would increase productivity by 1 to 3 percent, the USDA market model demonstrated that wholesale prices would rise by 1 percent and output would fall by less than 1 percent. The implications of a market ban had the greatest impact on price and quantity in the first year, but declined by the fifth year. Beyond static market analyses, dynamic modeling at the market level is needed to assess how producers will change their production practices to offset the costs of curbing use of non-therapeutic antimicrobials and how consumers might be willing to pay higher prices on food animal products raised without such antimicrobial inputs. A full accounting of externalities from industrial food animal production though goes beyond the scope of resistance discussed here.

Alternatives to non-therapeutic antimicrobials range from changing production practices such as altering the weaning period or improving hygienic conditions to using

substitutes such as vaccines or feed additives. Changes in production practices may require initial capital investment costs and moderate resource inputs over time. Nevertheless, in countries such as Denmark, Sweden, and Netherlands, which are among the world's largest exporters of food animal products with largely intensive operations, bans on growth-promoting antimicrobials have not adversely affected productivity over time – in fact, productivity levels have been maintained or been increased. This has been attributed to changes in production practices and use of antimicrobial alternatives that have decreased the need for such non-therapeutic uses.

We also provide a preliminary assessment of what data gaps in costing exist, what data elements might be more pivotal for policymaking and economic decision-making, and how these gaps might be filled. The shortcomings of existing data include gaps in surveillance data, costing data, and data on production practices and characteristics. Economic studies from high-income settings such as the United States and Europe must be complemented by studies conducted in resource-limited settings, and local costing data for existing and alternative production practices would be important to capture. Even in industrialized countries, a paucity of antimicrobial use data complicates relating resistance patterns observed in bacteria to patterns of drug administration. At the same time, while such data collection might inform the best approach to implementing changes, it need not delay taking steps to remove non-therapeutic use of antimicrobials in animal agriculture.

To help focus efforts to assess the costs of transitioning away from the non-therapeutic use of antimicrobials, we might consider whether identifying critically important antimicrobials, examining the mode of agricultural production, or looking for geographic hotspots might be strategic. By identifying the classes of critically important, new antimicrobials, these drugs might be reserved for human use. Along the same lines, the emergence of resistant pathogens induced by the use of other antimicrobials might prompt regulatory removal of such drugs from specific veterinary uses. However, co-resistance to multiple classes of antimicrobials makes it imperative to reduce non-therapeutic use of antimicrobials across the board.

Existing evidence suggests greater use of antimicrobials in intensive production. By contrast to extensive or smaller-scale modes of animal production, intensive modes of production rely on high stocking densities and have generated concerns over non-therapeutic use of antimicrobials. Recognizing who controls the inputs of non-therapeutic antimicrobials in vertically integrated livestock or aquaculture production systems though can be key to designing effective policy interventions.

In tackling this global challenge of drug resistance, some regions and countries of the world may contribute disproportionately to the growth in consumption of antimicrobials in food animal production. The OECD analysis projects that China and the United States will account for 40 percent of global antimicrobial consumption in food animal production by 2030. Intensive production also lends itself to geographical concentration. The growth in industrial pig and poultry production will give rise to hotspots of increased antimicrobial consumption, particularly in Asia. By analyzing trade patterns, it can be seen that some countries are more reliant on the import and export of livestock and poultry products. With the flow of such trade also comes the risk of transporting drug-resistant pathogens across borders.

The primary goal of a research agenda focused on economic analysis is to estimate the human disease burden attributable to antimicrobial use in food animals. When considered on a global scale, infrastructure enhancements are needed to drive data collection and surveillance systems. In developing countries, investments in human and physical resources may be required before data collection will be possible. The secondary goal of a research agenda is to identify what costs and benefits are associated with antimicrobial drug use in food animal production. Better empirical data are needed on the costs and benefits of antimicrobial uses under varying production practices, food animal species, and environment. A third goal of a research agenda is a broader market analysis for antimicrobial drug use in the industry. In addition, such analysis should consider price fluctuations and potential cost savings that affect consumer demand and access to food animal products. Externalities from antimicrobial uses (in the form of not just human health effects, but ecosystem impacts) should be considered, and have yet to be well measured. A final goal of a research agenda is the ethical evaluation of the distribution of costs and benefits of antimicrobial drug use in food animal production across stakeholder groups. To ensure that benefits and risks are equitably distributed, such evaluation could occur on the global scale or within country, considering unique subpopulations that are placed at disproportionate economic or disease risk.

Prioritizing the research agenda can begin with existing data and projections, but can be refined as data gaps are surmounted. With stakeholder input, this work needs to be accompanied by assessing the feasibility of collecting such data, both in the near term and over the longer term. To provide credible evidence for policymakers, such research must be conducted independent of financial conflict of interest.

We also recommend consideration of alternative strategies less reliant on these data gaps for implementation and monitoring, including strategies developed within a larger ethical framework that considers issues of sustainability, resilience, local accountability, and food security. A systems thinking perspective would consider interventions to reduce the demand for meat, to increase the reliance on plant-based proteins, and to shift from industrial food animal production to more sustainable agricultural practices.