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Executive action to combat the rise of drug-resistant bacteria: is agricultural antibiotic use sufficiently addressed?

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ABSTRACT

On September 18, 2014, President Barack Obama issued an Executive Order titled *Combating Antibiotic-Resistant Bacteria*. The order demands a 'strategic, coordinated, and sustained effort' to detect, prevent, and control antibiotic resistance. According to the Centers for Disease Control and Prevention (CDC), antibiotic-resistant infections are a rising health concern that result in at least two million illnesses and 23,000 deaths each year in the United States. The Executive Order and accompanying documents have been criticized for taking a weak stance against the use of antibiotics in agriculture; however, they include goals to promote antibiotic stewardship on farms, better surveillance of antibiotic use, and the development of alternatives to antibiotics. The criticisms are also unwarranted based on the current state of scientific evidence; nevertheless, there remain compelling reasons to limit the use of antibiotics in agriculture, and if fully implemented, the executive action is set to achieve this goal. This paper will explore why the criticisms are unwarranted, present the conflicting evidence on whether antibiotic use in farm animals poses a significant health threat to humans, offer other reasons to limit the use of antibiotics in livestock, and suggest ways that the government can maximize the efficacy of the proposed actions.

KEYWORDS: antibiotics, antibiotic resistance, agriculture, executive order

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INTRODUCTION

On September 18, 2014, President Barack Obama issued an Executive Order titled *Combating Antibiotic-Resistant Bacteria*.[1] The order demands a 'strategic, coordinated, and sustained effort' to detect, prevent, and control antibiotic resistance. According to the Centers for Disease Control and Prevention (CDC), antibiotic-resistant infections are a rising health concern that result in at least two million illnesses and 23,000 deaths each year in the United States.[2] The Executive Order mandates the creation of a task force for combating antibiotic-resistant bacteria co-chaired by the Secretaries of Defense, Agriculture, and Health and Humans Services. This task force must submit a five-year action plan by February 15, 2015, laying out goals, milestones, and metrics for measuring progress. The Executive Order also mandates the creation of a Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria and sets out specific areas where action must be taken. These include (1) improved antibiotic stewardship, (2) strengthening national surveillance efforts for resistant bacteria, (3) promoting new and next-generation antibiotics and diagnostics, (4) preventing and responding to outbreaks, and (5) international cooperation.[3]

Two additional documents were released simultaneously with the Executive Order to outline future steps for combating antibiotic resistance: the *National Strategy on Combating Antibiotic Resistant Bacteria*[4] (the '*Strategy*') and a report by the President's Council of Advisors on Science and Technology (PCAST), *Combating Antibiotic Resistance*.[5] The Strategy is meant to inform the PCAST report and describes five primary goals set to decrease the incidence of drug-resistant infections that are the biggest threats to human health as determined by the CDC. These goals are to be achieved by 2020. Like the *Strategy*, the PCAST report presents actionable steps to reduce the rising threat of bacterial infections but also includes the allocation of funding that should be allotted to each set of activities.

Together the documents have been criticized for failing to take a stronger stance against the use of antibiotics in agriculture; however, all three documents include goals to promote antibiotic stewardship on farms, better surveillance of antibiotic use and the emergence of resistant bacteria, and the development of alternatives to antibiotics in agriculture. The magnitude of the impact of antibiotic use in agriculture on human health remains uncertain based on current scientific evidence. The Government Framework, defined in this paper as the Executive Order, PCAST report, and National Strategy together, seeks to learn more about the health consequences of the inappropriate use of antibiotics in agriculture while simultaneously putting measures in place to reduce overuse.

The criticisms of the Government Framework are therefore unwarranted based on the current state of scientific evidence; nevertheless, there remain compelling reasons to limit the use of antibiotics in agriculture, and if fully implemented, the Government

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1 Executive Order No. 13676, 79 C.F.R 56931(2014).

2 Antimicrobial Resistance, CDC, *Threat Report 2013*, http://www.cdc.gov/drugresistance/threat-report-2013/index.html (accessed Nov. 30, 2014).

3 Executive Order No. 13676, 79 C.F.R 56931(2014).

4 *National Strategy for Combating Antibiotic-Resistant Bacteria* (2014), http://www.whitehouse.gov/sites/default/files/docs/carb_national_strategy.pdf (accessed Nov. 19, 2014).

5 President's Council of Advisors on Science and Technology (US), Report to the President on Combating Antibiotic Resistance (2014).

Framework is set to achieve this goal. This paper will explore why the criticisms are unwarranted, present the conflicting evidence on whether antibiotic use in farm animals poses a significant health threat to humans, offer other reasons to limit the use of antibiotics in livestock, and suggest ways that the government can maximize the efficacy of the proposed actions.

AGRICULTURAL USE OF ANTIBIOTICS

Antibiotics are used in agriculture today for three reasons: disease treatment, disease prevention, and growth promotion. The use of antibiotics for the purpose of growth promotion began in the United States in the 1950s when scientists, somewhat by accident, realized that adding antibiotics to animal feed accelerated their growth and cost less than traditional feed supplements.[6] This was great news for an industry that had struggled through World War I and II to meet the demand for meat and keep costs low for consumers. Farmers found that their livestock reached the desired weight more quickly and production costs dropped dramatically because of more rapid growth and a higher survival rate. Ever since this time, the industry has become dependent upon sub-therapeutic uses of antibiotics in feed to promote the health of their animals.

In December of 2013, the United States Food and Drug Administration (FDA) issued voluntary guidance for animal pharmaceutical companies to change labels on drugs so that they are no longer marketed for growth promotion in animals. This change in label would make using antibiotics for growth promotion illegal. Drugs that are used for other preventive or therapeutic purposes must be prescribed by a veterinarian rather than available over-the-counter as in current practice.[7]

CRITICISMS OF THE GOVERNMENT FRAMEWORK

The Government Framework has been widely criticized for failing to adequately address the use of antibiotics in agriculture, especially given that agriculture uses 'more than three times as many antibiotics in the United States every year as people do'.[8] In the Nature news article, 'White House takes aim at antibiotic resistance', Sara Reardon describes these criticisms, including those of Mae Wu, a health attorney at the National Resources Defense Council in Washington DC. Wu claims that there are 'few details on how surveillance would work or what evidence would lead to stricter regulations'. She is further dissatisfied that the 2013 FDA guidance and Government Framework does not do more to prevent use of antibiotics for disease prevention, suggesting that only use for treatment is acceptable.[9]

These sentiments are echoed in other news publications. In an article from the Wired science blog, Maryn McKenna, a journalist and senior fellow of the Schuster Institute at Brandeis University, commends the executive action for outlining significant steps

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6 Maureen Ogle, *Riots, Rage and Resistance: A Brief History of How Antibiotics Arrived on the Farm Scientific American* (2013), http://blogs.scientificamerican.com/guest-blog/2013/09/03/riots-rage-and-resistance-a-brief-history-of-how-antibiotics-arrived-on-the-farm/ (accessed Nov. 29, 2014).

7 FDA, *Consumer Updates—Phasing Out Certain Antibiotic Use in Farm Animals*, http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm378100.htm (accessed Dec. 28, 2014).

8 Maryn McKenna, *White House Actions on Antibiotic Resistance: Big Steps, Plus Disappointments*, Wired (2014), http://www.wired.com/2014/09/wh-amr-pcast/ (accessed Nov. 30, 2014).

9 Sara Reardon, *White House Takes Aim At Antibiotic Resistance*, Nature (2014), http://www.nature.com/news/white-house-takes-aim-at-antibiotic-resistance-1.15962 (accessed Nov. 30, 2014).

towards combating antibiotic resistance but expresses concern that action against agricultural use of antibiotics is lax.[10] McKenna acknowledges that there is a chapter in the PCAST report that addresses animal agriculture, but claims that it is shorter and less aggressive than the recommendations for other areas. She notes that the report fails to touch on specific action and instead continues with the FDA's voluntary plan from 2013 to curb use of antibiotics. She also claims that other recommendations fail to support new research and fail to include dollar-specific objectives or benchmarks, including the creation of a United States Department of Agriculture (USDA) national education and stewardship program to assist farmers and an effort by the FDA to monitor changes in the sale and use of antibiotics in animal agriculture. She refers to it as a 'wait-and-see' approach.[11]

McKenna claims that the *Strategy*, in contrast, specifies more direct action on animal antibiotic use, stemming from its 'One-Health' approach. The One-Health approach advocates for surveillance efforts that take into account the interplay between public health, veterinary disease, food, and the environment.[12] She poses the question of which document will ultimately inform action by the government.[13]

In reality, the combination of the three reports encourages substantial action to combat the use of antibiotics in agriculture; in addition to having sections devoted specifically to agriculture, recommendations in the general categories for stewardship, surveillance, and drug development are extended to include agricultural practices. For example, the PCAST report contains an overarching Recommendation 3 that calls for an increase in fundamental research to develop new antibiotics and recommends creating alternatives in agriculture for treatment and disease prevention.[14] It specifically recommends the creation of a multidisciplinary innovation institute through the USDA to develop alternatives to antibiotics in agriculture. It calls for a budget of $25 million annually and states that this amount has already been requested for the fiscal year 2015.[15]

The PCAST report builds on the voluntary guidance by the FDA. Many expressed concern that voluntary guidelines would be ineffective, but these guidelines, according to the PCAST report, have been adopted by all 26 animal drug companies that manufacture and label the drugs.[16] PCAST co-chair Eric Lander has acknowledged that companies can continue to use antibiotics for disease prevention instead of growth promotion, but that veterinary oversight should help limit inappropriate use. He adds that monitoring should be carried out to assess progress.[17]

As mentioned by McKenna, a useful approach to surveillance defined by the *Strategy* is the idea of a 'One-Health' approach that promotes the idea that 'the health of humans is connected to the health of animals and their shared environment'.[18] In

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[10] McKenna, *supra* note 8.

[11] *Id.*

[12] *National Strategy for Combating Antibiotic-Resistant Bacteria, supra* note 4, at 2.

[13] *Id.* McKenna, *supra* note 8.

[14] President's Council of Advisors on Science and Technology (US), *supra* note 5, at 5.

[15] President's Council of Advisors on Science and Technology (US), *supra* note 5, at 5.

[16] President's Council of Advisors on Science and Technology (US), *supra* note 5, at 53.

[17] *Presidential Council Calls for New Antibiotics in Upcoming Report on Antibiotic Resistance*, Food Safety News, http://www.foodsafetynews.com/2014/07/pcast-previews-upcoming-report-on-antibiotic-resistance/ (accessed Nov. 30, 2014).

[18] *National Strategy for Combating Antibiotic-Resistant Bacteria, supra* note 4, at 11.

addition to the suggestions for better surveillance, the *Strategy* lays out specific anticipated outcomes of the recommended actions. Among these outcomes is: (1) the USDA will develop at least three drugs or probiotic treatments as alternatives for growth promotion in animals, (2) the FDA and USDA will work with the National Institute for Mathematical and Biological Synthesis to develop an analytic modeling framework to assess the relationship between antibiotic use in livestock and the development of antibiotic resistance, and (3) the gut microbiome of at least one food animal will be sequenced and characterized.[19]

DOES ANTIBIOTIC USE IN AGRICULTURE POSE A THREAT TO HUMAN HEALTH?

It is difficult to establish a connection between antibiotic use in livestock and the emergence of resistant and disease-causing bacteria in humans because of the complexity of the process. For a clinical impact to emerge, strains of bacteria must evolve resistance to antibiotics, spread from animals to humans, and subsequently cause disease in humans.[20] This course of events is difficult to study and results in our persisting uncertainty. There are conflicting views on the association between the use of antibiotics in food animals and disease-causing resistant bacteria found in humans. The US seems to be taking a precautionary approach but is inclined to wait on more evidence before taking stronger action. Indeed, PCAST co-chair Eric Lander stated, 'We'd like more data on some of these things, but we also recognize that there are actions that have to be taken, given the data we have.'[21]

The PCAST report describes the evidence well and takes a fair approach in evaluating the issue, claiming that 'the risks to human health posed by the agricultural use of antibiotics are, appropriately, a matter of very serious concern'[22] but that 'the magnitude of the impact of agriculture on the prevalence of resistant infections in humans still needs to be clarified'.[23] The report acknowledges that all uses of antibiotics promote the emergence and spread of antibiotic resistance and that treatment with one antibiotic can lead to resistance to that antibiotic and others.

The report cites a number of studies (and addresses their limitations) concerning what is known about antibiotic resistance in agriculture. It is known that the use of antibiotics in animal agriculture results in the development of antibiotic-resistant microbes in animals, and that meat can be a source of these microbes. It is also known that antibiotic-resistant microbes can spread between animals and people in close proximity to each other.[24] What is not as clear is the relative contribution of the impact on human health of antibiotic use in agriculture versus inappropriate use for human health.

One study cited by the report showed that poultry workers in Maryland and Virginia were at a higher risk of infection by multidrug-resistant E. coli than those in the

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19 *Id.* at 18.

20 David L. Smith, Jonathan Dushoff & J. Glenn Morris, Jr., *Agricultural Antibiotics and Human Health*, 2 PLoS Med. e232 (2005), at 0731.

21 *Presidential Council Calls for New Antibiotics in Upcoming Report on Antibiotic Resistance*, *supra* note 17.

22 President's Council of Advisors on Science and Technology (US), *supra* note 5, at 2.

23 *Id.* at 28.

24 *Id.* at 51.

surrounding communities.[25] Another that studied MRSA from animals and humans across 19 countries and 4 continents showed that a strain that originated in humans spread to livestock, acquired methicillin resistance, and migrated back to humans as more resistant but less virulent. A third study indicates that a hospital-adapted multidrug-resistant enterococci originated from animal sources. Finally, the report describes contradicting evidence from Scotland that found little transmission of bacteria and resistance genes between animals and humans.[26]

The report is optimistic that surveillance can evaluate this issue and notes that a number of newer studies using whole-genome sequencing have made strides in understanding the relationship between resistance in animals and humans. Elucidating the relationship will be important for the creation of appropriate policies in the future.[27]

REASONS TO LIMIT ANTIBIOTIC USE IN AGRICULTURE

In addition to the possible risk to human health, there are other compelling reasons for the government and industry to reduce the use of antibiotics in agriculture. First, consumers are increasingly demanding transparency in how their food is produced[28] and many desire that their meat be produced antibiotic-free. Companies in the United States have already begun accommodating the requests of their consumers. On September 3, 2014, Perdue Farms, the third-largest chicken producer in the United States, released a statement saying that it has phased out the use of most antibiotics on its chickens.[29] The company no longer uses antibiotics for growth promotion or for disease prevention and does not use antibiotics important for humans in 95% of its poultry. Lastly, it no longer injects its chickens with antibiotics while they are still in their shells. The phase-out was a 12-year process, culminating in the removal of antibiotic use in its hatcheries.[30] In order to compensate for the effect that the antibiotics produced, the company has now improved the diets of its chickens by using all-vegetable feed, using prebiotics and probiotics, increasing vaccinations for its chickens, and cleaning its chicken houses more diligently.[31] Purdue Farms executive Bruce Stewart-Brown explained that the chickens that receive probiotics stay healthier and grow faster than those that do not, and that even though they grow slower than the rest of the industry,

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[25] Johns Hopkins Bloomberg School of Public Health, *Poultry Workers at Increased Risk of Carrying Antibiotic-Resistant E. coli*, http://www.jhsph.edu/news/news-releases/2007/price-poultry-workers.html (accessed Nov. 30, 2014).

[26] President's Council of Advisors on Science and Technology (US), *supra* note 5, at 52.

[27] President's Council of Advisors on Science and Technology (US), *supra* note 5, at 52.

[28] Maria Godoy, *Americans Want Antibiotic-Free Chicken, And The Industry Is Listening*, NPR.org, http://www.npr.org/blogs/thesalt/2014/02/14/276976353/americans-want-antibiotic-free-chicken-and-the-industry-is-listening (accessed Nov. 30, 2014).

[29] Perdue Farms Inc., *Antibiotics Position Statement* (2014), http://www.perduefarms.com/News_Room/Statements_and_Comments/details.asp?id=545&title=Antibiotics%20Position%20Statement (accessed Nov. 29, 2014).

[30] Maryn McKenna, *Chicken Company Perdue Takes Big Steps to Reduce Antibiotic Use*, Wired (2014), http://www.wired.com/2014/09/abx-perdue/ (accessed Nov. 30, 2014).

[31] *Id.*

the extra cost is ultimately worth it because consumers do not mind paying a little extra for antibiotic-free chicken.[32]

If using antibiotics is necessary to grow animals in sub-optimal conditions, then their use should be limited to promote animal welfare and encourage better practices for raising livestock. There have been a number of success stories, including that of Purdue Farms, in which promoting better living conditions for livestock has resulted in a decreased need for antibiotics. A company in the Netherlands, Vencomatic, raises chickens in a special warehouse 'patio barn' in which they thrive.[33] Even without antibiotics, the chickens are healthier and grow faster than the industry average. The company initially designed the warehouse for animal welfare and sustainability reasons, and later realized that antibiotics were no longer necessary. They learned that keeping chicks healthy is possible by hatching birds where they are raised; traditionally, shells are incubated and hatched in a hatchery and subsequently grown on a farm, but the transport puts stress on the chicks. With this new model, they can eat and drink as soon as they hatch, and their immune systems are thus strengthened. This is profitable for the company because more birds survive, yield is increased, and the Dutch government allows them to charge more for their sustainably raised meat.[34]

BARRIERS TO SUCCESS AND INTERNATIONAL EXAMPLES

While the Government Framework covers the actions that will be necessary to successfully reduce the use of antibiotics in agriculture, the United States must learn from the experience of companies and countries that have previously banned inappropriate use of antibiotics in livestock.

The most important action taken by the United States is the 2013 FDA voluntary guidance that seeks to phase out the use of antibiotics as growth promoters over a three-year period and put other uses of antibiotics under veterinary oversight. There are two major concerns about this phase-out. The first is that animals will get sick more often and cause therapeutic use of antibiotics to increase. The other concern is that production efficiency will decrease significantly and affect profits. Indeed, the initial outcome in both the Netherlands and in Denmark was a marked increase in antibiotic use for therapeutic purposes; in both countries, these problems were overcome with better management and husbandry practices on farms.

In the Netherlands, the problems were due to weak implementation of a ban and were remedied in 2009 when the Dutch government made it mandatory for farmers to cut antibiotic use by half in three years. The farmers managed to meet this goal in two.[35] Pigs were kept healthy by altering their feed recipes, increasing barn

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[32] Dan Charles, *Giving Chickens Bacteria ... To Keep Them Antibiotic-Free*, NPR.ORG, http://www.npr.org/blogs/thesalt/2014/09/22/350590488/giving-chickens-bacteria-to-keep-them-antibiotic-free (accessed Nov. 30, 2014).

[33] Maryn McKenna, *The Future of Chicken*, SLATE, 2014, http://www.slate.com/articles/health_and_science/feed_the_world/2014/04/antibiotics_in_chicken_vencomatic_patio_system_makes_birds_healthier_drug.2.html (accessed Nov. 29, 2014).

[34] *Id.*

[35] National Geographic Society P. O. Box 98199 Washington, DC, 20090-8199 800-647-5463 Lat/Lon: 38.90531943278526 & -77 0376992225647 Inspiring people to care about the planet since 1888 Learn

temperatures, keeping piglets with their mothers for longer, and providing their animals with more space. Dutch farmers say that they are not losing money, and in some cases are making more because their animals are healthier.[36]

In Denmark, a powerhouse for pork production, the government banned antibiotics for both growth promotion and disease prevention in 1999.[37] After the initial hurdles, producers similarly changed their practices by weaning pigs later, reducing the density of animals, changing the airflow to minimize disease transmission, and investing in hardier animal breeds. Since that time, Danish pork production has actually increased[38] and antibiotic use has been cut by more than half.[39]

ANALYSIS OF ADDITIONAL MEASURES

Monitoring antibiotic use and resistance patterns is a critical component of a plan to reduce overuse. The Government Framework proposes a number of improved surveillance activities in the realm of agriculture. These activities include enhanced data collection on antibiotic sales and use as well as the expansion of food safety laboratories to conduct susceptibility testing and characterize emerging resistance patterns. The *Strategy* proposes strengthening the existing National Antimicrobial Resistance Monitoring System (NARMS) in the United States to incorporate surveillance into every step of meat production. Currently, NARMS only has enough funding to sample retail meat in 14 states.[40] The PCAST report estimates the cost of expanding the NARMS program and the CDC's Emerging Infections Program at $50 million dollars[41]. As briefly outlined in the *Strategy,* expansion of the NARMS program is an important objective to monitor antibiotic sales, usage, and resistance patterns throughout the production chain from food animals to retail meat.[42]

In 2000, Denmark also implemented a monitoring program called VetStat to collect data at the farm and species level on prescriptions of antibiotics. It accomplishes this through a monitoring system of all veterinary uses of antibiotics by collecting the information from pharmacies, feed mills, and veterinary practitioners.[43] This program allows a great deal of specificity on the types of animals and diseases for which antibiotics are used. The United States lacks this specificity by collecting only data on sales of antibiotics and should work to implement comprehensive data collection on how antibiotics are used.

More', *Can Farms Reduce Antibiotic Use? Dutch Farms Did – The Plate: Maryn McKenna*, http://theplate.nationalgeographic.com/2014/06/27/can-farms-reduce-antibiotic-use-dutch-farms-did/ (accessed Nov. 29, 2014).

36 *Id.*

37 Dan Charles, *Europe's Mixed Record On Animal Antibiotics,* NPR.ORG, http://www.npr.org/blogs/thesalt/2012/03/23/149221287/europes-mixed-record-on-animal-antibiotics (accessed Nov. 30, 2014).

38 *Id.*

39 Margaret Munro, *As Canada Dawdles, Denmark Shows the World How to Stop Mass Medicating Animals*, CANADA.COM (2014), http://o.canada.com/news/national/as-canada-dawdles-denmark-shows-the-world-how-to-stop-mass-medicating-animals (accessed Dec. 12, 2014).

40 *National Strategy for Combating Antibiotic-Resistant Bacteria*, *supra* note 4, at 11.

41 PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY (US), *supra* note 5, at 24.

42 *National Strategy for Combating Antibiotic-Resistant Bacteria*, *supra* note 4, at 11.

43 *Id.*

Another important proposed government action is to use the USDA's Cooperative Extension Service to lead an education and stewardship program for farmers and veterinarians to enable them to comply with the FDA Guidance. The Cooperative Extension Service is a trusted source of information for farmers and has a presence in every US county.[44] While the Government Framework briefly mentions a need for educational strategies to 'identify, develop, and revise key agricultural practices that allow timely and effective implementation of interventions that improve animal health and efficient production'[45], it spends little time on the importance of using the education services specifically to promote the better husbandry practices that will likely be the most important factor for maintaining efficient production. As seen in the example of Perdue Farms and the successes of Denmark and the Netherlands, better diet and living conditions go a long way in reducing the need for antibiotics.

Lastly, the Government Framework proposes the development of alternatives to antibiotics in agriculture for use as growth promoters and to prevent infection. This development will be carried out by the USDA and will be enhanced by the creation of the USDA Innovation Institutes. The *Strategy* anticipates that by 2020, the USDA will develop at least three drug candidates or probiotic treatments for this purpose. The United States should build upon current knowledge of effective probiotics to reach this goal.[46]

RECOMMENDATIONS

The Government Framework lays out a comprehensive strategy to reduce the inappropriate use of antibiotics in livestock, but in order to be successful, the Government has to prioritize high-impact actions and learn from the experiences and barriers that other countries have encountered.

First, the government must follow through with eliminating the use of antibiotics as growth promoters for animals. Because drug companies have already agreed to remove growth promotion as a use, and because other uses will come under veterinary surveillance, antibiotic use will certainly decrease. In order to avoid the obstacles that Denmark and the Netherlands suffered after initial bans on antibiotics as growth promotion, the United States must use its planned education programs to educate farmers and veterinarians about improving husbandry practices to maintain efficient production based on the experiences of companies in the United States and abroad.

Next, the importance of appropriate surveillance is integral to success and will serve a variety of functions. A strong surveillance program will (1) more accurately track the use of antibiotics in agriculture and (2) track patterns of antibiotic resistance in agriculture across the United States. This will enable more targeted policy action later and will help illuminate the connection between the use of antibiotics in agriculture and the impact on human health. Expanding the NARMS program as outlined in the Government Framework is an important step towards improving surveillance. Moreover, the government should work to collect animal-specific information on

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[44] President's Council of Advisors on Science and Technology (US), *supra* note 5, at 53.

[45] *National Strategy for Combating Antibiotic-Resistant Bacteria*, *supra* note 4, at 9.

[46] Gerard Huyghebaert, Richard Ducatelle & Filip Van Immerseel, *An Update on Alternatives to Antimicrobial Growth Promoters for Broilers*, 187 Vet. J. 182, 188 (2011).

antibiotic use rather than simply antibiotic sales; the Framework mentions needing to monitor use more closely and could benefit from a program like VetStat to make it successful.

Lastly, the government should follow through with its development of probiotics and other alternatives to antibiotics in livestock in order to ease the transition away from the use of antibiotics as growth promoters. The creation of the USDA Innovation Institutes will be instrumental for this goal, and cooperation with industry and other countries will build upon current knowledge of effective probiotics to accelerate development of alternatives.

CONCLUSION

The Government Framework has laid out a strong foundation to reduce inappropriate uses of antibiotics in agriculture and to elucidate the relationship between antibiotic use in agriculture and antibiotic-resistant infections in humans. By learning from the countries that have long banned antibiotics for growth promotion, the United States can avoid the productivity problems that others initially faced. Educating farmers on good husbandry practices and promoting the discovery and subsequent use of probiotics for growth promotion will result in a meat industry that keeps its consumers happy without sacrificing farm productivity. If the government follows through with its proposed actions and if industry responds to the demands of its consumers, antibiotic use in agriculture will significantly decrease and surveillance efforts will enable the FDA and USDA to create appropriate policies to further improve antibiotic stewardship.