AgBioForum – Volume 3, Number 2&3 – 2000 – Pages 141-147

REGULATION OF ANTIBIOTIC RESISTANCE IN THE US

James Coffman[1]

This paper provides a United States (US) perspective on the issue of antibiotic resistance as it pertains to the use of antibiotics in animals. A recent National Research Council (NRC, 1999) report concludes that drug residue issues are being effectively addressed in the US. The report also found that antibiotic use in food and animals is related to antibiotic resistance and the development of a set of diseases that exhibit resistance in humans. Although there is an urgent need to find alternatives to the use of antibiotics in animal production, an outright ban is unwarranted, and is likely to come down to a political issue. Scientific risk assessment, impact assessment, and a pragmatic recognition of existing conditions are important inputs in the political process.

Key words: National Research Council; ban; antibiotic resistance; drug resistance; animal production.

This paper addresses the issue of antibiotic resistance as it pertains to the use of antibiotics in animals. In particular, the recent results and recommendations of a National Research Council (1999) report entitled The Use of Drugs in Food Animals: Benefits and Risks are discussed. This report resulted from the work of a sub-committee appointed at the request of the Center for Veterinarian Medicine in the Food and Drug Administration (FDA) and the United States Department of Agriculture (USDA).

In 1995, the FDA/USDA requested a study of the use of drugs in food animals, and of the associated benefits and risks pertaining to their use. The study was to make recommendations based on available knowledge of the human health effects of these drugs. In addition, the accessibility of drugs, and the accountability and overall adequacy of the United States regulatory process was to be examined. The sub-committee was assembled to represent a broad mix of stakeholders including industry (pharmaceutical companies; beef producers; the National Pork Producer Council); scientists and academics (e.g., dairy specialists, agricultural economists); consumer advocates (e.g., the Consumer's Union); and medical doctors (with an interest in antibiotic use and resistance). The mix of committee members entailed definitively held viewpoints about the use of drugs in food animals. However, the report resulted from a consensus viewpoint based on available evidence.

[1]*James Coffman is the Provost at Kansas State University and Chair of the NRC Committee.*

Conclusions And Recommendations Of The NRC Report

The sub-committee began its work in early 1996. A pre-publication report came out in 1998, while the final report was published in 1999. The committee drew two main conclusions from their research that are as follows.

- There was no finding of any fulminating hazards from drug residues. In addition, the US food system has effectively succeeded in addressing residue issues. This did not imply that there was no need for more research to be conducted into drug resistance and continuing enhancements to the process. However, the committee's opinion was that drug residue issues were being effectively addressed.

- A second finding was that antibiotic use in food and animals is related to antibiotic resistance, and the development of a set of diseases that exhibit resistance in humans. This was an important conclusion, as it was the first US report to find a direct link between the use of antibiotics in food animals, microbial resistance to those antibiotics, and human disease. The report went on to emphasize that the incidence of resistance was very low. However, it was very difficult to track and predict this incidence because of the fragmentary nature of relevant data sets, and because antibiotic resistance could have considerably more effect in the future. Closely monitoring resistance trends was therefore necessary.

The report also made the following recommendations:

- The Center for Veterinary Medicine should continue to find ways to expedite the drug approval process. A considerable amount of progress has been made in this direction already including pulling disparate parties together into the process. However, a considerable amount of work remains to be done. The approval process was felt to, perhaps, unreasonably impose similar approval standards and procedures on animal drugs as those for humans, and to be fraught with redundancies. Cost and time factors became prohibitive. This was compounded by additional environmental standards and requirements that have increased over time. In addition, political factors seemed to be present in ways that impeded efficiencies.

- The availability of veterinary drugs should be enhanced through worldwide harmonization of standards and requirements. Research efforts are being duplicated around the world, which is particularly troublesome with regard to efficacy trials.

- In tracking residues in animal organs, emphasis should be placed on those organs most commonly consumed rather than those rarely consumed. This is currently not the case. This change in emphasis would require further basic research.

- The establishment of an integrated, national database of research and data to support rational, physical, science-driven decision-making processes. The committee, in the process of interviewing large numbers of stakeholders, and in reading volumes of reports pertaining to drug and antibiotic use and antibiotic resistance patterns, found that data are badly fragmented. This fragmentation limits the ability of stakeholders to find common points of interest as data are used to support opposing viewpoints. Political issues could also be better addressed if integrated, user-friendly, readily accessible data sets were available. Decision makers would not be subject to political pressures based on data taken out of context.

- An interdisciplinary oversight group, similar to that represented by the sub-committee itself, should be established. The experience of the sub-committee was that a group of reasonable people, no matter how firmly held their opinions, could reach consensus. Such an oversight group would need to be nurtured to exist with protection from political pressures.

- The sub-committee interviewed a large number of federal employees who were frustrated at the political process, as they seemed to have little input in the work of relevant congressional sub-committees. An integrated approach was recommended in order to draw on all available expertise and insight.

- Further research into alternatives to drug use were also recommended as part of the solution to drug resistance. Tables 1-3 illustrate the distribution of microbial contaminants in poultry, pork, and beef. These tables emphasize the ubiquitous nature of the problem and how it pertains to the transfer of antibiotic resistance in humans. The main message of these tables is that the problem could largely be resolved if food was properly cooked.

Should Therapeutic Use Of Antibiotics Be Banned?

Although there is an urgent need to find alternatives to the use of antibiotics in animal production, the case for some level of therapeutic administration of antibiotics can still be made. A total ban on the use of antibiotics in animal production comes at a cost. Hayes (1999) has investigated the potential cost of a total ban using a model which estimates the direct cost to consumers.

The model only looked at cost to consumers, not to producers. Depending on the variables and assumptions used, potential costs range from $5 to $10 per year per consumer. This cost is manageable. However, the model did not look at multiplier effects and indirect costs from the imposition of a total ban. Some individual producers might exit the industry during an initial shakeout from the ban. Financial costs of individual producers forced out of business were not considered. Costs from the erosion of export markets due to domestic price increases were also not considered.

Clearly, the question of whether countries would engage in a total ban is likely to come down to a political issue. Nevertheless, scientific risk assessment, impact assessment, and a pragmatic recognition of existing conditions are important inputs in the political process. Despite a relatively low direct impact to consumers, the NRC report did not recommend an outright ban on the therapeutic use of antibiotics in food producing animals. In contrast, the World Health Organization (WHO, 1997) has strongly advocated such a position.

Recently, the FDA Commissioner made it explicit that the major cause of antibiotic resistance in humans is sub-therapeutic use of antibiotics in animals (Henney, personal communication, February, 2000). The NRC report did not draw this conclusion for several reasons. Scientific evidence available was not conclusive. In addition, the most important cause of human resistance, in the sub-committee's view, was considered to be the direct administration of antibiotics to humans. Certainly, the physicians that served on the sub-committee took this position. Whether one argues this position strongly or not, there is clear evidence that the direct administration of antibiotics to humans is an important cause of antibiotic resistance. However, probably the most compelling reason for not engaging in an outright ban in animal agriculture is that over-the-counter sales of antibiotics would have to be banned for resistance to be adequately addressed. Prescription use also would have to be heavily restricted. So the report concluded that to ban the sub-therapeutic uses of antibiotics (without banning over the counter use as well) would not really address the issue.

References

Committee on Drug Use in Food Animals, Panel on Animal Health, Food Safety, and Public Health, National Research Council. (1999). The use of drugs in food animals: Benefits and risks. Washington DC: National Academy Press.

Hayes, J.D. (1999). Costs of eliminating sub-therapeutic use of antibiotics. In Committee on Drug Use in Food Animals, Panel on Animal Health, Food Safety, and Public Health, National Research Council, The Use of Drugs in Food Animals: Benefits and Risks (pp. 179-187). Washington DC: National Academy Press.

World Health Organization (WHO). (1997). The medical impact of the use of antimicrobials in food animals: Report of a WHO meeting (Document No. WHO/EMC/ZOO/97.4). Berlin, Germany.

Table 1: Survey Report of Microbiological Hazards in Swine.

Human Pathogen	Mean Percentage of Samples Yielding Pathogenic Bacteria in Swine					Critical Source
	Carcass	*Fresh Meat*	*Organ Meat*	*Ground Meat*	*Processed Product*	
Salmonella spp.	16.2	14.7	30.0	40.3	35.0	Animal
Campylobacter jejuni/coli	10.0	13.4	----	----	----	Animal
Yersinia enterocolitica	3.7	43.7	21.5	11.9	38.5	Animal
Erysipelothrix rhusiopatheae	----	29.5	----	----	----	Animal
Arcobacter spp.	----	89.0	----	----	----	Animal
Aeromonas hydrophila	----	----	----	100.0	33.0	Animal
Listeria monocytogenes	----	34.0	----	12.0	----	Environment
Clostridium perfringens	----	66.0	12.0	39.0	81.0	Environment
Clostridium botulinum	----	----	----	----	1.0	Environment
Bacillus cereus	----	38.0	----	----	25.5	Environment
Staphylococcus aureus	100.0	55.0	----	----	5.5	Human
Escherichia coli O157:H7	----	1.5	----	----	----	Human

Note. From "The Use of Drugs in Food Animals: Benefits and Risks" by the Committee on Drug Use in Food Animals, Panel on Animal Health, Food Safety, and Public Health, National Research Council, 1999. Washington DC: National Academy Press, p. 128.

Table 2: Survey Report of Microbiological Hazards in Cattle.

Human Pathogen	Mean Percentage of Samples Yielding Pathogenic Bacteria in Cattle					Critical Source
	Carcass	*Fresh Meat*	*Organ Meat*	*Ground Meat*	*Processed Product*	
Salmonella spp.	1.0	7.8	----	46.0	44.3	Animal
Campylobacter jejuni	27.0	0.8	12.0	0.0	----	Animal
Yersinia enterocolitica	----	2.0	----	----	----	Animal
Aeromonas spp.	----	----	100.0	100.0	12.0	Animal
Escherichia coli O157:H7	0.2	3.7	0.3	----	----	Animal
Listeria monocytogenes	4.1	18.2	----	65.6	30.0	Environment
Clostridium perfringens	2.6	25.5	----	----	----	Environment
Bacillus cereus	0.0	12.0	----	20.0	----	Environment
Staphylococcus aureus	4.2	41.6	72.0	23.0	73.5	Human

Note. From "The Use of Drugs in Food Animals: Benefits and Risks" by the Committee on Drug Use in Food Animals, Panel on Animal Health, Food Safety, and Public Health, National Research Council, 1999. Washington DC: National Academy Press, p. 130.

Table 3: Survey Report of Microbiological Hazards in Poultry.

	Mean Percentage of Samples Yielding Pathogenic Bacteria in Poultry					
Human Pathogen	*Carcass*	*Fresh Meat*	*Organ Meat*	*Ground Meat*	*Processed Meat*	**Critical Source**
Salmonella spp.	47.4	41.9	52.7	----	56.3	Poultry
Campylobacter jejuni	66.2	52.7	63.3	----	----	Poultry
Aeromonas hydrophila	98.0	50.0	100.0	----	6.0	Poultry
Listeria monocytogenes	22.0	23.8	7.0	----	32.0	Environment
Clostridium perfingens	79.0	----	----	----	----	Environment
Bacillus cereus	----	21.5	----	----	----	Environment
Staphylococcus aureus	----	40.0	----	----	----	Human
Escherichia coli O157:H7	----	1.5	----	----	----	Human

Note. From "The Use of Drugs in Food Animals: Benefits and Risks" by the Committee on Drug Use in Food Animals, Panel on Animal Health, Food Safety, and Public Health, National Research Council, 1999. Washington DC: National Academy Press, p. 134.