RESEARCH REPORT
PORK SAFETY

Title: Economic Impacts of Potential Restricted-Use Policies for Antimicrobial Agents Used As Growth Promotants in Swine Production – **NPB #98-237**

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Date received: 7/6/2000

ABSTRACT

Public health officials and physicians are concerned about possible development of bacterial resistance and potential effects on human health that may be related to the use of antimicrobial agents in livestock feed. This concern has raised the question of a possible ban for subtherapeutic use of these drugs as growth promotants, similar to what has already occurred in several European countries. The National Pork Producers Council funded research to determine the economic implication of potential growth promotant bans on U.S. swine production. The focus of this research was aimed at determining changes in cost of swine production and the economic effects that subtherapeutic bans of antimicrobials would have on both swine producers and consumers.

Benefits from growth promotants used in growing and finishing swine included 3.25% increased average feed efficiency in addition to improved health and reduced sort loss at marketing that was attributed to more uniform growth rates. These benefits had an estimated average net economic value of $2.88 per hog. Available data indicated that a ban on use of antimicrobials as growth promotants would likely affect 93% of projected annual production of 105 million market hogs.

A ban on growth promotants for swine would be costly, totaling $280 million annually with swine producers and consumers sharing this cost nearly equally in the short run. In the long run, consumers would bear more than 80% of this cost. If a ban affected poultry as well as pork production, these losses would expand to $673 million per year with distribution of costs between producers and consumers similar to those in the short run. The net present value of these increased costs over a 30-year period with a 4% discount rate would be $8.4 billion and $11.6 billion, respectively, for a ban that would affect pork or both pork and poultry production.

INTRODUCTION

Food animal production in the U.S. uses antimicrobial agents to promote animal welfare and to enhance the efficiency of livestock production. Of the total antibiotic production for both human treatment and animal purposes, approximately 25% is used in food animals and 90% of that portion has been reported as being used in subtherapeutic concentrations* for disease control and as growth promotants.[8]

Antimicrobial agents have been added to feed and used extensively in swine production since their introduction in the early 1950's.[13] Hog performance is potentially improved by using subtherapeutic concentrations of any of the 12 currently available antibiotic or chemotherapeutic drugs that are approved for use in hogs with claims for increased rate of gain or improved feed conversion.[5] Because of the economic benefit to producers, antimicrobial drugs are used in about 90% of the starter feeds, 75% of the grower feeds, and over 50% of the finisher feeds.[4]

Growth promotant or subtherapeutic use of antimicrobials administered in animal feeds has been strongly criticized as a serious public health threat causing life-threatening infections that are resistant to antimicrobial therapy.[1, 15] This concern has developed around the following issues:[12] (1) subtherapeutic use of antimicrobials in animal feeds is the principal cause of antimicrobial-resistant bacteria; (2) if subtherapeutic use were eliminated, the level of resistance of bacteria harbored by animals would be reduced; and (3) reduced resistance to antibiotics in animals would result in an improvement in human health because the potential for transmitting antibiotic-resistant bacteria from animals to humans would be reduced. However, in spite of these claims, which have been considered more speculation than fact, there appears to be no clear cut, definitive answer regarding whether subtherapeutic or therapeutic antimicrobial use in farm animals causes more or less emergence of drug resistance and adverse effects on human health.[12] Nonetheless, it appears that human health officials are moving towards the withdrawal of antimicrobials that are used for growth promotants in animals if these drugs are also used for human therapeutics.[7]

The Animal Health Institute has estimated that growth promotants save hog producers an estimated two billion dollars in annual production costs.[2] However, not all swine producers rely on these compounds to the same extent.[11] Responses to subtherapeutic uses of antimicrobials tend to be more positive when pigs are raised under less than ideal conditions.[10] Therefore, it is likely that producers who have good management practices would not be as greatly affected by a ban as producers with less desirable management systems.[11] It has been proposed that a ban on subtherapeutic drug use could ultimately improve animal care and improve industry efficiency, but the process to achieve that result could be painful for those producers who are unable to adopt improved management practices and are forced out of business.[11] The overall effect of a ban on antimicrobial drugs used as growth promotants, including the need to adopt technological improvements to obtain equal levels of production, would likely be an increase in costs and higher meat prices.[11]

Earlier studies on the economic impacts of bans on antimicrobial use in swine production were conducted in the 1970's and indicated an increase in the market price of pork and a 4 to 20% reduction in the quantity of pork supplied to the market.[3, 6] Shifts in technology and changes in management systems would likely alter these results that were obtained more than 20 years ago.

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* Subtherapeutic concentration of antibiotics added to feed in the United States is defined as a dosage of antibiotics at a concentration of less than 200 grams/ton.[8]

In two of the more recent economic studies dealing with the ban on subtherapeutic antimicrobials in swine production, a basic assumption was made that would appear to seriously flaw the results of these reports.[9, 14] Both of these studies assumed that there would be an increase in the demand for pork of 5% because of perceived improvements by consumers that pork produced under these bans would be more wholesome and less likely to contain antibiotic residues.[11] This assumption seems to be unfounded because further decrease in the extremely low level of current antibiotic residue rates would be unlikely. Because of this assumption, the study by Wade and Barkley reported net economic gains for both producers and consumers due to the proposed ban on antibiotics.[14]

The most recently published economic evaluation of the effects of a ban on subtherapeutic use of antimicrobials in swine production also included some assumptions and methods that were questionable.[11] This study assumed that there would be no change in consumption with a concomitant increase in the market price of meat. No elasticity measurements were included in this study that would make adjustments for changes in consumer demand due to price increases and provide for economic changes related to substitution effects among competing goods, such as beef or poultry.

The current climate of increased regulatory pressures by health officials and notable deficiencies or flaws in previously reported studies on the economic impact of restricted antimicrobial use policies indicate the need to obtain better quality information about this potential economic problem facing the U.S. pork industry.

OBJECTIVES

The overall objective of this research project was to develop useful economic estimates of the impact of potential restricted-use policies for antimicrobial agents used in swine production as growth promotants. These estimates of economic change were developed at three levels: a) swine producer [costs of production], b) aggregated U.S. pork industry [supply], c) U.S. consumer [demand].

PROCEDURES

An economic simulation model was developed to provide estimates of the net benefits associated with the use of growth promotants in swine production.[a,b,c] Three key components were identified as the most important for contributing potential economic advantages for growth promotant use at the producer level: a) improved feed efficiency over drug cost, b) reduced mortality rate, and c) reduced sort loss at marketing. The size of the sort loss benefit would vary according to the type of feeding management. Production systems using targeted days on feed would achieve potentially greater benefits related to reduced sort loss compared to targeted marketing weight management systems. Review of relevant scientific literature and swine industry reports was used to provide estimates of the range of benefits associated with feeding growth promotants. USDA statistics and reports were used to estimate total hog production, growth promotant use, and the percent distribution of management systems (targeted days on feed or targeted marketing weight) for grower/finisher operations.

The losses to producers and consumers for the U.S. pork market were calculated using econometric methods similar to those described in the scientific literature by Wohlgenant.[16]

Economic variables for beef and poultry commodities were added to the pork model. Estimates of economic parameter values and necessary elasticities* were based upon published research when possible (Table 1). Changes in producer costs developed from the simulation model were used to provide some of the needed inputs for this econometric model. Alternative scenarios for sub-therapeutic antimicrobial bans limited to pork or applied additionally to poultry and beef were developed. We assumed that a ban would only affect cost of production and would have negligible changes on meat quality. Because of seemingly less reliance of beef cattle feedlots upon traditional antibiotics provided at subtherapeutic levels in feed for enhancing production efficiency, it was further assumed that no significant changes in beef cattle production costs would occur if a ban included beef cattle. This assumption would not be valid, however, if a ban were to include ionophore antibiotics used in cattle (e.g., monensin), which do not appear to pose a threat to human health. These results were described in terms of changes in producer and consumer surplus related to increased production costs for restricted use of antimicrobials. This part of the project determined how these increased costs would be allocated among the various commodities and the distribution of costs between producers and consumers.

RESULTS

Reduction in production costs

Improvements in feed efficiency or feed-to-gain ratio (F/G) for subtherapeutic levels of antimicrobials have been reported as ranging from –1% (a decrease) to 7% or greater for grower/finisher hogs. Improvements in F/G were determined to be compatible with a normal distribution ($P > .15$) having a mean value of 3.25% and a standard deviation of 2% (Figure 1). Analysis of published reports also indicated that the net economic benefit for each one percent improvement in F/G was \$0.68 ± 0.16 (mean ± standard deviation).

Published research indicated small reductions in death rate associated with use of antimicrobial growth promotants. A reduction in death rate of 0.75% was considered to be representative with possible values ranging from 0.0% (no benefit) up to 1.5%. The economic worth of this benefit was related to the market value of feeder pigs. This benefit would also contribute towards improvement in animal welfare.

Reductions in sort loss were related to better uniformity of market weight due to improvements in rate of gains attributed to growth promotants. Grid pricing discounts from packers significantly penalize underweight market hogs. Reduced sort loss has not often been considered in previous clinical trials as a benefit related to antimicrobial agents used for growth promotion, but this is an important benefit. Based on research reports examining reductions in variability of market weight distributions of hogs fed subtherapeutic antimicrobial agents, an average benefit of \$0.38 ± 0.12 per hog was calculated for targeted days-on-feed programs. A smaller but still important benefit of

* **Elasticity** refers to the degree of responsiveness of demand or supply to a change of price. If a small change in price results in a large change in demand or supply, then demand or supply, respectively, is elastic; if, on the other hand, a large change in price has only a slight effect on demand or supply, then demand or supply, respectively, is inelastic. **Price elasticity of demand** for a particular commodity, for example, measures the responsiveness of demand to changes of price. **Elasticity of farm supply** for a particular commodity likewise measures the responsiveness of supply to a change of price**. Elasticity of substitution** describes the extent to which one good can be substituted for another. Goods that are perfect substitutes would have an elasticity of substitution value of 1.0 while a good with no substitute at all would have a value of zero. (Adapted from *A Dictionary of Economics and Commerce, 2nd ed.* by J.L. Hanson. London:MacDonald & Evans, Ltd, 1967.*)*

$0.12 ± 0.04 per hog was estimated for hogs raised under targeted market weight management programs. It was projected that the percent of hogs raised under targeted days-on-feed programs has increased from the value of 42% reported in 1995 by the USDA National Animal Health Monitoring System (NAHMS) report.

The number of hogs marketed per year was estimated as 100 million head. The simulation model was based upon 105 million market hogs per year to allow for expected growth in swine production over the next few years. Data from the 1995 NAHMS report also showed that 93% of all grower/finisher pigs received preventive antibiotics/growth promotants in feed.

The total estimated net benefit for subtherapeutic use of antibiotics in swine production was calculated as $2.88 ± $1.62 as determined by the previously described components. Although a wide spread in the value of this benefit was possible, the majority of values most likely to occur would range from $1.79 to $3.89 per head (Figure 2). The average benefit of $2.88 per hog was used to calculate the proportional change in production costs for the swine industry and the resulting impact on economic values related to changes in supply and demand of pork in the U. S., if the use of subtherapeutic antibiotics in feed were banned.

Who Pays the Cost?

The total annual loss would be $279M (million) if the ban on antimicrobials as growth promotants were on pork alone and $673M if the ban were applied to beef, pork and poultry (Table 2). In the short run, the estimated loss borne by swine producers would be $177M if the ban were only on swine production and $173M if the ban is across pork, beef, and poultry. In the long run, the total losses will be similar, but consumers would bear more of the cost. In the long run the swine producer surplus lost will be $72M if the ban is only on pork and $69M if the ban is across pork, beef, and poultry. Because of the low price elasticity between pork and poultry, it does not make much difference to swine producers as to whether the ban included swine only or also included poultry.

If the resulting change in cost of pork production is lower or higher than assumed, all numbers change proportionately. The calculated average increased cost of production of $2.88 per hog due to loss of the net benefits associated with growth promotants was considered to be the best estimate for figuring the cost change listed in Table 1. Unfortunately, wide ranges of published elasticity estimates were available. The elasticity estimates determined whether producers or consumers incurred the cost of the ban. Because neither pork nor poultry production uses many resources that are specialized and fixed in the long run, their supply curves are likely very elastic in the long run.

The estimates of the total cost of banning subtherapeutic antimicrobial use in swine and poultry were roughly half of that estimated by Committee on Drug Use in Food Animals.[11] The main difference was that they assumed that marketing cost would increase proportionately to any change in production cost while this model held marketing costs constant.

Summary

More research is needed to clearly define the role that sub-therapeutic antimicrobials may play in development of bacterial resistance and any possible effect their use could have on human health.

Benefits from growth promotants used in growing and finishing swine included increased feed efficiency in addition to improved health and reduced sort loss at

marketing that was attributed to more uniform growth rates. These benefits had an estimated average net economic value of $2.88 per hog.

A ban on the use of antimicrobial agents as growth promotants for swine would be costly, totaling $279M annually with swine producers and consumers sharing this cost nearly equally in the short run. In the long run, consumers would bear more than 80% of this cost. If a ban affected poultry as well as pork production, these losses would expand to $673M per year with distribution of costs between producers and consumers similar to those in the short run. Based on a 30-year planning horizon and a 4% discount rate, the net present value of these increased costs would be $8.4 billion and $11.6 billion, respectively, for a ban that would affect pork or both pork and poultry production.

[a] Microsoft Excel 97 SR-2, Microsoft Corp., Redmond, WA.
[b] @Risk for Windows, Version 3.5e, Palisade Corp., Newfield, NY.
[c] BestFit for Windows, Versions 2.0d, Palisade Corp., Newfield, NY.

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Table 1. Estimates of Parameter Values for the U.S. Beef, Pork and Poultry Industries

	Value		
	Beef	Pork	Poultry
Price elasticity of demand for beef (η_1)	-.6	.1	.21
Price elasticity of demand for pork (η_2)	.14	-.35	.04
Price elasticity of demand for poultry (η_3)	.05	.07	-.3
Elasticity of substitution (σ)	.72	.35	.35
Elasticity of farm supply, short run (ε_{SR})	.15	.2	.2
Elasticity of farm supply, long run (ε_{LR})	.70	1	1
Farmer's share of consumer's dollar (S)	.49	.4	.4
Increase in production costs[a] (k)	0	.02318	0
Total farm revenue (WX)	$35 bil.	$12 bil.	$17 bil.

[a] The proportional change in production costs was calculated as:

- increased production cost per hog due to growth promotant ban = $2.88
- $2.88*92.7% utilization of growth promotants = $2.67 per hog for industry
- weight of one pig = 256 lb. = 2.56 cwt
- market value per pig = $45/cwt*2.56 = $115.20
- production cost increase = $2.67/$115.20 = 2.318%

Table 2. Change in Producer and Consumer Surplus from Increase in Production Costs Due to Banning Subtherapeutic Antibiotics in Swine Only or Both Swine and Poultry Production ($ Million).

	Producers			Consumers		
Situation	Beef	Pork	Poultry	Beef	Pork	Poultry
B						
B						
a						change
F						

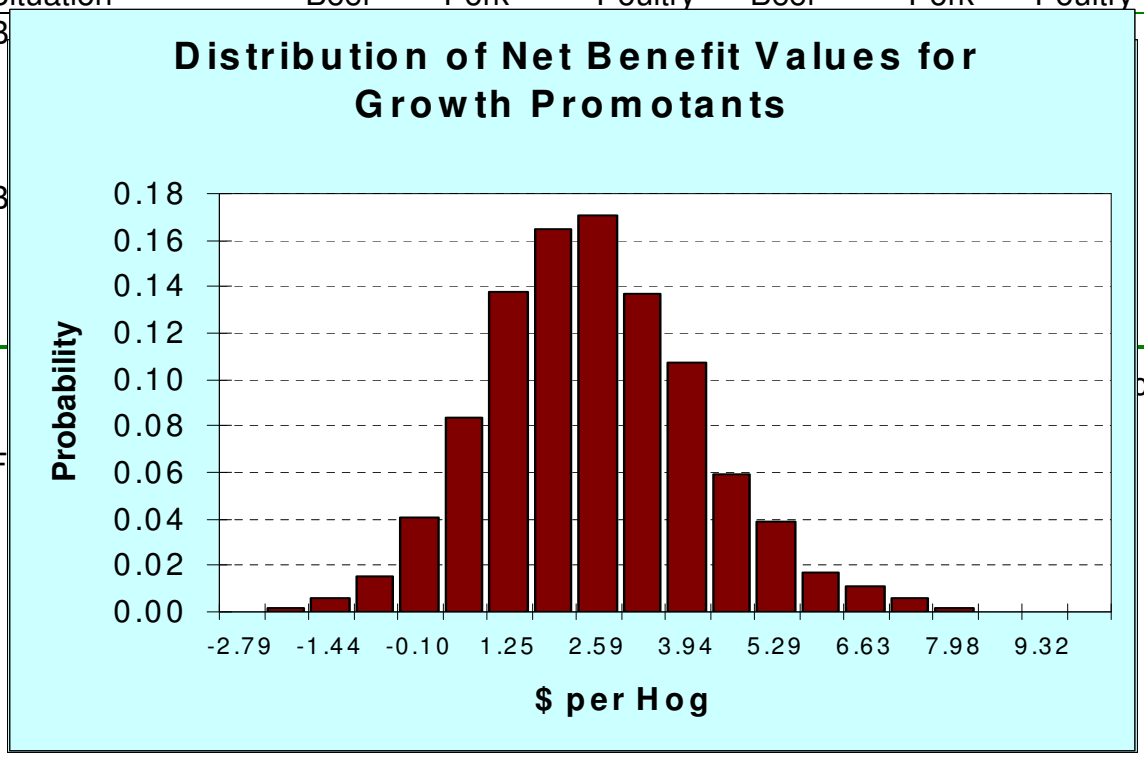

Figure 2.