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THE EFFECTS OF MORAL OBLIGATIONS TO OTHERS AND OTHERS' INFLUENCE ON VETERINARIANS' ATTITUDES TOWARD AND RECOMMENDATIONS TO UTILIZE ANTIBIOTICS IN FEEDLOT CATTLE*

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ABSTRACT

Decisions to behave in particular ways depend on beliefs, social norms, perceived constraints, and attitudes. Recently, this perspective has been expanded to consider the role of moral obligations in such decisions. Largely ignored are the possible interrelations among moral obligations to significant others and significant others' influences as they interact to affect decisions. This is of particular interest when a strong moral obligation toward a significant other is associated with strong behavioral expectations by that same significant other. We investigated the interrelations among moral obligations to, and behavioral expectations from, 11 types of significant others in the cattle feeding industry to determine their joint influences on attitudes toward antibiotic use and recommendations for antibiotics in feedlot cattle, drawing data from a random sample of feedlot veterinarians (n=103). Results show that subjective norms and a sense of moral obligation affect both the attitudes toward, and the recommendations for, the use of antibiotics in feedlot cattle. We found several significant interactions among subjective norms and moral obligations, which suggests that perceived moral obligations to peers, clients, and the regulatory norm-setting sector associated with the feedlot industry increase the impact of social pressures from those sectors on the recommendation to use antibiotics in acutely sick, chronically sick, and high-risk feedlot cattle.

The use of antibiotics in animal agriculture is an important issue not only for animal health and agricultural profitability but also for human health (Rollin 2001). Animal antibiotic use is thought to have a significant impact on the emergence of

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antibiotic resistance in pathogenic bacteria found in food animals (Smith et al. 2002), which could affect human health. As a result, many scientists and medical professionals have advocated for restrictions on the use of certain types of antibiotics in animal agriculture (Aarestrup and Wegener 1999; Khachatourians 1998; Witte 1998), while others have strongly encouraged the elimination of certain classes of antibiotics in food animals, particularly when used as growth promotants (Gorbach 2001; Gourmelen 2001; U.S. Food and Drug Administration 2009). Food companies have alertly attempted to market to the public's fears regarding either antibiotic residues or resistant-bacteria in meats by promoting "antibiotic-free" products (see the Tyson Foods 2009 press release). Several studies dealing with physicians' antibiotic prescribing patterns have found differences among physicians from various specialties with respect to antibiotic use and knowledge about resistance (Srinivasan et al. 2004). A few studies have investigated veterinarians' attitudes and beliefs concerning antibiotic use (e.g., Busani et al. 2004). However, these have been atheoretical in nature and thus have not tested the model we put forth in the present paper. The limited published research on antibiotic use in the cattle-feeding industry demonstrates the importance of social and moral norms in decision making (Dean and Scott 2005; McIntosh et al. 2009), but there is no presently published work on the interplay between social and moral norms in arriving at such decisions.

THE THEORY OF PLANNED BEHAVIOR

Research concerned with the effects of beliefs, attitudes, and subjective norms on behavior often relies on the theory of planned behavior (TPB) to explain how intentions to behave are determined by these factors and how those intentions affect actual behaviors (Ajzen 1991). Intentions are considered the best predictors of behavior, and intentions, in turn, are a product of attitudes and perceived social pressures or subjective norms. Some have suggested that intentions and behavior may also be affected by moral obligations toward others. While some studies based on the theory of planned behavior have examined the reasons for which physicians prescribe antibiotics to human patients (which include social pressures) (Jackson et al. 2006; Limbert and Lamb 2002; Walker, Grimshaw, and Armstrong 2001), these have not considered any moral obligations to use antibiotics in patients.

Attitudes are the product of beliefs about the costs and benefits of outcome evaluations and are correlated with behavioral intentions. Walker et al. (2001) argued that physicians who planned to continue prescribing antibiotics for sore throats held different beliefs about the cost-effectiveness of antibiotics than those

physicians who did not plan to do so. Others have found that attitudes play a significant role in predicting physicians' intentions to prescribe antibiotics (Limbert and Lamb 2002).

Previous studies have shown that the link between attitudes and intentions is usually stronger than that between subjective norms and intentions (Ajzen 1985, 1991; Terry and Hogg 1996). This means that personal beliefs and attitudes about the outcome of that behavior usually yield greater influence than others' expectations. However, in other research subjective norms, perceived behavioral control, and moral obligation exhibited a greater impact on behavior than attitudes or beliefs (Légaré et al. 2003).

Subjective norms are: (1) the perception by actors that their significant others expect them to behave in particular ways, combined with (2) their motivation to comply with significant others' expectations. Subjective norms are thus a form of perceived social pressure. Individuals may find themselves in situations in which an entire network of relationships may have to be taken into account, including economic, social, and moral obligations to others in the network, before developing an intention to behave and then behaving (Dean and Scott 2005; McIntosh et al. 2009). With feedlot veterinary medicine, the subjective norms of significant others in the feedlot industry likely vary across conditions or circumstances of antibiotic use and the subjective norms of one group of significant others might actually contradict those of another group. That is, in a given circumstance, one set of significant others (e.g., pharmaceutical companies) might strongly encourage the use of antibiotics in feedlot cattle, while another (e.g., the consumer sector of the food economy) might strongly oppose this use.

Besides perceived costs and benefits of acting in a particular manner, individuals may perceive that certain constraints prevent them from behaving in that way. Perceived behavioral control (PBC), different from actual behavioral control, is how an individual perceives his or her ability to perform a certain behavior, despite the real situation. PBC is hypothesized to affect both intentions to behave and actual behavior (Ajzen 1991). It invokes the perceptions of the availability of skills, resources, and situational or personal opportunities, allowing a person to believe that they are or are not able to carry out a behavior.

MORAL OBLIGATION

The TPB perspective has begun to address the role of moral obligations in predicting intentions and behavior. A few studies have shown that moral norms have an impact on both intentions to behave and behavior itself (Lam 1999;

Pomazal and Jaccard 1976; Schwartz and Tessler 1972; Sparks and Shepherd 2002; Sparks, Shepherd, and Frewer 1995;Warburton and Terry 2000). Findings from this research demonstrate that moral obligation has independent effects on attitudes as well (Sparks and Shepherd 2002). We argue that moral obligations interact with subjective norms (significant others' influences). However, such an interaction and its effect on behavior have largely been ignored, save one study by Baron (2006). This is of particular interest when a strong moral obligation to a significant other is associated with strong behavioral expectations by that same significant other. In our case, feedlot veterinarians may be more likely to recommend the use of antibiotics in a given situation if they sense they (a) have a moral obligation to others in their network to do so, and (b) perceive that these others strongly support their doing so. However, feedlot veterinarians may be less likely to recommend antibiotics if they feel less moral obligation toward others, despite those others' social pressures to use antibiotics. Again, moral obligations felt by feedlot veterinarians likely vary across type of significant other as well as across situations of use. Early work that considered moral obligations examined only a general sense of moral duty that feedlot veterinarians felt in using antibiotics in feedlot cattle (McIntosh et al. 2009), rather than moral obligations toward specific significant others in the feedlot industry, namely, persons and organizations that veterinarians perceive as social pressures on them to use/not use antibiotics in specific situations.

The feedlot can be viewed as a network of relationships among different interested parties, including other feedlot veterinarians, animal nutritionists, feedlot owner/operators, retained owners of cattle, retailers, consumers, packers, pharmaceutical company representatives, the U.S. Food and Drug Administration (FDA), veterinary professional organizations, and state licensing boards. We perceive that these significant others differ from one another in terms of relationship type and obligations. Other feedlot veterinarians and feedlot nutritionists represent peers and working partners. Feedlot veterinarians are few and may share information with one another through professional organization meetings, continuing education courses, and other peer networks. Even if they do not, they may perceive other veterinarians as a key reference group. In addition, as prescribing antibiotics for feedlot cattle often involves mixing them in cattle feed, feedlot veterinarians often consult with nutritionists before making recommendations regarding antibiotic use. Feedlot veterinarians have financial obligations to feedlot clients (i.e., managers/owners of the feedlots, who usually sell feedlot cattle to meat packers) as well as retained owners of cattle (i.e., individuals who place their cattle temporarily in the hands of the feedlot operator for weight

gain, but once this is done, sell these cattle to meat packers on their own). As suggested earlier, feedlot veterinarians who also perceive pressures from the food consumer sector of society (e.g., meat packers, beef retailers, and beef consumers)—while not wishing animals to suffer—have indicated concerns about some uses of antibiotics in food animals (Brewer and Rojas 2008). A fourth group of others consists of organizations and agencies that provide ethical guidelines or rules and regulations regarding antibiotic use in cattle; these include professional veterinary organizations such as the American Veterinary Medicine Association (AVMA), American Association of Bovine Practitioners (AABP) and the Association of Veterinary Consultants (AVC); the U.S. Food and Drug Administration (FDA); and state-level veterinary licensing boards. A group that stands alone includes various pharmaceutical companies that send sales personnel to feedlots to promote the use of the companies' various drugs, including antibiotics, and provide advice via the "technical service veterinarians" that they employ. This group applies pressure on feedlot operators and feedlot veterinarians to use antibiotics under almost all possible circumstances, but feedlot operators and veterinarians are likely to feel less morally obligated to these companies. We argue that the presence of moral obligations among feedlot veterinarians (a) renders attitudes toward antibiotic use more positive and (b) increases the frequency with which they recommend the use of antibiotics.

Feedlot veterinary medicine involves decision-making in situations such as whether and when to use antibiotics to treat acutely sick, chronically sick, at-risk, and high-risk cattle with antibiotics. The distinction between acutely sick and chronically sick cattle (i.e., disease of recent onset; reappearing disease) is found in veterinary medical texts (see Radostits 2001), whereas the distinction between at-risk and high-risk cattle has been made by individuals associated with the feedlot industry (Dean 2005). Antibiotic use in these four situations elicits differences concerning therapeutic (i.e., to treat a sick animal) versus subtherapeutic use (i.e., to prevent an animal or group of animals from becoming sick) and in financial cost/benefit evaluations. The costs and benefits of antibiotic use vary across these types of use, and each member of the feedlot industry has a stake in the outcome of such uses. For example, the FDA recognizes the importance of antibiotic use in acutely sick or chronically sick cattle, and for controlling disease during outbreaks, but calls for "judicious use of antibiotics" to prevent cattle from becoming sick, listing a set of criteria that define judicious use (U.S. Food and Drug Administration 2009:2).

In this study, we investigated the interrelations among moral obligations toward, and behavioral expectations from, the aforementioned 11 significant other groups in the feedlot industry to determine their joint influences on attitudes toward antibiotic use and recommendations to use antibiotics in feedlot cattle, drawing data from a random sample of feedlot veterinarians. We anticipated that moral obligations to others in the feedlot network would increase the effect of social pressures from those others both on feedlot veterinarians' favorable attitudes toward using antibiotics in cattle and on those veterinarians' recommendations to use antibiotics in cattle. The goals of the study were: (1) to determine the utility of a modified theory of planned behavior model (one that contains moral obligations to significant others) in the study of antibiotic use in the feedlot cattle industry, and (2) to determine the usefulness of including interaction terms involving subjective norms and moral obligations in such models. We accomplished these goals by running three models for each of the four situations. The first model (Model 1) contains behavioral beliefs, economic necessity, and subjective norms (e.g., perception that feedlot managers pressure the veterinarians to use antibiotics in acutely sick cattle). In line with this study's first goal, the second model (Model 2) contains the same variables as the first model plus moral obligations to the significant others identified as the source of subjective norms (e.g., perception of a moral obligation to feedlot managers to use antibiotics in acutely sick cattle). To accomplish the second goal, Model 3 tests all Model 2 variables plus interaction terms between the subjective norms variables and their counterpart moral obligation variables (e.g., perceived social pressure from feedlot managers multiplied by perceived moral obligation to feedlot managers to use antibiotics in acutely sick cattle).

METHODS

The questionnaire for this study was developed based on 35 initial qualitative interviews with feedlot operators, feedlot veterinarians, pharmaceutical managerial and regulatory staff, government policy and regulatory personnel, technical services veterinarians, large scale beef retailers, beef packers, antimicrobial resistance advocacy coalitions, and veterinary journalists (Dean 2005). Content analysis suggested concepts compatible with those contained in the theory of planned behavior (Ajzen 1991). These interviews indicated that feedlot veterinarians identified 11 groups or organizations as sources of social pressure. These 11 became our indicators of significant others' influence. Furthermore, many of these same groups/organizations, as well as the cattle themselves, were mentioned when moral

issues in the feedlot industry were discussed. We thus based our questions regarding moral obligations on the same list of significant others. Although we added cattle as a source of moral obligation, we do not include this moral obligation in the present paper because it has no counterpart among the significant others. We do not believe that cattle expect veterinarians to treat them with antibiotics. It is possible, however, that perceived moral obligations to cattle may interact with social pressures from feedlot clients or others. We return to this possibility in our conclusions.

Sample

We drew a random sample from membership lists of the American Association of Bovine Practitioners (AABP) and the Association of Veterinary Consultants (AVC), which led to a random sample of 325 feedlot veterinarians practicing in 37 different states. The membership of AABP numbers around 4,800, whereas AVC's membership is close to 720. Roughly 45% of AVC members also belong to AABP, however, less than 10% of AABP members belong to AVC.[*] Following the Dillman method, we sent a letter to these veterinarians alerting them to our research; one week later, we mailed the questionnaire itself, followed 10 days later by a postcard reminder. Ten days after that, a second copy of the questionnaire was mailed to the sampled veterinarians. Nearly 80 of the veterinarians contacted stated that they no longer practiced feedlot medicine. One hundred and three feedlot veterinarians (a 42% response rate) completed our 18-page questionnaire investigating their attitudes, beliefs, norms, moral obligations, current recommendation practices regarding the use of antibiotics in feedlot cattle, and intentions regarding antibiotic use. Response rates of large animal veterinarians have traditionally been low; a recent study that employed a much shorter questionnaire than ours produced a response rate of 49% (Misch et al. 2007); similarly, Wright et al. (2008) obtained a response rate of 41% using a 2-page mail survey and Harling et al. (2009) garnered 52.9% of their sample of veterinarians. Our sample consisted of more than 99% male non-Hispanic whites; we investigated the degree to which our sample matches the large animal veterinarian population and we found that less than 1 percent of female veterinarians have entered and stayed in large food animal medicine (Narver 2007) and Elmore (2003) reported that 91% of all veterinarians of both genders are non-Hispanic whites.

[*] Information obtained from M. Gatz Riddell, Jr., Executive Vice President of the American Association of Bovine Practitioners, July 1, 2010.

The above components of the TPB model were investigated in four models for intended behaviors concerning antibiotic use in four situations: namely, for acutely sick cattle, chronically sick cattle, at-risk cattle, and high-risk cattle. As mentioned previously, the first two categories are found in veterinary medicine texts; furthermore, all four were mentioned in the qualitative interviews conducted before constructing the survey instrument. The questionnaire provided definitions of each of these conditions for the respondents. Thus, cattle in an acutely sick state referred to cattle with a bacterial disease of sudden or recent onset. Chronically sick cattle concerned those with a bacterial disease of long duration; unlike acute illnesses, chronic conditions often represent an extended relapse or protracted illness after initial treatment has ceased. At-risk cattle were currently healthy, but because of their age (under one-year-old), they were at some risk of becoming ill following their introduction into the feedlot. Veterinarians sometimes recommend that such animals receive antibiotics to prevent diseases. These antibiotics have also been shown to promote growth through mechanisms that are not well understood. High-risk cattle were those determined to be at elevated risk for acquiring diseases because of their histories (e.g., they had recently arrived, been exposed to sick animals either in transit or in their home pen, or been transported over a long distance). Veterinarians sometimes recommend that such cattle be provided with a strategically-timed therapeutic dosage regimen before exhibiting illness themselves to reduce morbidity or mortality in a group of cattle. Often, an entire pen of animals (up to 300 head) is treated at once.

Variables

The present application of the theory of planned behavior led to the development of the following independent variables for each of the four situations in which antibiotics are commonly used: 1) beliefs about the efficacy of using antibiotics in cattle, 2) significant others' expectations regarding the four uses of antibiotics in cattle, 3) perceived constraints on using (or, not using) antibiotics in cattle, and 4) perceived moral obligations to significant others to use antibiotics. Our dependent variables included attitudes toward using antibiotics and the frequency of recommended use (i.e., the behavior) of antibiotics in feedlot cattle; however, we also treated attitudes as an independent variable when behavior was the dependent variable. Because of the high number of significant others involved in the feedlot network, we formed summary variables.

As described earlier, to measure subjective norms, a list of 11 significant other types in the feedlot network of relationships was developed with information from

qualitative interviews and discussions with key informants in the feedlot industry. These included other feedlot veterinarians, animal nutritionists, feedlot owner/operators, retained owners of cattle, beef retailers, beef consumers, meat packers, pharmaceutical company representatives, the U.S. Food and Drug Administration (FDA), veterinary professional organizations (e.g., American Association of Bovine Practitioners), and state licensing boards. Respondents were asked the extent to which each of these significant others expected them to recommend the use of antibiotics under each of the four situations described above (e.g., at-risk cattle), using a bipolar scale of response choices, and how important it was to the veterinarians to meet the expectations of each of those significant others (using a uni-polar scale of response choices). The theory of planned behavior calls for the multiplication of responses to each significant other's expectation by its counterpart regarding the importance of meeting the given significant other's expectations. Rather than include these significant others as separate variables in the multivariate analyses, we grouped them. Thus, other feedlot veterinarians and feedlot nutritionists formed the first group; feedlot owners/managers and retained owners of cattle formed the second; packers, retailers, and consumers of beef formed the third; veterinary professional organizations, the FDA, and state licensing boards comprised the fourth; and pharmaceutical companies made up the fifth.

To measure moral obligations, we developed a set of questions about each of the four behaviors. The questions asked veterinarians whether it was their responsibility to each of the 11 kinds of significant others to recommend antibiotic use for feedlot cattle in the four situations described above. A 5-point bipolar scale was used. We also measured veterinarians' perceptions about the importance of these responsibilities regarding each of the 11 kinds of significant others. Following standard TPB model procedures, the scores of responsibilities to each of the 11 kinds of significant others were multiplied by the scores of the importance of responsibility to each significant other. We used the same categories as above to group these significant others.

For beliefs about likely outcomes, we asked three questions for each of the four situations about whether the antibiotic use would likely: 1) improve the health of their clients' cattle, 2) be profitable for their clients, and 3) improve the well-being of their clients' cattle. Then, we asked a similar set of questions regarding the importance of these three outcomes for each of the four conditions. Bipolar scales were used in measuring these two variables. Following standard TPB variable-handling procedures, the answers for the likelihood of each outcome were multiplied by their relative importance. Separate principal components analyses were run for

each of the four conditions and these analyses generated a single factor from three multiplied variables under each condition.

For perceived behavior control, instead of asking veterinarians the degree to which they thought that they could control the making of recommendations to use antibiotics, we asked the degree to which they agreed that economic pressures made it difficult for them not to recommend antibiotics to cattle in each of the four situations. As for attitudes toward antibiotic use, veterinarians were asked about the degree to which they believed they must recommend antibiotic use under each of the four conditions. A five-point uni-polar scale was used for this question. Behavior was measured by ascertaining how frequently feedlot veterinarians recommended to clients the use antibiotics under each of the four conditions (using a 5-point, uni-polar scale ranging from never to very frequently).

A behavior such as recommending the use of antibiotics is likely associated with the background of the veterinarians, including their race/ethnicity, education, gender, and age as well as experience in the feedlot industry; thus such variables should be controlled for (Conner and Flesch 2001; Lobb, Mazzocchi, and Traill 2007; Martin, Oliver, and McCaughtry 2007). Because the veterinarians in our study were nearly all male non-Hispanic whites and 99 percent of them had a D.V.M. (Doctor of Veterinary Medicine) or equivalent degree, we did not control for these characteristics. However, they differed in other respects. Fifty-five percent of the feedlot veterinarians were aged between 35 and 54. Veterinarians in the sample also differed in: 1) the number of years they had practiced feedlot medicine, 2) the types of practice they were engaged in (none; solo; partnership), and 3) the U.S. state(s) where they practiced feedlot medicine; these variables served as initial controls in the models. We used ordinary least squares (OLS) regression to examine the effects of subjective norms, moral obligation, and interaction effects of moral obligation and significant others' influences on each attitude toward antibiotic use and on each recommendation to use antibiotics by feedlot veterinarians. Because we were creating interaction variables for this analysis, we standardized both the subjective norm and moral obligations variables.

Statistical Modeling

We used hierarchical regression modeling to test the contribution of the interaction effects to the additive regression models. A partial F-test was used to test the statistical significance of adding these interactions to the additive models. This was accomplished by creating equations that include beliefs, perceived constraints, and subjective norms (Model 1); then adding moral obligations to this

model (Model 2), and finally adding interactions between subjective norms and moral obligations (Model 3). In cases in which interaction terms were significant, these interactions were interpreted using graphical representations (available from the first author on request). As the focus of this paper is on subjective norms and moral obligations, we discuss only those findings.

RESULTS

Because the control variables (demographics and practice variables) were not significant in the regression models, they were dropped from the regression models to conserve statistical power. Because this paper focuses on the impact of subjective norms and moral obligations, we have confined our comments to the effects of such norms and obligations on attitudes and behaviors rather than reporting on the effects of economic constraints and beliefs on attitudes and behavior.

Attitude Models

Table1, Model 1, shows that the greater the pressure (subjective norm) experienced by veterinarians from pharmaceutical companies, the less likely feedlot veterinarians had a positive attitude toward using antibiotics in acutely sick cattle. The second model, which explains a significantly greater amount of variance than the first, shows that besides social pressure from pharmaceutical companies, social pressures from rule and norm-making organizations positively affected feedlot veterinarians' attitudes toward this use of antibiotics. This model shows, in addition, that a sense of moral obligation to feedlot managers and retained owners of cattle increased feedlot veterinarian favorability toward using antibiotics in acutely sick cattle. Model 3, while not explaining a significantly greater amount of variance in attitudes toward antibiotic use, indicates that when other feedlot veterinarians and feedlot nutritionists strongly desired the use of antibiotics in acutely sick cattle, and when the veterinarian perceived a strong moral obligation to these persons to do so, this created a more favorable attitude toward this use of antibiotics.

In Table 2, Models 1 and 2 show that subjective norms of nutritionists and other veterinarians positively affected the attitude toward antibiotic use in chronically sick cattle; that is, the stronger the perceived pressure to treat these cattle with antibiotics, the more positive feedlot veterinarians were about doing so. Model 2 explains a significantly greater amount of variance than Model 1, and Models 2 and 3 indicate that moral obligations toward feedlot managers, clients, and retained owners of cattle increased feedlot veterinarians' perceptions that they

must use antibiotics in chronically ill cattle. However, no interaction effects were found significant in Model 3.

TABLE 1. THE EFFECTS OF SUBJECTIVE NORMS, MORAL OBLIGATIONS, AND THEIR INTERACTIONS ON ATTITUDE TOWARD ANTIBIOTIC USE IN ACUTELY SICK CATTLE (n = 90).

	MODEL 1	MODEL 2	MODEL 3
Predictors.	B	B	B
Intercept.	1.073	1.084	1.049
Economic constraints.	.059*	.062*	.059*
Beliefs about antibiotic use.	.079*	.058	.054
Subjective norm 1 (other feedlot vets, nutritionists).	-.011	-.041	.033
Subjective norm 2 (clients, retained owners).	.049	-.004	.040
Subjective norm 3 (packers, retailers, customers).	-.002	.002	-.009
Subjective norm 4 (professional organizations, FDA, state licensing boards).	.094	.129*	.145*
Subjective norm 5 (pharmaceutical companies).	-.071*	-.079*	-.091*
Moral obligation 1 (other feedlot vets, nutritionists).		.077	.012
Moral obligation 2 (clients, retained owners).		.130**	.140**
Moral obligation 3 (packers, retailers, customers).		.008	.011
Moral obligation 4 (professional organizations, FDA, state licensing boards).		-.028	-.029
Moral obligation 5 (pharmaceutical companies).		-.011	.014
Subjective norm 1 * Moral obligation 1.			.138*
Subjective norm 2 * Moral obligation 2.			.038
Subjective norm 3 * Moral obligation 3.			-.060
Subjective norm 4 * Moral obligation 4.			-.028
Subjective norm 5 * Moral obligation 5.			-.059
Adjusted R^2.	.100*	.179**	.193***
F-test for model comparisons		2.556*	1.279

NOTES: * $p<.05$, ** $p<.01$, *** $p<.001$ (two-tailed test); Other feedlot vets = other feedlot veterinarians, Nutritionists = feedlot nutritionists, Clients = feedlot owner/managers, Retained owners = cattle owners who have placed their cattle at a feedlot for finishing; once the cattle are ready these owners retrieve their animals so that they can put them on the market for slaughter.

TABLE 2. THE EFFECTS OF SUBJECTIVE NORMS, MORAL OBLIGATIONS, AND THEIR INTERACTIONS ON ATTITUDE TOWARD ANTIBIOTIC USE IN CHRONICALLY SICK CATTLE (n = 79).

	MODEL 1	MODEL 2	MODEL 3
Intercept.	2.243	1.628	1.611
Economic constraints.	.301**	.280***	.264***
Beliefs about antibiotic use.	.501***	.399***	.391***
Subjective norm 1 (other feedlot vets, nutritionists).	.294*	.303**	.059
Subjective norm 2 (clients, retained owners).	.160	.136	.069
Subjective norm 3 (packers, retailers, customers).	-.155	-.238	-1.001*
Subjective norm 4 (professional organizations, FDA, state licensing boards).	.173	.183	.045
Subjective norm 5 (pharmaceutical companies).	.006	-.107	.085
Moral obligation 1 (other feedlot vets, nutritionists).		-.014	.007
Moral obligation 2 (clients, retained owners).		.215***	.229***
Moral obligation 3 (packers, retailers, customers).		-.003	-.019
Moral obligation 4 (professional organizations, FDA, state licensing boards).		.001	-.003
Moral obligation 5 (pharmaceutical companies).		.207	.220
Subjective norm 1 * Moral obligation 1.			.026
Subjective norm 2 * Moral obligation 2.			.009
Subjective norm 3 * Moral obligation 3.			.098
Subjective norm 4 * Moral obligation 4.			-.029
Subjective norm 5 * Moral obligation 5.			-.153
Adjusted R^2.	.472***	.549***	.540***
F-test for model comparisons.		3.252*	.782

NOTE: $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$ (two-tailed test)

In Table 3, Model 1, subjective norms of other feedlot veterinarians and nutritionists had a positive influence on attitude toward antibiotic use in at-risk cattle. The more the veterinarians perceived that these significant others wanted them to use antibiotics in at-risk cattle, the greater the likelihood that they would hold the attitude that recommending antimicrobial use in at-risk cattle is necessary. This effect disappears in Models 2 and 3, which also show that the stronger the perceived moral obligation toward feedlot clients and retained owners of cattle, the more positive feedlot veterinarians' attitudes were toward using antibiotics in

TABLE 3. THE EFFECTS OF SUBJECTIVE NORMS, MORAL OBLIGATIONS, AND THEIR INTERACTIONS ON ATTITUDE TOWARD ANTIBIOTIC USE IN AT-RISK CATTLE (n = 79).

	MODEL 1	MODEL 2	MODEL 3
Intercept.	2.486	2.822	2.847
Economic constraints.	.307**	.211**	.204**
Beliefs about antibiotic use.	.288***	.246*	.285**
Subjective norm 1 (other feedlot vets, nutritionists).	.282**	.164	.161
Subjective norm 2 (clients, retained owners).	-.099	-.142	-.138
Subjective norm 3 (packers, retailers, customers).	.067	.060	-.012
Subjective norm 4 (professional organizations, FDA, state licensing boards).	.087	.096	.180
Subjective norm 5 (pharmaceutical companies).	.087	.129	.005
Moral obligation 1 (other feedlot vets, nutritionists).		.189	.232
Moral obligation 2 (clients, retained owners).		.328**	.316***
Moral obligation 3 (packers, retailers, customers).		-.161	-.253*
Moral obligation 4 (professional organizations, FDA, state licensing boards).		.100	.187
Moral obligation 5 (pharmaceutical companies).		-.078	-.053
Subjective norm 1 * Moral obligation 1.			-.329*
Subjective norm 2 * Moral obligation 2.			.198
Subjective norm 3 * Moral obligation 3.			.032
Subjective norm 4 * Moral obligation 4.			-.148
Subjective norm 5 * Moral obligation 5.			.244*
Adjusted R^2.	.445***	.503***	.534***
F-test for model comparisons.		2.672***	1.989

NOTE: *$p<.05$, **$p<.01$, ***$p<.001$ (two-tailed test)

at-risk cattle. Model 3, while not explaining significantly more variance in this attitude than Model 2, indicates that social pressure from feedlot veterinarians and nutritionists, when combined with moral obligation to these colleagues, produced a decline in the attitude that antibiotics ought to be used in at-risk cattle, while social pressure from pharmaceutical companies and a sense of obligation to such companies led to a more positive attitude toward using antibiotics in at-risk cattle. Clearly, however, these effects are minimal.

In Table 4, Model 1, perceived pressures from veterinary professional organizations, the FDA, and state licensing boards to use antibiotics in high-risk cattle increased feedlot veterinarians' attitude that they should use antibiotics in such cattle. In Model 2, none of the moral obligation variables were significant and the model did not explain a significant amount of additional variance in this attitude. However, in Model 3, the less moral obligation feedlot veterinarians felt to rule- and norm-setting agencies, the less positive their attitude was toward using antibiotics in high-risk cattle. A significant interaction indicates that the stronger

TABLE 4. THE EFFECTS OF SUBJECTIVE NORMS, MORAL OBLIGATIONS, AND THEIR INTERACTIONS ON ATTITUDE TOWARD ANTIBIOTIC USE IN HIGH-RISK CATTLE (n=84).

	MODEL 1	MODEL 2	MODEL 3
Intercept.	2.059	2.214	2.146
Economic constraints.	.058	.017	.016
Beliefs about antibiotic use.	.323**	.325**	.325*
Subjective norm 1 (other feedlot vets, nutritionists).	.026	.027	.041
Subjective norm 2 (clients, retained owners).	.034	-.002	.112
Subjective norm 3 (packers, retailers, customers).	-.067	-.079	-.165
Subjective norm 4 (professional organizations, FDA, state licensing boards).	.274**	.303**	.301***
Subjective norm 5 (pharmaceutical companies).	.006	-.009	.009
Moral obligation 1 (other feedlot vets, nutritionists).		.043	-.123
Moral obligation 2 (clients, retained owners).		.054	.124
Moral obligation 3 (packers, retailers, customers).		.110	.072
Moral obligation 4 (professional organizations, FDA, state licensing boards).		-.212	-.293*
Moral obligation 5 (pharmaceutical companies).		.181	.278*
Subjective norm 1 * Moral obligation 1.			.164
Subjective norm 2 * Moral obligation 2.			-.220*
Subjective norm 3 * Moral obligation 3.			.037
Subjective norm 4 * Moral obligation 4.			-.110
Subjective norm 5 * Moral obligation 5.			.188
Adjusted R^2.	.206***	.192***	.223***
F-test for model comparisons.		.741	2.537*

NOTE: $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$ (two-tailed test)

the perceived moral obligation was to feedlot clients, the greater the effect of social pressures was from these significant others on feedlot veterinarians' attitudes that they should use antibiotics in high-risk cattle.

Behavior Models

In Table 5, Models 1-3 consistently show that the subjective norms of other feedlot veterinarians and nutritionists and pharmaceutical companies positively affected the frequency with which feedlot veterinarians recommended antibiotics in acutely sick cattle. However, subjective norms from professional organizations, the FDA, and state licensing boards led to less frequent recommendations for using antibiotics in such cattle. Model 2 found no effects of moral obligations on this behavior. Model 3 did not significantly increase the variance explained by Model 2. However, note that the greater the sense of moral obligation feedlot veterinarians felt toward other feedlot veterinarians and nutritionists, the less social pressure they felt to recommend antibiotic use in acutely sick feedlot cattle.

Models 1 and 2 in Table 6 indicate that the stronger the subjective norms from other feedlot veterinarians and nutritionists, the more frequently feedlot veterinarians recommended the use of antibiotics in chronically sick cattle. In Model 2, the greater the sense of moral obligation toward regulatory/ethics setting organizations, the less likely feedlot veterinarians recommended antibiotic use in such cattle; however, this model adds an insignificant amount of variance explained to Model 1. No interaction effects were found significant in Model 3, nor did it add significantly to variance explained.

Turning to Table 7, Model 1 demonstrates that the stronger the perceived social pressure from feedlot owners/managers (clients) or from pharmaceutical companies, the more frequently feedlot veterinarians recommended antibiotics for at-risk cattle. Model 3, while not increasing variance explained compared with Model 2, includes a significant interaction between the subjective norms toward members of the consumption sector (meat packers, retail sellers of beef, and beef consumers) and moral obligation to these members. This interaction can be interpreted as follows: the less feedlot veterinarians feel a moral obligation toward these groups and perceive that these groups would prefer feedlot veterinarians to use antibiotics in at-risk cattle, the more frequently these veterinarians recommended this use of antibiotics.

Regarding high-risk cattle, Model 1 shows that the feedlot veterinarians who perceive social pressure from other feedlot veterinarians and nutritionists

TABLE 5. THE EFFECTS OF SUBJECTIVE NORMS, MORAL OBLIGATIONS, AND THEIR INTERACTIONS ON RECOMMENDATION OF ANTIBIOTIC USE IN ACUTELY SICK CATTLE (n = 90).

	MODEL 1	MODEL 2	MODEL 3
Intercept.	.792	.783	.763
Attitude.	.359***	.369***	.336**
Economic constraints.	-.027	-.027	-.027
Beliefs about antibiotic use.	.126**	.129**	.142**
Subjective norm 1 (other feedlot vets, nutritionists).	.104**	.108*	.110*
Subjective norm 2 (clients, retained owners).	-.043	-.037	.017
Subjective norm 3 (packers, retailers, customers).	-.022	-.028	.034
Subjective norm 4 (professional organizations, FDA, state licensing boards).	-.144**	-.153**	-.186***
Subjective norm 5 (pharmaceutical companies).	.104**	.091*	.102*
Moral obligation 1 (other feedlot vets, nutritionists).		-.027	-.068
Moral obligation 2 (clients, retained owners).		.006	.017
Moral obligation 3 (packers, retailers, customers).		-.025	-.007
Moral obligation 4 (professional organizations, FDA, state licensing boards).		.031	.034
Moral obligation 5 (pharmaceutical companies).		.036	.045
Subjective norm 1 * Moral obligation 1.			.133*
Subjective norm 2 * Moral obligation 2.			-.034
Subjective norm 3 * Moral obligation 3.			.023
Subjective norm 4 * Moral obligation 4.			-.029
Subjective norm 5 * Moral obligation 5.			.047
Adjusted R^2.	.277**	.242***	.267***
F-test for model comparisons.		.237	1.530

NOTE: $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$ (two-tailed test)

recommend the use of antibiotics in high-risk cattle (see Table 8). In Models 1 and 2, the stronger the social pressure from ethics-providing and regulatory agencies, the less frequently feedlot veterinarians made this recommendation. However, the greater their sense of moral obligation to feedlot clients and retained owners of cattle to use antibiotics in at-risk cattle, the more frequently feedlot veterinarians made this recommendation. In Model 3, none of the interaction variables were significant and the model did not significantly increase variance explained.

TABLE 6. THE EFFECTS OF SUBJECTIVE NORMS, MORAL OBLIGATIONS, AND THEIR INTERACTIONS ON RECOMMENDATION OF ANTIBIOTIC USE IN CHRONICALLY SICK CATTLE (n = 79).

	MODEL 1	MODEL 2	MODEL 3
Intercept.	1.192	1.092	1.219
Attitude.	.502***	.503***	.523***
Economic constraints.	.054	.079	.050
Beliefs about antibiotic use.	.036	.023	.017
Subjective norm 1 (other feedlot vets, nutritionists).	.215*	.224**	.312
Subjective norm 2 (clients, retained owners).	-.054	-.023	.229
Subjective norm 3 (packers, retailers, customers).	-.002	-.056	-.157
Subjective norm 4 (professional organizations, FDA, state licensing boards).	.079	.116	.224
Subjective norm 5 (pharmaceutical companies).	-.019	-.047	-.082
Moral obligation 1 (other feedlot vets, nutritionists).		.036	.013
Moral obligation 2 (clients, retained owners).		-.004	-.002
Moral obligation 3 (packers, retailers, customers).		.017	.022
Moral obligation 4 (professional organizations, FDA, state licensing boards).		-.052*	-.047
Moral obligation 5 (pharmaceutical companies).		.008	.036
Subjective norm 1 * Moral obligation 1.			-.013
Subjective norm 2 * Moral obligation 2.			.038
Subjective norm 3 * Moral obligation 3.			.017
Subjective norm 4 * Moral obligation 4.			-.018
Subjective norm 5 * Moral obligation 5.			.058
Adjusted R^2.	.720***	.715***	.712***
F-test for model comparisons.		.780	.809

NOTE: $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$ (two-tailed test)

CONCLUSIONS

Our paper had two goals. The first was to determine whether adding moral obligations to significant others provided additional information about feedlot veterinarians' attitudes about, and recommendations toward, the four prominent uses of antibiotics in the cattle feeding industry in models that contained social pressures from these significant others. The second was to determine whether interactions between these social pressures and moral obligations increased the predictability of

TABLE 7. THE EFFECTS OF SUBJECTIVE NORMS, MORAL OBLIGATIONS, AND THEIR INTERACTIONS ON RECOMMENDATION OF ANTIBIOTIC USE IN AT-RISK CATTLE (n = 79).

	MODEL 1	MODEL 2	MODEL 3
Intercept.	1.724	2.004	1.769
Attitude.	.387***	.320**	.380***
Economic constraints.	.137	.123	.119
Beliefs about antibiotic use.	.188*	.200*	.116
Subjective norm 1 (other feedlot vets, nutritionists).	.129	.122	.131
Subjective norm 2 (clients, retained owners).	.205*	.168	.265*
Subjective norm 3 (packers, retailers, customers).	-.109	-.113	-.159
Subjective norm 4 (professional organizations, FDA, state licensing boards).	-.070	-.083	-.089
Subjective norm 5 (pharmaceutical companies).	.180*	.223**	.297***
Moral obligation 1 (other feedlot vets, nutritionists).		.036	.007
Moral obligation 2 (clients, retained owners).		.137	.187*
Moral obligation 3 (packers, retailers, customers).		.055	.091
Moral obligation 4 (professional organizations, FDA, state licensing boards).		.118	.052
Moral obligation 5 (pharmaceutical companies).		-.142	-.156
Subjective norm 1 * Moral obligation 1.			.129
Subjective norm 2 * Moral obligation 2.			-.229
Subjective norm 3 * Moral obligation 3.			.152*
Subjective norm 4 * Moral obligation 4.			.089
Subjective norm 5 * Moral obligation 5.			.088
Adjusted R^2.	.604***	.599***	.604***
F-test for model comparisons.		.831	1.449

NOTE: $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$ (two-tailed test)

attitudes toward, and recommendations to use, antibiotics in the four situations. We found that, while moral obligations were significant in five of the eight analyses (attitudes and behaviors toward the four conditions in which antibiotics are considered in the feedlot industry), adding interaction terms between social pressure from and moral obligations to significant others added little explanation in most of these situations. Furthermore, when these interactions were significant, they were not always in the direction we had hypothesized.

TABLE 8. THE EFFECTS OF SUBJECTIVE NORMS, MORAL OBLIGATIONS, AND THEIR INTERACTIONS ON RECOMMENDATION OF ANTIBIOTIC USE IN HIGH-RISK CATTLE (n = 84).

	MODEL 1	MODEL 2	MODEL 3
Intercept.	1.312	1.336	1.359
Attitude.	.426***	.420***	.411**
Economic constraints.	-.011	.007	.013
Beliefs about antibiotic use.	.184**	.195**	.232**
Subjective norm 1 (other feedlot vets, nutritionists).	.117	.097	.080
Subjective norm 2 (clients, retained owners).	.037	-.057	-.030
Subjective norm 3 (packers, retailers, customers).	-.016	.002	-.027
Subjective norm 4 (professional organizations, FDA, state licensing boards).	-.161*	-.147*	-.108
Subjective norm 5 (pharmaceutical companies).	.032	.026	.042
Moral obligation 1 (other feedlot vets, nutritionists).		.128	.142*
Moral obligation 2 (clients, retained owners).		.136*	-.089
Moral obligation 3 (packers, retailers, customers).		.050	.023
Moral obligation 4 (professional organizations, FDA, state licensing boards).		-.009	-.086
Moral obligation 5 (pharmaceutical companies).		-.080	-.012
Subjective norm 1 * Moral obligation 1.			.020
Subjective norm 2 * Moral obligation 2.			.005
Subjective norm 3 * Moral obligation 3.			.027
Subjective norm 4 * Moral obligation 4.			-.075
Subjective norm 5 * Moral obligation 5.			-.025
Adjusted R^2.	.490***	.502***	.476***
F-test for model comparisons.		1.421	.317

NOTE: $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$ (two-tailed test)

Attitudes

Subjective norms and perceived moral obligations affected veterinarians' attitudes toward antibiotics across all four conditions, but their effects depended on the particular condition under consideration. Furthermore, in models in which moral obligations to others were significant, perceived normative pressures from those same others were not significant. In part, this was the result of moderate to high correlations (.30 to .50 in size) between moral obligations to particular others and perceived normative expectations of those same others; the greater the sense of moral obligation, the more important social pressures from others became to the feedlot

veterinarians. Perceived subjective norms had positive effects in three of four cases. Social pressures from colleagues and co-workers (other feedlot veterinarians and feedlot nutritionists) led to a more favorable attitude among feedlot veterinarians toward using antibiotics in chronically ill cattle. Perception of such social pressures from norm setting organizations (professional organizations, FDA, and state licensing boards) increased the favorability of veterinarians' attitudes toward using antibiotics in acutely ill and high-risk cattle. Perception of pressure from pharmaceutical companies, however, decreased feedlot veterinarians' favorability toward using antibiotics in acutely sick cattle. Earlier research suggests that cattle owners sometimes pressure veterinarians to use antibiotics in their cattle (Cattaneo et al. 2009), but such pressures had little influence on attitudes or recommendations of the veterinarians in our study. However, as noted below, moral obligations to clients (feedlot operators and retained owners of cattle) led to more positive attitudes toward antibiotic use in acutely sick, chronically sick, and at-risk cattle

Finally, despite several individual interaction effects being significant, their overall contribution to the models (R^2-change) were insignificant every time, save that of the model for feedlot veterinarians' attitudes about treating high-risk cattle with antibiotics. Here, social pressures have a stronger effect on feedlot veterinarians' attitudes toward using antibiotics in high-risk cattle when their sense of moral obligation to clients and retained owners is low.

Behavior

While four subjective norms were statistically significant in the attitude analyses, they were significant seven times in the behavior models. However, five moral obligation variables were significant in the attitude analyses compared with only two moral obligation variables achieving statistical significance in the behavior models. Subjective norms from other feedlot veterinarians and nutritionists appeared in three of the four behavior analyses and were always positive. In other words, the more social pressure feedlot veterinarians perceived from their colleagues and co-workers, the more frequently they advised the use of antibiotics in acutely sick, chronically sick, and high-risk cattle. However, the more they perceived social pressures from norm-producing organizations and agencies, the less frequently they advised the use of antibiotics in either acutely sick or high-risk cattle. The only model in which social pressure from clients and retained owners of cattle increased the frequency of veterinarians' advice to treat cattle with antibiotics occurred in at-risk cattle. Perceived moral obligations appeared in only two of the behavior analyses. The perceived moral obligation to norm-setting organizations to use antibiotics was

associated with a decrease in the frequency with which feedlot veterinarians advised antibiotics be used in at-risk cattle. As such organizations generally have argued such use ought to be done 'judiciously,' only under a narrow set of circumstances, this is an anticipated finding. In fact, most of the veterinarians in the sample perceived little social pressure from these norm-setting organizations, and did not feel a strong moral obligation to these organizations to use antibiotics in such cattle.

The only other behavior model in which moral obligation appears is that for high-risk cattle, and concerning feedlot clients and retained owners of cattle. Here, the greater the moral obligation to this set of individuals, the more frequently feedlot veterinarians recommended the use of antibiotics in high-risk cattle. When a herd of cattle is suspected of being at high-risk of becoming sick, the financial stakes may be so high that feedlot veterinarians perceive the seriousness of the situation requires the use of antibiotics in all the cattle in the herd.

Several additional points are worth considering. Subjective norms or social pressures have several sources, the most common of which come from peers and colleagues, suggesting there are informal as well as formal norms governing veterinarians' antibiotic use recommendations on feedlots. This provides an interesting contrast with the more formal expectations by norm-setting bodies. In addition, social pressure from pharmaceutical companies decreases feedlot veterinarians' perceptions that antibiotics ought to be used in acutely sick cattle, but appears to increase the frequency of their recommending such usage. Here, it is likely unwanted pressure from pharmaceutical companies may lead to a less favorable view of such a practice, yet simultaneously increase veterinarians' knowledge of antibiotics for the treatment of acutely sick and at-risk cattle, increasing their recommendations to do so.

Limitations of our Research

While our sample was relatively representative, it was small and thus the statistical power of several our models was well below .80. This helps explain the lack of support for interactions between subjective norms and moral obligations. In addition, influences other than those tested here operate in the feedlot industry and impact disease rates and responses to those diseases. Some of this relates to the increased size of feedlots as the cattle industry has consolidated. Narver (2007) has argued that this size increase has made it more difficult for veterinarians to concentrate on the health of individual animals. Thus, they instead give more attention to overall herd health. Our data indicated no such effects, but this issue requires further investigation.

Because our study was cross-sectional, we were unable to create the typical TPB model in which current beliefs, attitudes, behavioral controls, and so on predict intentions regarding future behavior and actual future behavior. The most comprehensive TPB models collect data at a later point in time to measure and predict that future behavior; we did not. Future research in this area should endeavor to include a second wave of data collection in which behavior at a later time is measured.

Finally, we note that while our earlier work has generally shown that moral obligations toward using antibiotics in cattle often have positive effects on beliefs and attitudes (McIntosh et al. 2009), the present work indicates that the referent of the moral obligation matters contextually. This analysis can be extended. For instance, future work should take into account feedlot veterinarians' perceived moral obligations to cattle. Preliminary investigations with our data indicate that when feedlot veterinarians perceived a strong moral obligation to the cattle themselves to treat those cattle with antibiotics, social pressures from feedlot clients lead to both more positive attitudes toward, and more frequent recommendations for, the use of antibiotics under several conditions studied. When moral obligations toward treating cattle with antibiotics are less strong, social pressures from both regulating/norm-setting bodies and pharmaceutical companies to use antibiotics in cattle have less of an effect on both attitudes and behaviors. In other words, attitudes toward antibiotic use in cattle are less strong and recommendations to use antibiotics in cattle are less frequent.

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