Economic implications of the Veterinary Feed Directive final rule on conventional and antibiotic-free swine production systems

by

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B.A., University of Minnesota, 2014

A THESIS

Submitted in partial fulfillment of the requirements

for the degree

MASTER OF AGRIBUSINESS

Department of Agricultural Economics

College of Agriculture

KANSAS STATE UNIVERSITY

Manhattan, Kansas

2019

Approved by:

Major Professor
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ABSTRACT

The use of antibiotics in livestock production has been a point of contention since first utilized in 1951. Since then, numerous attempts to better regulate their use have been made. On January 1, 2017, a new Veterinary Feed Directive (VFD) officially went into effect banning the use of medically-important antibiotics in animal production for the purposes of feed efficiency or growth promotion. This paper uses pre- and post-VFD enactment survey data collected from Iowa pork producers and actual financial data from the FINBIN database to predict (pre-enactment) and measure (post-enactment) the immediate economic impact the VFD had on the swine industry. An additional analysis based on previous research evaluates the impacts of changes in feed efficiency and mortality rates, two factors most prominently affected by the removal of antibiotics, on the economic bottom-line for operations. Data from the study suggests that while there were concerns that feed and veterinary costs would increase following the enactment of the VFD, minimal financial impact has been realized to this point. However, the analysis suggests that a broader window following the VFD enactment is likely to show lower profits on a per head basis due to the effects that removal of antibiotics has on key cost of production areas.

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ACKNOWLEDGMENTS

Thank you to Drs. Lee Schulz of Iowa State University and Joleen Hadrich of University of Minnesota for their guidance and support throughout this research. Thank you to Drs. Ted Schroeder and Dustin Pendell of Kansas State University for serving as additional advisors and sitting on the thesis committee. Thank you to the 2019 MAB cohort and faculty and staff of the program, as well as family and friends, for the relentless encouragement throughout the journey.

CHAPTER I: INTRODUCTION

Antibiotics were first approved in 1951 by the Food and Drug Administration (FDA) as feed additives for farm animals. The two primary uses for these additives are purposes of growth promotion and disease prevention (Miller, et al. 2005). According to the Swine 2000 Survey (USDA's Animal and Plant Health and Inspection Service), U.S. pork producers used antimicrobials for growth promotion in 83 percent of starter feeds and 88 percent of grower/finisher feeds. In general, producers can expect to see improved productivity, reduced disease prevalence, increased average daily gain, and decreased feed conversion rates and mortality based on this kind of application (Miller, et al. 2005). These benefits occur as use of antibiotics can help to improve nutrient absorption and depress the growth of organisms competing for nutrients—including those which are known to be disease-causing (McBride, Key and Mathews 2011). Additionally, many operations utilize antibiotics for disease prevention purposes. These can range from general disease prevention to more specialized measures used to prevent respiratory, enteric, and other highly infectious diseases (Liu, Miller and McNamara 2005).

Over the years, increased concern regarding the use of antibiotics important in human medicine for livestock production have mounted. In particular, hog production utilizes many of the same drugs as are applied in human health care (McBride, Key and Mathews 2011), and livestock production in general accounts for approximately 70% of the use of medically important antibiotics sold in the United States. The U.S. is the second highest user of antibiotics in food production, making up nearly 13% of all use (Expert Commission on Addressing the Contribution of Livestock to the Antibiotic Resistance Crisis 2017). Many believe that use of antibiotics in livestock production could result in an

increased incidence of antibiotic-resistant disease strains. In order to combat these fears, changes in regulatory requirements have been imposed on producers and other industry participants in pursuit of public health, stemming from the belief that limiting antibiotic use in production will in-turn limit or decrease the chance for antimicrobial resistance (Miller, et al. 2005).

The largest U.S. regulatory change in recent history was the final rule on Veterinary Feed Directives (VFD) policy, effective October 1, 2015 and with required industry changes by January 1, 2017. The primary purpose of the VFD final rule was to work in conjunction with Guidance for Industry (GFI) documents #209 and #213 to ensure the appropriate use of medically-important antibiotics in food-producing animals by eliminating use of in-feed and in-water treatments for production purposes; requiring all therapeutic use to be under the oversight of a licensed veterinarian; and changing the marketing status of previously over-the-counter (OTC) antibiotics to VFD marketing status which requires veterinary intervention (Food and Drug Administration, Department of Health and Human Services 2015).

Among the changes anticipated from the VFD final rule were increased costs in relation to disease prevention, veterinary care, and time commitments for managing herd health and maintaining required records and documentation (Wynne, et al. 2017). The costs associated with veterinary consults to facilitate the use of feed- or water-based antibiotic treatments will be borne by producers, with small operations likely experiencing higher costs on a per-unit basis. Further, the cost of feed-based antibiotic treatment is likely to rise as feed mills and feed distributors are required to mix and sell medicated feeds in compliance with regulations, while engaging in more stringent record-keeping obligations.

As producers substitute away from medically important antibiotics to unregulated alternatives, prices for these drugs may be driven up by increased demand.

The objective of this research is to analyze the anticipated and actual economic and managerial impacts of the VFD final rule on major participants in the Iowa swine industry, including: independent producers, contract producers, integrators, nutritionists, and veterinarians. Impacts were measured during two enumerated interview time periods: summer and fall of 2016 (pre-enactment); and summer and fall of 2017 (post-enactment). Iowa was selected as the case study area as it is the largest swine production state, accounting for over 30% of the total hog inventory and sales on average (National Agricultural Statistics Service (NASS) 2018).

Due to the timing of the enactment of GFI #213, this is among the first studies seeking to measure the economic impacts of the new VFD on swine producers. This research is significant as changes in production practices, such as a reduction in the type or amount of antibiotics used and whether they are used for prevention or treatment of disease, could have major implications for the industry. These changes could result in changes to total production, and in-turn, affect consumer meat prices. Data collected and analyzed from this 2016 through 2017 time period will be valuable in gauging the impact of the FDA policy changes and should provide insight for further policy discussions. In addition, a clearer understanding of the impacts these changes had on swine producers and other industry participants will assist Extension educators and other outreach-based organizations in guiding producers in decision-making for their operations.

CHAPTER II: LITERATURE REVIEW

2.1 Background

Antibiotics have been used in livestock production for decades, with nearly 89% of livestock producers reporting use of antibiotics on their operations as of 2000 (Miller, et al. 2005). Although used widely across the livestock industry, antibiotics are most commonly used in swine and poultry production. Antibiotics can be administered in three levels: subtherapeutic, used for growth promotion, reduced mortality and morbidity, and improved reproductive performance; intermediate levels, for disease prevention; and high levels, to treat disease (Cromwell 2002). Growth promotion refers to the use of antibiotics for increased rate of weight gain or feed efficiency; disease prevention is the administration of an antimicrobial drug to animals not exhibiting clinical symptoms where a disease is likely to occur (U.S. Department of Health and Human Services 2012). Both antibiotic use cases have important economic implications for swine producers as improved productivity (through increased average daily gain or lower feed conversion ratios) and decreased disease prevalence and mortality (Miller, et al. 2005) directly effect a producer's bottom line. At the same time, is it important to note that all uses of antibiotics can promote resistance, and it is believed that regardless of purpose, the higher the use, the more resistance will emerge and spread (Expert Commission on Addressing the Contribution of Livestock to the Antibiotic Resistance Crisis 2017).

Use of antibiotics in swine production can vary based on operation type or business arrangement. A 2004 study by McBride et al. found that the most common use of antibiotics among swine producers was for disease prevention purposes, especially for nursery-aged pigs. Antibiotics were most commonly used for growth promotion purposes in finishing hogs, and weaned pigs received antibiotics for treatment purposes more than

animals at any other life stage. Operations that encompassed more life stages administered antibiotics for dual purposes at higher rates per life stage. For example, nursery pigs on a farrow-to-finish operation were more likely to receive antibiotics for both growth promotion and disease prevention than nursery pigs on a farrow-to-feeder operation (McBride, Key and Mathews 2011). Antibiotics were most effective in improving growth in young pigs. For disease prevention purposes, they were most beneficial in young pigs, pigs with a high disease load, and on operations where facilities were generally "dirtier" (Cromwell 2002).

The effectiveness of some antibiotics is dependent on the method by which they are provided to an animal: in-feed, in-water, or by injection. Approximately 95% of the antibiotics approved for and used in food-producing animals in the U.S. are sold as feed or water additives, and are generally administered to large groups or full herds. Although this can no longer be done for growth-promoting purposes under the revised VFD, similar administration is used to prevent disease. There are few limitations on the duration of use in such application, which is believed to contribute in similar ways to the development of antibiotic-resistant disease strains (Expert Commission on Addressing the Contribution of Livestock to the Antibiotic Resistance Crisis 2017).

2.2 History

On October 9, 1996, President Bill Clinton signed the Animal Drug Availability Act (ADAA) into effect as an amendment to the Food, Drug and Cosmetic Act of 1938 that had increased the controls that governed the production and dissemination of food and drugs into the consumer market. This new act provided additional flexibility to the way that the Food and Drug Administration (FDA) regulated the use of new animal drugs and medicated feeds in food-animal production. One of the key changes that occurred as a

result of the ADAA was the addition of a new category of drugs labeled as "Veterinary Feed Directive Drugs" (VFD drugs). This category covered all new drugs that would be used in or on animal feeds, either through approved application, conditionally approved application, or index listings under the professional supervision of a licensed veterinarian (Food and Drug Administration, HHS. 2015).

In response to nearly four decades of concern regarding the impacts that use of antimicrobial drugs in food-animal production may have on the human-consumer industry, the FDA released GFI #152 that stated: "The FDA believes that human exposure through the ingestion of antimicrobial resistant bacteria from animal-derived foods represents the most significant pathway for human exposure to bacteria that have emerged or been selected as a consequence of antimicrobial drug use in animals" (U.S. Department of Health and Human Services 2003).

In April 2012, the FDA finalized the first of a series of additional guidance documents that would impact the use of medically important antibiotics in animal production, GFI #209. The framework for GFI #209 was founded largely on the scientific research presented in GFI #152. Its primary purpose was to address public concern for the development of antimicrobial resistance as it is related to the use of medically important antibiotics in food-animal production by outlining recommendations that would attempt to minimize the development of antimicrobial resistance. These recommendations were to limit medically important antimicrobial drugs to uses in animals that are considered necessary for assuring animal health; and to limit medically important antimicrobial drugs to uses in animals that include veterinary oversight or consultation (U.S. Department of Health and Human Services 2012).

Following industry-wide discussion and further research on the part of the FDA, GFI #213 was issued in December 2013. This next GFI installment sought to provide guidance to new animal drug sponsors, veterinarians, and producers on the requirements for voluntary phase-in of changes anticipated in VFD regulation specifically related to the marketing status of medicated feed and water products from over-the-counter (OTC) to prescription (Rx). The GFI outlined the steps for a three-year phase-in period, intended to help those involved in the industry prepare themselves for changes in management/business practices, required labeling adjustments, etc. (U.S. Department of Health and Human Services 2013).

2.3 Industry responsibilities

The entire livestock industry has been impacted by the regulatory changes surrounding the enactment of the VFD final rule. Along with that, each industry participant has key responsibilities associated with the new rules. The responsibilities for veterinarians and producers are summarized in Veterinary Feed Directive Brochures from the USDA (U.S. Food and Drug Administration 2018).

Veterinarian responsibilities:

- must be licensed to practice veterinary medicine;
- must be operating in the course of the veterinarian's professional practice and in compliance with all applicable veterinary licensing and practice requirements;
- must write VFD orders in the context of a valid client-patient-relationship (VCPR);
- must issue a VFD that is in compliance with the conditions for use approved, conditionally approved, or indexed for the VFD drug or combination VFD drug;
- must prepare and sign a written VFD providing all required information;

- may enter additional discretionary information to more specifically identify the animals to be treated/fed the VFD feed;
- must include required information when a VFD drug is authorized for use in a drug combination that includes more than one VFD drug;
- must restrict or allow the use of the VFD drug in combination with one or more OTC drug(s);
- must provide the feed distributor with a copy of the VFD;
- must provide the client with a copy of the VFD order;
- must retain the original VFD for 2 years, and
- must provide VFD orders for inspection and copying by FDA upon request.

Producer responsibilities (as a veterinary client):

- only feed animal feed bearing or containing a VFD drug or a combination VFD drug (a VFD feed or combination VFD feed) to animals based on a VFD issued by a licensed veterinarian;
- not feed a VFD feed or combination VFD feed to animals after the expiration date on the VFD;
- provide a copy of the VFD order to the feed distributor if the issuing veterinarian sends the distributor's copy of the VFD through you, the client; and
- maintain a copy of the VFD order for a minimum of 2 years; and provide VFD orders for inspection and copying by FDA upon request.

2.4 Preparations

In January 2016, Farm Foundation released a report that outlined the results of 12 pre-enactment educational workshops designed to provide livestock producers, feed

suppliers, veterinarians and support service organizations with information related to the new VFD policies. Key findings included:

- There is low-level awareness of the implications of VFD policy changes among livestock producers, specifically those with small- to medium-sized operations.
- Farmers and ranchers anticipated increased costs and additional paperwork to be seen as the greatest impacts of the new regulations.
- Greater impacts will be felt by small producers versus those involved in integrated supply chains. Those who are integrated are more likely to have existing familiarity with the newly required documents and easier access to medicated feeds and veterinarians.
- Small producers are less likely to have the necessary established relationships with a veterinarian that will be needed to obtain Veterinary Client Patient Relationship (VCPR) documents.
- Relationships with veterinarians are expected to change as producers have greater reliance on their services for prevention and treatment of food-producing animals.

The Farm Foundation report found that 32% of livestock producers had made no preparations for the updated regulations. Sixty-eight percent of respondents had taken some step toward preparing for the new VFD policy, but only 5% had actually implemented any changes in their operation as of the interview date.

The Farm Foundation study also found that a lack of education and an increase in the time spent record-keeping were among the greatest concerns producers had regarding the impending changes. These producers feared that these issues would impact their ability to be in compliance with the revised rules.

Despite concerns outlined in the Farm Foundation study, the Veterinary Feed Directive Final Regulatory Impact Analysis released on June 3, 2015 estimated that producers would only spend one half-hour to research and familiarize themselves with the revised VFD requirements (Food and Drug Administration, Department of Health and Human Services n.d.). Additionally, total record-keeping time for producers, veterinarians, and feed manufacturers was expected to decrease nearly 50% from current practices—contrary to concerns of the need for increased record-keeping capacity. The analysis also suggested that the overall purpose of the final rule was to ease the burden and increase efficiency of the VFD process by creating greater flexibility through revised VCPR and VFD form requirements. The estimated one-time costs to industry from this final rule are $1,411,000, most of which are simply costs to review the rule and prepare a compliance plan (Food and Drug Administration, Department of Human Services n.d.).

2.5 Initial estimates

A 2000 study published by Oklahoma State University in conjunction with Pork Checkoff estimated that the removal of antibiotics for growth promoting purposes would yield an increase in the cost of production to hog producers by approximately $2.88 per head, or 2.32%. Miller et al. conducted a similar study in 2005, and found that a ban on antibiotics for growth-promoting purposes would decrease average daily gain enough to cause a loss of $1,400 in profits per 1,020 head barn—or a cost of approximately $1.37 per head. These results align with the estimate from Liu et al. in 2005, suggesting that use of antibiotics for growth promotion purposes increases average daily gain and decreases variability in live weights enough to increase producer profits by $2.99 per market hog. Estimates based on the USDA Agricultural Resource Management Survey,

analyzed by Sneeringer et al. (2015), suggest that producers using antibiotics in subtherapeutic settings will experience production cost increases of 1–2% if their access to antibiotics is restricted.

A major limitation of all four studies was that they only took into account the removal of antibiotics as a growth promotant. The revised VFD disallows use for growth promotion, but also limits the ability to use medically-important antibiotics as a method for disease prevention or treatment by removing many of the OTC drugs previously available. Under the revised VFD, producers have access to many disease-preventing drugs only under veterinary oversight. This change further impacts the industry, and would therefore be expected to yield an even greater increase in production cost per hog. Additionally, many producers have already decreased or discontinued antibiotic use for growth promotion or feed efficiency in preparation for the impending regulatory changes (Schulz and Rademacher 2017). Measures related specifically to the impacts of limited use of antibiotics for prevention and treatment on herd health and management is an area in need of additional research.

CHAPTER III: METHODOLOGY

3.1 Methods

The USDA collects data on farm-level use of antibiotics through voluntary farm surveys collected just once every five to seven years. These surveys are limited in that questions are not necessarily consistent from one survey to the next, and their collection is voluntary and therefore not considered comprehensive (Expert Commission on Addressing the Contribution of Livestock to the Antibiotic Resistance Crisis 2017). Due to these factors as well as the recent enforcement date of the protocol outlined in the VFD final rule and GFIs #209 and #213, no initial data existed regarding the anticipated and actual impacts of the revised VFD on the swine industry. For this reason, a survey was developed to meet the needs of this research. Funding for these surveys was provided by the Economic Research Service through USDA/ERS Cooperative Agreement # 58-6000-6-0064, entitled Economic Effects of Changing Antibiotic Use Preferences in US Livestock Production.

Two separate interviews were conducted over the course of a one year period that encompassed the pre- (summer and fall 2016) and post-enactment (summer and fall 2017) timeframes of the VFD final rule. Pre- and post-enactment interviews mirrored one another. The pre-enactment interview asked questions regarding the participant's operation or business, followed by what types of business and management changes were anticipated following VFD enactment. The post-enactment interview addressed the same basic details followed by what types of changes had actually occurred during the first year of active regulation. The interview questionnaires are provided in Appendices A and B.

Interview participants were selected by Iowa State University (ISU) Extension Swine Specialists based on a number of criteria. These included active participation in swine production, and a working relationship with ISU Swine Extension to help ensure thoughtful and accurate responses representative of each sector. Interviews were conducted over the phone or in-person by ISU Extension Swine Specialists.

3.2 Participants

Five participant groups were interviewed including: independent producers, contract producers, integrators, nutritionists, and veterinarians. For producers, interview questionnaires were tailored based on business management as defined by the U.S. Census of Agriculture (Table 3.1). Nutritionists and veterinarians were also separately interviewed because the FDA was relying on stakeholder (producers, drug companies, veterinarians, and feed milling sector) collaboration, and there were significant efforts made by these groups to cooperatively implement the new antibiotic use guidelines.

Table 3.1: Prevalence of swine operation business arrangement in Iowa, measured as percent of total operations and percent of hog and pig sales (head) based on 2002, 2007, and 2012 Census of Agriculture

	2002		2007		2012	
Type	**Ops**	**Sales**	**Ops**	**Sales**	**Ops**	**Sales**
Independent producer	69.5%	49.7%	63.9%	47.8%	53.7%	47.0%
Contract producer	27.8%	39.3%	33.6%	45.0%	45.5%	46.1%
Integrator	2.7%	11.0%	2.4%	7.3%	0.8%	7.0%

Independent producers accounted for 57.8% (pre) and 65.2% (post) of the interview sample compared to the 53.7% reported in the 2012 U.S. Census of Agriculture. Contract producers make up 35.6% and 30.4% of the sample while 6.7% and 4.3% are integrators. In the 2012 Census, 45.5% of operations were contract growers and .8% were integrators.

As such, the interview sample provides a representative cross section of the Iowa swine industry.

Table 3.2: Number of swine participants in pre- and post-enactment VFD interview data, by participant type, 2016-2017

	No. of Participants	
Participant group	**Pre**	**Post**
Independent producer	26	15
Contract producer	16	7
Integrator	3	1
Nutritionist	8	7
Veterinarian	8	6
Total	61	36

These operation types are all part of the pork production system, and operation type can have a significant impact on the way that these businesses are managed. Interview participants were asked to identify their production set-up in order to better understand the context behind their operational decisions.

Table 3.3: Number of swine producers who identified specific production set-up in pre- and post-enactment VFD interview data

	No. of Respondents		Percent Respondents	
Type	**Pre**	**Post**	**Pre**	**Post**
Farrow-to-finish	14	8	33.3	36.4
Wean-to-finish	17	9	40.5	40.9
Feeder-to-finish	10	4	24.0	18.2
Other	1	1	2.4	4.6
Total	42	22		

Table 3.4: Prevalence of production set-up in Iowa, measured as percent of total operations of associated types based on 2012 Census of Agriculture

Type	**No. of Operations**	**% of Operations**
Farrow-to-feeder	226	2.2
Farrow-to-finish	2,566	24.6
Farrow-to-wean	418	4.0
Finishing	7,216	69.2
Total	10426	

The operation types in our sample are farrow-to-finish (33.3 and 36.4%), wean-to-finish (40.5 and 40.9%), feeder-to-finish (24.0 and 18.2%) compared to the Census breakdowns of farrow-to-feeder (3.4%), farrow-to-finish (33%), farrow-to-wean (4.4%) and finishing only (59.2%) (Tables 3.3, 3.4). USDA Defines these operation types as follows (National Agricultural Statistics Service 2009):

1) Nursery/farrow-to-nursery – farm specializes in breeding and early development, selling off feeder pigs when they reach 40-50lbs
2) Farrow-to-wean – farm specializes in breeding and early development, selling off weanling piglets
3) Farrow-to-feeder – farm specializes in breeding and raising newborn pigs until feeder size at 40-50lbs
4) Farrow-to-finish – farm managers all stages of growth and development, from breeding to market
5) Finishing – farm specializes in feeding pigs from other operations to market weight and selling for slaughter; this type does not manage any breeding stock

Each interview participant received a numeric identifier during the initial data collection period in which they participated. This identifier was used to match their pre- and post-enactment responses. Maintaining a consistent identification across both made it possible to more precisely compare preparation and anticipated impacts with how the VFD actually impacted the operations and what adjustments had to be made to be in compliance. It should be noted that not all participants were recorded in both pre- and post-enactment windows due to lack of response in the post-enactment, or reports that little change had occurred from the pre-enactment window.

3.3 Interview structure and data coding

Interview questions were broken down into three primary categories, identified below:

1) Current practices regarding the operation/business
2) Anticipated changes at the operation/business due to FDA guidances (e.g., new VFD regulations) (pre); Actual changes at the operation/business due to FDA guidances (post)
3) Raised Without Antibiotic (RWA) production/practices

Sub-sets of questions following each of these three categories varied depending on the type of participant involved.

All questions were open-ended, allowing respondents to elaborate as much as necessary to fully answer the question as it pertained to their own practices. Because responses were open-ended, all answers were formally coded as yes/no or numeric responses with further detail as applicable during the analysis stage in order to standardize and quantify interview responses. Additionally, some response totals will add up to more than 100% since respondents could answer in multiple ways.

CHAPTER IV: ANALYSIS

As discussed in Chapter III, interview participants were categorized into five distinct groups: independent producers, contract producers, integrators, nutritionists, and veterinarians. A summary of the results from each group are presented here:

4.1 Independent producers

Independent producers have the most autonomy among business arrangements. These producers generally own all inputs involved in raising their stock, as well as the stock itself, and make the decisions about when and where their stock will be marketed (Gillespie and Eidman 1998). Independent producers represent an average of about 54% of all hog operations in Iowa, and accounted for approximately 58% of pre-interview producer respondents, and 65% of post-interview producer respondents.

4.1.1 Current practices regarding the operation/business for independent producers

Operation size varied greatly. Two operations carried an inventory of over 100,000 hogs, while the average among other operations was just 7,183[1]. No significant changes to operation size occurred between the pre- and post-enactment interview data.

Of the independent producers interviewed, over half operated farrow-to-finish operations, another 38% specialized in wean-to-finish, and roughly 4% were feeder-to-finish (Table 4.1). One respondent operated a split production system, with approximately half of their operation being farrow-to-wean, and the other half being farrow-to-finish. Once again, no significant changes occurred to the operation system between the pre- and post-enactment interviews.

[1] This number was calculated by dropping the two outlying operations whose annual inventory exceeded 100,000 hogs.

Table 4.1: Independent producers by operation specialty, pre- and post-VFD interview

	No. of Respondents		Percent Respondents		Avg Inventory (Head)	
Type	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Farrow-to-finish	14	8	53.9	53.3	23,458	12,820
Wean-to-finish	10	6	38.5	40.0	3,633	3,153
Feeder-to-finish	1	0	3.9	0.0	1,150	0
Other	1	1	3.9	06.7	7,500	7,500

For the wean-to-finish and feeder-to-finish operations, some additional sourcing of pigs occurred primarily from out-of-state producers, company connections, and cooperatives.

Independent producers were asked to identify what the most common and/or problematic disease at their operation was, both pre- and post-enactment. The results between the two interview time periods remained mostly consistent, with porcine reproductive and respiratory syndrome (PRRS), influenza (varied strains), and porcine epidemic diarrhea virus (PEDV) being the most common in the pre-interview data; and PRRS, influenza, PED, strep (varied strains), and porcine enteropathy (PE)/ileitis being the most problematic in the post-enactment interview.

Table 4.2: Most common/problematic diseases reported by independent producers, pre- and post-VFD interviews

	No. of Respondents		Percent Respondents	
Disease	**Pre**	**Post**	**Pre**	**Post**
APP	1	0	3.9	0.0
Dysentery	1	0	3.9	0.0
E.coli	3	1	11.5	6.7
Enteric diseases	1	0	3.9	0.0
Glassers	4	3	15.4	20.0
Ileitis	4	4	15.4	26.7
Influenza	8	4	30.8	26.7
Lameness	2	0	7.7	0.0
Misc. respiratory	1	0	3.9	0.0
Mycoplasma	2	0	7.7	0.0
PED	6	4	23.1	26.7
Pneumonia	2	1	7.7	6.7
PRRS	11	4	42.3	26.7
Roto virus	2	1	7.7	6.7
Scours	5	2	19.2	13.3
Strep	5	4	19.2	26.7

After identifying the most problematic or common disease in their operation, participants were asked to discuss how they most commonly treated diseases. Over half of all respondents said that they treated with either vaccines or injections. Another 72% used either medicated feeds or medicated water to address larger herd issues (Table 4.3). Although vaccines are generally used to prevent disease and injectable antibiotics are administered for treatment, the numbers listed reflect how respondents reported that they treated prevalent diseases.

Throughout the remainder of this analysis, one of the most challenging topics yet to be addressed is the distinction between prevention and treatment. No standard definition issued by the USDA or FDA, or other literature could be located defining the key differences between the two. This left them largely open to interpretation. In general, many

regard prevention as the measures taken to ensure that disease development does not occur; treatment would be used to eradicate the disease or manage its symptoms once it appeared. However, in herd-based situations where one animal becomes sick, how do you distinguish between the two? One could argue that you would administer medicine to treat the single animal, but it is likely that you would provide herd-based prevention measures to the rest of the exposed animals as well. In this scenario, do you report use as preventative, treatment, or a combination of the two?

This interpretation will be important in tracking use of antibiotics over time, and will need to be defined by a regulatory body going forward. For the purpose of this research, many questions regarded how antibiotics were used specifically in relation to prevention practices. This means some data was manually scrubbed during the coding process to ensure consistency. For example, if a producer was asked whether they use in-feed, in-water, or injectable antibiotics for prevention purposes and they responded that they use it for treatment purposes, their response was counted as an N/A response versus a yes or no. In cases where this interpretation was different, it has been noted. Although this provides consistency throughout this paper, it also brings into question how and why producers may be interpreting or understanding the difference between the two methods—or if they believe there is a difference at all. This further supports the need for a clearer distinction to be made in this area.

Without a more concrete distinction between prevention and treatment, it is difficult to discern in this scenario whether respondents actually used injections and vaccinations in the ways listed, or whether this was a problem with interpretation on either the part of the interviewee, or during the data cleaning process.

Table 4.3: Most common treatment method for problematic diseases reported by independent producers in pre- and post-VFD interviews

	No. of Respondents		Percent Respondents	
Treatment	**Pre**	**Post**	**Pre**	**Post**
Biosecurity increase	2	1	7.7	6.7
Depends	4	2	15.4	13.3
Diet changes	2	1	7.7	6.7
Increased husbandry	5	2	19.2	13.3
Injections/vaccinations	15	8	57.7	53.3
Management changes	5	2	19.2	13.3
Medicated feed	8	4	30.8	26.7
Medicated water	11	7	42.3	46.7
Natural solutions	1	0	3.9	0.0
Sanitation increase	2	1	7.7	6.7

For those producers who said that treatment was dependent on some other factor, this was often the severity of the infection, or the stage of production that an individual hog was in when disease struck.

Nearly 90% of pre- and 75% of post-interview respondents said that they separate animals based on disease status. In most cases, this involved use of a sick pen, or another form of cull or recovery area for pigs that fell behind due to illness.

Independent producers were also asked how they decide whether to treat an entire pen/barn versus individual animals. Over half of pre- and post-interview answers suggested that this was dependent on a combination of things, including: the type of disease in question, its historic patterns within their operation, and/or probability of spread and ultimately impact to their bottom-line.

Table 4.4: Determining factor for treating whole pen/barn versus individual treatment as reported by independent producers, pre- and post-VFD interviews

	No. of Respondents		Percent Respondents	
Determining factor	**Pre**	**Post**	**Pre**	**Post**
Depends	16	9	61.5	60.0
Exams/veterinarian	2	2	7.7	13.3
Percent sick	8	5	30.8	33.3
Severity	7	2	26.9	13.3
Stage/weight	1	0	3.9	0.0
Timing	1	0	3.9	0.0

Although eliminating the use of medically-important antibiotics for growth promotion purposes was the primary focus of the VFD final rule, interview data suggested that only 35% of independent producers in Iowa were using antibiotics for growth promotion or feed efficiency prior to December 2016. Those who were using antibiotics for this purpose indicated that it helped to lower feed cost and death loss, which results in increased overall return. Over a third of the producers who reported that they did not use antibiotics for growth promotion or feed efficiency purposes cited the ability to collect a market premium for not using antibiotics as a driver behind their decision to avoid them. This is consistent with USDA's Agricultural Marketing Service report, National Weekly Direct Swine Non-Carcass Merit Premium (LM_HG250) which has an OTHER category that includes premiums for antibiotic free.

It is important to note that while antibiotic use for growth promotion and feed efficiency are no longer allowable under GFI #213, the guidance states that, "…FDA considers uses that are associated with the treatment, control, and prevention of specific diseases to be therapeutic uses that are necessary for assuring the health of food-producing animals." (U.S. Department of Health and Human Services 2013) Because of this, much of the disease portion of interviews focused on use of in-feed (Tables 4.5, 4.6), in-water

(Tables 4.7, 4.8), and injectable antibiotics (Tables 4.9, 4.10) as a means of preventing disease. For questions regarding what diseases producers are seeking to prevent through use of antibiotics in varying forms, number of respondents refers only to those who answered in the affirmative regarding use, and percent of respondents takes into account these numbers as a percent of affirmative responses rather than the total interview population.

Table 4.5: Use of in-feed antibiotics to prevent disease as reported by independent producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Use	**Pre**	**Post**	**Pre**	**Post**
Yes	20	6	76.9	40.0
No	6	9	23.1	60.0

Use of in-feed antibiotics for disease prevention dropped significantly from the pre- to post-enactment interviews. Because hogs are usually fed by pen, it can be difficult to take individual measures of prevention for at-risk animals without treating the entire group that they reside with. Since many producers are trying to move from prevention to treatment as needed in response to the changes in antibiotic-use guidelines, it is possible that this contributed to the reduction of in-feed prevention measures.

Table 4.6: Primary diseases prevented through use of in-feed antibiotics as reported by independent producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Disease	**Pre**	**Post**	**Pre**	**Post**
APP	1	0	5.0	0.0
Dysentery	1	0	5.0	0.0
Enteric diseases	2	1	10.0	16.7
Glassers	1	0	5.0	0.0
Ileitis	9	4	45.0	66.7
Influenza	3	2	15.0	33.3
Misc. respiratory	3	1	15.0	16.7
Mycoplasma	2	0	10.0	0.0
Pasturella	1	0	5.0	0.0
Pneumonia	2	1	10.0	16.7
PRRS	1	1	5.0	16.7
Salmonella	1	0	5.0	0.0
Scours	4	1	20.0	16.7
Strep	3	0	15.0	0.0
Uterine infection	1	1	05.0	16.7

Ileitis and influenza remained among the most common diseases prevented by use of in-feed antibiotics during the pre- and post-enactment interviews. Enteric diseases, miscellaneous respiratory, pneumonia, and PRRS saw increased preventative measures in the post-enactment interviews.

Table 4.7: Use of in-water antibiotics to prevent disease as reported by independent producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Use	**Pre**	**Post**	**Pre**	**Post**
Yes	15	9	57.7	60.0
No	11	6	42.31	40.0

In contrast to a decrease in use of in-feed antibiotics for disease prevention, the incidence of in-water use of antibiotics for disease prevention saw a reported increase relative to the number of respondents in the post-enactment interviews. This is likely

because water-based prevention is easier to administer, quicker to take effect, and carries a lower cost once the infrastructure (water lines, controls, etc., for facilities) are established (Marco 2012). These factors would allow for a more effective way at providing prevention to a herd or a subset of the herd while limiting total length of exposure to antibiotics.

Table 4.8: Primary diseases prevented through use of in-water antibiotics as reported by independent producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Disease	**Pre**	**Post**	**Pre**	**Post**
APP	2	0	13.3	0.0
Dysentery	1	0	6.7	0.0
E.coli	1	0	6.7	0.0
Enteric pressure	1	1	6.7	11.1
Glassers	1	0	6.7	0.0
Ileitis	2	1	13.3	11.1
Influenza	3	2	20.0	22.2
Misc. respiratory	2	1	13.3	11.1
Mycoplasma	3	0	20.0	0.0
Pneumonia	1	0	6.7	0.0
Roto virus	1	1	6.7	11.1
Scours	4	4	26.7	44.4
Strep	5	1	33.3	11.1

Ileitis and influenza both appear among some of the top diseases prevented through in-water measures in addition to in-feed. However, in-water prevention also appears to target GI related illnesses such as scours (diarrhea) and enteric pressures, specifically in the post-enactment period.

Table 4.9: Use of injectable antibiotics to prevent disease as reported by independent producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Use	**Pre**	**Post**	**Pre**	**Post**
Yes	11	9	42.31	60.0
No	15	6	57.69	40.0

Similar to in-water prevention measures, an increase in the use of injectable antibiotics for prevention was reported in the post-enactment interview (Table 4.9). The benefit of injections is that they can be used on individual animals rather than at the pen or herd level.

Table 4.10: Primary diseases prevented through use of injectable antibiotics as reported by independent producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Disease	**Pre**	**Post**	**Pre**	**Post**
E.coli	1	0	9.1	00.0
Enteric	2	2	18.2	22.2
Flu	0	1	0.0	11.1
Ileitis	3	1	27.3	11.1
Misc. respiratory	2	1	18.2	11.1
Mycoplasma	0	1	0.0	11.1
Scours	1	0	9.1	00.0
Strep	2	2	18.2	22.2

Once again, ileitis, influenza, and enteric diseases are the most likely to be targeted for prevention using injectable antibiotics. Injections also appear to be used in higher incidence for prevention of strep.

In most cases, the primary diseases that producers are seeking to prevent through use of in-feed, in-water, or injectable antibiotics align closely with those diseases earlier reported as being the most common or problematic within an operation (Tables 4.6, 4.8, 4.10). Although judicious use of antibiotics is permitted under the VFD final rule, it is interesting to note that total use of preventative antibiotics dropped from the pre- to post-enactment time period in all three forms of administration. Additionally, the total antibiotic use dropped from approximately 81% of independent producers using at least one method of use in the pre-enactment interview to just 75% in the post-enactment interview (Table 4.11). Based on the

limited sample size, it is likely that these values are sample dependent. Additionally, the lack of clear distinction between the terms "treatment" and "prevention" may have led some survey respondents to provide answers that conflict with their actual antibiotic practices.

Table 4.11: Number of methods of preventative use antibiotics as reported by independent producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
No. of methods	**Pre**	**Post**	**Pre**	**Post**
None	5	4	0.1923	0.2500
One method	4	1	0.1538	0.0625
Two methods	9	4	0.3462	0.2500
Three methods	8	7	0.3077	0.4375
Total use	21	12	0.8077	0.7500

Both prior to and following the January 1, 2017 enactment date, about 35% of independent producers were using non-antibiotic feed additives as way to help with growth promotion and feed efficiency. Paylean was the most commonly used additive, with a series of natural remedies (such as essential oils, spices, etc.) as a close second. As anticipated, overall use of non-antibiotic feed additives dropped in the post-enactment interview responses.

When interviewed during pre- and post-enactment, all respondents reported having an existing relationship with a veterinarian. In over 60% of cases, independent producers relied on oversight of a local large animal veterinarian rather than any other classification. Respondents cited disease prevention (80%) and disease treatment (70%) as the primary reasons for maintaining a relationship with a veterinarian. Overall, communication between independent producers and their veterinarians increased from the pre- to post-enactment period, with "as needed" communication seeing the largest increase (Table 4.12). The increased communication, specifically on an as-needed basis, is most likely to be the result

of needing a VCPR for each individual treatment measures prescribed by the veterinarian for each instance in which they occur. This differs from the pre-enactment period in that producers could historically administer their own antibiotics or work under the oversight of a health representative without having a VCPR.

Table 4.12: Frequency of communication with veterinarian as reported by independent producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Frequency	**Pre**	**Post**	**Pre**	**Post**
As needed	10	8	38.5	53.3
Monthly	5	3	19.2	20.0
Rarely/not at all	2	1	7.7	6.7
Several times a week	2	1	7.7	6.7
Several times a year	7	5	26.9	33.3
Weekly	5	3	19.2	20.0

4.1.2 Anticipated changes at the operation/business due to FDA guidances for independent producers (pre); Actual changes at the operation/business due to FDA guidances for independent producers (post)

Overall, only 4% of interviewed independent producers anticipated the VCPR requirements to be burdensome to their operations. These producers cited additional time and costs related to disease management (through VCPRs, additional veterinarian visits, etc.) as the primary reason for concern leading up to the final rule going into effect. For the post-enactment interviews, even those few producers who were worried about the changes said that it had ultimately not had much impact on their management practices and if anything, had only increased the frequency with which they communicated with their veterinarian.

During the pre-enactment interview, over 70% of independent producers reported that they anticipated the new requirements to increase their costs. Of those who expected to

see increased costs, only 21% felt those increases would be significant. When reporting on the post-enactment changes, half of respondents said costs had increased, while half said they had not. Close to 90% of interviewed independent producers who reported a cost increase said it had been minimal, while the other 11% were unsure of the total financial impact over the first year.

With respect to the impact on cost of production, 77% of independent producers anticipated the time spent on record-keeping to increase with the new regulations. Of these producers, 60% expected minimal increase, and 25% thought the added time would be significant. Once again, the post-enactment interview data suggests that changes were less drastic than originally assumed, with 67% of producers reporting an increase in the amount of time spent record-keeping, but 90% of those respondents saying that the increase was minimal (Table 4.13).

Table 4.13: Anticipated and actual financial impacts of VFD regulation on independent producers, pre- and post-VFD interview[2]

	No. of Respondents		Percent Respondents	
Increase costs	**Pre**	**Post**	**Pre**	**Post**
Yes	19	9	73.1	60.0
No	6	6	23.1	40.0
Unsure	1	0	3.9	0.0
Minimally	12	8	63.2	88.9
Significantly	4	0	21.1	0.0
Unsure	3	1	15.8	11.1

In addition to prevention through the above outlined methods, independent producers were asked to identify any other measures that they used to keep stock healthy in preparation for regulation changes. Almost 90% of those interviewed reported using some additional

[2] The impact percentages were calculated using only those respondents who answered yes to the initial question regarding whether or not increased costs were expected.

form of biosecurity, often encompassing a number of additional components. These measures remained consistent between the interviews, with a slight increases in general husbandry and cleanliness of facilities in the post-enactment responses (Table 4.14). These measures all add to the management time of the operation, however they serve to decrease total cost as cleaner facilities and more attention to care are likely to yield a lower incidence of sick or infected animals.

Table 4.14: Additional measures taken to ensure animal health and safety as reported by independent producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Measure	**Pre**	**Post**	**Pre**	**Post**
All-in-all-out (ALL-IN ALL-OUT) production	3	3	11.5	20.0
Biosecurity	23	13	88.5	86.7
Care in regards to new/moving stock	2	2	7.7	13.3
Clean facilities	15	9	57.7	60.0
Controlled stocking density	1	0	3.9	0.0
Husbandry	5	4	19.2	26.7
Limited access	10	5	38.5	33.3
On-farm feed production	2	2	7.7	13.3
Temp control	2	1	7.7	6.7
Vaccination	5	4	19.2	26.7
Ventilation	8	5	30.8	33.3
Winterizing	1	0	3.9	0.0

4.1.3 Raised without antibiotic (RWA) production/practices for independent producers

Of the independent producers interviewed, less than 30% reported raising animals without antibiotics. These producers were raising a minimum of 95% of their herd as RWA, and those few hogs that were not RWA were only those which had to be treated for disease at some point during their development.

Conversion to RWA production, where it applied, was primarily due to the ability to receive market premiums on RWA stock—though 60% of the producers who were RWA production started their business under this production style. Those who had converted said that the most challenging part of the conversion process was finding a way to keep pigs healthy, which meant trying to identify signs of illness earlier and following stricter biosecurity practices overall. Both of these required more time on the part of the producer and their labor force, as well as more diligent surveillance over the herd for signs of illness or disease so that sorting could occur to prevent further spread.

4.2 Contract producers

Contract producers generally own the production facilities, provide all labor, and oversee all management within the operation, but they do so under the contractual obligation of a larger company or integrator (Gillespie and Eidman 1998). This additional entity owns the hogs, provides feed, veterinary services, and directions for care, among other factors. Under this type of business arrangement, contract producers may receive incentive bonuses for greater feed efficiency, better market weights, or more sow productivity. They may also operate under a standard agreement without the benefit of such bonuses (Jackson and Marx 2016). Contract producers comprise approximately 36% of the operations in Iowa on average based on the 2012 Census of Agriculture, and represented 36% and 30% of pre- and post-enactment interview responses, respectively.

4.2.1 Current practices regarding the operation/business for contract producers

Interviews respondents reported an average inventory of approximately 5,000 hogs in the pre-enactment interview and 5,100 hogs in the post-enactment interview data.

Operations represented close to 50/50 wean-to-finish and feeder-to-finish, with a slightly higher representation for feeder-to-finish (Table 4.15). One operation reported a transition from wean-to-finish to feeder-to-finish production following the final rule enactment in an attempt to reduce antibiotic use in their herd.

Table 4.15: Contract producers by operation specialty, pre- and post-VFD interview

	No. of Respondents		Percent Respondents		Avg Inventory (head)	
Type	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Wean-to-finish	7	3	43.8	42.9	7007	7100
Feeder-to-finish	9	4	56.3	57.1	5084	4334

The most common and/or problematic diseases reported by contract producers were influenza (varied strains), pneumonia, ileitis, and PRRS in the pre-enactment interview. Increased incidence of pneumonia and PRRS were reported when the post-enactment interviews took place (Table 4.16).

Table 4.16: Most common/problematic diseases seen by contract producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Disease	**Pre**	**Post**	**Pre**	**Post**
APP	1	1	6.3	14.3
Circo virus	2	1	12.5	14.3
E.coli	1	0	6.3	0.0
Hemorrhagic bowl	4	1	25.0	14.3
Ileitis	5	2	31.3	28.6
Influenza	6	1	37.5	14.3
Misc. respiratory	4	2	25.0	28.6
Mycoplasma	4	1	25.0	14.3
PED	2	1	12.5	14.3
Pneumonia	5	4	31.3	57.1
PRRS	5	3	31.3	42.9
Scours	1	1	6.3	14.3
Strep	1	0	6.3	0.0

Among the most common treatments for these diseases were medicated water and injections/vaccinations (Table 4.17). Though some medicated feed use was reported, it occurred at a much lower percent than the use of medicated water. Two respondents in the pre-enactment interview period and one in post-enactment period said that they primarily try to let these diseases run their course when severity and incidence of infection is low enough. One respondent from this group even indicated that their contractor does not prescribe anything for treatment of these diseases, meaning the cost of treatment would fall to the contract producer themselves despite not owning the animals.

Table 4.17: Most common treatment method for problematic diseases reported by contract producers in pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Treatment	**Pre**	**Post**	**Pre**	**Post**
Injections/vaccinations	14	6	87.5	85.7
Medicated feed	3	2	18.8	28.6
Medicated water	11	5	68.8	71.4
Time	2	1	12.5	14.3

In the pre- and post-enactment interviews, 100% of contract producers reported using sick pens based on disease status to separate animals. For cases where treatment of animals was required, producers based the decision to treat an individual animal or an entire barn on a combination of criteria, outlined in Table 4.18. The most common determining factor was the percent of animals affected, followed by the type of symptoms or disease in question.

Table 4.18: Determining factor for treating whole pen/barn versus individual treatment as reported by contract producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Determining factor	**Pre**	**Post**	**Pre**	**Post**
Field agent	1	0	6.3	0.0
Integrator	1	0	6.3	0.0
Percent sick	8	5	50.0	71.4
Site/territory mgr.	3	2	18.8	28.6
Symptoms/disease	5	1	31.3	14.3
Weight of pigs	2	0	12.5	0.0

Unlike some other types of business arrangements, contract producers have obligations to their contractor or integrator that dictate how their herd is managed. A primary question posed to these producers revolved around required management practices related to animal health. All contract producers reported having required protocols outlined within their production contract. These ranged from basic biosecurity measures—which include bio-exclusion, bio-containment, and bio-management practices (Baker and Levis 2011)—to

more stringent controls on clothing and contact. A full list of reported measures can be seen in Table 4.19. Of those respondents whose integrators required specific measures or practices, 38% reported that their integrator paid for training related to these protocol.

Table 4.19: Integrator-required practices as reported by contract producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Measure	**Pre**	**Post**	**Pre**	**Post**
All-in all-out (AIAO)	1	1	6.3	14.3
Basic protocols	8	5	50.0	71.4
Bird/rodent control	2	0	12.5	0.0
Clothing/boot change	3	3	18.8	42.9
Controlled contact	2	0	12.5	0.0
Equip/fac disinfectant	4	2	25.0	28.6
Manure mgmt.	4	0	25.0	0.0
Restricted entry	3	0	18.8	0.0
Sign-in sheet	2	1	12.5	14.3
SOP	2	0	12.5	0.0
Traffic mgmt.	3	0	18.8	0.0

In the context of these interviews, fifty percent of the contract producers interviewed reported that they used in-feed antibiotics for growth promotion or feed efficiency prior to the VFD final rule. Of these, 75% said they were receiving direction for this use from the company that oversees their contract, while another 38% reported that they received this direction from a veterinarian.

Tables 4-20 through 4-23 outline use of in-feed and in-water antibiotics for disease prevention purposes.

Table 4.20: Use of in-feed antibiotics to prevent disease as reported by contract producers, pre- and post-VFD interview[3]

	No. of Respondents		Percent Respondents	
Use	**Pre**	**Post**	**Pre**	**Post**
Yes	16	4	100.0	57.1
No	0	3	0.0	42.9

Although contract producers utilized in-feed antibiotics at a higher rate than independent producers in the pre-enactment interviews, this group also reported reducing the use of in-feed antibiotics for preventative measures in the post-enactment interviews.

Table 4.21: Primary diseases prevented through use of in-feed antibiotics as reported by contract producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Disease	**Pre**	**Post**	**Pre**	**Post**
Enteric conditions	1	0	6.3	0.0
Ileitis	2	0	12.5	0.0
Respiratory/mycoplasma	3	0	18.8	0.0
Scours	1	0	6.3	0.0
Unsure	6	1	37.5	25.0

More than 50% of contract producers reported using in-feed antibiotics for disease prevention during the post-enactment interview time period, but only one producer responded about the type of disease they were seeking to prevent through judicious use. There was a low response rate to the specifics of this question during the pre-enactment period as well, suggesting that contractors are not always aware of the purpose of the presence of in-feed antibiotics, or what diseases these medications are meant to prevent.

[3] For questions regarding what diseases producers are seeking to prevent through use of antibiotics in varying forms, number of respondents refers only to those who answered in the affirmative regarding use, and percent of respondents takes into account these numbers as a percent of affirmative responses rather than the total interview population.

Table 4.22: Use of in-water antibiotics to prevent disease as reported by contract producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Use	**Pre**	**Post**	**Pre**	**Post**
Yes	14	5	87.5	71.4
No	2	2	12.5	28.6

Similar to independent producers, use of in-water antibiotics to prevent disease occurred at a higher rate than other types of antibiotic use. As was cited in the review of independent producers, this likely has to do with higher effectiveness of this preventative method as well as the reduction in associated cost.

Table 4.23: Primary diseases prevented through use of in-water antibiotics as reported by contract producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Disease	**Pre**	**Post**	**Pre**	**Post**
APP	1	0	7.1	0.0
Ileitis	6	1	42.9	20.0
Influenza	4	2	28.6	40.0
Misc. respiratory	1	0	7.1	0.0
Mycoplasma	1	0	7.1	0.0
PED	2	0	14.3	0.0
Pneumonia	2	0	14.3	0.0
PRRS	1	0	7.1	0.0
Scours	1	1	7.1	20.0
Strep	2	2	14.3	40.0

Contract producers seemed to have greater awareness of the application of in-water antibiotics for disease prevention than they did for in-feed antibiotics. The most commonly prevented diseases were consistent with those reported by independent producers, with influenza, ileitis, scours, and strep being among the top in pre- and post-enactment time periods (Table 4.23).

None of the contract producers interviewed reported using injectable antibiotics for prevention purposes; this method was used only in treatment of illness. Overall, contract producers are using in-feed and in-water antibiotics less frequently post-enactment than they had been previously (Tables 4-20, 4-22).

The integrator often handles major feed and operational decisions for contract producers. Of those interviewed, 94% reported that their integrator provided all feed for their operation; only one producer reported an additional source of feed, which in their case was own-farm sourcing for all stages of production except for the first nursery ration. Nearly half of the contract producers interviewed were unsure about whether their operation used any non-antibiotic feed additives.

All contract producers reported having a relationship with a veterinarian, though more than 56% of pre-enactment respondents said this relationship was through another entity, such as their integrator; in the post-enactment interview, this number jumped to 86%. Over 80% of pre- and post-enactment responses claimed that veterinarians were employed by a parent company overseeing the contractor's operation.

In many cases, the contract producer was not interacting with the veterinarian directly. Instead, those communications were flowing through a site manager, field agent, integrator, or other company representative. Most respondents said that they communicated with their veterinarian via phone or email several times a year, but not regularly. Similar information was true regarding on-site visits to operations, with annual visits being the most commonly reported frequency with which veterinarians physically spent time with a contract producer on their farm; semi-annually was the next most common response. These two frequencies traded orders in the post-enactment interview, suggesting that a slight increase

in frequency may have been deemed necessary by parent companies of contractors (Table 4.24).

Table 4.24: Frequency of on-site veterinarian visits as reported by contract producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Frequency	**Pre**	**Post**	**Pre**	**Post**
Almost never	2	1	12.5	14.3
Annually	6	2	37.5	28.6
Bi-monthly	1	1	6.3	14.3
Never	2	0	12.5	0.0
Several times a year	1	0	6.3	0.0
Twice a year	4	3	25.0	42.9

4.2.2 Anticipated changes at the operation/business due to FDA guidances for contract producers (pre)/Actual changes at the operation/business due to FDA guidances for contract producers (post)

None of the contract producers interviewed felt that the VCPR requirements would be difficult or burdensome. The majority of respondents felt that access to veterinarians in their region would be enough to support the regulation changes. Only 19% of pre-enactment respondents felt that their need to use a veterinarian to treat animals would impact their operation, and only in the sense that additional visits would be required. One respondent thought additional approvals may be needed from their parent company. In the post-enactment interviews, 100% of contract producers said that no changes had actually occurred in regards to the way they approach veterinary care on their operation.

Only one pre-enactment respondent was concerned that the revised requirements would increase costs; in the follow-up interviews, none of the producers had experienced a change to costs, some citing that even if there had been a difference, the parent company or integrator would have incurred the cost increases and ultimately impact contractee payments. Although changes in costs were not experienced, contract producers did expect

the time spent record-keeping to increase, but not significantly. Many reported that they were already required, under company policy, to keep the newly-required documents on-hand.

Two producers in the pre-enactment interview said that they would be making changes to increase biosecurity or other management practices of their operation in anticipation of the final rule, but only one producer in the post-enactment interview mentioned this change having taken effect. This producer had transitioned from a wean-to-finish into feeder-to-finish operation in order to potentially reduce antibiotic use in their herd. It is likely that, based on statistics outlined by McBride et al., this would be accomplished through the reduction in nursery pigs on the operation when transitioning from a weaning-age operational to start to feeder-age. According to their research, nursery pigs are more likely to receive antibiotics for both growth promotion and disease prevention or treatment purposes, whereas feeder pigs more commonly receive antibiotics only for the latter two. The producer's integrator/contractor helped to cover the costs associated with this transition.

Once again, contract producers did not relay a strong level of concern; only 6% were concerned about slower growth and 13% about higher death loss in the pre-enactment interview; none felt either were of concern in post-enactment data, though 25% were unsure of what to expect or what changes had so far occurred.

Seventy-five percent of the respondents were unsure which diseases may become more prevalent after the change in antibiotic use guidelines; 19% felt there would be no change, and 6% expected more respiratory problems. These numbers were consistent for pre- to post-enactment periods. Highlighting again that contract producers often have less

control of managerial decisions in their operation than other business arrangements, contract producers were asked whether or not their integrator would make adjustments to rations in order to offset any losses in feed efficiencies as a result of no longer being able to use antibiotics for growth promotion purposes. Pre-enactment, over 50% of producers felt that their integrator was likely to make necessary adjustments, but less than 30% reported that these changes had occurred in the year following the revised regulations (Table 4.25).

Table 4.25: Increased feed provided by integrator to offset growth promotion problems as reported by contract producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
More feed	**Pre**	**Post**	**Pre**	**Post**
Yes	7	2	43.8	28.6
No	0	1	0.0	14.3
Maybe	2	3	12.5	42.9
Probably	7	1	43.8	14.3

Though none of the contract producers interviewed anticipated having to renegotiate their contracts in response to the FDA changes, 19% were not entirely sure what implications it may have on their current practices. In the post-enactment interview, however, all confirmed that no changes had occurred to the contracts themselves. However, many reported that their integrator would or did require changes to management of the operation in some capacity outside of the contract (Table 4.26).

Table 4.26: Changes required by integrator related to VFD regulation as reported by contract producers, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Integrator required changes	**Pre**	**Post**	**Pre**	**Post**
Yes	8	5	50.0	71.4
No	6	2	37.5	28.6
Unsure	2	0	12.5	0.0

In the case of those who did see required changes, 80% were required to provide financing for those changes themselves as part of their contractual obligation. The other 20% received financial assistance from their integrator or parent company.

4.2.3 Raised without antibiotic (RWA) production/practices for contract producers

Only one contract producer reported having RWA stock. This producer varies between RWA and standard production periodically depending on the needs of their parent company and where the pigs are being sourced from. In this producer's perspective, the biggest challenge in RWA production is the need to pull sick pigs of out the herd quickly and get them tagged to enter standard production. This producer believes that costs are generally higher in RWA production as the labor required to move and treat this pigs increases. They also mention a higher incidence of euthanasia when raising RWA stock in order to maintain herd health.

The RWA producer indicated that more injectables are used when RWA stock gets sick, whereas with conventional methods pigs seem to recoup more quickly and efficiently on their own. The integrator makes the decision when to treat pigs in the RWA line. Any pigs that do get treated are tagged and sold separately from the rest of the RWA line.

4.3 Integrators

Integrators oversee the contractual obligations of the contract producer. While contract producers own all facilities and handles day-to-day labor, waste management, etc., integrators and parent companies own the livestock and set the requirements in the contract surrounding how this stock should be raised and managed. They dictate the type and amount of feed fed, veterinarian care, the conditions of the producer's contract, etc. Integrators make up an average of just under 2% of all swine operations in Iowa as represented by the 2012 USDA Census of Agriculture (Table 3.1), and were 7% of pre-enactment respondents and

4% of post-enactment respondents. Although this group had the smallest number of respondents, its representation is in-line with state and national averages. That said, due to such small participation in terms of quantity, these responses should not be relied upon as representative of the entire sector. A large population of integrators would need to be surveyed to confirm the findings.

Three integrators participated in the pre-enactment interviews. A different, fourth integrator was the only participant for the post-enactment interview. Unfortunately, this means that integrator responses do not provide a one-to-one comparison opportunity as was possible for the other interview groups.

4.3.1 Current practices regarding the operation/business for integrators

For the pre-enactment time period, the three Iowa integrators interviewed reported marketing 240,000, 730,000, and 4.5 million hogs annually, respectively, for an average of 1.8 million across the three companies. The post-enactment respondent had a smaller business, marketing just 160,000 hogs a year.

All integrators in the pre- and post-enactment interviews reported owning the sows, sow farms, and feed mills. They also had contracts for additional space, usually in addition to some standard contract producer relationships. One pre-enactment respondent also owned a processing facility.

Integrators in the pre-enactment interview operated 6, 60, and 150 (average of 72) production sites; the single post-enactment respondent had three sites. Animals were shipped between these locations at a minimum distance of 45 miles, and a maximum of 1,300 miles.

Similar to the other business arrangements, the most common/problematic diseases for integrators in the pre-interview were PRRS and influenza (varied strains); this group also had concerns about mycoplasma. The sole respondent for the post-enactment interview

reported influenza and strep (varied strains) as the primary diseases affecting their operation (Table 4.27).

Table 4.27: Most common/problematic diseases seen by integrators, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Disease	**Pre**	**Post**	**Pre**	**Post**
APP	1	0	33.3	0.0
Circo	1	0	33.3	0.0
Hemorrhagic bowel	1	0	33.3	0.0
Ileitis	1	0	33.3	0.0
Influenza	3	1	100.0	100.0
Misc. respiratory	1	0	33.3	0.0
Mycoplasma	3	0	100.0	0.0
PED	2	0	66.7	0.0
PRRS	3	0	100.0	0.0
Strep	0	1	0.00	100.0

Treatment of these diseases was most commonly reported to be injectable antibiotics pre-enactment; and in-feed and in-water medication post-enactment.

All integrators who responded to the pre- and post-enactment interviews provided feed and veterinary oversight to their contract producers. They also reported having specific requirements regarding management practices and biosecurity measures for their producers, and they regularly provided training and financial assistance to ensure that these requirements were met.

Although three of the pre-enactment respondents said that certain features were required in the barn, only one provided financial assistance to producers to help establish these features. The post-enactment respondent reported no required features, and therefore no financial assistance in this capacity.

In regards to vaccinations, all integrators required that animals receive specific vaccines. One respondent reported that the type of vaccine was dependent on the flow specific to that operation, as well as the region of the country that they were in.

Integrators were asked what separated a contractee with excellent outcomes from a less successful contract producer. Sixty-seven percent said that both time and attention to detail were the biggest differences in managerial practices between operations. Better facility maintenance was also mentioned in both interviews (Table 4.28).

Table 4.28: Factors influencing contract producer success as reported by integrators, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Factors	**Pre**	**Post**	**Pre**	**Post**
Attention to detail	2	1	66.7	100.0
Facility maintenance	1	1	33.3	100.0
None	1	0	33.3	0.0
Time	2	0	66.7	0.0

Prior to January 1, 2017, two-thirds of the integrators interviewed were using antibiotics for growth promotion and feed efficiency purposes, though neither respondent used them with all contractors. Instead, the decision to incorporate antibiotics into an operation for these purposes was driven primarily by regional disease pressures. These integrators felt that use of antibiotics for growth promotion and feed efficiency helped to reduce variation in pig weights, reduce the need for individual treatments, and decrease the labor associated with these individual treatments over time. One integrator said that the improved feed efficiency achieved by pre-dosing hogs with antibiotics accounted for a $3 per head increase in net return.

Tables 4-29 through 4-34 outline whether integrators provided in-feed, in-water, or injectable antibiotics to contract producers for disease prevention purposes.

Table 4.29: In-feed antibiotics provided to contract producers to prevent disease as reported by integrators, pre- and post-VFD interview[4]

	No. of Respondents		Percent Respondents	
Provided	**Pre**	**Post**	**Pre**	**Post**
Yes	3	1	100.0	100.0
No	0	0	0.0	0.0

Due interview participation not being consistent from pre- to post-enactment, it is difficult to determine whether or not use of in-feed antibiotics for prevention truly stayed consistent between interview time periods. Based on responses from our interviewed contract producers, it is possible than many integrators did continue to provide in-feed antibiotics to their contract producers, though on a more limited basis than they had previously.

Table 4.30: Primary diseases prevented through use of in-feed antibiotics as reported by integrators, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Disease	**Pre**	**Post**	**Pre**	**Post**
Enteric diseases	1	0	33.3	0.0
Hemorrhagic bowel	1	0	33.3	0.0
Ileitis	1	0	33.3	0.0
Misc. respiratory	1	1	33.3	100.0
Mycoplasma	1	0	33.3	0.0
PRDC	1	0	33.3	0.0
Strep	1	0	33.3	0.0

Overall, the diseases being prevented by use of in-feed antibiotics were aligned with those reported by both contract and independent producers, with the exception of influenza. Due to the small sample size, it is possible that influenza is less common in the

[4] For questions regarding what diseases producers are seeking to prevent through use of antibiotics in varying forms, number of respondents refers only to those who answered in the affirmative regarding use, and percent of respondents takes into account these numbers as a percent of affirmative responses rather than the total interview population.

areas from which these integrators were reporting, or that it is simply of less concern than the other diseases listed.

Table 4.31: In-water antibiotics provided to contract producers to prevent disease as reported by integrators, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Provided	**Pre**	**Post**	**Pre**	**Post**
Yes	2	1	66.7	100.0
No	1	0	33.3	0.0

It is interesting to note that, in contrast to contract and independent producers, there is less reported in-water antibiotic preventative use than in-feed. It is possible that this is because contract producers generally own the facilities and the contractees associated with the integrators that were interviewed may not have the infrastructure to manage in-water preventatives as easily or effectively as in-feed measures.

Table 4.32: Primary diseases prevented through use of in-water antibiotics as reported by integrators, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Disease	**Pre**	**Post**	**Pre**	**Post**
Enteric diseases	1	1	50.0	100.0
Ileitis	1	0	50.0	0.0
Misc. respiratory	0	1	0.0	100.0
Mycoplasma	1	0	50.0	0.0
PRRS	1	0	50.0	0.0
Strep	1	0	50.0	0.0

Again, the diseases prevented through in-water antibiotics mirror what was reported in other producer groups suggesting that general disease concerns and pressures are similar across Iowa.

Table 4.33: Injectable antibiotics provided to contract producers to prevent disease as reported by integrators, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Provided	**Pre**	**Post**	**Pre**	**Post**
Yes	2	1	66.7	100.0
No	1	0	33.3	0.0

Injectable antibiotic use occurred at the same rate as in-water preventatives, both of which were less than in-feed use. Again, it is possible that this has to do with the integrator having less oversight of day-to-day operations or infrastructure at contract facilities, so providing the necessary preventatives through feed becomes the easiest route to ensuring a herd is protected.

Table 4.34: Primary diseases prevented through use of injectable antibiotics as reported by integrators, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Disease	**Pre**	**Post**	**Pre**	**Post**
"All"	1	0	50.0	0.0
GI	0	1	0.0	100.0
Misc. respiratory	1	1	50.0	100.0
Systemic pathogens	1	0	50.0	0.0

Because none of the pre-enactment respondents participated in the post-enactment interviews, it is difficult to determine whether use of in-feed, in-water, or injectable antibiotics increased, decreased, or remained the same following enactment of the new FDA regulations. This result is better captured when comparing contract producer responses from pre- and post-enactment interviews. In all cases where interventions were required, the integrator covered the cost for these preventative measures.

In addition to antibiotics provided for prevention purposes, all pre-enactment respondents said they use some type of non-antibiotic feed additive. The post-enactment respondent did not use non-antibiotic feed additives (Table 4.35).

Table 4.35: Non-antibiotic feed additives provided to contract producers as reported by integrators, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Additive	**Pre**	**Post**	**Pre**	**Post**
Natural remedies	3	0	100.0	0.0
None	0	1	0.0	100.0
Paylean	2	0	66.7	0.0
Vitamins/minerals	2	0	66.7	0.0

In the pre-enactment interview, integrators had an average of two veterinarians on staff, though one reported being part of a larger company where the number of veterinarians on staff reported was representative of only their region. The post-enactment respondent had one on-staff veterinarian. Veterinarians in the pre-enactment interview were only responsible for disease diagnosis and treatment. In the post-enactment, the integrator's veterinarian served this purpose as well as defining rations for their herds, whereas those in the pre-enactment interview used a nutritionist for ration development. Veterinarians generally made regularly-scheduled visits to production sites as determined by type of facility, as well as issue-driven visits related to health concerns.

4.3.2 Anticipated changes at the operation/business due to FDA guidances for integrators (pre)/Actual changes at the operation/business due to FDA guidances for integrators (post)

The integrators who participated in the pre-enactment interview had mixed feelings about what to expect in relation to changes from the VCPR requirements. Though two felt the regulation changes would not be a challenge, one integrator felt that the verbiage used

was confusing and unlikely solve the concerns surrounding antibiotic use. At the same time, this integrator reported that because they were aware that this change would likely come at some point in time, they had proactively sought out more non-antibiotic treatments. The post-enactment respondent did not find the requirements burdensome. All respondents felt that their integrated nature would allow them to satisfy the requirements more easily.

Interestingly, respondents generally felt the regulations would not be overly burdensome, but they did expect to see increases in cost and time (Tables 4.36, 4.37). The post-enactment response confirmed that changes to cost were significant due to a number of additional site visits, non-routine applications or treatments, etc. Record-keeping time increased only minimally.

Table 4.36: Expectations of cost increases post-regulation as reported by integrators, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Increase costs	**Pre**	**Post**	**Pre**	**Post**
Yes	2	1	66.7	100.0
No	1	0	33.3	0.0

Table 4.37: Expectations of impact of cost increase post-regulation change as reported by integrators, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Effect	**Pre**	**Post**	**Pre**	**Post**
Minimal	1	0	50.0	0.0
Significant	1	1	50.0	100.0

All pre-enactment respondents indicated that sometime leading up to January 1, 2017, they had been in the process of decreasing use of in-feed antibiotics. One pre-enactment respondent said they faced some seasonal disease problems that led them to reinstate use of in-feed antibiotics on a smaller basis during this transition window; another said they have increased their health budget and vaccine use, but had not yet faced a disease

outbreak to see if the methods were working. The post-enactment respondent said they were using the same amount of in-feed antibiotics, but the antibiotics used had changed.

When asked whether contract producers would be required to increase biosecurity or change management practices, two integrators in the pre-enactment interview said that they are always improving their operational requirements, but had not made changes directly related to VCPR. The third pre-enactment respondent reported that they would be implementing more stringent inspection practices in regards to cleaning and disinfecting.

Two-thirds of pre-enactment respondents felt growth rates would slow and death loss would increase with decreased use of antibiotics; the post-enactment respondent reported no change to either. None of the integrators interviewed anticipated or saw increases in antibiotic use for disease prevention or treatment purposes, however all felt there would be an increase in certain diseases due to decreased antibiotic use (Table 4.38).

Table 4.38: Diseases expected to increase in prevalence due to regulation changes as reported by integrators, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Disease	**Pre**	**Post**	**Pre**	**Post**
Enteric diseases	2	0	66.7	0.0
Ileitis	1	0	33.3	0.0
Influenza	0	1	0.0	100.0
Misc. respiratory	2	0	66.7	0.0
Mycoplasma	1	0	33.3	0.0
Salmonella	1	0	33.3	0.0
Strep	1	0	33.3	0.0

Pre-enactment interview data suggests that integrators will not be requiring any major changes to management, infrastructure, etc. following the FDA changes. In the post-interview, the respondent reported that they had required some upgrades, and the contract producer had been expected to pay for this themselves.

None of the pre-enactment integrators interviewed expected to change the prices they paid to their integrator in response to the additional requirements of the regulation, but the post-enactment respondent had made some changes though they did not elaborate on what those were.

4.4 Nutritionists

Another important member of the swine industry is the swine nutritionist. The nutritionist is expected to provide guidance in nutrition and health management by designing feed programs based on the latest scientific and policy-driven discoveries (Cargill, Inc. 2018). Eight nutritionists participated in the pre-enactment interview; seven participated in the post-enactment interviews.

4.4.1 Current practices regarding the operation/business for nutritionists

Of the nutritionists interviewed, 50% of the pre-enactment respondents operated independent businesses, and 50% were employed by a feed or other industry-related company. Independent nutritionists and those employed by a larger company were represented by 43% and 57% respectively in the post-enactment interview. Independent nutritionists primarily worked with smaller, independent producers, whereas company nutritionists were often involved with feed mills, ingredient suppliers, and integrators.

Nutritionists were asked to identify how hog diets have changed during their time in the industry. Table 4.39 highlights the primary responses given.

Table 4.39: Changes to hog diets during industry involvement as reported by nutritionists, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Changes	**Pre**	**Post**	**Pre**	**Post**
Formulation	8	7	100.0	100.0
Genetic potential	2	1	25.0	14.3
Growth rate/FE	3	2	37.5	28.6

One of the most descriptive answers received covered all three of the primary changes mentioned, and elaborated further on what impacts these changes have had:

> *"We have increased dietary fiber needs when we withdrew them in the early 2000's and went after ultra lean (high crude protein & amino acid needs). We have changed direction with genetics (moderated the carcass and improved ADG & FE) and we have backed off the ultra lean needs.*
>
> *Diets have become much more complex with the given variety of ingeredients and increased ability to access ingredients. The lactation diet and intake levels and the weaned pig diet palatability have seen tremendous refinement in my period as a nutritionist (at least my chief interests).*
>
> *Changes occurring: designing the pig for more robustness (ability to eat, live, breathe); this helps use maintain intake, growth and health through disease pressures. Also more selection of the pig based on feed conversion. These two characteristics (robustness vs feed efficient) naturally contradict each other a little, so it's hard being in the middle of two. We also see lots of searching for magical non-grain ingredients that will improve feed efficiency and/or health."*

4.4.2 Anticipated changes at the operation/business due to FDA guidances for nutritionists (pre)/Actual changes at the operation/business due to FDA guidances for nutritionists (post)

Nutritionists reported having prepared for the changes required by FDA in a number of ways, as seen in Table 4.40. The greatest preparations seen as necessary were to remove the use of medically important antibiotics from their nutrition programs, and the need to educate producers on the impacts of the policy change.

Table 4.40: Preparations for required FDA changes as reported by nutritionists, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Preparation	**Pre**	**Post**	**Pre**	**Post**
Educating producers	5	5	62.5	71.4
Removal of medically important antibiotics	7	6	87.5	85.7
Stock change	0	1	0.0	14.3
VFD Issuance	4	3	50.0	42.9

Most nutritionists reported that additional changes had been made to their feeding regime either in preparation for or in response to, the new regulations. The most common non-antibiotic feed additives being tested in practice were natural remedies (like oils, spices, and herbs) and probiotics (Table 4.41).

Table 4.41: Non-antibiotic feed additives used more frequently in response to FDA changes as reported by nutritionists, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Additive	**Pre**	**Post**	**Pre**	**Post**
Enzymes	3	3	37.5	42.9
Natural remedies (oils/spices/herbs)	6	6	75.0	85.7
Probiotics	3	5	37.5	71.4
Vitamins/minerals	3	2	37.5	28.6

Only one nutritionist reported being approached by more potential clients in relation to GFIs 209 and 213. This nutritionist stated that these producers were attempting to address specific health challenges in advance of the regulatory changes to come. None of the post-enactment respondents had seen any new business directly related to the revised regulation.

Seventy-five percent of nutritionists expected to have more communication with company veterinarians and feed mills as a result of changes in requirements, however only 29% of post-enactment respondents felt that communication had actually increased; the other 71% reported no change to these relationships following enactment.

The major concerns associated with managing the new requirements varied, but the primary concern was for the increase in record-keeping. Table 4.42 lists all potential concerns brought up during the interview time periods.

Table 4.42: Major concerns associated with FDA regulation changes as reported by nutritionists, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Concern	**Pre**	**Post**	**Pre**	**Post**
Appropriate usage	0	2	0.0	28.6
Delayed response	1	0	12.5	0.0
Interpretation of rules/regs	2	0	25.0	0.0
Inventory control	1	0	12.5	0.0
No concerns	2	3	25.0	42.9
Record keeping	4	3	50.0	42.9

Though a number of concerns were mentioned during the pre-enactment interview time period, a larger percentage of post-enactment interviewees reported that they had no concerns. This suggests that the changes had had lesser impacts than originally anticipated on their businesses. There was an increase in concern for appropriate usage, however.

4.4.3 Raised without antibiotic (RWA) production/practices for nutritionists

Approximately 63% of pre-enactment and 57% of post-enactment nutritionists interviewed reported working with any herds that were RWA production (specifically adhering to the FSIS and/or organic label standards). Though just over half had direct experience with RWA, there was not a single nutritionist who felt there were major differences or challenges in approaching RWA diets as compared to and conventional production, citing that changes in genetics and husbandry were bigger factors in maintaining health in these herds than feed additives.

4.5 Veterinarians

There were eight veterinarians interviewed pre-enactment, and six in post-enactment. One of the post-enactment interview respondents did not-participate in the pre-enactment time period. Tables 4.43 through 4.45 present basic practice metrics for each of the interviewed veterinarians.

4.5.1 Current practices regarding the operation/business for veterinarians

Table 4.43: Employment type as reported by veterinarians, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Employment	**Pre**	**Post**	**Pre**	**Post**
Contract	1	0	12.5	0.0
Independent	8	6	100.0	100.0

Table 4.44: Service type as reported by veterinarians, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Service	**Pre**	**Post**	**Pre**	**Post**
100% hogs	1	1	12.5	16.7
Large animal	2	2	25.0	33.3
Mixed practice	2	2	25.0	33.3

Table 4.45: Client type as reported by veterinarians, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Clients	**Pre**	**Post**	**Pre**	**Post**
Large operations	1	1	12.5	16.7
Mid-size operations	2	0	25.0	0.0
Small operations	7	4	87.5	66.7

4.5.2 Anticipated changes at the operation/business due to FDA guidances for veterinarians (pre)/Actual changes at the operation/business due to FDA guidances for veterinarians (post)

Veterinarians were assumed to become the bearers of the largest burden in relation to the new VFD requirements due to the additional time commitments that would be necessary for site visits, client interactions, and documentation. Nearly 88% reported doing extensive research in preparation for the changes, and 50% in each interview period reported having attended workshops, communicated with clients, and utilized Global Veterinarianlink resources to prepare their practice. None of the pre-enactment respondents became licensed

in additional states in order to be more accessible, and only one post-interview respondent had—though not in direct relation to VFD regulations.

Pre-enactment, only 25% of veterinarians said they had been approached by more potential clients in relation to GFIs 209 and 213, and only 17% reported any additional clientele in the post-enactment interview. The one veterinarian who had seen more clientele following regulation changes stated that these clients were primarily local producers who rarely used veterinary service but now needed VCPRs and VFDs in order to gain access to medically important antibiotics.

Veterinarians expressed a handful of major concerns leading up to January 1, 2017, and many of these concerns remained following the enactment. Table 4.46 outlines these concerns.

Table 4.46: Concerns regarding regulation changes as reported by veterinarians, pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
Concern	**Pre**	**Post**	**Pre**	**Post**
Compliance/implications	4	2	50.0	33.3
Data use	0	1	0.0	16.7
Delayed care	3	1	37.5	16.7
No concern	0	3	0.0	50.0
Time commitment	3	1	37.5	16.7

One of the veterinarians interviewed in the pre-enactment interview said:

> *"I have been concerned with the lack of a clear process by FDA. The Dec. 12 release of update antibiotic labels was a frustration ... without that information, I could not proceed with implementation plans. I am also concerned with the time needed to complete/file (even electronic) the paper work ... it take time away from working with pigs and people in the barns ... that is where I earn my keep for my clients."*

Like with nutritionists, post-enactment interviews suggested that overall concerns subsided following the final rule, with 50% of the post-enactment respondents having no

concerns regarding the regulation changes. This is also evidenced in the reduction in concern over compliance/implications of the regulations, as well as issues pertaining to delayed care. It can be assumed then, that although many producers reported a slight increase in the regularity of communication with their veterinarian, the total impact to practices was less than anticipated in terms of time.

Post-enactment, one veterinarian felt the changes had primarily turned out to be positive. The ISU Swine Extension Specialist that recorded this veterinarian's response wrote:

> *"Found that the new regulations are helping him develop a closer relationship with his clients, they are calling him in sooner when problems arise because they now need him to get the antibiotics they need. It is helping solve disease issues earlier and more effectively. Some problem when Veterinarian is out of town or tries to take time off (less available), need to fax VFDs from various places, if leaving for a couple days need to bring VFD forms with him and be in tune with the phase of the producer's likely needs before he leaves."*

4.5.3 Raised without antibiotics (RWA) production/practices for veterinarians

Of those veterinarians interviewed, 75% reported working with animals in RWA production. Table 4.47 lists the ways in which their approach to recommendations and treatment in a RWA environment differ from that of standard production operations.

Table 4.47: Differences in RWA production practices from standard production as reported by veterinarians pre- and post-VFD interview

	No. of Respondents		Percent Respondents	
RWA differences	**Pre**	**Post**	**Pre**	**Post**
Avoid overstock	1	0	12.5	0.0
Clean facilities	1	0	12.5	0.0
Focus on prevention	1	0	12.5	0.0
Less antibiotics	1	1	1225	16.7
More natural remedies	3	2	37.5	33.3
More vaccines	3	3	37.5	50.0
More vitamins	1	1	12.5	16.7
No response	1	2	12.5	33.3

Over a third of veterinarians said they felt their role in RWA production was greater than that of conventional production; another third felt it was less, though some reported that while it was technically less, they felt it should be greater given the nature of the operation.

CHAPTER V: FINBIN DATA

FINBIN is the largest national farm financial benchmarking database. It is the most accessible source of farm financial and production benchmark information in the country, with data from eleven participating states. FINBIN provides producers, educators, and researchers with cost of production metrics based on data aggregated from nearly 3,500 farms and representative of more than 3.2 million acres of crop land, 1.3 million head of hogs, and 342,000 head of cattle. The database is hosted by the Center for Farm Financial Management (CFFM) at the University of Minnesota, and was created in partnership with farm business management associations throughout the country by assistance of funds awarded through the Farm Business Management and Benchmarking (FBMB) grant program.

FINBIN receives input from over 200 hog producers annually, with representation of farrow-to-finish, farrow-to-weaning, weaning-to-feeder, weaning-to-finish, and finishing-only operations from both independent and contract producers. This data is the most detailed on-farm financial benchmarking information available to-date. Data is submitted to FINBIN using a standardized chart of accounts to help ensure production and financial information are reported consistently across participating states. Data is validated in three stages: first, reviewed by the instructor or educator that inputs the data; next, reviewed by either an individual analyst or group of farm business management educators that check for errors and outliers; and finally by the CFFM team before inclusion in the database.

No financial information was collected during the pre- and post-enactment surveys. Because of this, FINBIN data will be used to parameterize and model the impacts of VFD changes for comparison with the survey results. Unfortunately, Iowa's data is not available in FINBIN. However, production and financial metrics are available from the bordering states of Illinois, Minnesota, Missouri, Nebraska, and South Dakota. While this measure is

not perfect, each of these states play a significant role in national swine production and have similar practices to operations located in Iowa.

Production cost information was collected for farrow-to-finish, wean-to-finish, and feeder-to-finish operations operated by independent producers which were the most prominent operation types represented in the survey data. This data spanned a six year window that encompassed both pre- and post-enactment years, from 2013 through 2018. The total sample size varied by production system and year, as seen in Tables 5.1.

Table 5.1: Hog production system representation across Iowa border states in FINBIN (2013-2018)

	Year						
Production system	2013	2014	2015	2016	2017	2018	Total
Farrow-to-finish	12	14	12	14	13	14	79
Wean-to-finish	36	37	36	40	32	29	210
Feeder-to-finish	27	30	33	30	26	24	170

Although the sample size is small, this data is representative and valuable as a foundation for further research. Some variations are seen in the corresponding data as not all operations are included in the FINBIN output each year, and the addition or subtraction of large operations can play a significant role in the averages of individual metrics.

Three primary cost metrics were evaluated for each production system: feed, labor, and veterinary. These costs were chosen for evaluation because they were the most commonly identified concern for producers during the survey. Feed costs comprised the total combined cost of protein, vitamin and minerals, complete ration, corn, other feedstuffs; dried distillers grain costs were also used for feeder and wean-to-finish operations. Labor was made up of the total combined cost of direct and overhead hired labors costs, and also included custom hire for feeder and wean-to-finish operations. Veterinary costs were pulled from a single veterinary line item. The total change for each cost metric was calculated as

the post-enactment average cost of each metric (2017-2018), less the pre-enactment average cost (2013-2016) of each metric. An initial view of the impacts across each production system is seen in Tables 5.2-5.4.

Table 5.2: Changes in production cost per head, pre- to post-enactment for farrow-to-finish operations

	Year									
Cost	2013	2014	2015	2016	Avg Pre	2017	2018	Avg Post	Change	Percent Change
Feed	$ 94.14	81.21	86.40	75.93	84.42	94.63	82.08	88.35	3.94	4.66%
Labor	8.83	7.53	9.85	9.62	8.96	8.88	8.25	8.57	-0.39	4.34%
Veterinary	6.11	5.79	5.58	5.77	5.81	5.97	5.46	5.71	-0.10	1.72%
						Total:			$ 3.45	

Table 5.3: Changes in production cost per head, pre- to post-enactment for wean-to-finish operations

	Year									
Cost	2013	2014	2015	2016	Avg Pre	2017	2018	Avg Post	Change	Percent Change
Feed	$101.90	85.69	73.59	68.31	82.37	65.50	68.16	66.83	-15.54	18.87%
Labor	5.49	4.67	4.30	4.82	4.82	4.85	5.08	4.97	0.03	3.01%
Veterinary	3.29	3.35	3.32	3.76	3.43	3.61	3.33	3.47	0.18	1.17%
						Total:			-$15.33	

Table 5.4: Changes in production cost per head, pre- to post-enactment for feeder-to-finish operations

	Year									
Cost	2013	2014	2015	2016	Avg Pre	2017	2018	Avg Post	Change	Percent Change
Feed	$91.39	77.12	65.90	59.99	73.60	58.24	61.06	59.65	-13.95	18.95%
Labor	3.08	7.27	2.22	2.55	3.78	1.50	2.15	1.83	-1.96	51.72%
Veterinary	0.71	1.10	1.59	1.76	1.29	1.33	1.15	1.24	-0.05	3.88%
						Total:			-$15.96	

Though producers in each section of the survey identified increases in feed, labor, and veterinary costs as some of the primary concerns related to the VFD, both the post-enactment survey and the metrics from FINBIN suggest that impacts to cost were minimal. Farrow-to-finish operations were the only production system that reported an increase in production costs per head based on the metrics analyzed. Wean-to-finish operations saw a slight increase in labor and veterinary fees, but high average feed costs in the pre-enactment window due to high corn prices in 2013 and higher than normal complete ration prices in 2014 led to a decrease in overall production costs per head.

Though these metrics provide a cursory view of the impacts of the VFD, it is important to reiterate that the sample size was small, the post-enactment data is limited due to the proximity to VFD enactment, and the data does not directly assess the impacts on Iowa producers as measured in the survey itself. Additionally, other industry factors may have played a role in these numbers, such as the PED outbreak in 2013-2014.

CHAPTER VI: ECONOMIC IMPACTS OF ANTIBIOTIC-FREE PRODUCTION

The pork industry, like most livestock sectors, is driven by consumer demands. While the regulations outlined in the VFD help to address some of the concerns the public has regarding overuse of antibiotics and fears of antibiotic resistance, the final rule does not eliminate the use of antibiotics in production entirely. Instead, it serves to safeguard consumers against overuse for purposes of growth promotion and feed efficiency. For some consumers, however, this change either fails to mitigate the risks enough, or it does not address other concerns that the general public associates with conventional production practices.

A survey published in the February 2019 edition of National Hog Farmer presented findings from both conventional and RWA producers and industry veterinarians. Respondents of the survey largely believed that a switch to RWA production would lead to negative herd impacts, including decreased feed efficiency, increased mortality, and a slight or significant worsening of food safety and animal health and welfare (Hess, 2019). The article went on to outline that while these are the top concerns of industry participants, presumed consumer perceptions of such a transition are at odds with the reality. In fact, more than 80% of the producers said that they believe that consumers perceive higher levels of animal health and welfare associated with RWA production.

Research has shown that positive correlation exists between perceptions of higher animal welfare and consumers' willingness to pay (Tonsor, Olynk, & Wolf, 2009). A 2006 study showed that consumers have a preference for antibiotic-free pork products, with an estimated premium of 76.7% (Lusk, Norwood, & Pruitt, 2006). Based on the research by Lusk et al. (2006), the premium on antibiotic-free pork in today's market should remain high as the team believed that consumer awareness and information asymmetry regarding the use

of antibiotics in production was likely a driving factor in the high value placed on these products. They also noted that demand for antibiotic-free pork would likely remain unchanged with a ban or other policy impact such as the VFD due to this gap in consumer knowledge.

With consumers' desire for antibiotic-free products either due to concerns for animal welfare or human health, it is important for producers to understand the implications that a transition from conventional to antibiotic-free production would have on their operational bottom-line. Since the VFD final rule has already forced many producers to change their herd management practices regarding antibiotic administration in the form of increased costs of production, this analysis could provide even more insight to their operation when determining whether a full transition would help alleviate the burden of these higher costs. Though not modeled here, it should be noted that antibiotic-free hogs would receive a higher market price which would immediately offset some of the added costs of this production style.

Several studies have already been published on the relative effects of transitioning from a conventional to antibiotic-free production system. An outline for each of the three studies used in this analysis are below.

- Holden et al., "Minimizing the Use of Antibiotics in Pork Production" (2002) – Compared production costs in farrow-to-finish operations raising pigs with the use of sub-therapeutic antibiotics (STA) and without the use of sub-therapeutic antibiotics (non-STA); based on a 100 sow outdoor pork production system with market sales weight of 250 pounds

- Kohler et al., "Profitable antibiotic-free pork production" (2008) – Analyzed changes in production cost during conversion to antibiotic-free (ABF) production from before ABF (2002-2004) to after ABF (2005-2007); based on 1,000 sow farrow-to-finish conventional confinement system
- Main et al., "A Field Experience Implementing an Antibiotic-Free Program in a Commercial Production System" (2010) – Followed implementation of ABF production program in a three-site commercial system, then a return to conventional production

Just as respondents to the survey published by National Hog Farmer anticipated, changes in feed efficiency and mortality were among the greatest indicators of operational change in all three studies. Table 6.1 outlines the efficiency impacts captured in each of the studies respectively.

Table 6.1: Previous study efficiency impacts with and without antibiotics

Study	Holden et al. [1]		Kohler et al.		Main et al. [2]	
Antibiotic status	STA	Non-STA	Non-ABF	ABF	Non-ABF	ABF
Lbs fd/lbs gain	3.34	3.48	2.65	2.69	2.34	2.42
Mortality	5.00%	6.30%	1.60%	1.70%	3.80%	6.30%

[1] Calculations for Holden et al. mortality based on the average of pre-wean, nursery, and grow/finish mortality percentages given in the paper
[2] Calculations for Main et al. non-ABF measures based on the non-ABF average of nursery, finisher, and wean-to-finish values given; ABF values based on the non-ABF average of nursery, finisher, and wean-to-finish values given less the average of the nursery and finishing differential average given

STA and non-ABF imply use of sub-therapeutic antibiotics; while non-STA and ABF imply antibiotic-free operation practices. It is unclear whether there are fundamental differences in the scope of antibiotics permitted for non-STA, ABF, and RWA production systems. For the purpose of this analysis, it is assumed that all formats follow the same antibiotic guidelines.

The Pig Profit Tracker (PPT) is a decision-making tool developed by the Iowa Pork Industry Center to allow producers to easily test the impacts of varying scenarios on their economic bottom line by changing inputs and operational costs in a pre-populated worksheet. The PPT was used in conjunction with the metrics from the studies to test the impacts that changes in feed efficiency and mortality rates would have on the income over total cost per head between STA/non-ABF and non-STA/ABF production systems, and ultimately determine the premium necessary for antibiotic-free production to be a profitable endeavor. Table 6.2 outlines the base measurement values provided with the pre-populated inputs from PPT. The feed efficiency (lbs fd/lb gain) and mortality rates were then changed to reflect the conventional and antibiotic-free metrics provided in the previously cited studies to provide the basis for comparison between the two production systems. Economic impacts were measured based on income over total costs on a per head basis using gross income, total feed costs, and total non-feed costs. The percent change is a measurement of the difference between the income over total costs in the conventional system and antibiotic-free system in each study.

Table 6.2: Pig Profit Tracker (PPT) base pre-populated measurement values

Lbs feed/lb gain	2.85
Mortality	5%
	$/hd
Gross income	129.57
Total feed costs	82.64
Total non-feed costs	51.9
Total costs	134.54
Income over total costs	-4.97

Table 6.3 reports feed efficiency changes as reported in the three cited studies. Feed efficiency varied slightly across each study due to the variables such as confinement system

used and operation size. Although these values were different, the conventional and antibiotic-free systems are being compared only against their inner-study counterpart. The decreased feed efficiency reported in antibiotic-free structures lead to a 20% decrease in income on a per head basis for the Holden et al. and Main et al. studies. Although the percent difference reported in the Kohler et al. study is large (257.14%), this is due to how nominal the base values are with both non-ABF and ABF income over total costs per head being valued at less than one dollar. The total dollar difference between the production systems is only $1.08. Increases are observed in both feed and non-feed costs for all three studies, and can likely be attributed in large part to the additional days to market required with lower rates of gain.

Table 6.3: Impacts of feed efficiency rate changes on income over total costs ($/hd)

Study	Holden et al.		Kohler et al.		Main et al.	
Antibiotic status	STA	Non-STA	Non-ABF	ABF	Non-ABF	ABF
Lbs feed/lb gain	3.34	3.48	2.65	2.69	2.34	2.42
			$/hd			
Gross income	129.57	129.57	129.57	129.57	129.57	129.57
Total feed costs	95.01	98.55	77.59	78.60	69.76	71.78
Total non-feed costs	52.74	52.98	51.56	51.63	51.03	51.16
Total costs	147.75	151.53	129.15	130.23	120.79	122.94
Income over total costs	-18.18	-21.96	0.42	-0.66	8.78	6.63
Difference ($)	-3.78		-1.08		-2.15	
Difference (%)	-20.79%		-257.14%		-24.49%	

An increase in mortality rate requires all expenses to be distributed across less animals, therefore increasing the relative cost per head of production. Table 6.4 reports changes in income as a result of increased mortality rates. Just as with a decrease in feed efficiency, an increase in mortality rate associated with the removal of antibiotics from the production cycle has a negative impact on the per head income. However, increased mortality

appears to be less significant on a marginal basis than losses in feed efficiency. When antibiotics are removed from the production cycle, mortality rates rise as animals cannot be given preventative medications as they would in conventional production; nor can they receive treatment for disease, illness, or injury without being removed from the antibiotic-free herd. This leaves them more susceptible to the impacts of their environment.

Table 6.4: Impacts of mortality rate changes on income over total costs ($/hd)

Study	Holden et al.		Kohler et al.		Main et al.	
Antibiotic status	STA	Non-STA	Non-ABF	ABF	Non-ABF	ABF
Mortality	5.00%	6.30%	1.60%	1.70%	3.80%	6.30%
			$/hd			
Gross income	129.57	129.57	129.57	129.57	129.57	129.57
Total feed costs	82.64	82.64	82.64	82.64	82.64	82.64
Total non-feed costs	51.90	52.56	50.15	50.21	51.29	52.56
Total costs	134.54	135.20	132.79	132.85	133.93	135.20
Income over total costs	-4.97	-5.63	-3.22	-3.28	-4.36	-5.63
Difference ($)	-0.66		-0.06		-1.27	
Difference (%)	-13.28%		-1.86%		-29.13%	

Because each study reported changes in feed efficiency and mortality simultaneously, the final set of results includes the effects of both of these changes rather than each individually. Table 6.5 illustrates the concerns many swine industry participants have regarding the transition from conventional to antibiotic-free production. Raising pigs without the use of antibiotics is more costly (approximately 36-53% more expense) on a per head basis. It is important to note that we are only using only two variables—feed efficiency and mortality rates, and as other inputs change with this production system, we expect it to affect profit as well.

It is worth noting that both conventional and antibiotic-free production systems achieved a positive income per head in the Kohler et al. and Main et al. studies. Based only

on the metrics given, it is clear that this is due to higher rates of feed efficiency than the operation in Holden et al. The increased feed efficiency leads to significantly lower total feed costs, which has the greatest impact on bottom line in these scenarios.

Table 6.5: Impacts of feed efficiency and mortality rate changes on income over total costs ($/hd)

Study	Holden et al.		Kohler et al.		Main et al.	
Antibiotic status	STA	Non-STA	Non-ABF	ABF	Non-ABF	ABF
Lbs feed/lb gain	3.34	3.48	2.65	2.69	2.34	2.42
Mortality	5.00%	6.30%	1.60%	1.70%	3.80%	6.30%
			$/hd			
Gross income	129.57	129.57	129.57	129.57	129.57	129.57
Total feed costs	95.01	98.55	77.59	78.60	69.76	71.78
Total non-feed costs	52.74	53.71	49.87	49.98	50.46	51.78
Total costs	147.75	152.26	127.46	128.58	120.22	123.56
Income over total costs	-18.18	-22.69	2.11	0.99	9.35	6.01
Difference ($)	-4.51		-1.12		-3.34	
Difference (%)	24.81%		53.08%		35.72%	

The snapshot presented in Table 6.5 does not take into account any facility or personnel changes needed for a transition, nor does it fully evaluate the differences in management or rations for a conventionally-raised versus antibiotic-free pig. While a myriad of other factors would impact the bottom line, these estimates suggest that it is more expensive to run an antibiotic-free operation, but that there is room for profit if consumers maintain a willingness to pay a premium for what they perceive as healthier, safer, or kinder to the animals.

CHAPTER VII: RECOMMENDATIONS

As mentioned previously in this paper, the timing of the enactment of GFI #213 makes this research significant as it is among the first to study the economic impacts of the new VFD regulation on livestock producers, and specifically those in the swine industry. While the data collected during the pre- and post-enactment time periods in the falls of 2016 and 2017 provide some valuable information to help gauge the effectiveness of the FDA policy changes and may help to provide some decision-marking metrics on which future legislation can be built, there are a few limitations that were uncovered during the study.

The nature of the study relied on taking quick action to gauge the impact that the regulatory changes have had on swine industry participants within the first year of enactment. This time period was limiting. Many interview respondents had not yet noted any change, while others felt operational changes had occurred, but they could not be quantified in terms of economic impact so early. Extending the follow-up interview time period to three and five-year check-ins would help to create a clearer picture of measureable change to the industry related to the VFD final rule.

The interview revolved around the structure of the questions. Although the ultimate goal of the study was to seek out the economic impacts of the VFD final rule, few questions surrounded the actual production cost to operations and businesses. The open-ended nature of the questions and stacked format made it difficult to withdraw the information specifically related to financial impact. If additional follow-up interviews were conducted, it would be worthwhile to revisit the sort and composition of questions in order to ensure that more quantifiable measures were obtained.

Collection of data relied on two key components: participants had to have an existing relationship with ISU Extension, and they had to be available to answer interview question via phone or in-person conversations in two separate periods of time. In order to improve participation, it would be helpful to create an online and/or paper version of the interview that could be distributed to a broader audience, and on their own terms. Additionally, the research conducted represents only a small group of swine industry participants due to the previously noted parameters. In order to gain a deeper understanding of the effects on the industry as a whole, a national-level view would be valuable. This could be achieved by reissuing this or a similar, edited interview based on the recommendations above, and distributing this to participants in some of the other major swine producing states such as those reviewed in the FINBIN data: Illinois, Minnesota, Missouri, and South Dakota.

During the data cleaning process it became clear that interpretations surrounding some words used in the interview were different among individual participant groups. For example, the difference between "prevention" and "treatment" led to some confusing conclusions, as did "antibiotics" versus "medically-important" antibiotics, and what parameters had to be met in order to be classified as "raised without antibiotics" or "antibiotic-free". Adding clarity within this language to better guide the participants' responses would be beneficial in capturing a more consistent set of answers with which to base additional research.

The interview was conducted as part of a larger cooperative agreement that encompassed similar studies in other parts of the livestock industry that were directly affected by VFD legislation. With the recommendations above and comparison data available

surrounding other livestock groups, a more complete picture of the financial and managerial implications of the regulatory changes will be obtainable.

CHAPTER VIII: CONCLUSION

This research sought to analyze the economic and managerial impacts the VFD final rule had on major participants in the Iowa swine industry through comparison of survey data and financial reference data covering both pre- and post-enactment windows. Additionally, a cost of production analysis was completed using previous research in order to extract an estimate for the difference in profit between conventional and antibiotic-free production systems. Data analyzed may be used to help provide a better understanding of the financial impacts of the FDA policy change for producers and other industry participants and will help advice Extension educators and other outreach-based organizations in guiding producers in decision-making for their operations.

Previous studies focused on removing antibiotics for growth promoting purposes in pork production and estimated increased costs to hog producers of $1.37-$2.88 per head. However, these studies did not take into account that GFI #213 also removed use of medically-important antibiotics for disease prevention and treatment.

Data was aggregated from two separate interview windows encompassing both pre- and post-enactment timeframes, and targeted five separate industry groups: independent producers, contract producers, integrators, nutritionists, and veterinarians. Questionnaires were tailored to business and management type. Questions were open-ended and responses were coded for consistency and data measurement purposes.

Industry participants expected that the primary areas in which economic impacts would be felt were the areas of feed cost per head, veterinary cost, and labor prior to the VFD enactment. On the post-enactment survey, the majority of participants reported little to no change to their operational costs. Financial data was unavailable for Iowa hog production, but FINBIN numbers for Iowa's bordering states (Illinois, Minnesota, Missouri, and South

Dakota) confirmed that there has been very little economic change in the immediate post-enactment window of 2017. Minor increases to feed cost were seen for some operators, and a marginal increase in veterinary care per head was also reported.

The initial effects of the antibiotic limitations imposed by GFI #213 have been minor. With advanced notice, many swine industry participants were able to prepare their business for the associated economic changes.

Further analysis of the economic impacts of a transition to antibiotic-free production suggest that the concerns reported from survey participants are accurate longer-term; antibiotic-free production is associated with both decreased feed efficiency (higher feed costs) and increased mortality rates. These cost of production changes ultimately lead to a lower per head profit at an average of 38%, without taking into account additional investments needed for facility changes, personnel, or other associated expenses. Though the VFD final rule does not require operations to be antibiotic-free, the related changes are still likely to be observed given the decrease in antibiotic use.

As addressed in Chapter VII, a larger survey window, a broader participant group, and a more standardized format could help to achieve a more complete view of the long-term effects of the VFD final rule.

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APPENDIX A – SURVEY FOR INDEPENDENT HOG PRODUCERS

QUESTIONS REGARDING CURRENT PRACTICES AT THE OPERATION:

A. Basics of the operation

1. What is the number of animals in inventory on average?
2. What is the number that get removed/sold annually?
3. How would you describe your operation in terms of the portion of the hog life-span covered? (i.e., farrow-to-finish, feeder-to-finish, etc.)
4. If your operation is not farrow-to-finish, where do you source your weanling or feeder pigs?
5. How many production sites do you have?
6. What type of manure management system do you use?
7. Do you practice all-in/all-out production?

B. Diseases of concern

1. What are the most common diseases seen at your operation? What comes to mind first as your most problematic disease?
2. Describe how you treat your most problematic disease.
3. In general, how do you determine treatment regime?
4. Do you use any diagnostic tests when animals display symptoms? If yes, how often do you use diagnostic tests: first case, every time, never periodically, sometimes or other?
5. Do you separate animals according to disease status (i.e., do you use a sick pen)?
6. How do you decide whether to treat the entire pen or barn versus single animals?

C. Use of antibiotics specifically for purposes of growth promotion or feed efficiency

1. Do you use antibiotics for growth promotion or feed efficiency on some or all of the hogs at your operation?
2. If you use antibiotics for growth promotion or feed efficiency for some but not all hogs, how do you make decisions about whether to feed an antibiotic for feed efficiency/growth promotion reasons?
3. Do you only provide these for animals of a certain age range? Which age range?
4. What can you tell us about how this affects your economic bottom line (any information you are willing to share about profits per change in unit of feed conversion, differences in daily gain, costs of the antibiotics per head, differences in grading or meat quality when slaughtered as a result, etc.)

D. Use of *in-feed* antibiotics specifically *for disease prevention*

1. Do you use *in-feed* antibiotics to prevent disease? If so, what diseases?

2. Do all hogs get antibiotics *in feed* to prevent these diseases?
3. If you do not provide antibiotics *in-feed* for disease prevention *to all hogs*, how do you make decisions about which hogs receive in-feed antibiotics for disease prevention?
4. Are these in feed antibiotics currently administered under the oversight of a veterinarian (i.e., through a VFD or prescription)?
5. What can you tell us about how this affects your economic bottom line?

E. Use of *in-water* antibiotics specifically for disease prevention

1. Do you use *in-water* antibiotics to prevent disease? If so, what diseases?
2. Do all hogs get antibiotics *in water* to prevent these diseases?
3. If you do not provide antibiotics via water for disease prevention *to all hogs*, how do you make decisions about which hogs receive in-water antibiotics for disease prevention?
4. Are these in-water antibiotics currently administered under the oversight of a veterinarian or are they purchased and administered over-the-counter?
5. What can you tell us about how this affects your economic bottom line?

F. Use of *injected* antibiotics specifically for disease prevention

1. Do you use *injected* antibiotics to prevent disease? If so, what diseases?
2. Do all hogs get antibiotics *injected* to prevent these diseases?
3. If you do not provide antibiotics via injection for disease prevention *to all hogs*, how do you make decisions about which hogs receive injectable antibiotics for disease prevention?
4. Are these injected antibiotics currently administered under the oversight of a veterinarian or are they purchased and administered over-the-counter?
5. What can you tell us about how this affects your economic bottom line?

G. Diets, feed, and non-antibiotic feed additives

1. Can you tell me about the rations for different groups of animals? Do different groups get different rations (i.e., by age, weight, disease risk)? How do you determine rations? How many different rations do you have?
2. What types of non-antibiotic feed additives do you use, if any?

H. Relationship to feed mills

1. Do you have your own feed mill and mix your own medicated feeds?
2. If not, where do you get your feed, and how do you provide instructions/order feed? How do you order/purchase medicated feed (is it the same?)
3. If you use medicated feed from a separate feed mill, are there records kept by you and/or the feed mill, such as a VFD?

I. Other management practices for disease prevention

1. What types of measures do you take to keep animals healthy other than the ones we've already talked about? (manure management, minimizing animal stress, biosecurity)

J. Current relationship/use of veterinarians and veterinary services

1. Do you have a relationship with a veterinarian?
2. If so, what category of veterinarian do you currently use? (i.e., full-time veterinarian on your operation, veterinarian employed by a parent company full time that is assigned to work with you, local large animal vet)
3. If you do have a veterinarian, how often do you interact with your vet by phone or email?
4. If you do have a veterinarian, how often are they on site?
5. If you do have a veterinarian, are you using them for advice about disease prevention, to prescribe treatment for sick animals, anything else?

QUESTIONS REGARDING ANTICIPATED CHANGES AT THE OPERATION DUE TO FDA GUIDANCES:

K. Changes in veterinarian access and use. The FDA guidelines require producers to a) have a relationship with a veterinarian (a Veterinary Client Patient Relationship – VCPR), and b) have all medically important antibiotics prescribed or overseen (in the case of a VFD) by a veterinarian.

1. Do you anticipate or have you found the requirement for a VCPR to be difficult/burdensome? Do you have access to a large-animal vet? Are there enough large animal vets in your region?
2. How will the need to use a veterinarian affect how you treat animals? In what way?
3. Will these requirements increase your costs, and how significantly?
4. Will these requirement increase the time you spend in record-keeping? How significantly?

L. Production changes related to no longer using medically important antibiotics for growth promotion/feed efficiency.

1. Have you increased biosecurity, changed management practices, or made other adjustments to your production line, *in order to prepare for not using medically important antibiotics for growth promotion/feed efficiency?*
2. How costly have these been?
3. Have you changed suppliers or transportation models (i.e., distance, cleaning, types)?

M. Expectations of animal health and productivity

1. Are animals expected to grow more slowly or require more feed per unit of weight gain? Do you expect to have higher death losses?
2. Do you anticipate having to purchase more feed?
3. Do you expect to have to use more antibiotics for disease prevention or treatment?
4. Which diseases (if any) do you expect to become more prevalent or more of a problem?

N. Relationship with feed mill

1. How will your relationship and interaction with a feed mill (if you access one) change?

QUESTIONS FOR OPERATIONS WITH RAISED WITHOUT ANTIBIOTICS PRODUCTION

1. Do you *raise* animals without the use of *any* antibiotics?
2. Do you *market* products that are raised without the use of any antibiotics (as specified under FSIS processing label standards and/or organic practice standards)?
3. If yes to either of the above, what percentage of your animals are RWA?
4. Tell us what your RWA production model looks like. How is RWA production structured? Do you have two lines (the RWA and conventional lines) on the same operation? Do you only produce RWA?
5. What encouraged you convert to or begin RWA production?
6. What were the biggest challenges when converting to RWA?
7. Do you experience higher costs related to RWA production, compared to conventional? What are the primary drivers of these costs?
8. How does overall antibiotic use compare between RWA and conventional production?
9. How do you decide when to administer antibiotics to an animal or group of animals that would have been in an RWA line?
10. What happens when these animals (that would have otherwise been in an RWA) are treated with antibiotics?

APPENDIX B – SURVEY FOR CONTRACT HOG PRODUCERS

Survey questions for contract hog producers.

QUESTIONS REGARDING CURRENT PRACTICES AT THE OPERATION:

A. Basics of the operation

1. What is the number of animals in inventory on average?
2. What is the number that get removed/sold annually?
3. How would you describe your operation in terms of the portion of the hog life-span covered? (i.e., farrow-to-finish, feeder-to-finish, etc.)
4. How many production sites do you have?
5. What type of manure management system do you use?
6. Do you practice all-in/all-out production?

B. Diseases of concern

1. What are the most common diseases seen at your operation? What comes to mind first as your most problematic disease?
2. Describe how you treat your most problematic disease.
3. In general, how do you determine treatment regime?
4. Do you use any diagnostic tests when animals display symptoms? If yes, how often do you use diagnostic tests: first case, every time, never periodically, sometimes or other?
5. Do you separate animals according to disease status (i.e., do you use a sick pen)?
6. How do you decide whether to treat the entire pen or barn versus single animals?

C. Contractual arrangements regarding animal health

1. Does your integrator provide feed?
2. Does your integrator provide veterinary oversight?
3. Does your integrator require management practices related to animal health, such as biosecurity measures? What types of practices? Does your contractor provide training, financial assistance, or other aid in performing these management practices?
4. Does your integrator require certain features of your barn or operation for animal health? (for example, ventilated barns) Does your contractor provide financial assistance or other aid in constructing these barn or operation features?
5. Outside of what is required by your contract, what other types of measures do you take to keep animals healthy other than the ones we've already talked about?

D. Use of antibiotics specifically for purposes of growth promotion or feed efficiency

1. Some contractors do not know the content of their feed. Do you know if you use antibiotics for growth promotion or feed efficiency on some or all of the hogs at your operation?
2. If you use antibiotics for growth promotion or feed efficiency for some but not all hogs, how do you make decisions about whether to feed an antibiotic for feed efficiency/growth promotion reasons? Do you make these decisions or does a veterinarian or nutritionist from the company?
3. Do you only provide these for animals of a certain age range? Which age range?
4. What can you tell us about how using antibiotics for growth promotion/feed efficiency affects your economic bottom line (any information you are willing to share about profits per change in unit of feed conversion, differences in daily gain, costs of the antibiotics per head, differences in grading or meat quality when slaughtered as a result, etc.)

E. Use of *in-feed* antibiotics specifically *for disease prevention*

1. Some contractors do not know the content of their feed. Do you know if you use *in-feed* antibiotics to prevent disease? If so, what diseases?
2. Do all hogs on your operation get antibiotics *in feed* to prevent these diseases?
3. If you do not provide antibiotics *in-feed* for disease prevention *to all hogs*, how do you make decisions about which hogs receive in-feed antibiotics for disease prevention? Do you make these decisions, or does a representative of the contractor (e.g., veterinarian or nutritionist)?
4. Are these in feed antibiotics currently administered under the oversight of a veterinarian (i.e., through a VFD or prescription)?
5. What can you tell us about how this affect your economic bottom line?

F. Use of *in-water* antibiotics specifically *for disease prevention*

6. Some contractors do not know the content of their feed. Do you know if you use *in-water* antibiotics to prevent disease? If so, what diseases?
7. Do all hogs on your operation get antibiotics *in water* to prevent these diseases?
8. If you do not provide antibiotics *in-water* for disease prevention *to all hogs*, how do you make decisions about which hogs receive in-water antibiotics for disease prevention? Do you make these decisions, or does a representative of the contractor (e.g., veterinarian or nutritionist)?
9. Are these in water antibiotics currently administered under the oversight of a veterinarian (i.e., through a VFD or prescription)?
10. What can you tell us about how this affects your economic bottom line?

G. Use of *injected* antibiotics specifically for disease prevention

1. Do you use *injected* antibiotics to prevent disease? If so, what diseases?
2. Do all hogs get antibiotics *injected* to prevent these diseases?

3. If you do not provide antibiotics via injection for disease prevention *to all hogs*, how do you make decisions about which hogs receive injectable antibiotics for disease prevention?
4. Are these injected antibiotics currently administered under the oversight of a veterinarian or are they purchased and administered over-the-counter?
5. What can you tell us about how this affects your economic bottom line?
6. Does the integrator pay for these interventions, or do you?
7. Does the integrator provide veterinarian or other guidance on disease treatment with antibiotics?

H. Diets, feed, and non-antibiotic feed additives

1. Can you tell me about the rations for different groups of animals? Do different groups get different rations (i.e., by age, weight, disease risk)? Who determines rations, and how many different rations are there during the time when the animals are on your operation?
2. What types of non-antibiotic feed additives do you use, if any?

I. Relationship to feed mills

1. Does your integrator provide all feed, or do you also purchase or mill any of your own feed?
2. Do you have your own feed mill and mix your own medicated feeds?
3. If not, where do you get your feed, and how do you provide instructions/order feed? How do you order/purchase medicated feed (is it the same?)
4. If you use medicated feed from a separate feed mill, are there records kept by you and/or the feed mill, such as a VFD?

J. Current relationship/use of veterinarians and veterinary services

1. Do you have a relationship with a veterinarian?
2. If so, what category (or categories) of veterinarian do you currently use? (i.e., full-time veterinarian on your operation, veterinarian employed by a parent company full time that is assigned to work with you, local large animal vet)
3. If you do have a veterinarian, how often do you interact with your vet by phone or email?
4. If you do have a veterinarian, how often are they on site?
5. If you do have a veterinarian, are you using them for advice about disease prevention, to prescribe treatment for sick animals, anything else?

QUESTIONS REGARDING ANTICIPATED CHANGES AT THE OPERATION DUE TO FDA GUIDANCES:

K. Changes in veterinarian access and use. The FDA guidelines require producers to a) have a relationship with a veterinarian (a Veterinary Client Patient Relationship –

VCPR), and b) have all medically important antibiotics prescribed or overseen (in the case of a VFD) by a veterinarian.

1. Do you anticipate or have you found the requirement for a VCPR to be difficult/burdensome? Do you have access to a large-animal vet? Are there enough large animal vets in your region?
2. How will the need to use a veterinarian affect how you treat animals? In what way?
3. Will these requirements increase your costs, and how significantly?
4. Will these requirements increase the time you spend in record-keeping? How significantly?

L. Production changes related to no longer using medically important antibiotics for growth promotion/feed efficiency.

1. Have you increased biosecurity, changed management practices, or made other adjustments to your production line, *in order to prepare for not using medically important antibiotics for growth promotion/feed efficiency?*
2. How costly have these been to you (the producer)? Has the contractor provided any financial assistance for these changes?

M. Expectations of animal health and productivity

1. Are animals expected to grow more slowly or require more feed per unit of weight gain? Do you expect to have higher death losses?
2. Do you expect to have to use more antibiotics for disease prevention or treatment, or to access a veterinarian more frequently?
3. Which diseases (if any) do you expect to become more prevalent or more of a problem?

N. Changes to contracts

1. If your operation's feed efficiency declines based on your feed no longer having antibiotics, will your integrator provide more feed per animal (adjusting for age, etc.)?
2. Do you anticipate having to renegotiate your contract, based on any changes in costs to you related to the FDA changes?
3. Do you anticipate your integrator will require changes to your management methods or operation, based on the FDA changes? Who do you anticipate will bear the costs of these changes – you or the integrator?

QUESTIONS FOR OPERATIONS WITH RAISED WITHOUT ANTIBIOTICS PRODUCTION

1. Do you *raise* animals without the use of *any* antibiotics?
2. If yes to either of the above, what percentage of your animals are RWA? Do you have two lines (the RWA and conventional lines) on the same operation? Do you

only produce RWA? Does this vary over time, depending upon the needs of the company?

3. At what point in time did you convert to or begin RWA production? Why did this transition happen?
4. What were the biggest challenges when converting to RWA?
5. Do you experience higher costs related to RWA production, compared to conventional? What are the primary drivers of these costs?
6. Can you comment on how overall antibiotic use compares between RWA and conventional production?
7. How do you decide when to administer antibiotics to an animal or group of animals that would have been in an RWA line?
8. What happens when these animals (that would have otherwise been in an RWA) are treated with antibiotics?

APPENDIX C – SURVEY FOR HOG INTEGRATORS

QUESTIONS REGARDING BUSINESS STRUCTURE:

A. Basics of the business

1. What is the average number of hogs that your company brings to market annually?
2. Can you provide an overview of your business model? (e.g., a portion of your business contracts with individual producers, a portion has integrator-owned production facilities, your company owns a feed mill, your company owns a processing facility, etc.)
3. With how many operations does your company contract?
4. How many operations/sites does your company own?
5. Do you own your processing facilities or contract with them?
6. Do you purchase animals from other companies?
7. Do you purchase animals from companies or operations based in other countries?
8. How far do you ship animals between locations (i.e., between nursery and feeder pig operations, or feeder and finishing operations)
9. Do you sell internationally? Which countries are your largest markets?
10. Do you have a product line that is "raised without antibiotics"?

B. Diseases of concern

1. What are the most common diseases at hog operations with which your company contracts?
2. What are the common treatments for the most common diseases?

C. Management of animal health in between locations

1. What are the methods that your company uses to reduce disease risk when transporting animals between locations?

D. Management of animal health via contractual relationship with hog operations

1. Do you provide feed to your contractors?
2. Do you provide veterinary oversight?
3. Do you require management practices related to animal health, such as biosecurity measures? Do you provide training, financial assistance, or other aid in performing these management practices?
4. Do you require certain features of barns or operations for animal health? (for example, ventilated barns) Do you provide financial assistance or other aid in constructing these barns or operation features?
5. Do you require that animals have specific vaccines, and do you provide the delivery of these vaccines?

6. What types of management practices or other overall farm characteristics differentiate a contractor with excellent outcomes from one with lesser outcomes?

E. Use of antibiotics specifically for purposes of growth promotion or feed efficiency

1. Do you provide antibiotics for growth promotion or feed efficiency on some or all of your contractors?
2. If you provide antibiotics for growth promotion or feed efficiency for some but not all contractors, how does your company make decisions about whether to feed an antibiotic for feed efficiency/growth promotion reasons?
3. What can you tell us about how this affects your economic bottom line (any information you are willing to share about profits per change in unit of feed conversion, differences in daily gain, costs of the antibiotics per head, differences in grading or meat quality when slaughtered as a result, etc.)

F. Use of *in-feed* antibiotics specifically *for disease prevention*

1. Does your company provide *in-feed* antibiotics to prevent disease to your contractors? If so, what diseases are these meant to prevent?
2. Does your company provide *all* contractors with antibiotics *in feed* to prevent these diseases?
3. If you do not provide antibiotics *in-feed* for disease prevention *to all contractors*, how do you make decisions about which contractors receive in-feed antibiotics for disease prevention?
4. Are these in feed antibiotics currently administered under the oversight of a veterinarian (i.e., through a VFD or prescription)?
5. What can you tell us about how this affects your economic bottom line?

G. Use of *in-water* antibiotics specifically *for disease prevention*

6. Does your company provide *in-water* antibiotics to prevent disease to your contractors? If so, what diseases are these meant to prevent?
7. Does your company provide *all* contractors with antibiotics *in water* to prevent these diseases?
8. If you do not provide antibiotics *in-water* for disease prevention *to all contractors*, how do you make decisions about which contractors receive in-water antibiotics for disease prevention?
9. Are these in water antibiotics currently administered under the oversight of a veterinarian (i.e., through a VFD or prescription)?
10. What can you tell us about how this affects your economic bottom line?

H. Use of *injected* antibiotics specifically for disease prevention

1. Does your company use *injected* antibiotics to prevent disease? If so, what diseases?
2. Do all hogs get antibiotics *injected* to prevent these diseases?

3. If you do not provide antibiotics via injection for disease prevention *to all hogs*, how do you make decisions about which hogs receive injectable antibiotics for disease prevention?
4. Are these injected antibiotics currently administered under the oversight of a veterinarian or are they purchased and administered over-the-counter?
5. What can you tell us about how this affects your economic bottom line?
6. Does the contractor pay for these interventions, or do you?
7. Does the contractor provide veterinarian or other guidance on disease treatment with antibiotics?

I. Diets, feed, and non-antibiotic feed additives

1. Can you tell me about the rations for different groups of animals? Do different groups get different rations (i.e., by age, weight, disease risk)? How do you determine rations? How many different rations do you have?
2. What types of non-antibiotic feed additives do you use, if any?

J. Relationship to feed mills

1. Do you have your own feed mill and mix your own medicated feeds?
2. If not, where do you get your feed, and how do you provide instructions/order feed? How do you order/purchase medicated feed (is it the same?)
3. If you use medicated feed from a separate feed mill, are there records kept by you and/or the feed mill, such as a VFD?

K. Veterinarians associated with integrators

1. How many veterinarians do you have on staff, and what geographic areas/types of operations do they cover?
2. Can you describe the functions of the veterinarians? Do they define the rations? Do they visit operations to help with disease management?
3. Do the veterinarians make regularly scheduled visits to producers, or only visit if an issue comes up?

QUESTIONS REGARDING ANTICIPATED CHANGES DUE TO FDA GUIDANCES:

L. Changes in veterinarian access and use. The FDA guidelines require producers to a) have a relationship with a veterinarian (a Veterinary Client Patient Relationship – VCPR), and b) have all medically important antibiotics prescribed or overseen (in the case of a VFD) by a veterinarian.

1. Do you anticipate or have you found the requirement for a VCPR to be difficult/burdensome? Does the integrated nature of your organization help satisfy this requirement? (i.e., because you have veterinarians on staff, your producers already have a relationship with a veterinarian?)
2. Will these requirements increase your costs, and how significantly?

3. Will these requirement increase the time you spend in record-keeping? How significantly?

M. Production changes related to no longer using medically important antibiotics for growth promotion/feed efficiency.

1. Do you intend to or are you already reducing in-feed antibiotic use? How, and over what timeline?
2. Have you required your contractors to increase biosecurity, change management practices, or make other adjustments to your production line, *in order to prepare for not using medically important antibiotics for growth promotion/feed efficiency?* How costly have these been to your company?

N. Expectations of animal health and productivity

1. Are animals expected to grow more slowly or require more feed per unit of weight gain? Do you expect to have higher death losses?
2. Do you expect to have to use more antibiotics for disease prevention or treatment, or to hire more veterinarians with the expectation that they will be in higher demand?
3. Which diseases (if any) do you expect to become more prevalent or more of a problem?

O. Changes to contracts

1. If you anticipate feed efficiency declining based on your feed no longer having medically important antibiotics, do you anticipate having to provide more feed to your contractors?
2. Do you anticipate you will require contract producers to change management practices or make upgrades to barns or other infrastructure as a result of the FDA changes? Who do you anticipate will bear the costs of these changes – you or the contractor?
3. Will the prices you pay do your contract producers change as a result of any of these new requirements?

QUESTIONS FOR INTEGRATORS WITH A "RAISED WITHOUT ANTIBIOTICS" PRODUCT LINE

1. Do you market products that are raised without the use of any antibiotics (as specified under FSIS processing label standards and/or organic practice standards)?
2. What percentage of your animals are RWA?
3. Tell us what your RWA production model looks like. How is RWA production structured? Do you have two lines (the RWA and conventional lines) on the same operation? Do you only produce RWA?
4. What encouraged you convert to or begin RWA production?
5. What were the biggest challenges when converting to RWA?

6. Do you experience higher costs related to RWA production, compared to conventional? What are the primary drivers of these costs?
7. How does overall antibiotic use compare between RWA and conventional production?
8. How do you decide when to administer antibiotics to an animal or group of animals that would have been in an RWA line?
9. What happens when these animals (that would have otherwise been in an RWA) are treated with antibiotics?

APPENDIX D – SURVEY FOR SWINE NUTRITIONISTS

A. Background information

1. Please describe your professional activities. For example, is 100% of your time spent working for a specific integrator? Are you an independent nutritionist who works with multiple large companies? Do you work with small producers?
2. Tell us a little bit about how you design an animal's diet to meet their nutritional and health needs.
3. How have diets for hogs at different life stages changed during your time in the industry? What types of changes do you see going on right now in the industry as a whole, or in your company?

B. Preparation for the new FDA requirements

1. How have you been preparing for the changes required by the FDA? Has your company feed for some or all operations? If so, what other types of changes to animals' diets have accompanied these changes?
2. Are there any new non-antibiotic feed additives you use or have begun to use more frequently as a result of these changes?
3. Have you been approached by more potential clients due to GFI 209 &213?
4. How will your relationships with company veterinarians and feed mills change as a result of the new requirements?
5. What are your major concerns with the new requirements?

C. RWA production

1. Do you attend to animals that are "raised without antibiotics" (per the specific FSIS and/or organic label standards)?
2. How are diets different in RWA production for different life stages? Are there any alternative products/feed additives that you are more likely to use?
3. Do you feel like designing diets/rations for RWA production is more challenging, compared to conventional production?

APPENDIX E – SURVEY FOR SWINE VETERINARIANS

A. Background information

4. Please describe your practice. For example, is 100% of your practice spent working for a specific integrator? Are you an independent veterinarian who works with multiple large companies? Do you work with small producers?

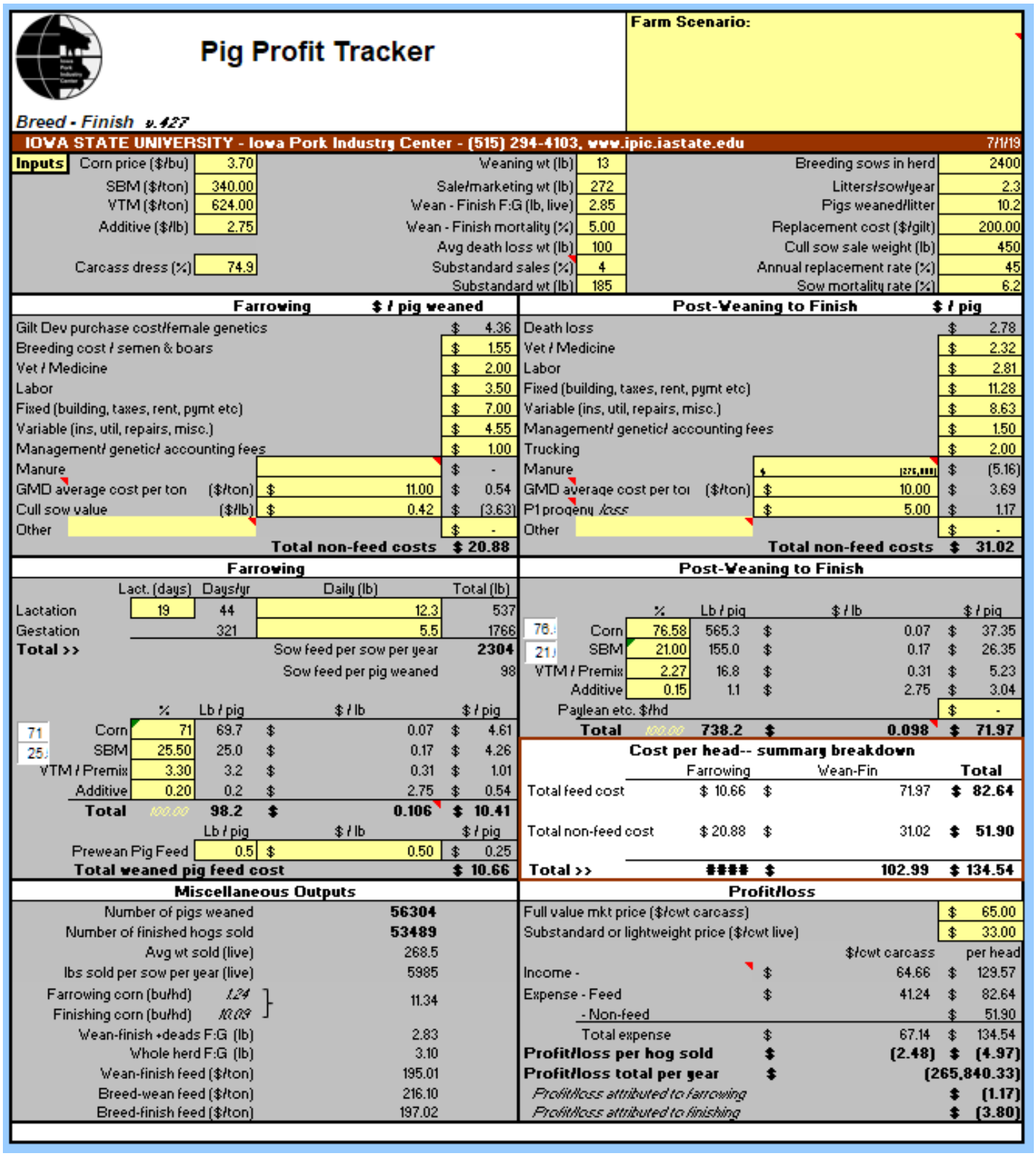
B. Preparation for the new FDA requirements

1. How have you been preparing for the changes required by the FDA?
2. Have you become licensed in additional states in preparation to serve a wider geographic set of producers?
3. Have you been approached by more potential clients due to GFI 209 &213?
4. What are your major concerns with the new requirements?

C. RWA production

1. Do you attend to animals that are "raised without antibiotics" (per the specific FSIS and/or organic label standards)?
2. How do you do things differently in RWA production? What are the alternative products that you are more likely to use?
3. Do you feel like your role in production is greater or lesser in RWA production, compared to conventional production?

APPENDIX F – PIG PROFIT TRACKER (PPT) BASE SCENARIO



Pig Profit Tracker

Farm Scenario:

Breed - Finish v.427

IOWA STATE UNIVERSITY - Iowa Pork Industry Center - (515) 294-4103, www.ipic.iastate.edu 7/1/19

Inputs

Corn price ($/bu)	3.70	Weaning wt (lb)	13	Breeding sows in herd	2400
SBM ($/ton)	340.00	Sale/marketing wt (lb)	272	Litters/sow/year	2.3
VTM ($/ton)	624.00	Wean - Finish F:G (lb, live)	2.85	Pigs weaned/litter	10.2
Additive ($/lb)	2.75	Wean - Finish mortality (%)	5.00	Replacement cost ($/gilt)	200.00
		Avg death loss wt (lb)	100	Cull sow sale weight (lb)	450
Carcass dress (%)	74.9	Substandard sales (%)	4	Annual replacement rate (%)	45
		Substandard wt (lb)	185	Sow mortality rate (%)	6.2

Farrowing — $ / pig weaned

Gilt Dev purchase cost/female genetics			$ 4.36
Breeding cost / semen & boars			$ 1.55
Vet / Medicine			$ 2.00
Labor			$ 3.50
Fixed (building, taxes, rent, pymt etc)			$ 7.00
Variable (ins, util, repairs, misc.)			$ 4.55
Management/ genetic/ accounting fees			$ 1.00
Manure			$ -
GMD average cost per ton ($/ton)	$	11.00	$ 0.54
Cull sow value ($/lb)	$	0.42	$ (3.63)
Other			$ -
Total non-feed costs			**$ 20.88**

Post-Weaning to Finish — $ / pig

Death loss			$ 2.78
Vet / Medicine			$ 2.32
Labor			$ 2.81
Fixed (building, taxes, rent, pymt etc)			$ 11.28
Variable (ins, util, repairs, misc.)			$ 8.63
Management/ genetic/ accounting fees			$ 1.50
Trucking			$ 2.00
Manure	$	[redacted]	$ (5.16)
GMD average cost per ton ($/ton)	$	10.00	$ 3.69
P1 progeny /pig loss	$	5.00	$ 1.17
Other			$ -
Total non-feed costs			**$ 31.02**

Farrowing

	Lact. (days)	Days/yr	Daily (lb)	Total (lb)
Lactation	19	44	12.3	537
Gestation		321	5.5	1766
Total >>			Sow feed per sow per year	**2304**
			Sow feed per pig weaned	98

	%	Lb / pig	$ / lb	$ / pig
71 Corn	71	69.7	$ 0.07	$ 4.61
25 SBM	25.50	25.0	$ 0.17	$ 4.26
VTM / Premix	3.30	3.2	$ 0.31	$ 1.01
Additive	0.20	0.2	$ 2.75	$ 0.54
Total	100.00	**98.2**	**$ 0.106**	**$ 10.41**

	Lb / pig	$ / lb	$ / pig
Prewean Pig Feed	0.5	$ 0.50	$ 0.25
Total weaned pig feed cost			**$ 10.66**

Post-Weaning to Finish

	%	Lb / pig	$ / lb	$ / pig
76 Corn	76.58	565.3	$ 0.07	$ 37.35
21 SBM	21.00	155.0	$ 0.17	$ 26.35
VTM / Premix	2.27	16.8	$ 0.31	$ 5.23
Additive	0.15	1.1	$ 2.75	$ 3.04
Paylean etc. $/hd				$ -
Total	100.00	**738.2**	**$ 0.098**	**$ 71.97**

Cost per head-- summary breakdown

	Farrowing	Wean-Fin	Total
Total feed cost	$ 10.66	$ 71.97	**$ 82.64**
Total non-feed cost	$ 20.88	$ 31.02	**$ 51.90**
Total >>	**####**	**$ 102.99**	**$ 134.54**

Miscellaneous Outputs

Number of pigs weaned	**56304**
Number of finished hogs sold	**53489**
Avg wt sold (live)	268.5
lbs sold per sow per year (live)	5985
Farrowing corn (bu/hd) 1.24	11.34
Finishing corn (bu/hd) 10.09	
Wean-finish +deads F:G (lb)	2.83
Whole herd F:G (lb)	3.10
Wean-finish feed ($/ton)	195.01
Breed-wean feed ($/ton)	216.10
Breed-finish feed ($/ton)	197.02

Profit/loss

		$/cwt carcass	per head
Full value mkt price ($/cwt carcass)			$ 65.00
Substandard or lightweight price ($/cwt live)			$ 33.00
Income -	$	64.66	$ 129.57
Expense - Feed	$	41.24	$ 82.64
- Non-feed			$ 51.90
Total expense	$	67.14	$ 134.54
Profit/loss per hog sold	**$**	**(2.48)**	**$ (4.97)**
Profit/loss total per year	**$**		**(265,840.33)**
Profit/loss attributed to farrowing			**$ (1.17)**
Profit/loss attributed to finishing			**$ (3.80)**