Timely On-Farm Euthanasia of Pigs:
Exploring Caretaker Decision-Making and Training Methods

THESIS

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By

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Abstract

Though 115 million pigs are marketed and slaughtered annually in the United States (U.S.), pre-slaughter swine mortality still reaches the scale of millions, especially for piglets. On-farm swine mortality consists of both natural death and death caused by the administration of euthanasia by the pig caretaker. Euthanasia, derived from two Greek terms meaning ‘good’ and ‘death,’ enables pig caretakers to humanely end the life of a pig when recovery from injury or illness is impossible or after attempts to treat the pig have failed. Administering euthanasia demonstrates compassion for the life of the animal and helps reduce the incidence of poor welfare outcomes for compromised pigs.

As a welfare tool, the U.S. Common Swine Industry Audit (CSIA) serves as an assurance for swine industry stakeholders of the standard of pig care, and it details specific timely euthanasia requirements. Despite these and other industry guidelines, anecdotal evidence suggests that timeliness of euthanasia on swine farms remains a challenge for the industry. Therefore, ensuring timely euthanasia requires the technical skills to understand euthanasia guidelines and make decisions to perform euthanasia when needed.

To assess swine industry leaders’ understanding of current CSIA guidelines, a survey was conducted with 37 members of the U.S. National Pork Board. ‘Euthanasia
scores,’ a set of proxy numbers developed for this study, were assigned by participants to indicate their beliefs about proper euthanasia time frames for 26 clinical conditions. Results demonstrate that disagreement exists between industry leaders and CSIA guidelines. This was especially apparent when evaluating ‘non-ambulatory,’ ‘uterine prolapses,’ and ‘perforated hernias,’ where only 61.3, 74.2, and 86.7% of respondents, respectively, assigned score 1 (Euthanize immediately) despite the fact that these clinical signs warrant immediate euthanasia under the CSIA. Furthermore, two focus groups (n=18) were conducted with members of the U.S. National Pork Board to evaluate barriers to timely euthanasia and factors which influence the decision-making process. In addition to logistical—e.g., availability of suitable equipment—and economic barriers, participants suggested that an unsupportive farm culture and lack of caretaker accountability are key determinants in permitting untimely euthanasia.

Equipping swine caretakers with euthanasia skills is predominantly conducted as ‘on-the-job’ training. However, evidence from other studies suggests that interactive multimedia-based learning that caters to adult learners’ unique needs offers advantages related to information retention, satisfaction, clinical decision-making, and perceived credibility. Therefore, a computer- and case study-based training program [On-Farm Swine Euthanasia: Making Timely Decisions] was developed as a means to improve the timeliness of euthanasia decision-making in the U.S. By providing feedback to users as they make management decisions for compromised pigs, the program aims to improve caretakers’ understanding of CSIA euthanasia guidelines, and abilities to identify compromised pigs and recognize euthanasia endpoints.
The results of this research indicate a need to develop educational materials for industry leaders to encourage top-down timely decision-making and consistency of euthanasia recommendations. Additionally, opportunities exist to further evaluate the acceptability and efficacy of the interactive computer-based training program for swine caretakers.
Acknowledgements

First and foremost, I would like to express my deep gratitude to Dr. Monique Pairis-Garcia, an advisor who consistently provided constructive feedback, allowed me industry experience, supported my personal and professional goals, shared her love of pigs, and demonstrated compassion and understanding throughout my two years. I move on to veterinary school having a deeper understanding and appreciation for the role of animal behavior and welfare in animal production. Secondly, thank you to Dr. Henry Zerby and Dr. Tony Parker, with whom I had the immense pleasure of learning, growing both personally and professionally, seeking guidance and advice, and getting through difficult times. Thank you also to Dr. Andy Bowman, a dedicated committee member who provided advice and guidance along the way and shared with me his knowledge of swine health. Thank you to Dr. Magnus Campler, an outstanding research partner who spent countless hours editing papers, abstracts, videos, photos, and software, and always kept the sense of humor in the lab. Thank you to my lab partners, Allison Pullin and Brady Campbell, for their assistance, advice, humor, and friendship through the thick and thin. Thank you to Mariette Benage for her kind words and mentorship, and to my co-authors for their many revisions and suggestions to improve the papers. Thank you also to The Ohio State University Graduate School and Ohio Agricultural Research and
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Fields of Study

Major Field: Animal Sciences

Emphasis: Animal welfare and behavior
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Chapter 1

Literature Review

1. Introduction

In the swine industry, pigs may be removed from the herd earlier than expected by either culling or humane euthanasia. Culling is defined as the early removal of a pig during production (Stein et al., 1990) to be processed for meat consumption or sold to another producer while the term euthanasia is defined as good death and is derived from the two Greek terms eu meaning good and thanatos meaning death. Euthanasia is implemented on-farm to eliminate animal suffering when there is a low likelihood of recovery for the animal and continued life produces excessive suffering (AVMA, 2013). Those animals euthanized on-farm will not enter the food supply chain or be used for any additional processed products.

This literature review will address the importance of timely euthanasia from an animal welfare standpoint for all swine production stages. Following this, common indications for euthanasia across all production stages will be addressed in addition to challenges associated with euthanasia decision-making for each production stage. This review will then include a brief overview on decision trees utilized for on-farm
euthanasia decisions in swine and other animal industries and a discussion of the challenges and benefits for training swine caretakers on euthanasia. This review will conclude with a discussion of caretaker characteristics and psychological implications associated with euthanasia decision-making.

1.1 Euthanasia

The definition of animal welfare has many meanings, with some defining an individual animal’s welfare as “its state as regards its attempts to cope with its environment” (Broom, 1986, p524) while others define it as a freedom from disease, injury, suffering, pain, and distress (Fraser, 1993). Regardless of the definition, timely and effective euthanasia is a critical component in ensuring good welfare by eliminating unnecessary suffering due to disease or injury.

Euthanasia is a part of regular pig husbandry (NPB & AASV, 2008), and it is a critical tool used to eliminate animal suffering (AVMA, 2013). The caretaker is responsible for visually assessing individual pigs and identifying those that are compromised. Depending on the severity and chronicity of the pig’s condition, the caretaker must undertake the decision-making process to either segregate and treat the pig or euthanize (Turner & Doonan, 2010). The decision-making process and performance thus ultimately falls to the caretaker (Morrow et al., 2006; Turner & Doonan, 2010; Gemus-Benjamin et al., 2015). Therefore, equipping caretakers with the educational tools to make good decisions on euthanasia and teaching caretakers the skills to competently perform euthanasia is critical.
Making timely decisions regarding euthanasia is important from an animal welfare standpoint as it provides the ability to end pain and suffering (Fraser et al., 2013). Suffering is defined as experiencing unpleasant or adverse mental states and physiological distress (Morton, 1998) as a result of unmanaged physical or emotional pain and/or discomfort (Spinelli & Markowitz, 1987). Gonyou (2001) indicated that an animal’s welfare can be improved by reducing the incidence, duration, and severity of conditions that result in pain and suffering to the pig. Timely euthanasia acknowledges the importance of these considerations and maximizes the quality of life for the animal by eliminating negative affective and physiological states associated with suffering.

As a whole, animal management decisions, which include euthanasia, must consider the economic impacts on a producer and the humaneness of the consequences for the animal (Hemsworth, 2007). Timely euthanasia involves subjectively considering the careful balance between euthanizing a pig too early and losing the economic investment of that individual, and waiting too long, resulting in that pig experiencing physical and mental suffering (Morrow et al., 2006).

Decisions to euthanize can also have an impact on consumer perceptions of the swine industry. Some consumers recognize that pigs may need to be euthanized during the course of their lives (DeDecker, 2012), and many believe euthanasia can be an appropriate endpoint for compromised animals (Yildirim & Kadioglu, 2014). However, methods of euthanasia, especially manual blunt force trauma, have faced criticism from consumers and caretakers as being visually distressing (Rault et al., 2013). Furthermore, the lack of timely euthanasia and subsequent suffering of individual pigs have prompted
significant concern from the public (Rushen, 2003), those in the field of veterinary medicine (Herzog et al., 1989; Morrow et al., 2006), retailers, and consumers of pork.

1.2 Need for euthanasia

Euthanasia is not a one-step process. It requires the skill and knowledge to identify compromised individuals, treat, manage, and in some situations, make timely decisions to euthanize. In any livestock operation, there will be a small proportion of animals that become sick or ill to the extent that they will not be able to recover. In these cases, euthanasia is required to minimize unnecessary pain and suffering (NPB & AASV, 2008).

Recognizing the difficulty sometimes associated with decision-making on-farm and the importance of timely euthanasia from welfare and consumer standpoints, the U.S. swine industry has supported the development of research and extension programs to assure appropriate and timely on-farm euthanasia decisions. These programs include the 2017 Common Swine Industry Audit (CSIA), Iowa Swine Welfare School, and Care of Compromised Pig workshops at The Ohio State University. Furthermore, the Pork Checkoff Animal Welfare Advisory Committee has committed to supporting research related to pig euthanasia since 2002 and has since funded 14 euthanasia-specific projects, emphasizing the importance of a humane death.

In Table 1, data from the 2015 Pork Industry Productivity Analysis study (Stalder, 2016) demonstrates percent mortality by production stage from 2011-2015. Changes to mortality occur across all production stages and mortality rates increase dramatically as a reflection of current disease challenges on-farm. Such an example of
this was the dramatic increase in piglet mortality in 2014 due to national widespread impact of porcine epidemic diarrhea virus (PEDV) following its introduction to North America in 2013. Though PEDV primarily affects pre-weaning piglets, data suggest that the increased on-farm mortality in the nursery and grower-finisher stages seen during 2014 may have been due to poorer pig growth performance (Stalder, 2016) or viability (Alvarez et al., 2015).

<table>
<thead>
<tr>
<th>Production Stage</th>
<th>Year 2011</th>
<th>Year 2012</th>
<th>Year 2013</th>
<th>Year 2014</th>
<th>Year 2015</th>
<th>National Pig Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-weaning piglets</td>
<td>15.5%</td>
<td>15.5%</td>
<td>17.3%</td>
<td>20.5%</td>
<td>17.4%</td>
<td>120,833,000</td>
</tr>
<tr>
<td>Nursery pigs</td>
<td>4.32%</td>
<td>3.80%</td>
<td>3.87%</td>
<td>5.47%</td>
<td>5.22%</td>
<td>62,387,000</td>
</tr>
<tr>
<td>Conventional finisher pigs</td>
<td>4.48%</td>
<td>5.03%</td>
<td>5.04%</td>
<td>5.78%</td>
<td>5.53%</td>
<td>6,002,000</td>
</tr>
<tr>
<td>Breeding pigs</td>
<td>9.18%</td>
<td>8.12%</td>
<td>8.36%</td>
<td>8.81%</td>
<td>8.94%</td>
<td>6,002,000</td>
</tr>
</tbody>
</table>

1From the 2015 Pork Industry Productivity Analysis report (Stalder, 2016).
2From the USDA Quarterly Hogs and Pigs Report (USDA, 2016).
3One-year piglet crop from December 2014-November 2015 [59,219,000 + 61,614,000].
4Market hog inventory as of December 1, 2015.
5Breeding hog inventory as of December 1, 2015.
6From the PigCHAMP Benchmarking summaries 2011-2015 (PigCHAMP, 2017).

Table 1.1. National average percent mortality of pigs in different production stages from 2011-2015 and national pig inventory and pig crop in 2015

As of December 1, 2015, the total current U.S. pig inventory was 68.4 million pigs (USDA, 2016). Based on the 2015 crop of approximately 121 million weaned pigs (USDA, 2016) and a 17.4% pre-weaning mortality rate (Stalder, 2016), it can be estimated that approximately 25 million piglets died in the first several weeks of life. Though this 2015 mortality rate represents a slightly greater rate than for 2011-2012 due to losses caused by PEDV, the magnitude of on-farm mortality for all years is significant.
While mortality rates do not differentiate between natural death and on-farm euthanasia, which has not been investigated in the national swine herd, swine caretakers must make on-farm euthanasia decisions for any pig that becomes compromised. Data regarding euthanasia rates in nursery, grower-finisher, and breeding pigs is limited. Thus, timely euthanasia decisions are of paramount concern for the industry as the annual number of pigs euthanized can be significant.

2. Swine mortality

2.1 Culling

Cull pigs are those fit for transport that are removed from the herd and slaughtered or sold because they are not meeting expected performance standards, or the producer is facing space constraints or trying to control disease, among other reasons. Thus, sows, boars, nursery pigs, and grower-finisher pigs may leave the farm as a result of culling, natural death, or euthanasia. Grower-finisher pigs may also leave the farm to be commercially slaughtered upon reaching a marketable weight. The cull pig population is chosen based on severity of a condition, the pig’s ability to successfully complete transportation, and its estimated market value. Therefore, culling of pigs is not an animal welfare concern unless compromised pigs are placed onto trucks. However, concerns may arise if compromised pigs are kept on-farm for extended periods of time due to a delay in transport or producer’s efforts to bring the pig to a suitable condition to cull instead of euthanizing.

Sows and boars are commonly culled once they begin to display reduced reproductive efficiency (Dagorn & Aumaitre, 1979; Argañosa et al., 1981; D’Allaire &
Leman, 1990; Stein et al., 1990; Christensen et al., 1995; Engblom et al., 2007; Koketsu & Sasaki, 2009; Mote et al., 2009; Segura-Correa et al., 2010; de Jong et al., 2014), although non-specific disease (Segura-Correa et al., 2010), generalized leg problems (D’Allaire & Leman, 1990; Sanz et al., 2007; Knox et al., 2008), and age (Mote et al., 2009) have also been indicated.

There is a lack of literature detailing the exact causes for culling within nursery and grower-finisher herds. However, experiential evidence from swine producers suggests these pigs may be culled if they do not display adequate growth rates or develop conditions which may impact future growth and well-being. Hernias, prolapses, respiratory disease, severe lameness, aggression-related injuries, and neurological disease are all causes for culling. Additionally, growing pigs which appear anemic (“white”) or are unable to compete with pen mates for access to feed and water may be culled.

2.2 Common causes of sow and boar mortality

Sows and boars are kept on the farm longer than the typical finisher production period and generate income primarily as breeding stock as well as when sold for the cull market. Breeding pigs therefore represent a significant economic investment for producers but require time on-farm for a return in profit. For example, sows will not begin to make a profit for an operation until their third parity, in both breed-to-wean (Stalder et al., 2003) and farrow-to-finish operations (Stalder et al., 2000). This inherent economic value of a breeding pig is one of many considerations used by managers in making euthanasia decisions on-farm (Morrow et al., 2006), and sow replacement
decisions are increasingly taking into consideration a sow’s disease status and the associated negative impact on her welfare (Rodríguez et al., 2011).

Though much work has been done on identifying reasons for sow culling, less is known about the reasons for on-farm humane euthanasia. Sanz and colleagues (2007) found sows were routinely euthanized for arthritis, rectal and uterine prolapses, and respiratory diseases in North Carolina. Other conditions which have been noted as necessitating euthanasia include shoulder ulcers in Danish herds (Jensen et al., 2012); udder mastitis or abscesses in Swedish herds (Engblom et al., 2007); and digestive disorders including ulcers, peritonitis, urinary system disorders, and dystocia in Danish herds (Christensen et al., 1995). Though not indicated as a cause for euthanasia, Abiven and colleagues (1998) found that a high rate of urinary tract infections within a French sow herd was associated with mortality.

Unlike the sow, little literature is available regarding reasons for boar mortality, euthanasia, or culling. One of the primary papers addressing boar euthanasia noted the importance of euthanizing any boar that displayed locomotor problems (Koketsu & Sasaki, 2009).

2.3 Common causes of nursery and grower-finisher pig mortality

Though little information on causes for euthanasia of pigs intended for market slaughter is available, a couple of studies have detailed some common findings. The most common indications for humane euthanasia include respiratory and gastrointestinal diseases and disorders, locomotory-related problems including limb fractures (Straw et al., 1983), systemic infections, hernias, cardiovascular disease, and injuries related to the
integument (Baumann & Bilkei, 2002), which may be the result of antagonistic behaviors displayed during the mixing of new groups (Andersen et al., 2004; Guy et al., 2009; Scolo et al., 2013). Similar causes have been documented by both nursery and grower-finisher producers in the National Animal Health Monitoring System 2012 report (USDA, 2015).

As compared to piglets, identifying sick and compromised pigs may be more difficult in the nursery and grower-finisher stages based on the number of pigs placed in larger pens. Furthermore, grower-finisher pigs gain, on average, approximately 1.85 pounds per day during an average of 121 days in the barn (Stalder, 2016). This fast growth rate and large pig size present unique occupational safety issues as caretakers may have to enter pens to fully investigate each pig. Therefore, the safety of caretakers must be balanced with the caretaker’s need to closely examine and identify compromised pigs while in the facilities.

2.4 Common causes of piglet mortality

The neonatal period presents the greatest death losses in most swine operations, with most mortality occurring within the first few days of life (Bereskin et al., 1973; English & Morrison, 1984; Roehe & Kalm, 2000; Velarde et al., 2015). The most common causes of piglet death are hypothermia (Weary et al., 1996; Marchant et al., 2000; Edwards, 2002; Velarde et al., 2015), and crushing, defined as a piglet being overlain by the sow often resulting in musculoskeletal injuries, which may or may not immediately kill the piglet (English & Morrison, 1984; Spicer et al., 1986; Svendsen et al., 1986; Dyck & Swierstra, 1987). Both conditions most likely occur as a consequence
of small body size (Baxter et al., 2008), as low piglet weight at birth is a positive indicator of pre-weaning mortality (Bereskin et al., 1973; Kerr & Cameron, 1995; Roehe & Kalm, 2000). The potential for mortality also increases if piglets do not consume adequate colostrum early in life (Rutherford et al., 2013) which increases overall risk of low-viability due to generalized weakness and disease (Spicer et al., 1986; Vaillancourt et al., 1990; Shankar et al., 2009; USDA, 2015). Though specific causes of mortality may be identified by swine producers or caretakers, pre-weaning death is often the result of complex interactions amongst multiple factors (Shankar et al., 2009). Therefore, when making timely decisions regarding euthanasia, disease etiology or diagnosis may not be as important as recognizing critical care points that identify piglet success for recovery.

3. Use of decision trees

3.1 What are decision trees?

Russell and Norvig (2003) state that “a decision tree takes as input an object or situation described by a set of attributes and returns a ‘decision’–the predicted output value for the input” (p653). Decision trees contain a set of structured guidelines with associated questions (Meadows et al., 2005), which help classify situations or a set of data based on the answers to each question (Azar & El-Metwally, 2013). Each question is situated in a ‘node,’ which is connected to each child node by an arrow; the topmost node is known as the ‘root’ and the bottommost as a ‘leaf’ (Kingsford & Salzberg, 2008). Decision trees are an extremely useful tool in a wide variety of disciplines and practical applications because they are relatively simple (Kingsford & Salzberg, 2008), efficient, and provide support to those making decisions (Azar & El-Metwally, 2013). They have
been widely used in a range of non-animal disciplines and fields including medical ethical decisions (Storl et al., 1999), decisions regarding retribution in cases of staff misconduct (Meadows et al., 2005), and in computational biology research (Kingsford & Salzberg, 2008). Azar and El-Metwally (2013) suggest that decision trees can help radiologists more effectively diagnose breast cancer on mammogram scans, a task sometimes difficult to perform due to a doctor’s potential lack of objectivity. A similar approach using decision trees could be applied to the issue of timely euthanasia in the swine industry (Turner & Doonan, 2010). If compromised animals are over-treated or not euthanized when they are noticed, the animals may suffer unnecessarily due to subjective assessment of the animal’s prognosis (Yeates, 2010). Decision trees can therefore reduce the subjectivity involved in making euthanasia decisions and facilitate the decision-making process.

3.2 Currently available decision trees and euthanasia criteria in the swine industry

On commercial swine farms, euthanasia decisions may or may not be based on a standardized decision tree which delineates the specific conditions or situations when euthanasia is required. A set of clearly-defined endpoint criteria can reduce compromised pig suffering and input costs required for feed and treatment of pigs not likely to recover (Morrow et al., 2006; NPB, 2008). In addition, decision tree use on-farm is an important welfare assurance component of any swine operation (NPB & AASV, 2008; Turner & Doonan, 2010; NFACC, 2014; Gemus-Benjamin et al., 2015).

Though some farms do not have established euthanasia protocols at all, many producers follow either self-developed standards (Morrow et al., 2006), auditing program
standards, or the National Pork Board’s (NPB) and American Association of Swine Veterinarians’ (AASV) “On-Farm Euthanasia of Swine: Recommendations for the Producer” booklet (NPB & AASV, 2008).

For a decision tree to be effective, clear criteria for euthanasia must be defined. Humane endpoints on pig farms are varied and numerous, but several common issues continually recur. The issue of severe pain (AHA, 2013; HFAC, 2013; Wilson et al., 2014) and severe injury (NPB & AASV, 2008; Gemus-Benjamin et al., 2015) are frequently cited as triggers for immediate euthanasia. These criteria can be applied to all classes and ages of pigs. However, difficulty arises when making decisions to euthanize based on pain alone as pain is a subjective affective state and may be difficult to recognize (Wallace et al., 1990; CCAC, 1998). Pain may also be associated with a condition which is not visibly obvious to the caretaker but still includes a high degree of suffering (e.g., arthritis; Morrow et al., 2007). Turner and Doonan (2010) provided a simple example decision tree for on-farm use with weaner pigs, and this can be found in Figure 1.1. The decision tree identifies four pathways a caretaker can take in evaluating a sick pig based on its fitness for transportation, medication history, and response to treatment. However, this decision tree fails to provide firm guidelines on the degree or severity of the disease as it relates to timely euthanasia. Furthermore, it does not account for the wide variety of clinical signs which may be encountered on a swine farm. Nonetheless, it is a valuable template which can serve as a model for more comprehensive decision trees which incorporate a greater number of euthanasia criteria.
and may be expanded to include information on the euthanasia technique to be used, caretaker training, and proper carcass disposal.

Morrow and colleagues (2006) provided some guidance on euthanasia criteria as they relate to a pig’s clinical signs by conducting an extensive study investigating the economic and welfare considerations associated with euthanizing injured, diseased, or disadvantaged nursery pigs. This study identified the most common causes of euthanasia in several farm systems addressing wide variation in clinical signs ranging from aggression-related skin lesions to systemic disease and lameness issues. This study conceptualized the degree of suffering by assigning a numerical score from 0-10 for each clinical sign; signs which were classified as an 8, 9, or 10 indicated the greatest degree of

Figure 1.1. From Turner and Doonan, 2010

Morrow and colleagues (2006) provided some guidance on euthanasia criteria as they relate to a pig’s clinical signs by conducting an extensive study investigating the economic and welfare considerations associated with euthanizing injured, diseased, or disadvantaged nursery pigs. This study identified the most common causes of euthanasia in several farm systems addressing wide variation in clinical signs ranging from aggression-related skin lesions to systemic disease and lameness issues. This study conceptualized the degree of suffering by assigning a numerical score from 0-10 for each clinical sign; signs which were classified as an 8, 9, or 10 indicated the greatest degree of
pig pain and suffering and required immediate euthanasia. Such an approach allows for objectification of a pig’s clinical signs and health history and can be one approach to assessing negative pig welfare on-farm and determining when to euthanize. Decision trees may be developed by understanding to what extent an animal’s welfare is compromised and by utilizing a similar type of numerical scoring scheme to define situations when treatment should be stopped and/or immediate euthanasia is necessary. Though this project identified common health conditions of concern in a nursery population, it must be recognized that not all production systems will experience the same types and prevalence of health concerns due to differences in disease risk and severity based on geographical location (Morrow et al., 2006). Thus, a holistic approach that considers the farm’s production stage and common health concerns in combination with established industry guidelines and requirements can best equip a producer to understand their unique challenges and develop relevant decision-making aids.

From an industry-wide standpoint, development of euthanasia decision criteria has been implemented into national standards outlined by the AASV and the CSIA. The AASV is an international organization that strives to improve swine health and welfare through education of current and future swine veterinarians, advocacy for science-based solutions to veterinary and public health issues, and development and distribution of resources which encourage professional development (AASV, 2016). The CSIA, which was developed in 2014, is the first audit tool for use by pork producers nationwide. It addresses situations under which a pig should be immediately euthanized. Within both entities, guidelines have been developed to assist producers in making decisions based on
clinical conditions of swine. Since 2008, the swine industry has expanded upon its criteria for immediate euthanasia scenarios. On-farm euthanasia requirements and recommendations from both the 2017 CSIA and the 2008 AASV booklet are detailed and compared in Table 1.2. It should be noted that while two of the listed conditions (designated as “No” in Table 1.2) are not explicitly defined by the On-Farm Euthanasia of Swine Booklet (NPB & AASV, 2008), it is possible these conditions may have previously been considered to be covered by the criteria requiring euthanasia in cases where there is no prospect for recovery. The CSIA has further expanded on the previous document by more clearly stating euthanasia criteria for specific conditions.
<table>
<thead>
<tr>
<th><strong>Source</strong></th>
<th><strong>American Association of Swine Veterinarians and National Pork Board</strong>&lt;sup&gt;1&lt;/sup&gt;</th>
<th><strong>Common Swine Industry Audit</strong>&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigs which have shown no improvement in condition after two days of intensive care or which have no prospect for improvement</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Severely injured or non-ambulatory&lt;sup&gt;3&lt;/sup&gt; pigs which cannot recover</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Any non-ambulatory&lt;sup&gt;3&lt;/sup&gt; pig with a body condition score of 1</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Pigs with perforated or ulcerated hernias which are necrotic, or hernias which touch the ground while standing, are ulcerated, and impede movement</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Pigs which have uterine or necrotic prolapses</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<sup>1</sup>“On-Farm Euthanasia of Swine: Recommendations for the Producer” booklet; NPB & AASV, 2008

<sup>2</sup>NPB, 2017

<sup>3</sup>The NPB has defined a non-ambulatory animal as one which cannot rise or which can stand with support but cannot bear weight on two or more legs (NPB, 2017).

Table 1.2. Guidelines for timely euthanasia of pigs by two industry documents

Aside from the clearly-defined situations outlined by AASV, NPB, and CSIA, other guidelines do not directly define clear euthanasia criteria for pigs. Instead, they have emphasized several considerations to be made when producers are deciding on their farm-specific euthanasia criteria. These include evaluation of the animal’s pain and distress; their ability to reach food and water; ability to walk; potential risk for disease transmission; probability of recovery; and availability of any diagnostic information.
which may indicate the potential for recovery (NFACC, 2014). As a whole, the availability of some basic euthanasia criteria is available for swine producers from the CSIA, but this information is provided in a list format and does not take advantage of the usability and objectivity afforded by decision trees. Opportunities exist for greater exploration of the role that combining euthanasia criteria into a decision tree can play in facilitating on-farm decision-making.

3.3 Currently available standard euthanasia criteria for other species

To date, no other primary livestock industries have an industry-standard euthanasia decision tree for use by producers (Shulaw, 2005; NCC, 2010; AABP, 2013; NTF, 2013). In companion animal medicine, veterinarians and owners often employ a subjective assessment of the pet’s overall quality of life when making euthanasia decisions (Morrow et al., 2006). Specific medical reasons for euthanasia of dogs and cats are few and generally focus on specific populations of animals (Edney, 1998; Moore et al., 2001).

Perhaps the most research and guidelines on appropriate endpoints have been developed for laboratory animals, and such research on the development of euthanasia decision trees may be extrapolated to the swine industry. Weight loss, physical appearance (Morton & Griffiths, 1985), posture (Wallace et al., 1990), visible lesions (CCAC, 1998), discharges, body temperature, and decreased mobility (Hawkins, 2002) may all be considered as contributing factors in an assessment of animal suffering and be influential in making euthanasia decisions. Vision and respiratory function, eliminative behaviors, vocalization (Wallace et al., 1990), tachycardia, excessive sweating, and
salivating (Close et al., 1996) have all been implicated as key observations in determining endpoints for laboratory animals. Though each of these signs can indicate distress or pain, a combination of clinical signs may indicate severe pain and provide better guidance on when euthanasia is warranted (OECD, 2000). Morton and Griffiths (1985) suggested the use of an independent scoring system from 0-3 for five key factors — general appearance, bodyweight, vital signs, undisturbed behavior, and stimuli responses; the sum of each score from the five factors indicates the severity of the animal’s condition and prompts specific actions (i.e., 0-4 considered ‘normal,’ 5-9 indicates the need for further monitoring). However, the guidelines set forth by one laboratory are not always applicable to other laboratories, and researchers identify clinical signs specific to their study which may merit euthanasia (CCAC, 1998). Similarly, swine farms face a variety of circumstances unique to their operation, and conditions which may be prevalent or severe on one farm may not be as common on another. Thus, decision trees can and must be adaptable to individual operations.

4. Caretaker training

4.1 Caretaker training and animal welfare

The swine industry must continually train new employees, as the population from which to recruit potential caretakers is generally limited because farms are usually located in rural areas (Coleman, 2004), and job turnover rate is high (Cleary, 1990; Hemsworth & Coleman, 1998). Training programs can help increase an employee’s readiness to euthanize an animal (Reeve et al., 2004), yet some swine farms may offer little to no training (Ravel et al., 1996). Improving training protocols improves animal
welfare and audit performance in beef packing plants (Grandin, 2006) and in employees’ ability to recognize and alleviate laboratory animal discomfort (Hawkins, 2002; Anderson, 2007). Additionally, cognitive-behavioral intervention training has been successfully used in improving caretaker-animal interactions and handling in both the swine (Hemsworth et al., 1994) and dairy cattle industries (Hemsworth et al., 2002). Furthermore, effective swine caretaker training programs have been shown to be highly desirable to employees who requested more frequent training sessions (English et al., 1999b). In another study, English and colleagues (1999a) developed a training program which successfully improved caretakers’ detection and treatment of diseased animals. Caretakers vary greatly in their knowledge of swine management practices, with some caretakers requiring extensive training to gain the technical knowledge necessary to become a competent and sensitive caretaker (Cleary, 1990; Boivin et al., 2003; Turner & Doonan, 2010). For experienced caretakers, training programs may also need to target behavioral modification, a more difficult task than training designed for new employees who have no set tendencies or established behaviors (Coleman & Hemsworth, 2014).

As caretakers are often the ones making the treatment and euthanasia decisions (Blackwell, 2004), training to ensure competency in this area is critical. Regardless of the caretaker’s experience, a euthanasia training program should include information on indications for euthanasia, defined criteria for decision-making, and the need for timely euthanasia to reduce animal suffering (Reynolds, 2004). Though no official training requirements exist for caretakers in the swine industry, those farms wishing to pass the
CSIA must provide for initial and annual retraining of all employees, including those responsible for euthanasia, in the areas in which they work (NPB, 2017).

4.2 Types of training

Training programs for caretakers may include minimal formal education in which new employees shadow experienced caretakers or managers (English et al., 2002); farm-specific educational programs (English et al., 1999a); or training programs developed by an outside entity, such as the National Pork Board’s Pork Quality Assurance® Plus program (PQA Plus®; Cleary, 1990; NPB, 2013). On-the-job training may not be recognized by employees as an official training program, though satisfaction with that type of education can still be high (Howard et al., 1991). The method of delivery of training varies in its acceptability and efficacy and can have an impact on retention of the material presented. For example, Matthis (2004) found in a survey of swine caretakers in North Carolina that those who received in-person training were more willing to euthanize a compromised pig than those who only read company literature.

4.2.1 Multimedia training

Najjar (1996) defined “multimedia” as the “use of text, graphics, animation, pictures, video, and sound to present information” (p129). Multimedia training programs have been shown to increase flexibility of learning and possibly reduce alienation associated with a lack of understanding of the material (Klupiec et al., 2014). In addition, interactive training programs have been highlighted as useful in helping students focus by engaging them in the delivery of the material (Mehrabi et al., 2000). Coleman and colleagues (2001) stated that, in general, swine caretakers have lower levels of formal
education and thus may feel uncomfortable in a traditional classroom environment. In their study they found that those caretakers trained with PowerPoint presentations were more satisfied, had greater information retention six weeks later, and found the training more acceptable than those trained with a manual. Similarly, others have suggested that delivering caretaker training materials in a multimedia format may help increase the acceptance and perceived credibility of the information (Hemsworth et al., 2002). In a review of the literature, Najjar (1996) noted that multimedia-based training is highly effective for those with little knowledge of the information presented. Furthermore, especially for applications requiring people to be able to recognize certain situations, picture-based learning is efficacious (Najjar, 1996). In the United States, census data indicates that 31% of all agricultural farm workers including livestock farm laborers have less than a 9th grade education (USDA ERS, 2016) and these people may therefore be more receptive to training presented in a multimedia format. Both seasoned and new swine farm employees, needing the skills to be able to recognize compromised pigs and possibly with little formal educational background, could benefit from presentation of euthanasia training materials in a multimedia format.

5. Ethical dilemmas and caretaker characteristics

5.1 Euthanasia-related strain

One of the earliest mentions of the term *compassion fatigue* was used in the field of nursing to describe the emotional distress and burnout experienced by those in caretaker positions (Joinson, 1992). Since then, its use has been adopted by those working in the animal industries, especially in the fields of veterinary medicine,
biomedical research, and animal shelters to describe the emotional strain that results when a person must continually euthanize animals (Scotney et al., 2015). Later, Arluke (1994) introduced the concept of the ‘caring-killing paradox,’ which describes when animal caregivers must sometimes euthanize the same healthy or compromised animals for which they have been providing care. Both compassion fatigue and the caring-killing paradox have been used to explain emotional burnout associated with long-term involvement with human and/or animal patients in situations where natural death or euthanasia is frequent. In these cases, caretakers’ ability to mentally and emotionally process the death of their patients is overwhelmed. In working with animals where the caretaker often must make end-of-life decisions, the psychological impact can, over time, lead to a general unwillingness or inability to perform euthanasia when necessary. However, despite this emotional fatigue, many animal caretakers can acknowledge and justify their actions by realizing that euthanasia may relieve animal suffering (Arluke, 1991; White & Shawhan, 1996).

The psychological impact on caretakers has been explored in a variety of working environments and can include significant grief, sadness, and frustration. In studies of animal shelter and research laboratory workers, surveyed employees have indicated that euthanasia of the animals for which they have provided care is stressful (Reeve et al., 2005; Rohlf & Bennett, 2005; Scotney et al., 2015) due to the emotional attachment (Arluke, 1991) developed through their daily interactions (Arluke, 1992). Rohlf and Bennett (2005) studied the incidence of euthanasia-related traumatic stress in veterinarians, veterinary technicians, researchers, and animal shelter staff and found that
regardless of the context of euthanasia or species involved, the average stress load on individuals did not differ between the four surveyed groups. Furthermore, anecdotal evidence suggests that euthanasia of sick companion pets can result in significant guilt when owners must make euthanasia decisions (Podrazik et al., 2000). This guilt and associated emotional distress may be magnified by caretakers’ beliefs that extra or prolonged treatment may allow the animal to recover (Blackwell, 2004). Considering these findings, it may be appropriate to consider that the same mental conflict associated with having to euthanize companion or laboratory animals is present in those caretakers tasked with performing euthanasia of livestock on-farm.

In addition to daily euthanasia decisions for companion animals, the mass depopulations of farms in response to disease outbreaks can magnify the psychological impacts of euthanasia because many animals are euthanized over a short period of time. Euthanizing livestock during a disease epidemic can heavily impact a producer’s mental well-being especially when the animals are healthy but must be culled to control spread of the disease (Chur-Hansen, 2010). Though the farm owner and caretakers are heavily impacted, veterinarians responsible for providing care to these herds also express anger when they must euthanize animals to contain an outbreak (Hall et al., 2004). This became particularly relevant during the 2001 UK Food and Mouth Disease outbreak and the 1995 outbreak of Johne’s disease in Australia. Reports and analysis of farmer surveys and diaries during these times showed significant psychological stress and a sense of failure among farmers when large numbers of pigs, cattle, and sheep were culled and euthanized (Hood & Seedsman, 2004; Olff et al., 2005; Mort et al., 2008). Mort and colleagues
(2008) suggest that this mental and emotional stress may be in part due to the disruption of physical and psychological distancing normally present between the farm and the abattoir. When caretakers are faced with the task of depopulating large groups of any livestock species, including pigs, they may view this new role negatively and feel that the task of performing mass killings falls only to the abattoir worker and that their own involvement is limited to providing on-farm care. These psychological consequences, if severe, can exacerbate farmers’ occupational stress (Booth & Lloyd, 1999) and result in serious conditions including depression, suicidal ideation and attempts (Hood & Seedsman, 2004), and post-traumatic stress disorder (Olff et al., 2005; Hibi et al., 2015).

The U.S. nationwide outbreak of PEDV in April 2013 led to significant death losses across the swine industry due to high morbidity and mortality rates (80-100%) in the pre-weaning stage (USDA, 2013). Though the number of sows farrowing from September 2013 through August 2014 only decreased 0.25%, the number of pigs saved per litter decreased from 10.22 to 9.91, a 3.03% drop (Schulz & Tonsor, 2015). The U.S. pig crop during the same time period also decreased 3.7 million piglets (3.21%) compared with the previous 12-month period (Schulz & Tonsor, 2015), and commercial slaughter during 2014 decreased 4.6% compared to 2013 (Schulz & Tonsor, 2015). These findings suggest that euthanasia was employed more frequently during this time when herds became infected. The full psychological impact of this outbreak on swine producers, caretakers, and others engaged in the swine industry is yet to be investigated. However, the negative impacts that previous disease outbreaks have had on producers and caretakers suggests that this U.S. outbreak may also have significant psychological effects. The long-term
consequences may negatively impact caretakers’ willingness to regularly euthanize compromised animals for those caretakers tasked with euthanizing multiple litters during the outbreak.

5.2 Caretaker characteristics and attitudes towards euthanasia

Information regarding caretaker characteristics and attitudes towards euthanasia is extremely limited but potentially valuable, as it may be used as a selection tool to predict caretaker performance (Coleman, 2004). A common sentiment recognized and expressed by those working with any type of animal is that employees or caretakers who are not willing or are uncomfortable performing euthanasia should not be asked to do so (Blackwell, 2004; Reynolds, 2004; Gemus-Benjamin et al., 2015). As demonstrated in a previous study, pre-employment screening to identify caretaker characteristics and general attitudes towards pigs may be successfully used to predict some aspects of later workplace performance (Coleman, 2001). If newly-hired caretakers with negative attitudes towards euthanasia can be identified, it may allow the farm manager or owner to more cautiously place these people in positions which are not responsible for making euthanasia decisions to reduce the likelihood of unnecessary euthanasia delays. Caretaker attitudes and characteristics relating to swine euthanasia were evaluated by Matthis (2004) on North Carolina swine farms. While over 86% of respondents recognized the need for euthanasia of sick pigs, almost half still preferred to not have to carry out the act; thus, the act of euthanasia itself is aversive to some, despite the recognition of the positive impact that euthanasia can have on an animal’s welfare. Additionally, Matthis (2004) found that an employee’s gender, formal educational level, and area of work did
not impact his or her willingness to perform euthanasia. However, female, non-white, and farrowing room employees all had more negative attitudes towards euthanasia than male, white employees, or employees working in other production stages. Those caretakers who were least willing to perform euthanasia also preferred to use the least painful method of euthanasia, identified by many as carbon dioxide. This aforementioned study, though extensive, represents the limited amount of information available regarding swine caretaker characteristics which may influence attitudes towards and willingness to perform euthanasia in a timely fashion.

6. Summary

Swine caretakers are tasked with ensuring good welfare for individual pigs at all stages of production by the application of euthanasia when warranted. They face unique challenges in identifying compromised pigs due to differences in housing designs, management systems, and common illnesses or injuries unique to their specific farms. Decision trees are widely used in other fields, but their use in facilitating euthanasia decisions in the swine industry is limited. Standardized criteria for on-farm euthanasia based on a pig’s appearance or clinical presentation are extremely limited, with only a few recommendations provided by CSIA and AASV. Training programs, especially those which utilize a multimedia platform, are used to a varying extent in the swine industry. Euthanasia-specific training varies in content and delivery but offers promise to help encourage and facilitate better euthanasia decisions. Ensuring timely euthanasia decisions which do not prolong the life of a compromised animal is often difficult, as the caretaker may develop emotional attachments to pigs and feel a sense of failure in providing
adequate care when euthanasia is warranted. Information regarding caretaker characteristics and attitudes which influence a person’s willingness to perform euthanasia has been investigated to a limited extent, but it may facilitate proper placement of new employees or assist in identifying candidates who may benefit from interventional re-training. Timely euthanasia is of paramount concern in ensuring good pig welfare, and it will continue to grow as an increasingly important consideration for the swine industry. The objectives of this thesis are to: 1) identify euthanasia timelines and the most common reasons for euthanasia for all pig production stages using survey techniques; 2) identify barriers associated with making timely decisions and carrying out the act of euthanasia using focus group discussions; and 3) describe the development of an interactive computer-based training program regarding timely swine euthanasia.
7. References

AABP. Practical Euthanasia of Cattle.  


Chapter 2

Determination of Swine Euthanasia Criteria and Analysis of Barriers to Euthanasia in the
United States Using Expert Opinion

Caitlyn R. Mullins, Monique D. Pairis-Garcia, Kelly A. George, Raymond Anthony,
Anna K. Johnson, Grahame J. Coleman, Jean-Loup Rault, Suzanne T. Millman
2.1 Abstract

Timely euthanasia on swine farms can help to reduce the incidence of poor welfare outcomes for compromised pigs when recovery is prolonged or impossible. Timely euthanasia relies on caretakers’ abilities to identify compromised pigs and administer euthanasia in various environments. To determine appropriate timelines and most common reasons for on-farm euthanasia, an online survey was conducted with members of the United States National Pork Board. Additionally, two focus groups were conducted to investigate barriers and possible solutions associated with timely euthanasia. Clinical signs related to poor locomotion (57.6%), prolapses (47.2%), and hernias (43.5%) were identified by the greatest percentage of respondents who believed immediate euthanasia was warranted, while a greater percentage of respondents believed euthanasia was not warranted for clinical signs related to the integumentary (90.3%), reproductive (75.8%), and respiratory (67.5%) systems. The most common reason for euthanasia was poor body condition in pre-weaned piglets and non-ambulatory or severely weak for both breeding and non-breeding pigs. In the focus groups, two themes were identified when evaluating barriers to euthanasia on-farm, and participants agreed that making timely decisions relies on several dimensions of risk analysis. An unsupportive farm culture was identified as a critical barrier to timely euthanasia decision-making, suggesting that caretaker characteristics may play a role in the success of any timely euthanasia program. This present study has highlighted areas for future research and demonstrated the need to extend educational efforts both to swine industry
leaders and producers to improve overall animal welfare by ensuring timely euthanasia in swine.

**Keywords:** animal welfare, decision-making, education, euthanasia, swine, timeliness

### 2.2 Introduction

Performing euthanasia may be necessary on swine (*Sus scrofa*) farms for severely ill or injured pigs. Euthanasia, derived from the Greek terms ‘eu’ and ‘thanatos,’ meaning ‘good’ and ‘death,’ respectively (AVMA, 2013), is conducted to reduce the incidence of poor animal welfare outcomes, when, for example, a humane death is a better alternative for a pig than a continued life of pain and suffering. As with all livestock production systems, it is inevitable that a proportion of pigs on-farm will become injured or ill to the extent that recovery is unlikely, impossible, or would require invasive and/or prolonged treatment. In these cases, timely euthanasia, considered as euthanasia performed when recovery is unlikely or when the animal has demonstrated no signs of improvement, is warranted (NPB, 2008; NPB & AASV, 2008). Making timely euthanasia decisions is also warranted as a means to eliminate pain and suffering associated with decline in health (Fraser et al., 2013) and physiological distress (Morton, 1998).

The act of performing euthanasia is a multi-step process requiring those working with pigs to have the observational abilities to identify compromised animals and the technical skills and willingness to humanely terminate these animals. In the United States (U.S.), swine farm caretakers are often responsible for making independent decisions
regarding if and when to administer treatment, provide supportive care, and in some situations, administer euthanasia on-farm (Morrow et al., 2006; Turner & Doonan, 2010; Gemus-Benjamin et al., 2015). These decisions are often based on the farm’s established procedures and policies, which may include farm-developed standards (Morrow et al., 2006), auditing program requirements, or for the U.S., basic euthanasia guidelines provided by industry organizations (i.e., American Association of Swine Veterinarians [NPB & AASV, 2008], American Veterinary Medical Association [AVMA, 2013], and the Common Swine Industry Audit [CSIA; NPB, 2017]). Although these guidelines are available, implementing timely euthanasia may be problematic if guidelines are difficult to follow; incorrectly interpreted; or if logistical, emotional, and economic considerations associated with timely euthanasia decision-making are not addressed. Therefore, providing clear euthanasia policies that are understandable and accessible will better prepare caretakers to perform timely euthanasia.

The primary aim of this study was to evaluate how the current U.S industry euthanasia guidelines are understood and interpreted by industry leaders and more fully explore the challenges associated with timely euthanasia on-farm. This was accomplished with two objectives: Objective one: utilize survey techniques to identify the most common reasons for on-farm euthanasia and determine appropriate timeframes to implement euthanasia; Objective two: utilize focus group discussions to identify considerations associated with making euthanasia decisions and barriers to performing euthanasia. Both objectives were accomplished by drawing on the experiences of those actively engaged in the U.S. swine industry. This study is part of a larger project focused
on developing a euthanasia-specific training program for U.S. veterinarians and caretakers and utilizing the program to identify caretaker characteristics which influence the decision-making process (Mullins et al., in press).

2.3 Materials and Methods

All research was reviewed and approved by The Ohio State University IRB Committee for Humans Subjects Research (Approval #2015B0467). To target a diverse group of professionals within the swine industry, members of the U.S. National Pork Board (NPB) Animal Science and Animal Welfare Committees were recruited based on their on-farm experience and knowledge related to swine euthanasia and welfare. These committees were comprised of individuals involved in the industry and included swine producers, caretakers, veterinarians, industry representatives, academic professionals, and processing plant personnel. The Animal Welfare Committee contributed to the development of the U.S. CSIA; as such, the members of the committee were expected to have the most insight into appropriate euthanasia timelines selected as audit guidelines. The Animal Science Committee was selected to increase the sample size and because most of its members are experts in the field of swine physiology.

Objective 1: Survey

An Internet-based survey was created following the principles of the Tailored Design Method (Dillman et al., 2009) using the Qualtrics Research Suite 2015 online software platform (Qualtrics, LLC). The survey instrument was independently reviewed by six of the co-authors who are experts in swine production and survey methodology to
ensure content validity. These authors have worked extensively in both the U.S. and
Australian swine industries, published national surveys related to pig husbandry and
euthanasia, and/or investigated ethical decision-making in agricultural fields. The survey
was pre-tested with members of The Ohio State University Welfare and Behavior Lab to
assess functionality and approximate completion time (15-20 minutes). The survey
instrument can be found in the Appendix.

Potential respondents (n = 63) were recruited in January 2016 using email
listservs provided by NPB and consisted of members of both the Animal Science and
Animal Welfare Committees. Respondents were contacted via email from the Qualtrics
Survey Mailer and provided with a consent form and link to the survey. In most cases, the
members of these committees were located in geographically separate areas of the
country and were not expected to communicate with one another regarding the survey.
Additionally, because respondents remained anonymous and could complete as much of
the survey as they were comfortable answering in accordance with IRB protocol, concern
regarding response bias was minimal. Non-completion rates for the survey were not
anticipated to be large due to the estimated completion time and the committees’ interest
in furthering animal welfare research for the betterment of the U.S. swine industry. A
reminder email was sent one- and two-weeks after the initial email to non-responders. To
avoid discussion among respondents which could have altered respondents’ answers, the
survey was open for a total of three consecutive weeks and closed the day before the
Unified Research Review meeting (February 15, 2016), a gathering of NPB committee
members to review research proposals and discuss industry updates. To ensure
anonymity, no identifying information was collected by the Qualtrics platform in connection with the data.

The survey consisted of three parts. Part 1 of the survey collected demographic information. Part 2 asked participants to consider euthanasia decisions related to 26 selected illnesses and injury conditions. Respondents were asked to assign each illness and/or injury condition a ‘euthanasia score’ regarding the timeliness of euthanasia. The ‘euthanasia score’ presented five discrete choices organized in a unipolar matrix question design: *Euthanize immediately (score 1)*, *treat and euthanize on-farm within 12 hours if no improvement (score 2)*, *treat and euthanize on-farm within 24 hours if no improvement (score 3)*, *treat and euthanize on-farm within 48 hours if no improvement (score 4)*, and *do not euthanize and re-evaluate if condition worsens or cull (score 5)*. Based on CSIA guidelines, 48 hours is the maximum length of time allowable to see improvement in a pig’s condition (NPB, 2017). After this time, euthanasia is warranted if the condition does not improve or worsens. Thus, the survey was designed on this specific framework, to most closely match the current 2017 CSIA guidelines. In addition, respondents were provided an open-ended question to add additional comments or clinical signs with a corresponding euthanasia score. Part 3 asked respondents to rank the top five most common reasons for euthanasia over three production stages: breeding stock (sows and boars), pre-weaning piglets, and non-breeding stock (nursery and grower/finisher pigs). Rankings for each provided clinical sign were averaged to yield an average ranking. Similar to Part 2, opportunity was given for respondents to add
additional clinical signs and provide a corresponding ranking for each. The clinical signs list was randomized to eliminate order bias.

**Objective 2: Focus Groups**

The second objective was to identify barriers to timely euthanasia and considerations for decision-making using focus group discussions. Members of the NPB Animal Welfare Committee in attendance at the February 2016 Winter Unified Research Review meeting were recruited to participate in two focus group discussions using a purposive sampling approach (Morgan, 1998). This sampling method was important in the present study because it reduced bias in the results by the direct selection of swine welfare industry leaders for whom euthanasia decision-making and caretaker training are well-understood topics. Using convenience or self-selected samples from other NPB committees may have resulted in bias because participants may not have had the knowledge to comment regarding on-farm euthanasia. Focus groups were selected for this particular objective because they allowed participants to freely express their own opinions and generate ideas from interactions with others (Pivetti, 2007). Demographic forms provided before the discussions asked participants to identify their gender, number of years engaged in the swine industry, and current role in the swine industry. Participants were assigned an identifying number linked to their demographic form, and moderators and participants identified themselves throughout the discussions by number to maintain separation of identifying information. Groups were randomly assigned without regard to any of the demographic variables, and discussions were moderated by two CITI-trained (Collaborative Institutional Training Initiative) animal science academic
professionals. Both scripts consisted of six open-ended questions accompanied by a series of follow-up questions which were used to more deeply expand on a comment made by a participant or encourage discussion. Questions were developed to directly ask participants about current challenges and possible solutions to failures of timely euthanasia on-farm. The focus group script and questions were reviewed and modified by all authors. Main questions are summarized in Table 2.1. Each focus group lasted for an average of 80 minutes, and discussions were audio-recorded.

<table>
<thead>
<tr>
<th>Number</th>
<th>Question Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>What types of decision-making tools are currently used on farms to assist in deciding when to euthanize a pig, and how are they used?</td>
</tr>
<tr>
<td>2</td>
<td>What factors are considered and how are decision-making tools developed by individual farms?</td>
</tr>
<tr>
<td>3</td>
<td>What is the biggest factor for why euthanasia would be delayed or not performed on your farm or farms you have visited?</td>
</tr>
<tr>
<td>4</td>
<td>Would a standardized decision-making tool be positive or negative for the U.S. swine industry?</td>
</tr>
<tr>
<td>5</td>
<td>What types of euthanasia-specific training should be provided? How often should euthanasia-specific training be provided?</td>
</tr>
<tr>
<td>6</td>
<td>What characteristics of a decision-making tool maximize the ease of use and acceptability of the tool on farm?</td>
</tr>
</tbody>
</table>

Table 2.1. Questions utilized in a focus group discussion on timely euthanasia in the U.S. swine industry

Recordings were used to transcribe verbatim both discussions which resulted in a total length of 74 double-spaced pages. Scripts were independently analyzed by two of the authors for repeated themes and key concepts. Questions were analyzed both independently and as they related to other questions, and key quotes were extracted for illustrative purposes. Content analysis was performed using the techniques of Coffey and
Atkinson (1996) and Braun and Clarke (2006). Those ideas which were discussed by both groups and which could be explained by multiple smaller key points were categorized as main themes. Within each main theme, several subthemes were identified which may or may not have been discussed by both groups and which could be further expanded upon by examples provided by participants.

2.4 Results

Objective 1: Survey

Part 1: Demographics

A total of 63 committee members were contacted, and 37 responses were recorded, yielding a response rate of 59%; six respondents did not complete the survey (Table 2.2). In the ‘current role in the swine industry’ question, 10 identified as swine producers (3 farrow-to-finish; 3 sow; 3 nursery or grower/finisher; 1 farrow-to-finish and boar stud). Respondents who indicated ‘other’ (n = 6) categorized themselves as a nutritionist, animal care coordinator, animal welfare director, consultant, member of an allied industry, and state animal health official. For those who had previously or currently work with pigs (n = 24), the number of directly managed animals ranged from 4 to 200,000 for sow producers, 1,000 to 5,000,000 for nursery and grower/finisher producers, and 15 to 7,500 for boar stud producers. Overall, 51.4% of respondents had previously received euthanasia-specific training.
<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Respondents (%)</th>
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<td>Animal Science</td>
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<td>Other or did not respond</td>
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<td><strong>Current role in the swine industry</strong></td>
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<td></td>
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<td>Veterinarian</td>
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<td>Academia animal scientist</td>
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<td>Swine researcher in industry</td>
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<td>Swine producer (operation owner)</td>
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<td>Pork packer†</td>
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<td>Graduate degree (e.g., MS, MBA, Ph.D.)</td>
<td>17</td>
<td>45.9</td>
</tr>
<tr>
<td>Professional degree (e.g., DVM)</td>
<td>5</td>
<td>13.5</td>
</tr>
<tr>
<td>Did not respond</td>
<td>3</td>
<td>8.1</td>
</tr>
<tr>
<td><strong>History of euthanasia-specific training</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>19</td>
<td>51.4</td>
</tr>
<tr>
<td>No</td>
<td>11</td>
<td>29.7</td>
</tr>
<tr>
<td>Did not respond</td>
<td>7</td>
<td>18.9</td>
</tr>
</tbody>
</table>

* In this paper, the term ‘stockperson’ is synonymous with ‘caretaker’ and denotes a farm employee whose daily responsibilities include hands-on care of pigs.
† Pork packer refers to personnel working in a pig processing plant or abattoir.
‡ GED: General Educational Development Test is an U.S. equivalency test taken to demonstrate mastery of high school-level academic skills.
Not all percentages sum to 100 due to rounding error.

Table 2.2. Respondents’ demographic information collected in a survey on timely euthanasia in the U.S. swine industry
Part 2: Euthanasia scores

In Part 2 of the survey, respondents were asked to consider the potential impact of an individual pig’s conditions on its ability to function biologically, minimize negative mental states, and perform behaviors which allowed the pig to cope. ‘Euthanasia scores’ were used to denote five different euthanasia time points. Respondents’ choices were a reflection of when they believed compromised pigs should be euthanized based on their clinical signs. During the analysis, the 26 conditions were grouped into 10 categories based on their primary clinical signs: locomotory, gastrointestinal, integument, body condition, hernia, prolapse, respiratory, reproductive, neurological, and systemic conditions. This allowed for exploration of euthanasia scores across broader groupings of clinical signs. The results in Table 2.3 are presented as number of respondents and the corresponding percentage for each euthanasia score by individual condition and category. Five respondents provided additional conditions which warranted immediate euthanasia (score 1); these included umbilical hernias which touch the ground; tail biting which has led to necrosis around the anus; flank biting which has led to deep, open wounds; emaciated piglets which cannot access feed and water; and piglets which weigh less than 0.68 kg at birth. One respondent indicated that pigs that cannot rise due to fatigue should be euthanized on-farm within 12 hours (score 2).
Table 2.3. Response number and corresponding percentages for euthanasia scores assigned within 10 categories in a survey on timely euthanasia in the U.S. swine industry
Table 2.3 continued

<table>
<thead>
<tr>
<th>Respiratory</th>
<th>Open-mouth breathing</th>
<th>0 (0)</th>
<th>2 (6.7)</th>
<th>3 (10.0)</th>
<th>2 (6.7)</th>
<th>23 (76.7)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thumping</td>
<td>2 (6.5)</td>
<td>0 (0)</td>
<td>2 (6.5)</td>
<td>9 (29.0)</td>
<td>18 (58.1)</td>
</tr>
<tr>
<td></td>
<td>Shallow, rapid</td>
<td>1 (3.2)</td>
<td>1 (3.2)</td>
<td>3 (9.7)</td>
<td>7 (22.6)</td>
<td>19 (61.3)</td>
</tr>
<tr>
<td></td>
<td>breathing</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>8 (25.8)</td>
<td>23 (74.2)</td>
</tr>
<tr>
<td>Cumulative</td>
<td></td>
<td>3 (2.4)</td>
<td>3 (2.4)</td>
<td>8 (6.5)</td>
<td>26 (21.1)</td>
<td>83 (67.5)</td>
</tr>
</tbody>
</table>

| Reproductive | Dystocia             | 0 (0) | 2 (6.5) | 4 (12.9) | 2 (6.5) | 23 (74.2) |
|             | MMA*                 | 0 (0) | 0 (0) | 1 (3.2) | 6 (19.4) | 24 (77.4) |
| Cumulative  |                      | 0 (0) | 2 (3.2) | 5 (8.1) | 8 (12.9) | 47 (75.8) |

| Neurological | Convulsions           | 7 (23.3) | 3 (10.0) | 5 (16.7) | 8 (26.7) | 7 (23.3) |
|             | Circling or incoordination | 5 (16.1) | 3 (9.7) | 8 (25.8) | 11 (35.5) | 4 (12.9) |
|             | Nystagmus or head tilt | 3 (9.7) | 2 (6.5) | 6 (19.4) | 13 (41.9) | 7 (22.6) |
| Cumulative  |                      | 15 (16.3) | 8 (8.7) | 19 (20.7) | 32 (34.8) | 18 (19.6) |

| Systemic conditions | Septicemia            | 3 (9.7) | 6 (19.4) | 3 (9.7) | 13 (41.9) | 6 (19.4) |
|                     | Extremely weak        | 6 (9.4) | 5 (16.1) | 4 (12.9) | 14 (45.2) | 2 (6.5) |
| Cumulative          |                      | 9 (14.5) | 11 (17.7) | 7 (11.3) | 27 (43.5) | 8 (12.9) |

| Body condition | Dramatic weight loss or BCS 1 | 6 (19.4) | 1 (3.2) | 3 (9.7) | 14 (45.2) | 7 (22.6) |

Score 1: Euthanize immediately

Score 2: Treat and euthanize on-farm within 12 hours if no improvement

Score 3: Treat and euthanize on-farm within 24 hours if no improvement

Score 4: Treat and euthanize on-farm within 48 hours if no improvement

Score 5: Do not euthanize and re-evaluate if condition worsens or cull

* MMA: Mastitis-Metritis-Agalactia
Further explanation for each specific clinical sign can be found in the full survey provided in the Appendix. Respondents could only select one euthanasia score for each clinical sign. Not all percentages sum to 100 due to rounding error, and not all participants submitted a euthanasia score for each clinical sign.
The *locomotory* category contained the greatest percentage of respondents who believed immediate euthanasia (score 1) was warranted, followed by the *prolapse*, *hernia*, *body condition*, *neurological*, *systemic conditions*, and *respiratory* categories. No respondents indicated that conditions in the *integument*, *gastrointestinal*, and *reproductive* categories warranted immediate euthanasia.

Figure 2.1 presents the cumulative distribution of euthanasia scores for each clinical sign included in Part 2. Clinical signs are ranked in descending order based on the percentage of respondents who indicated ‘euthanize immediately’ first.
Part 3: Rankings of reasons for on-farm euthanasia

Table 2.4 summarizes the average rankings for reasons for on-farm euthanasia for each clinical sign by production stage. In the open-ended question available to provide additional comments, one respondent identified ulcers and paleness/weakness as the fifth and fourth most common reasons for euthanasia in both breeding and non-breeding stock, respectively. For pre-weaning piglets, one respondent indicated that surviving after being laid on was the most common reason for euthanasia while another respondent indicated this was the second most common reason. Two other respondents noted that being unthrifty or of low body weight was the second most common reason, while another respondent noted that piglets with broken limbs should be euthanized but did not provide a corresponding ranking.

<table>
<thead>
<tr>
<th>Production stage</th>
<th>Reason for euthanasia</th>
<th>Average ranking*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breeding stock</td>
<td>Non-ambulatory or severely weak</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>Severe lameness (non-weight bearing on one limb)</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>Prolapse</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>Respiratory disease</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>Reproductive disease</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>Dramatic weight loss or BCS 1</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>Systemic disease</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>Skin injuries</td>
<td>4.9</td>
</tr>
<tr>
<td></td>
<td>Gastrointestinal disease</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Table 2.4. Average ranking reasons for on-farm euthanasia in a survey on timely euthanasia in the U.S. swine industry
Table 2.4 continued

<table>
<thead>
<tr>
<th>Pre-weaning piglets</th>
<th>Starve outs or BCS 1</th>
<th>1.7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-ambulatory or severely weak</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>Severe lameness (non-weight bearing on one limb)</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>Respiratory disease</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>Hernias (umbilical or scrotal)</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>Gastrointestinal disease</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Skin injuries (e.g., facial injuries, leg abrasions)</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>Systemic disease</td>
<td>4.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-breeding stock</th>
<th>Non-ambulatory or severely weak</th>
<th>1.7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Severe lameness (non-weight bearing on one limb)</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>Dramatic weight loss or BCS 1</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>Systemic disease</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td>Respiratory disease</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td>Prolapse (necrotic)</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>Hernias (umbilical or scrotal)</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>Gastrointestinal disease</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>Skin injuries</td>
<td>4.3</td>
</tr>
</tbody>
</table>

* Average ranking determined by computing a simple arithmetic mean of all ranked responses for each clinical sign. Further explanation for each specific clinical sign can be found in the full survey provided in the Appendix.

Objective 2: Focus Groups

Each focus group consisted of nine participants for a total of 18 participants in the study. Group 1 consisted of five males and four females and included one clinical veterinarian, two academia veterinarians, one academia animal scientist, two swine operation owners, and three pork processors, all of whom had at least five years of experience in the swine industry. Group 2 consisted of six males and three females and included one clinical veterinarian, four swine operation owners, one animal care
coordinator, one allied industry representative, one veterinarian and operation owner, and one animal welfare manager. Seven participants in Group 2 had more than 10 years of experience in the swine industry.

The coding of data resulted in three to five subthemes within each of four main themes. Two of the four themes focused on barriers to euthanasia while the other two themes focused on caretaker training and decision tools. For the purpose of this study, only the two themes addressing barriers to euthanasia will be presented (Table 2.5). These themes were largely derived from discussion associated with Question 3 (Table 2.1). Quotes are accompanied by the group number [i.e., G1 = Group 1], participant number [i.e., P1 = Participant 1], and the participant’s role in the swine industry as indicated on the demographic form.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Main themes</th>
<th>Subthemes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Considerations in euthanasia decisions</td>
<td>Health status of animal and herd&lt;br&gt;Public perception and risk analysis&lt;br&gt;Caretakers’ perception of ability to recover</td>
</tr>
<tr>
<td>2</td>
<td>Barriers to timely euthanasia</td>
<td>Logistical challenges&lt;br&gt;Balancing competing priorities&lt;br&gt;Economic considerations&lt;br&gt;Emotional strain on caretakers&lt;br&gt;Farm culture and accountability</td>
</tr>
</tbody>
</table>

Table 2.5. Coded themes and subthemes identified in a focus group analysis on timely euthanasia in the U.S. swine industry

*Theme 1: Considerations in euthanasia decisions*

Participants acknowledged several external factors exist which influence the decision to euthanize. These factors were generally based on the importance of risk
analysis of performing euthanasia as it relates to potential impacts on overall herd health, public perception of animal care, and the pig’s likelihood of recovery. Several participants highlighted these ideas:

“When we’re thinking about risk related to euthanasia, it’s sort of a two-sided sword, having animals there that should be euthanized but weren’t, is a risk for people seeing that and then condemning you for your inaction. Likewise, euthanizing things is just not a pretty sight, and it’s not a pleasant experience for anybody, so that becomes a risk” (G2, P7, producer).

“We recently had an incident where an auditor said there were two piglets that were not timely euthanized. To this day, the auditor says timely euthanasia was a failure, and the producer is adamant that it was not a problem. So perception of timely euthanasia is always going to be a challenge” (G1, P3, pork processor).

“Timeliness of euthanasia is all in the eye of the beholder, and no matter how many rules, regulations, matrices that you put out there, you are never going to satisfy everyone’s definition of timely euthanasia” (G1, P7, pork processor).

“As a biological system, it [a compromised pig] doesn’t always fit the cookie-cutter protocols” (G2, P5, veterinarian and producer).
**Theme 2: Barriers to timely euthanasia**

Participants in both groups thoroughly described how logistical, economic, emotional, and cultural barriers play a significant role in timely euthanasia decision-making. The difficulty in detecting and monitoring compromised pigs; physical location and condition of equipment; and removing and disposing of carcasses were all indicated as common factors delaying the process. Euthanasia methods may also result in delayed euthanasia as one participant described that caretakers may wait until enough pigs are collected to fill the carbon dioxide chamber, or the caretaker moves all pigs at once to a central euthanasia location. The lack of available and capable personnel, particularly on weekends and holidays, and where company representatives are the only personnel authorized to euthanize was also discussed as a contributing factor for delaying euthanasia. Two participants additionally provided examples of competing priorities indicating that for some producers, euthanasia is not considered a top priority:

“I think it’s ‘breed and feed’ first and then ‘inspect, treat, and euthanize’” (G1, P9, producer).

“There is a disease flowing around called ‘cornitis,’ I call it. So in the spring and the fall, the value to that person, to his time, is not to be in the barn euthanizing pigs. They will take care of dying themselves, and I gotta get a crop in the ground.” (G2, P7, producer).
One of the most significant reasons for delaying euthanasia mentioned by nearly all participants is the economic value tied to pig loss. According to participants, both ‘per-head’ payment systems which compensate producers based on final pig numbers and the economic investment in breeding and grower/finisher pigs may encourage delayed decision-making. For pork processors, any system which rewards producers for shipping more pigs is problematic, and feedback to producers is an essential component to reducing the number of compromised pigs leaving the farm.

“So sometimes if we receive an animal in the plant that we believe should’ve been euthanized, we counsel that producer that you have spent the same amount of money feeding and paying for the animal but are now going to be paid a reduced price on that animal” (G1, P3, pork processor).

“We have, in our system, the decision to cull or the decision to euthanize, and ultimately it comes down to economic decision” (G2, P6, animal care coordinator).

An additional significant barrier explored by participants was the emotional effects felt by caretakers when euthanasia is viewed as a failure to provide adequate or sufficient care. Participants emphasized that caretakers are tasked with caring for pigs to the best of their ability, and asking caretakers to euthanize pigs is difficult because of their hope that additional treatment may allow the pig to heal, despite the length and success of past treatment. It also was noted that caretakers, by avoiding euthanasia duties
themselves, relegate the task to a higher authority on-farm, thus transferring the responsibility and perpetuating farm-wide systemic emotional strain. Furthermore, the emotional impact on caretakers of performing mass euthanasia in response to disease outbreak was discussed.

“Our job is to keep pigs alive and care for them well. The end-of-life decision is not one that really flows well with that mentality. So you’re asking people to make, essentially say, ‘I failed.’” (G2, P7, producer).

“I know that I’ve encountered some people with the mentality of ‘I can save them all,’ and they may have the best of intentions. They just continue trying to treat and improve the condition of the animal” (G1, P3, pork processor).

“But our personnel that work in the farrowing house, they’re subconsciously selected because of their caring nature for the sow and the piglets, and to tell them to euthanize is very difficult for them to do. I don’t know the answer to that one” (G1, P2, academia veterinarian).

“They [caretakers] just cannot emotionally wrap themselves around euthanizing one more animal” (G1, P8, producer).
A final barrier to timely euthanasia discussed by participants was the role that farm culture and accountability play in influencing the timeliness of euthanasia. Farm culture was explained as the degree to which caretakers and managers allow one another to delay timely euthanasia decisions while accountability reflected the idea that farm managers or upper management should expect caretakers to perform euthanasia when needed. Within Group 1, farm culture was indicated as a key driver determining caretaker’s willingness to euthanize as it influences expectations of performance in situations where oversight is not always present.

“…I think one of the key things I see just goes back to the culture and expectations…Most of us don’t walk out of a barn if it’s out of food or water. However, there’s several sites where we walk out of and there’s pigs that need to be euthanized or caretakers walked out. So it’s just that kind of mindset that I think we need to work on still” (G2, P6, animal care coordinator).

“The culture of an operation really drives appropriate procedures and handling and interactions with animals, especially at times when oversight isn’t always present which is typically the case. […] If the culture’s set appropriately, then that’s where the best decision-making can happen” (G2, P3, allied industry representative).

“Barn culture is really a big deal” (G2, P9, producer).
“[Euthanasia] is a highly dispersed decision occurring millions of times a day across our swine farms, and it really needs a community sense of discipline with each other to keep on doing it correctly” (G1, P9, academia veterinarian).

Similarly, participants in Group 1 emphasized the importance of holding caretakers accountable for performing euthanasia regardless of their personal feelings toward the act. In general, participants felt strongly that the expectations both from management and peers in regards to how timely decisions are made influence a great deal how caretakers act on-farm.

“Caretakers are perfectly capable of identifying which animals need to be euthanized, but they are very often not willing to take on the responsibility” (G1, P8, producer).

Overall, participants expressed the sentiment that timely euthanasia is a complex issue fraught with challenges to reducing the incidence of the problem on-farm. The act of performing euthanasia was described as aversive, and participants noted that the competent caretaker feels the need to provide care to sustain the life of the pig. One participant understood this well and expressed her thoughts.

“I would argue if you have someone that likes doing euthanasia you probably need to fire them” (G1, P8, producer).
Despite significant challenges that producers and caretakers still face, some participants acknowledged that significant progress has been made in the swine industry regarding timely euthanasia decisions. Many agreed that opportunity still exists for improvement.

“The progress in the industry over the last 5-10 years is amazing. It’s getting better. We have weaknesses, but at least the industry is attempting to address them. I’m pleased with that. […] In general, I would say we’re not very good as an industry with timely euthanasia” (G1, P2, academia veterinarian).

2.5 Discussion

The objective of this study was to identify possible avenues which influence decision-making and performance of euthanasia on-farm with the goal of reducing negative welfare outcomes on swine farms. Additionally, the study was intended to explore the opinions of U.S. swine industry leaders regarding appropriate euthanasia timelines, not to make generalizations about a larger population. Therefore, for both study objectives, targeting participants directly involved in influencing national euthanasia guidelines and on-farm euthanasia decision-making processes was determined to be the most direct and effective method to gain useful information.

Consistency across the swine industry in regards to euthanasia recommendations may help reduce the number of untimely euthanasia decisions and the likelihood of pigs experiencing poor welfare status on-farm. Within the 2017 CSIA, the industry has defined five situations in which a compromised animal must be euthanized (Table 2.6),
and failing to euthanize in these situations results in an automatic audit failure for the farm. However, results from the present study suggest that these guidelines may need to be more clearly defined.

| Pigs which have not improved after two days of intensive care or which have no prospect for improvement |
| Severe injured or non-ambulatory* pigs with the inability to recover |
| Any non-ambulatory pig with a body condition score of 1 |
| Pigs with hernias which touch the ground while standing, cause difficulty walking, and are ulcerated; or pigs with perforated or ulcerated hernias which are also necrotic |
| Pigs with uterine prolapses or untreated, necrotic prolapses |

* A pig is classified as non-ambulatory if it cannot rise or if it can stand with support but cannot bear weight on two legs.

Table 2.6. Timely euthanasia criteria of the 2017 U.S. Common Swine Industry Audit

Though it was not expected that all respondents be in agreement with all examples regarding euthanasia timelines as measured in Part 2 of the survey (euthanasia scores), the lack of consensus on several of the specific conditions was unexpected. Approximately one third of respondents (38.7%) indicated that a pig which is ‘non-weight bearing on two or more legs’ (one of the CSIA definitions of a non-ambulatory animal) should not be euthanized immediately (score 1). Non-ambulatory pigs represent not only a welfare concern on-farm but may portray a poor image of swine husbandry to the public as non-ambulatory animals have a very poor likelihood of recovery. This idea was supported by one producer who described the potential risk of poor public perception as a “two-sided sword” (G2, P7). However, it should be noted that other clinical conditions, including neurological deficits and acute stress, can result in non-ambulatory pigs which retain the ability to recover. In this study, no qualifiers were used to further
define non-ambulatory or the potential for recovery, so opportunities to draw conclusions for this specific condition are limited. Furthermore, pigs with uterine prolapses or perforated hernias are required to be euthanized immediately under the 2017 CSIA. Results for both of these conditions were unexpected and showed that only 74.2% and 86.7% of respondents assigned score 1 for ‘uterine prolapses’ and ‘perforated hernias,’ respectively. The expectation was that respondents would indicate score 1 for these clinical conditions, yet results showed that industry leaders did not respond according to the CSIA guidelines. These results highlight an area where further research can more closely examine the reasons why a delay in euthanasia is viewed as an appropriate option and where educational efforts can be directed to reduce the incidence of delayed decision-making, both of which steps may reduce the likelihood of an automatic CSIA failure.

Though widespread education may help improve consensus amongst industry leaders in some of the more critical euthanasia categories already defined by the CSIA, in other clinical conditions categories, there was more consensus towards not euthanizing (score 5). This was particularly evident for those categories which included conditions that are often associated with a greater potential for recovery. These included the gastrointestinal, integument, respiratory, and reproductive categories. These types of conditions are often treatable and thus may not present as much of a dilemma for caretakers in deciding whether or not to euthanize the pig within the next 48 hours. The wide distribution of euthanasia scores in both the neurological and systemic conditions categories may be an indication that these conditions are not as commonly seen,
diagnosed, or identified. In addition, both neurological and systemic conditions may manifest in a range of clinical signs which can be associated with both severe and mild conditions. Thus, making euthanasia decisions on very broadly defined clinical signs may have contributed to the variability of responses and lack of consensus among respondents. Supporting this idea, one veterinarian and producer (G2, P5) described how applying standardized responses—“cookie-cutter protocols”—to compromised pigs may not result in the best outcomes due to the inherent biological variability between individual animals.

It should be acknowledged that this biological variability can also influence the appearance and severity of certain disease conditions which are not acute in nature. As opposed to the situations clearly defined by the CSIA as immediate euthanasia cases, other conditions like poor body condition must be evaluated differently. Under CSIA, a compromised pig is given two days to respond to treatment before euthanasia is warranted. This ‘2-day rule’ and the nature of disease processes specifically in the body condition as well as the neurological and systemic conditions categories may explain why the greatest percentage of respondents indicated score 4 (‘treat and euthanize on-farm within 48 hours if no improvement’). Therefore, caretakers must be keenly observant of pig behavior in these cases to ensure continued feed and water intake, yet also understand that poor body condition requires a significant amount of time to resolve depending on the underlying pathology. Respondents also showed variation in response for the condition ‘fractured limb’ in which 3.2% of respondents provided score 5, 6.5% indicated score 4, and 90.3% indicated score 1. This may be because fractured limbs present very
differently depending on the location and severity of the condition. Despite established guidelines, it is evident by evaluating all of the euthanasia scores results that there is still a lack of understanding and agreement regarding euthanasia timeline standards amongst those tasked with establishing those standards. Thus, opportunities may exist for more thorough descriptions of guidelines within training programs and audit standards. These results are demonstrative of the need for further evaluation of communication efforts and training from scientists, veterinarians, and other animal welfare experts to guide timely on-farm euthanasia decision-making.

To ensure on-farm training efforts specifically for caretakers focus on assessment and treatment options for the pigs most likely to require euthanasia, survey respondents were asked in Part 3 to provide a ranking of the most common reasons for on-farm euthanasia for each production stage. An understanding of these reasons can allow caretakers to be more conscious when pigs present with certain ‘high-risk’ clinical signs. Given that ‘non-ambulatory’ and ‘severely lame’ were among the top three most common reasons for euthanasia for all three production stages, it may be prudent for producers to cautiously evaluate lame animals and ensure that euthanasia decisions are made in a timeframe that prevents lame animals from becoming non-ambulatory. Few studies have identified reasons for removal from the herd specifically by humane euthanasia, but it has been found that sows may be euthanized because of rectal and uterine prolapses, respiratory disease (Sanz et al., 2007), shoulder ulcers (Jensen et al., 2012b), mastitis (Engblom et al., 2007), and digestive disorders (Christensen et al., 1995) while grower/finisher pigs may be euthanized as a result of respiratory and gastrointestinal
diseases, locomotory problems including fractures (Straw et al., 1983), systemic infections, hernias, and integument injuries (Baumann & Bilkei, 2002). It is interesting to note that for pre-weaning piglets, the most common reason for on-farm euthanasia was ‘starve outs or poor body condition score (BCS 1).’ In interpreting this result, it is important to recognize that because death on swine farms is normally greatest in the first few days after birth (Kerr & Cameron, 1995; Roehe & Kalm, 2000; Velarde et al., 2015), producers may elect to euthanize piglets below a certain weight threshold without holistically evaluating the piglet’s body condition and health status as they relate to assessing injury or disease. Reflecting this sentiment, one respondent, an ‘academia animal scientist,’ indicated that piglets less than 0.68 kg at birth should be euthanized immediately without any qualifying statements regarding the piglet’s condition aside from the low birth weight. The present study, however, has ranked the relative frequency of common conditions in necessitating euthanasia which may be helpful in ensuring that euthanasia-specific training ensures caretakers’ competency in addressing pigs which are possible euthanasia candidates based on their clinical presentation. This information also helped inform the selection of relevant case studies for the development of the euthanasia-specific training program (Mullins et al., in press).

Focus group participants both confirmed that caretakers face significant and numerous obstacles related to timely decision-making and highlighted possible avenues for future research. Though participants acknowledged the importance of considering economic and logistical challenges associated with making timely decisions, they also noted that these obstacles are often highly specific to individual farms based on numerous
factors including, but not limited to, facility design, methods of euthanasia, pig production stage, interactions with upper management, and number of employees. Thus, approaches to improving the timeliness of decision-making and execution of euthanasia will be variable between farms with regard to these factors. However, most caretakers tasked with performing euthanasia face similar emotional challenges. This emotional strain is not unique to swine caretakers or those working with animals. Commonly termed ‘compassion fatigue,’ Joinson (1992) was one of the first to describe the distress experienced by those in nursing positions, but the term has since been used and investigated in describing the direct emotional effects of euthanizing animals (Scotney et al., 2015). Arluke (1994) introduced a similar concept—the caring-killing paradox—which describes how animal shelter caregivers must sometimes euthanize the same animals for which they have been providing care. As noted by participants, caretakers are often selected for their positions because they demonstrate a motivation to save, raise, and heal pigs in their care: “But our personnel that work in the farrowing house, they’re subconsciously selected because of their caring nature for the sow and the piglets…” (G1, P2, academia veterinarian). Therefore, when caretakers are asked to euthanize compromised pigs, some see this as a failure to provide adequate care (Blackwell, 2004). It may thus be appropriate to consider that the same mental conflict associated with having to euthanize healthy shelter animals occurs in swine farm caretakers as well. In addition to the routine euthanasia of individual pigs due to isolated illnesses and injuries, disease outbreaks can magnify the emotional strain on caretakers when mass depopulation of farms is necessary. To demonstrate, one participant recognized the
emotional breaking point which some caretakers faced during the large-scale euthanasia of piglets during the U.S. Porcine Epidemic Diarrhea Virus (PEDv) outbreak which began in May 2013. She described caretakers as being unable to “emotionally wrap themselves around euthanizing one more animal” (G1, P8, producer). Similarly, negative psychological impacts associated with the mass depopulations of livestock have been noted with previous mass outbreaks of Foot and Mouth Disease in the United Kingdom and Johne’s disease in Australia (Hall et al., 2004; Mort et al., 2008). The results of the present study suggest that these two concepts—compassion fatigue and the caring-killing paradox—are likely important factors driving euthanasia decisions on swine farms. Caretakers’ emotional states can therefore be concluded to play a large role in timely decision-making. Thus, performing euthanasia relies on more than just technical skills and knowledge. Caretakers not only must correctly identify compromised pigs, but they also must have the mental and emotional strength to apply euthanasia, when needed.

Broadening the scope of emotional obstacles from an individual to a farm level, participants emphasized that farm culture may play a large role in determining ultimate caretaker behavior related to euthanasia decisions. The revelation that widespread social interactions within the farm amongst caretakers and management personnel influence performance expectations highlights an area for further research. Though individual-level emotional challenges may serve as the primary individual barrier towards performing euthanasia, a farm culture which is perpetuated by caring management personnel who prioritize employee well-being may help ensure that those responsible for euthanasia are comfortable with the task. Ensuring a supportive farm culture may offer the needed
emotional support to individuals while also establishing expectations related to performance of caretaker duties. To address this critically influential factor, future research should seek to identify obstacles to establishing a supportive farm culture which encourages appropriate and timely euthanasia decision-making. As explained by an animal care coordinator (G2, P6), decision-making ultimately “…just goes back to the culture and expectations…”

To complement efforts to encourage a more supportive farm culture, research to identify how to modify caretakers’ internal motivations related to performing euthanasia may help induce behavior change on an individual level. Following established principles of modifying swine caretaker behavior demonstrated by others (Hemsworth et al., 1994; Coleman et al., 2000) may offer an opportunity to target caretakers’ internal motivations, thereby encouraging timely decision-making. Opportunities to establish and/or improve accountability procedures for caretakers, an important dimension of farm culture, should also be investigated.

It is important to recognize, however, that this study had limitations despite novel findings. In the survey, the generalized clinical conditions—e.g., vomiting, convulsions, cough—left room for ambiguity (e.g., previous history of disease or injury, severity of clinical signs, the caretaker’s past experience with similar situations, availability of intensive veterinary treatment). The conditions were also not delineated by a pig’s production stage. Thus, it is likely that respondents would assign different euthanasia scores to a rectal prolapse that occurred in a nursery pig and a gestating sow. Furthermore, euthanasia score 5 combined the option to re-evaluate the animal at a later...
time point or to cull the animal. Separating the two options may have revealed
differences in a pig’s ultimate disposition; however, it is difficult to create comprehensive
guidelines which consider every possible situation. Thus, having a foundation of
knowledge on which individual producers may build offers greater flexibility in
developing a euthanasia protocol which addresses the conditions most often encountered
on that farm. Despite these limitations, this approach in seeking to quantify the impact of
various conditions on an animal’s welfare by surveying industry experts is similar to that
utilized in other studies (Rodenburg et al., 2008; Jensen et al., 2012a). Additionally, the
exclusion of caretakers from the focus group samples due to the make-up of the NPB
committees eliminated the possibly valuable insight these individuals may have added
describing the specific challenges they face regarding euthanasia decision-making and
appropriate euthanasia timelines. To draw more robust conclusions regarding
impediments associated with euthanasia decision-making and understand the most
appropriate and acceptable methods of training, the addition of caretakers to future
research samples is imperative. Despite these limitations, this study presents a unique
opportunity to understand how industry leadership views the importance of animal
welfare and has revealed both the seriousness with which the U.S. swine industry views
timely euthanasia as well as possible avenues for future novel research.

2.6 Conclusions

This multimodal study sought to determine swine euthanasia criteria and the most
common reasons for euthanasia from swine industry experts. Furthermore, obstacles to
timely euthanasia were discussed by swine welfare experts. The results of this study suggest that there is a lack of understanding or acceptance of national audit guidelines by industry leaders, which may highlight an area for future education and clarification of standards for those integral to the swine industry. Additionally, an exploration of how different clinical signs impact euthanasia timeline decisions provided a unique perspective on how these signs can be incorporated as humane endpoints. Perhaps most notable in the focus group discussions was the finding that farm culture and caretaker accountability play an important—if not the most significant—role in determining the willingness of caretakers to euthanize a compromised pig immediately, when needed.

2.7 Animal Welfare Implications

Further investigation of the apparent knowledge discrepancy between U.S. swine industry euthanasia guidelines and industry leaders’ understanding of those guidelines can improve quality of swine care on-farm by caretakers. Furthermore, fostering a supportive farm culture which emphasizes making timely and humane euthanasia decisions may offer a novel avenue through which timely decision-making can be encouraged.

2.8 Acknowledgements

The authors would like to acknowledge the National Pork Board committee members who participated in this research. Funding was provided by the National Pork Checkoff.
2.9 References


Chapter 3

The Development of an Interactive Computer-Based Training Program for Timely and Humane On-Farm Pig Euthanasia

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3.1 Abstract

With extensive knowledge and training in the prevention, management, and treatment of disease conditions in animals, veterinarians play a critical role in ensuring good welfare on swine farms by training caretakers on the importance of timely euthanasia. To assist veterinarians and other industry professionals in training new and seasoned caretakers, an interactive computer-based training program was created. It consists of three modules, each containing five case studies which cover three distinct production stages (breeding stock, piglets, and wean to grower-finisher pigs). Case study development was derived from five specific euthanasia criteria defined in the 2015 Common Swine Industry Audit (CSIA), a nationally recognized auditing program utilized in the United States. Case studies provide information regarding treatment history, clinical signs, and condition severity of the pig and prompt learners to make management decisions regarding pig treatment and care. Once a decision is made, feedback is provided in order for the learners to understand the appropriateness of their decision compared to current industry guidelines. In addition to training farm personnel, this program may also be a valuable resource if incorporated into veterinary, graduate, and continuing education curriculum. This innovative tool represents the first interactive euthanasia-specific training program in the U.S. swine industry and offers the potential to improve timely and humane on-farm pig euthanasia.

Key words: adult learning, case study, computer training, education, pig welfare, timely euthanasia, veterinarian
3.2 Introduction

Under the veterinarian’s oath, veterinarians are expected to protect the health and welfare of all animals and prevent and relieve animal suffering (Nolen, 2011). Swine veterinarians are one of several professional groups that play a key role in training swine caretakers and other swine farm personnel in the identification, clinical assessment, and treatment of compromised pigs. Part of this process includes making timely euthanasia decisions when compromised pigs have little or no chance of recovery. Although euthanasia training is primarily conducted by veterinarians, it is common in the United States (U.S.) that the decision to euthanize is determined by swine caretakers when direct veterinary oversight is unavailable. Therefore, ensuring confidence within swine caretakers to identify, evaluate, and make appropriate decisions to treat or euthanize compromised pigs is imperative (NPB & AASV, 2008; AVMA, 2013; Fraser et al., 2013).

Training can improve a caretaker’s willingness and ability to euthanize a compromised pig (Reeve et al., 2004). Hence, it is a high priority for the U.S. swine industry to create robust educational programs which effectively train swine veterinarians, producers, and caretakers on timely and humane euthanasia. Euthanasia-specific training materials are often based on current industry guidelines provided by such organizations as The American Association of Swine Veterinarians and National Pork Board (NPB). To date, five specific clinical conditions have been identified which warrant immediate euthanasia. These conditions, which impact swine in all stages of
production, have been described and adopted by a nationally recognized U.S. auditing program, known as the Common Swine Industry Audit (CSIA; Table 3.1; NPB, 2015).

<table>
<thead>
<tr>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigs which have shown no response after two days of intensive care or which have no</td>
</tr>
<tr>
<td>prospect for improvement unless otherwise recommended by a veterinarian</td>
</tr>
<tr>
<td>Severely injured or non-ambulatory pigs with the inability to recover</td>
</tr>
<tr>
<td>Any non-ambulatory pig with a body condition score of 1</td>
</tr>
<tr>
<td>Pigs with hernias that are perforated or hernias that touch the ground while the pig is</td>
</tr>
<tr>
<td>standing, impede movement, and are ulcerated</td>
</tr>
<tr>
<td>Pigs with uterine prolapses or any untreated necrotic prolapses</td>
</tr>
</tbody>
</table>

The 2015 Common Swine Industry Audit has defined a non-ambulatory animal as one which cannot rise or which can stand with support but cannot bear weight on two or more legs (NPB, 2015).

| Table 3.1. Five conditions which require immediate euthanasia based on the Common Swine       |
| Industry Audit (CSIA) standards                                                               |
|                                                                                             |

To address the need for comprehensive and specific euthanasia training, this paper will discuss the development and implementation of an interactive computer-based training program. This program is targeted to enhance the capacities of veterinarians and educate caretakers on timely and humane euthanasia utilizing an objective training tool that is consistent with industry guidelines. The overall objective of the training program is to reduce the incidence of inadequate euthanasia decisions by improving caretakers’ competency in three areas: the ability to 1) identify compromised pigs; 2) recognize appropriate euthanasia endpoints; and 3) understand CSIA euthanasia guidelines.
3.3 Choosing an Appropriate Delivery Method

On-farm training and management for swine caretakers can involve many tools and exist in many mediums. For example, informal job shadowing of experienced caretakers (English et al., 2002); farm-specific educational programs (English et al., 1999); and national educational programs such as the U.S. Pork Quality Assurance® Plus program (PQA Plus®; Cleary, 1990; NPB, 2013) are all used on a regular basis. Additionally, on-farm training programs may employ standardized company literature, hands-on experience, farm-specific standard operating procedures, and multimedia tools including Microsoft PowerPoint, photographs, and video recordings. Although many training methods exist, the mode of delivery in which material is provided to learners can have an impact on its likeability and efficacy in material retention. Previous work conducted has demonstrated the value of multimedia training in both the medical (Mehrabi et al., 2000) and veterinary fields (Trace et al., 2012; Klupiec et al., 2014). For example, the use of multimedia in training programs improves clinical decision-making skills by allowing material to be “brought to life” utilizing a more realistic interface compared to other methods (Garrett & Callear, 2001, p384). In addition, the use of multimedia materials can promote greater satisfaction with training (Coleman et al., 2001), overall credibility (Hemsworth et al., 2002), and, for certain groups of learners (e.g., those with low prior knowledge or individuals with poor literacy), increase information retention (Najjar, 1996; Coleman et al., 2001).

In addition to the delivery mode, the intended audience has to be carefully considered. Since the beginning of the 20th century, the population of Americans living
on a farm has decreased (Dimitri et al., 2005), and hired farmworkers represent less than 1% of the total number of U.S. salary and wage employees (USDA ERS, 2016). As a consequence, the likelihood of employing an experienced animal caretaker is declining, and training programs must be designed to educate learners with little to no production animal experience. In the U.S. agricultural industry, approximately half of all farm laborers are Hispanic, and a third of these farm workers have less than a 9th grade education (USDA ERS, 2016). Therefore, recognizing that communication challenges may exist, utilizing training materials that do not inhibit understanding by caretakers with reading or writing limitations is important. Acknowledging these particular challenges for U.S. swine industry caretakers, the development of this computer-based training program focused on providing information via photographs and video recordings with accompanying audio narration and limited text. Given that veterinary terminology is not frequently used among caretakers on-farm, the accessibility of information afforded by a multimedia-based interactive format allows caretakers and other farm personnel to understand the material and be able to refer to the program in the absence of a veterinarian, if needed.

In addition to the demographic characteristics and population-specific experiences among swine farm caretakers, three additional factors were taken into consideration during the development of the training program: 1) technological capacity; 2) work day schedule; and 3) audience participation. When considering technological capacity, swine farms are most often located in rural areas with limited or no Internet connectivity. In addition, computers available on-farm may not remain up-to-date with modern software
applications; therefore, it was important that this training program was able to operate without requiring Internet access; could function on multiple platforms and systems; and did not incur a significant cost to the farm through a required purchase of new equipment or software upgrades. To meet these criteria, the training program is entirely contained on an USB flash drive which can accommodate at least 1 GB. Secondly, completion of the program by learners needed to be flexible to accommodate the typical swine farm work day schedule which includes frequently switching between different tasks throughout the day. Therefore, the interactive computer-based training program was organized into three discrete modules with self-contained case studies to allow learners to complete the program in segments. This approach also enables veterinarians who are facilitating on-farm training to only work through the module(s) which are relevant for the caretakers they are training. Such a structure also accommodates the adult learning style which emphasizes the importance of regular and adequate breaks (Backes, 1997). Third, understanding the audience demographics for the program played a large role in its development. Because the program must cater to diverse education and experience levels (i.e., veterinarians, farm managers, caretakers, and other swine industry professionals), the program needed to utilize non-technical language which would permit understanding by those who did not have formal or comprehensive training in animal health or welfare. Parts of the program, including media, text, and spoken narrative, were provided to current sow farm managers as well as members of the National Pork Board Animal Welfare committee to assess terminology and phrasing to ensure the language would be
understood by learners. Based on feedback received, colloquialisms proved more useful in the current application.

In addition, because euthanasia decision-making is complex and euthanasia is a sensitive topic, the program allows learners to complete case studies individually in a non-threatening and private environment to avoid making decisions based on peer pressure. This design also enables learners to work through case studies at their own pace and redo case studies or entire modules for additional review.

3.4 Data Collection

All work was approved by The Ohio State University Institutional Animal Care and Use Committee (ID# 2015A00000116) based on guidelines provided by the Guide for the Care and Use of Agricultural Animal in Research and Teaching. Animal interventions were limited to video recording, photography, and measuring basic vital signs on sows, gilts, piglets, and nursery and finishing pigs by trained research team members. Data to develop 15 individual case studies was collected on one 2,500 commercial sow farm, two 5,000-head nursery farms, and three 2,400-head wean-to-finish farms in the Midwest region of the United States. Video recordings and photographs were collected by trained personnel from both the farms and from The Ohio State University Animal Welfare and Behavior laboratory using a digital still camera (Sony Cyber-shot DSC-W810, 20.1 MP, 6x optical zoom, 26 mm wide-angle lens, Sony Corporation of America, New York, NY) and camcorder (Canon Vixia HF R600; 1080p HD; 35 Mbps, Melville, NY) over four months. Video recordings and photographs were
collected in a way that mimicked the caretaker or veterinarian viewpoint when walking down the alley or through pens. This approach helps maximize the program’s realism, thus improving the caretaker’s ability to transfer knowledge from the training program to real-world application (Kim et al., 2006).

3.5 Case Studies Design

The design of the program and case studies was carefully considered to maximize learner relevance and utility. A case study has been defined as “an account of a situation or the study of a topic that raises issues or problems for analysis” (Davis & Wilcock, 2005, p59) or which utilizes stories as educational tools (Herreid, 2011). The use of individual pig case studies enables learners to draw analogies between case studies and general conditions which require euthanasia, thus encouraging adult learner engagement (Richards et al., 1995; Backes, 1997). Furthermore, the emphasis on individual pig evaluation most closely parallels caretakers’ daily responsibilities when they address ill or injured pigs, and this contextual similarity improves learners’ retention of information (Cook & Triola, 2009; Herreid, 2011) and ability to transfer knowledge gained during training to new situations (Richards et al., 1995; Herreid, 1997; Crowther & Baillie, 2016). Case studies encourage learners to take an active role in the learning process (Dolmans et al., 1997) thereby enabling them to fulfill their need to be self-directed learners and apply new practical skills immediately in their daily tasks (Knowles, 1972; Knowles, 1990).
The case study format emphasizes the importance of individually evaluating pigs, by recognizing that differences in treatment history and clinical signs have an impact on what management or euthanasia decisions may be pursued. In addition to video recordings and photographs, information including, but not limited to, age, parity, body condition score, injuries, duration of clinical signs, and production records are provided. Case studies are organized into one of three modules based on pig production stage; 1) breeding stock, 2) piglets, and 3) wean to grower-finisher pigs. Within each production phase are five case studies. Learners are able to move between modules without completing all case studies, and the program does not require learners to complete all three modules, thereby permitting flexibility in allowing learners to focus on their production area. Thus, the case study format both complements the adult learning style while allowing for in-depth exploration of specific examples of pigs which are euthanasia candidates.
Figure 3.1. General schematic of the interactive computer-based training program related to timely on-farm swine euthanasia
Learners using the interactive computer-based training program are asked to utilize the provided information to make management decisions for each case study. Most case studies present the learner with three choices and ask them to make a selection: 1) do not intervene and continue to monitor the pig or piglet; 2) euthanize the pig or piglet within a particular timeframe; or 3) provide treatment or make management changes (e.g., pharmacological intervention, segregating the pig into a hospital pen, providing additional feed, etc.). Different iterations and combinations of choices are used to
increase the complexity and perceived difficulty of the case study decision. After the learner selects a management option, the program provides a short explanation on the appropriateness of the decision using CSIA guidelines as the conceptual basis. In case studies where immediate euthanasia is warranted, the program explains why each of the other treatment and monitoring options are inappropriate and emphasizes the clinical signs and health history which indicate immediate euthanasia. In case studies in which a pig does not meet the immediate CSIA euthanasia criteria (NPB, 2015), multiple correct options may be presented to recognize and provide positive reinforcement to the learner that multiple appropriate options exist. Such an approach enhances the richness and complexity of the program (Kim et al., 2006), and is critical to the program’s efficacy in increasing competency to identify and assess compromised pigs.

To facilitate training of multiple learners, a fillable PDF ‘Completion Checklist’ is provided as supplementary material on the flash drive for use in recording training completion (Figure 3.3). Additionally, after successful completion of each individual case study, a PDF ‘Certificate of Completion’ can be saved to the computer or printed, with the learner’s name and date of completion.
Figure 3.3. The ‘Completion Checklist’ PDF provided as supplementary material on the flash drive

3.6 Discussion

It is important for swine farms to provide and/or facilitate appropriate and sufficient timely euthanasia training to caretakers to reduce the incidence of poor welfare outcomes for compromised pigs. Veterinary training in the principles and practices of making timely euthanasia decisions can help bridge the gap between existing euthanasia-
specific training resources and needed on-farm education for caretakers. Familiarizing veterinarians with the case studies will allow them to guide training for on-farm personnel which continues to represent a significant opportunity for caretakers to gain confidence in identifying and managing compromised pigs. Presence of veterinarians during training allows caretakers to practice good decision-making under supervision. In this role, veterinarians play an important part in ensuring caretakers and farm managers are competent in making appropriate and timely euthanasia decisions.

At the present time, the CSIA and PQA Plus® documents are foremost in the swine industry, and equipping veterinarians with knowledge of those standards can help ensure they are well-prepared to provide needed guidance to producers. Similar multimedia-based training programs have been developed to provide education on specific topics, and these fit within the existing veterinary curriculum to supplement learning on current issues in animal agriculture and veterinary medicine (Gordoncillo et al., 2011; Trace et al., 2012; Klupiec et al., 2014).

Recognizing that swine farms and companies often vary in their approaches to economic decisions, management oversight, veterinary guidance, and daily on-farm schedules, several limitations are associated with the current design of the program. Euthanasia decisions often consider a pig’s economic value on-farm (Morrow et al., 2006), but this training program does not address this component for two primary reasons. Firstly, individual farms follow different protocols regarding euthanasia of pigs which are not meeting expected performance standards or which are not obviously compromised but are believed to have low viability (e.g., the low birthweight piglet
which is structurally smaller than its littermates but is not a body condition score of 1).
Secondly, while veterinarians may make suggestions to the producer about euthanasia decisions related to economic value, their foremost role is as a protector of animal health. Thus, to ensure the program is applicable to the widest range of veterinarians and on-farm caretakers, the economic component of decision-making was excluded from the program. An additional limitation focuses on the competing priorities that caretakers face associated with euthanasia decision-making and implementation. The time to administer treatment or euthanize compromised animals is one of many logistical obstacles which often influence management decision-making; however, recognizing the great deal of variance between farms in daily schedules, availability of equipment, etc., simulating time constraints in the program was avoided.

Though this program can increase competency related to identifying compromised pigs, it must be recognized that inducing behavioral change in animal caretakers requires changing established behaviors and beliefs, a task that often is more difficult than simple skills training (Coleman & Hemsworth, 2014). Addressing these barriers may require more extensive intervention where attitudes towards euthanasia are explored and challenged (Rault et al., in press). Past studies have shown that cognitive-behavioral intervention strategies have proven effective in modifying caretaker attitudes and resulting behavior directed at handling pigs on both small (Hemsworth et al., 1994) and large farms (Coleman et al., 2000). Since euthanasia is a core component of swine husbandry, similar intervention strategies may prove useful in changing behavior and willingness to perform euthanasia when necessary. Research exploring attitudinal barriers
could be used to develop supplemental material which increases the efficacy of this program as a training tool for all groups of learners.

Despite these limitations, the potential benefits to the swine industry in utilizing this training program for swine farm managers, caretakers, and other industry personnel are significant. Accustoming veterinarians with the training program will allow them to continue to serve as valuable educational resources and provide guidance regarding compliance with industry standards. Utilizing interactive case studies which more closely mimic caretaker and veterinarian duties offers an opportunity to more fully engage learners, encourage meaningful discussion, and enhance material retention. This innovative method to increase both caretaker and veterinarian competency in the clinical identification and assessment of sick or injured pigs may prove to have significant positive impacts for the swine industry in the continual effort to reduce instances of unnecessarily poor animal welfare.

3.7 Acknowledgements

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Appendix: Qualtrics Survey Used for Chapter 2
Swine Euthanasia Survey

This survey contains three parts. Part 1 covers your experience and role in the swine industry, job training, and formal education. Part 2 asks you to consider the relative impact on an individual pig's welfare due to common causes of illness, injury, or disease. It asks your opinions regarding when euthanasia should be considered for an individual animal. Part 3 covers causes of mortality on farm due to euthanasia of breeding stock, pre-weaning piglets, and non-breeding stock. Please answer the following questions based on your individual experiences, knowledge, and beliefs. Indicate your answer by selecting your choice, and/or typing in your response in the provided space. This survey should take 15-20 minutes to complete. Thank you for your time and participation in helping us gather this important information.

Part 1.

Which National Pork Board committee are you affiliated with?
- Animal Welfare
- Animal Science
- Other

What is your current, primary role in the swine industry?
- Veterinarian
- Academia animal scientist
- Swine researcher in industry
- Swine producer (operation owner)
- Swine farm stockperson (non-owner)
- Pork packer
- Industry representative
- Other (Please specify) ____________________

If ‘What is your current, primary role in the swine industry? Swine producer (operation owner)’ Is Selected
If you are currently a swine producer (operation owner), please specify what stage of production animals you own. Check all that apply.
- Farrow-to-finish
- Sow farm
- Nursery
- Grower/finisher
- Boar stud

If ‘What is your current, primary role in the swine industry? Swine farm stockperson (non-owner)’ Is Selected
If you are currently a swine farm stockperson (non-owner), please specify your role. Check all that apply.
- Farm manager
- Farrowing employee
- Sow farm employee
- Nursery farm employee
- Grower/finisher farm employee
- Boar stud employee
If you have worked or currently work with pigs, how many animals did/do you directly supervise or manage? Indicate approximate number of animals for each stage of production, as applicable.

☐ Breeding/farrowing (number of sows) ____________________
☐ Non-breeding stock (nursery and grower/finisher pigs) ____________________
☐ Boar stud ____________________

If you have worked or currently work with pigs, did you receive any euthanasia-specific job training (excluding training received in veterinary school related to euthanasia)?

☐ Yes
☐ No

If ‘If you have worked or currently work with pigs, did you receive any euthanasia-specific job training (excluding training received in veterinary school related to euthanasia)? Yes’ Is Selected

What type of training did you receive or participate in before or during your position?

☐ PQA/PQA Plus
☐ Company-specific quality assurance program
☐ On farm training
☐ Training by veterinarian
☐ Training by agricultural extension employee
☐ Other (Please specify) ____________________

What is your highest level of education received?

☐ No high school diploma/GED
☐ High school diploma/GED
☐ Associates degree/Certificate
☐ Bachelor’s degree
☐ Graduate degree (e.g., MS, MBA, Ph.D.)
☐ Professional degree (e.g., DVM, etc.)
Part 2. Euthanasia scores: This part concerns the impact of conditions on individual animals. Consider the potential impact of the condition on the animal's ability to function biologically, minimize negative mental states, and perform behaviors that allow him/her to cope with the environment.

For each condition listed, assign a euthanasia score by selecting the appropriate choice.

Note: Please respond to the below questions considering your personal experiences and knowledge. Consider situations under which a pig producer is faced with injured, ill, or diseased animals and must make a decision regarding the individual animal using the resources, time, and expertise typically available on a swine farm.
<table>
<thead>
<tr>
<th>Condition</th>
<th>Euthanize immediately (1)</th>
<th>Treat and euthanize on farm within 12 hours if no improvement (2)</th>
<th>Treat and euthanize on farm within 24 hours if no improvement (3)</th>
<th>Treat and euthanize on farm within 48 hours if no improvement (4)</th>
<th>Do not euthanize and re-evaluate if condition worsens or cull (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fractured limb</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Severe lameness (non-weight bearing on one leg not due to fracture)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Severe diarrhea</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Bloody diarrhea</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Vomiting</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Skin injuries from penmates</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Dramatic weight loss or poor body condition score (Body condition score 1)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Umbilical hernia (protrusion of intestines through the body wall)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Scrotal hernia (protrusion of intestines into the scrotum)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Perforated hernia (any type)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Vaginal prolapse (exteriorization of the vagina)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Rectal prolapse (exteriorization of the rectum)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Uterine prolapse (exteriorization of the vagina and uterus)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Penile prolapse (exteriorization of the penis)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Table A.1. Unipolar matrix question design used in a survey to assess swine experts' opinions regarding appropriate euthanasia timelines
<table>
<thead>
<tr>
<th>Condition</th>
<th>Euthanize immediately (1)</th>
<th>Treat and euthanize on farm within 12 hours if no improvement (2)</th>
<th>Treat and euthanize on farm within 24 hours if no improvement (3)</th>
<th>Treat and euthanize on farm within 48 hours if no improvement (4)</th>
<th>Do not euthanize and re-evaluate if condition worsens or cull (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open-mouth breathing</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Thumping (labored breathing)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Shallow, rapid breathing</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Cough</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Dystocia (difficulty farrowing)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>MMA (Mastitis-Metritis-Agalactia)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Nervous system disorders (convulsions)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Nervous system disorders (circling or incoordination)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Nervous system disorders (involuntary eye movement or head tilt)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Septicemia (infection in the blood)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Non-weight bearing on two or more legs</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Extremely weak</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Table A.2. Unipolar matrix question design used in a survey to assess swine experts' opinions regarding appropriate euthanasia timelines: additional clinical signs
You may use the empty boxes below to fill in any additional frequently seen conditions or symptoms which are not already listed. For each condition you list, assign a euthanasia score by selecting the appropriate choice.

<table>
<thead>
<tr>
<th>Condition or symptom</th>
<th>Euthanize immediately (1)</th>
<th>Treat and euthanize on farm within 12 hours if no improvement (2)</th>
<th>Treat and euthanize on farm within 24 hours if no improvement (3)</th>
<th>Treat and euthanize on farm within 48 hours if no improvement (4)</th>
<th>Do not euthanize and re-evaluate if condition worsens or cull (5)</th>
</tr>
</thead>
</table>

Table A.3. Unipolar matrix question design used in a survey to assess swine experts' opinions regarding appropriate euthanasia timelines: fillable fields
Part 3. The following questions are specified by pig production stage and your experience regarding each. We are only concerned with animals which are actively euthanized due to welfare concerns and not those which are euthanized strictly for economic reasons.

Definitions:

BCS: Body condition score (1-5 scale)
Umbilical hernia: protrusion of intestines through the body wall
Scrotal hernia: protrusion of intestines into the scrotum
Vaginal prolapse: exteriorization of the vagina
Rectal prolapse: exteriorization of the rectum
Uterine prolapse: exteriorization of the vagina and uterus
Penile prolapse: exteriorization of the penis
Nervous system disorders: circling, incoordination, convulsions, involuntary eye movement, head tilt, etc.
Septicemia: infection in the blood
Dystocia: difficulty farrowing
MMA: Mastitis-Metritis-Agalactia.

You may skip any question you do not feel you have adequate experience to answer.

Please rank the following common reasons for euthanasia regarding each of the production stages listed. "1" indicates the most common reason, "2" indicates the second most common reason, ..., and "5" indicates the fifth most common reason. Please rank the top 5 reasons. Type a 1,2,3,4, and 5 into your top 5 choices.

Breeding Stock:
_____ Severe lameness (non-weight bearing on one limb)
_____ Gastrointestinal disease
_____ Skin injuries (e.g., shoulder sores, vulva injuries, fighting wounds)
_____ Dramatic weight loss or poor body condition score (BCS 1)
_____ Respiratory disease
_____ Reproductive disease (e.g., dystocia, MMA)
_____ Prolapse (e.g., vaginal, rectal, uterine, penile)
_____ Systemic disease (e.g., nervous system disorders, septicemia)
_____ Non-ambulatory (non-weight bearing on two or more legs) or severely weak
_____ Other (Please specify)

Indicate any condition not listed above which could be easily used on farm by a stockperson or manager as an indicator for euthanasia for sows or boars.
Please rank the following common reasons for euthanasia regarding each of the production stages listed. "1" indicates the most common reason, "2" indicates the second most common reason, ..., and "5" indicates the fifth most common reason. Please rank the top 5 reasons. Type a 1, 2, 3, 4, and 5 into your top 5 choices.

Pre-Weaning Piglets:

- ______ Severe lameness (non-weight bearing on one limb)
- ______ Gastrointestinal disease
- ______ Skin injuries (e.g., facial injuries, leg abrasions)
- ______ Starve outs or poor body condition score (BCS 1)
- ______ Respiratory disease
- ______ Hernias (umbilical or scrotal)
- ______ Systemic disease (e.g., nervous system disorders, septicemia)
- ______ Non-ambulatory (non-weight bearing on two or more legs) or severely weak
- ______ Other (Please specify)

Indicate any condition not listed above which could be easily used on farm by a stockperson or manager as an indicator for euthanasia of pre-weaning piglets.

Please rank the following common reasons for euthanasia regarding each of the production stages listed. "1" indicates the most common reason, "2" indicates the second most common reason, ..., and "5" indicates the fifth most common reason. Please rank the top 5 reasons. Type a 1, 2, 3, 4, and 5 into your top 5 choices.

Non-Breeding Stock (nursery and grower/finisher pigs):

- ______ Severe lameness (non-weight bearing on one limb)
- ______ Gastrointestinal disease
- ______ Skin injuries
- ______ Dramatic weight loss or poor body condition score (BCS 1)
- ______ Respiratory disease
- ______ Hernias (umbilical or scrotal)
- ______ Prolapse (necrotic)
- ______ Systemic disease (e.g., nervous system disorders, septicemia)
- ______ Non-ambulatory (non-weight bearing on two or more legs) or severely weak
- ______ Other (Please specify)

Indicate any condition not listed above which could be easily used on farm by a stockperson or manager as an indicator for euthanasia for non-breeding stock.