## Improving Biosecurity through Instructional Crisis Communication: Lessons Learned from the PEDv Outbreak

At its peak, porcine epidemic diarrhea virus (PEDv) was killing "on average, more than 100,000 piglets and young hogs each week" in the United States, prompting Paul Sundberg, Vice President for Science and Technology at the Swine Health Information Center, to say, "I've been a vet since 1981, and there is no precedent for this" (Strom, 2014, para.1-4). Beginning in May of 2013, PEDv spread rapidly through the swine industry. Making matters worse, PEDv was a new disease to the United States and very little was known about it. Even farms with high levels of biosecurity that were not "getting pigs from the outside" were becoming infected with PEDv (Landen, 2014, para. 5). The rapid spread of the disease during the first months of the outbreak, its lethal impact on farms, and the novel and initially puzzling nature of the disease made crisis communication about PEDv extremely difficult. This challenge was addressed through the combined efforts of the National Pork Board, the National Pork Producer's Council, the American Association of Swine Veterinarians, extension agents, local veterinarians, and other swine specialists. Combined, this group of specialists responded to the unprecedented threat of PEDv with an equally unprecedented research and communication outreach effort. Ultimately, they created a robust research initiative and a steady flow of communication about how to contain and eliminate PEDv that helped to bring the disease under control by the end of 2014.

In this study, we describe, analyze and derive generalizable lessons learned from the instructional crisis communication provided to producers through this collaborative response to the PEDv crisis. We begin with a review of relevant literature, followed by an explanation of our research methods. Next, we provide an overview of the PEDv case followed by a summary of the themes that emerged through interviews with a sample of individuals who participated in the PEDv communication response efforts. We close by proposing several generalizable recommendations for instructional crisis communication in biosecurity contexts.

### Instructional Crisis Communication

Crises are characterized by three inherent elements: threat, surprise, and short response time (Hermann, 1963; Ulmer, Sellnow, & Seeger, 2015). From the perspective of the swine industry, the threat created by PEDv was clear. The disease was spreading at an alarming rate and thousands of pigs were dying daily. The surprising onset of crises makes them distinct from other ongoing risk management issues that occur on a regular basis. More specifically, although the swine industry was prepared to manage such diseases as Foot and Mouth Disease (FMD), Porcine Reproductive and Respiratory Syndrome (PRRS), and Transmissible Gastroenteritis (TGE), it was surprised by and not specifically prepared for the arrival of PEDv. Thus, the industry had to immediately undertake intense research to better understand the disease and to develop biosecurity strategies for stopping its spread as quickly as possible. The fact that the disease erupted and spread so quickly required the industry to respond with unprecedented speed. Ultimately, the success of this response was determined by the collaborative team's ability to generate effective instructional messages for producers; messages informing them how to best avoid, isolate, and treat the disease on their facilities.

Responding to crises such as PEDv requires a combination of research and communication. Research is essential for comprehending the nature of the disease, how it is spread, how it is best diagnosed and treated, what potential there is for vaccination, what are the best means for

eradicating the virus from an infected farm and, consequently, preventing its spread (Reynolds & Seeger, 2005). The crisis communication challenge in a case such as PEDv is to translate this highly complex research into instructional messages that are understandable, practical, and compelling for producers to take appropriate actions (Sellnow, Limperos, Frisby, Sellnow, Spence, & Downs, 2015). Despite the importance of such messages, "little research exists that explores ways to improve the development and delivery" of instructional crisis communication telling "stakeholders what to do to protect themselves from the crisis" (Coombs, 2009, pp. 105-106).

**The IDEA Model: Theoretical Grounding**

In response to the need for expanding instructional crisis communication research, scholars from a variety disciplines have sought to create a model for designing instructional crisis communication messages (e.g., Mileti & Peek, 2000; Mileti & Sorenson, 1990; Reynolds & Seeger, 2005; Seeger, 2006; Sellnow & Sellnow, 2010). More recently, researchers have sought to do so by grounding a number of empirical studies in John Dewey's (1938) experiential learning theory (e.g., Sellnow, Sellnow, Lane, & Littlefield, 2012; Frisby, Sellnow, Lane, Veil, & Sellnow, 2013; Littlefield, Beauchamp, Lane, Sellnow, Sellnow, Venette, & Wilson, 2014). Essentially, to get people to enact appropriate behaviors based on an instructional experience, Dewey defines experiential learning as a process where learners engage in knowing, doing, and reflecting. David Kolb (1984) and colleagues extended Dewey's theoretical notions by suggesting that effective instructional messages must round a "cycle of learning" that touches on concrete experience, reflective observation, abstract conceptualization, and active experimentation. Finally, learning outcome achievement is measured according to affective (perceived relevance), cognitive (comprehension/understanding), and behavioral (performance) learning outcome variables. Based on multiple empirical research studies of cases ranging from natural disasters, to health epidemics, to food contamination, grounded in these fundamental principles of experiential learning theory, a pattern for effective instructional crisis message design emerged.

Ultimately, these essential components were distilled further into four categories using the acronym, IDEA that stands for internalization, distribution, explanation, and action (Sellnow et al., 2012; Frisby et al., 2013; Littlefield et al., 2014; Sellnow & Sellnow, 2013; Sellnow & Sellnow, in press). Internalization involves compelling individuals to pay attention by illustrating personal relevance and impact via compassion, proximity, timeliness, level of risk, and exemplification. In simple terms, exemplification refers to the use of evocative words/phrases, visual images, or sounds that serve as cognitive shortcuts motivating receivers to attend to and remember a message (Sellnow & Sellnow, 2014; Zillman, 2006). Distribution focuses on selecting the communication channel(s) most likely to reach the target population(s). Explanation provides an accurate and credible account of what is happening and why, as well as the extent to which all information is known, all of which is translated intelligibly for non-scientific publics. Action refers to the specific action steps those at risk should take to protect themselves, their loved ones, and their assets. In sum, the IDEA model is a simple and easy to recall framework summarizing a body of research focusing on designing instructional crisis communication messages that include these components.

The IDEA model elements of internalization, distribution, explanation, and action are evident in agriculture crisis communication literature. For example, in their study of the 2008 *Salmonella* outbreak, Irlbeck, Akers, Baker, Burris, and Brashears (2013) found that, in some cases, the way television reporters internalize the threat of a crisis influences the way they frame their stories. Internalization in the acute period of crisis focuses mainly on identifying audiences at greatest risk and warning them about the threat at hand (Mileti & Peek, 2000). For example, Sellnow, et al.

(2011) found that message tailoring during a food recall promoted willingness to attend to the recall messages. In this case, message tailoring focused on reaching consumers in areas where contaminated ground beef was known to have been sold. Regarding distribution, Charanza and Naile (2012) discovered that in food safety incidents related to the U.S. Beef Industry, "individuals construct their media dependencies based on the situation and on which mediums will help them achieve their goals" (p. 47). For messages of explanation, Ashlock, Cartmell, and Leising (2009) found that, during crises, beef producers seek information from their personal veterinarians and through county extension publications. The USDA and area livestock specialists were also seen as highly credible sources for providing explanatory messages. In fact, Ashlock, Leising, and Cartmell, (2009) observed that by addressing "knowledge gaps" between what producers know and need to know, agriculture communicators can "raise awareness regarding crisis planning, response, and recovery" (p. 52).

With regard to action steps, messages that include specific instructions for protective action (in addition to internalization and explanation) have been shown to be significantly more effective in motivating people to take appropriate protective actions than standard news stories that focus primarily on explanation with only a vague mention of general action, such as directing receivers to a website for more information. More specifically, experiments comparing receiver responses from those viewing televised news stories that included specific instructions versus those that did not during the 2010 egg *Salmonella* outbreak were more confident in their ability to protect themselves and more likely to engage in appropriate behavioral actions (Frisby, Veil, & Sellnow, 2014). Similar results were noted in a study comparing messages with specific actions versus those without during a ground beef recall (Sellnow, et al., 2015).

In sum, there is considerable evidence to support the claim that messages designed to help those at risk protect themselves, their loved ones, and their assets include these essential elements of the IDEA model grounded in experiential learning theory. It stands to reason, then, that the extent to which these message elements are present in a communicative response to a crisis such as PEDv can serve as a means for assessing response effectiveness.

## Methods

Interviews were conducted with 13 individuals directly involved in developing and distributing crisis messages during the PEDv crisis using purposive sampling. Individuals were selected based on their positions in the National Pork Board, American Association of Swine Veterinarians, and university extension offices, as well as their reputation as specialists in swine research. Each of the interviewees selected from the National Pork Board and American Association of Swine Veterinarians were involved in translating the research into messages widely distributed to veterinarians, extension workers, and pork producers. These interviewees were selected because of their prominent role in responding to the PEDv crisis. A sample of specialists was also included from universities and extension programs in the five states generating at least a billion dollars in annual pork production: Iowa, Illinois, Minnesota, North Carolina, and Indiana (Potter, 2015). These specialists were selected based on their direct experience in sharing crisis messages with producers in their regions during the PEDv crisis. In addition, veterinarians who helped diagnose the first cases of PEDv were also selected as interviewees.

The interviewers and interviewees engaged in semi-structured, focused interviews using a consistent interview guide. Interviewees were afforded freedom to provide information diverging slightly from the guide if they so desired (McCracken, 1988). Interviews were conducted April

through July 2016 and each interview lasted from 30 to 60 minutes. Detailed notes were taken during each interview. As Lindlof and Taylor (2011) explain, such note taking during interviews affords researchers an ability to "concentrate on the real-time task of listening to what the researcher is saying [and] capture the highlights of the interview [via] a summary of the dialogue [and] a few exact phrases" (p. 192). All participants interviewed did so voluntarily with the understanding that their identity would remain confidential.

Because considerable research was available for messages designed during an agriculture crisis, an etic approach was used to analyze the interview content (Lindlof & Taylor, 2011). An etic approach uses established "conceptual categories provided by our disciplinary knowledge and theory" (p. 95). Similarly, Boyatzis' (1998) coding categories can be applied "deductively from theory and prior research" (p. 4). In this case, the categories of internalization, distribution, explanation, action, and other were used to categorize interview content.

Two of the authors coded the interview content into these established categories. Based on the recommendations of Boyatzis (1998), the following procedure was followed:

1. Both coders had considerable experience using the IDEA model to examine crisis communication data. The two coders were also comparable in their role on the research project, thereby avoiding dominance by a single coder.
2. The coding process began with both reviewers, first, reading through the interview content independently several times.
3. Next, the reviewers assigned content from the interviews to the most fitting category. The coders then met to discuss their coding outcomes. Disagreements were resolved through discussion.
4. Content within each category was then grouped into common themes. Both coders participated in this process. Coders established themes by looking for similarities, or patterns in the responses. Again, any disagreements in the development of themes for subcategories were resolved through discussion. An example of a coding resolution occurred in the action category. Coders had difficulty aligning the references to an ongoing planning process with recommendations for action. After discussion, the coders agreed that these recommendations for planning would be better described as an extension of the existing categories of internalization, distribution, explanation, and action. This theme, flexible planning, is included as an extension of the IDEA model in the conclusions.
5. Finally, member checks were conducted to determine whether or not participants believed the researcher interpretations of their statements were "true or accurate" (Lindlof & Taylor, 2011). To do so, the coded statements were sent to each participant asking them if they believed modifications or corrections were needed. Any recommended corrections were made based on this feedback. Corrections focused on technical wording and details related to PEDv. No major thematic changes were recommended.

## The PEDv Case Summary

PEDv is caused by a virus (Coronavirus) affecting only pigs and not humans or other livestock. The disease causes vomiting and severe diarrhea in pigs of all ages. Although older pigs typically survive the illness, PEDv has a mortality rate of almost 100% in pre-weaned pigs. The highly contagious disease is spread through oral contact with contaminated feces. The virus is so concentrated that "one thimble-full of feces could contain enough virus to infect all the pigs in the United States (Schwartz & Main, 2013). The disease was likely spread among and within farms

by common items that could house contaminated feces such as such as boots, clothing, feed and feed trucks, trucks hauling animals, and other fomites (PEDV Resources, 2015). Diagnosed in 2013, PEDv spread rapidly throughout the United States swine industry. In 2013 alone, approximately three million pigs were lost to the disease ("Three million pigs," 2014). Eventually, PEDv is estimated to have killed roughly 10% of the pig population in America (Dodrill, 2014). PEDv resulted in severe financial losses for many pork producers. Paarlberg (2014) calculated that "the estimated net annual decrease for U.S. economic welfare from PEDv summed across all effects ranges from $900 million to $1.8 billion" (p. 2). The tremendous loss of animals caused by PEDv in 2013 and 2014 reduced pork supplies and "boosted prices to all-time highs," however, the regression of cases in 2015 resulted in a return to abundant supplies and a rebound to normal price levels ("PEDv Impact on Pig Prices," 2016).

## Findings

As mentioned above, the interview data collected for this study are grouped into the headings of internalization, distribution, explanation, action, and other. Themes are provided within each of these categories. Examples from the interview notes are offered to illustrate the activities and opinions relevant to each category.

### Internalization

Internalization involves convincing target audiences to attend to the message. Doing so may be achieved by addressing personal relevance and impact of the risk to them and their livelihood (Sellnow & Sellnow, 2014). Three themes for internalization emerged from the interviews: characterizing the spread of the virus, communicating with workers, and maintaining consumer confidence. A communication specialist (participant #5) summarized the PEDv audience as anyone battling the disease on their farms and those with farms not yet infected. Many more audiences, however, were also entwined in the instructional crisis communication process. This communication network ranged from research and diagnostic laboratories to agencies including the National Pork Board, the National Pork Producer's Council, American Association of Swine Veterinarians, and the United States Department of Agriculture Animal Plant Health Inspection Service to swine veterinarians, extension workers, pork producers, workers at swine facilities, animal haulers, feed mill managers and haulers, sale barns managers, manure haulers, and anyone else either coming onto a swine facility or coming into contact with pigs. Participants #7 (swine specialist/academic) and #8 (extension) explained that anyone who came onto the site—as well as 4-H members traveling with their show pig—were part of the audience. In referring to the PEDv audience, participant #13 (veterinarian/academic) said definitively, "everyone is responsible."

#### Characterizing the spread of the PEDv.

Researchers and veterinarians worked quickly to develop diagnostic tests and to communicate protective measures farmers could take to reduce their farms' risk of being infected (participant #4, veterinarian). Identifying the farms at greatest risk had an ironic twist. Participant #1, a research specialist and veterinarian, observed that PEDv seemed to affect farms with high biosecurity more than farms with low biosecurity. For this reason, participant #1 explained that "feed was suspected" initially. To give all those involved a sense of how the disease was spreading, researchers, veterinarians, and extension workers made a conscious effort to map out farms and their function to build the communication network (participant #8, extension). Diagnostic labs

helped provide aggregate data on infected farms (participant #10, veterinarian/academic). In the end, "just about everybody was hit—not just hog-dense areas" (participant #9, extension).

**Communicating with workers.**

Several participants noted a challenge in getting farm workers to internalize the seriousness of the PEDv risk and their role in minimizing its spread. Participant #13 (veterinarian/academic) explained that there is a problem getting lower-level workers vested in caring enough to understand where problems can arise and making sure information gets to where it is needed. Participant #2 (extension agent) used an evocative form of communication to inspire workers at all levels in a facility to internalize the risk at hand. As part of a slide show he presented at many facilities, the extension worker showed a graphic picture of a "pickup mounded with euthanized baby pigs" and the words "this could be you." He discovered that emphasizing the potential personal impact of the risk helped to get the attention of workers and to improve compliance with recommended biosecurity strategies. On the other hand, several participants made specific mention of being sensitive to the emotional impact of the PEDv during the internalization process. Participant #6 (communication specialist) indicated the emotional toll became a "major factor" in communicating with those affected by the outbreak. Participant #10, a veterinarian/academic, explained that "fear and shock of euthanizing so many animals" took a "real emotional toll" on farm workers. Acknowledging this emotional toll involved being both considerate and cautionary when advising those at risk to attend to the instructional messages.

**Communicating with consumers.**

Although communication specialists at agencies such as the National Pork Board were prepared to communicate directly with consumers, there was little need to do so. Participant #6 (communication specialist) explained that PEDv had "zero impact on human life." The justifiable lack of public alarm meant the outbreak had no impact on demand for pork products. In other words, although the risk was great for those in the pork industry, the risk did not manifest itself in terms of food safety and security for pork product consumers.

**Distribution**

Understanding the most efficient and accessible channels for distributing information to key audiences is an essential step in risk and crisis communication (Sellnow & Sellnow, 2014). This section focuses primarily on the communication channels used during the PEDv crisis with added attention to channels emerging for rapidly updating key members of the communication network.

**Channels for producers.**

Participant #2 (extension) cogently stated that, in a crisis situation like the PEDv outbreak, "communication is everything." Participant #2 explained that distributing risk messages to all the people who could spread the disease was essential throughout the acute phase of the PEDv crisis. The goal was to help all those involved understand their impact on the system and how they could protect their farm or company (participant #2, extension). Participant #1, a research specialist and veterinarian, characterized this effort to connect with all those involved as a combination of "communication, education, and research."

Fortunately, the swine industry had an array of communication channels and resources available for distributing the instructional messages. Participant #6, a communication specialist, identified the following outlets as some of the most helpful: "fact sheets, research results, PEDv

update-available on Pork.Org website, and print magazines (*National Hog Farmer, Feedstuffs, Pork Network),* and news releases." Combined, these channels were intended to reach the "main audience," American pork producers.

**Channels for updated research.**

Several participants identified a series of calls taking place early in the morning on Fridays as essential in distributing the latest results of the ongoing PEDv research to approximately 30 key members of the network (participant #1, research specialist and veterinarian). Members of the American Association of Swine Veterinarians, the National Pork Producer's Council, the National Pork Board, and the diagnostic labs worked together rapidly to share information through this weekly call (participant #3, research specialist). The calls provided two essential elements in the distribution of information. First, the calls were a quick and efficient means for sharing information. Second, the calls created a forum for openness, discussion, expression of concerns, and questions (participant #3). "It wasn't that there was a clear strategy, but an openness allowing people to get on the phone" (participant #3).

## Explanation

Explanation involves information-sharing about what is happening, which includes what the disease is, how to diagnose it, how it is spread, and who is impacted. For this segment, participants emphasized farm-level education, and message design strategies.

**Farm-level education.**

Participant #1, a research specialist and veterinarian, described the explanation process as having three "key" components: "communication, education, and research." He indicated that "initially, the speed of commerce moved faster than we could move." This delay in explanation was due to a lack of information readily available on PEDv. Participant #9 (extension) explained that, because "we don't know everything about how the disease is transferred," the greatest difficulty in the explanation process was due to the "unknowns" rather than "poor communication." Several participants explained that the ultimate goal of the education process was to reach all of the way down to the farm level. At the farm level, the explanation process focused on "letting them know how easily [PEDv] moved around and heightening current prevention and treatment programs and awareness" (participant #12, veterinarian). Participants indicated that explanations at the farm level had the most impact when they included stories from peers. Participant #2 (extension) argued that "employee stories are the most powerful form of risk communication." He also contended that the familiarity of farm workers with their veterinarians and extension workers made them trusted sources for explaining the nature of the outbreak." For this explanation to be successful, participant #1 (research specialist and veterinarian) pointed out that a level of education is essential at the farm level. Participant #13, a veterinarian and academic, explained, "Carrying the message to the farm level is important." Yet, because farm personnel may not understand the reasons or importance of the biosecurity protocols or the risks they seek to mitigate, there is a need for basic education at the farm level among workers so they understand *why* protocols are needed. Participant #1 worried, however, that "We don't educate; we provide information." Participant #1 explained further that the instructional crisis communication shared in response to PEDv lacked a "metric" to measure whether or not workers learned "the right information" during the crisis.

**Message design.**

Participant #3 (research specialist) clarified that messages should be explained in ways that are "succinct, quick, easy to read." He noted that, in demanding circumstances like PEDv, audiences "want the shorter version." In addition to brevity, explanations were enhanced through the tailoring process. Tailoring the messages for specific audience needs helped ensure that specific audiences could understand "the significance of what we're doing" (participant #4, communication specialist). For example, Participant #8 (extension) mentioned that e-mail messages were also useful for explaining the PEDv outbreak as long as they were adapted to the particular needs of or risks faced by specific producer sites.

## Action

The action step calls for communicating specific actionable instructions focused on self-protection and recovery (Sellnow & Sellnow, 2014). In the PEDv case, these action steps focused on stopping the spread of the disease and eliminating it from infected farms. Participant #5 (communication specialist) explained it as a two-step process: "first, understand what is happening, then reach out to the appropriate audiences about how to respond." A third step identified by Participant #5 was to then reach out to consumers to maintain their confidence in the safety of pork products. The primary themes that emerged for action were general biosecurity measures and biosecurity measures specific to maintaining a line of separation on farm.

**Biosecurity in general.** The guiding philosophy for controlling PEDv was that "nothing is more important in preventing the spread of the disease than a high level of biosecurity" (participant #2, extension). Unfortunately, however, "not all biosecurity protocols were followed" (participant #3, research). For example, "Workers going outside just for a minute to pound a feed bin and come back in was a breach" (participant #8, extension). The disease spread through these biosecurity breaches (e.g., not fully disinfecting equipment, not using the shower facility). For example, hogs closest to the door got sick first, which is evidence of not following "shower-in, shower-out" protocol for biosecurity (participant #7, extension/academic). Participant #13 (veterinarian/academic) explained the challenges of maintaining biosecurity by asking the rhetorical question, "Everyone is trained on biosecurity, but are they doing it?" Participant #13 also pointed out, however, that workers do not circumvent protocols maliciously. Rather, they find easier ways of doing them if the protocols create more work and if there is not a clear understanding of the risks these protocols are designed to mitigate. "If it is a barrier without a reason, personnel will find a way to get around that."

The PEDv crisis emphasized the need for better biosecurity throughout the animal industry. Participant #13 (veterinarian/academic) acknowledged that the swine industry has consistently emphasized biosecurity. The real risks, according to Participant #13, are "momentary lapses in judgment – forgetting to change boots or crossing the clean line." Several participants indicated that biosecurity breaks down when workers are negligent or forgetful. PEDv, however, "took biosecurity to a whole new level" (participant #6, communication specialist). Participant #6 argued further that the industry had to move beyond the "basics of biosecurity" and "be willing to institute new or revised protocols immediately" for avoiding, containing, and eliminating the virus.

**Biosecurity specific to maintaining a line of separation.**

All of the study participants emphasized the importance of establishing a line of separation between secure and insecure environments. Participant #13 (veterinarian/academic) explained that clean and dirty lines "are of huge of importance—proper management of clean and dirty lines can

contain the disease." Maintaining the line of separation required actions based on both typical biosecurity measures and new efforts. Typical biosecurity practices were essential, such as minimizing the number of visitors and people doing maintenance, as well as restricting employees from coming into contact with other pigs, including those at their home or another farm. Enforcing the "shower in, shower-out" protocol and providing a better-defined line of separation (clean side versus dirty side) were all recommended. For example, "Maybe before farm workers may have helped load pigs leaving the farm. Now they stay off the ramp and preserve the line of separation. Any breach requires full re-entry biosecurity procedures" (participant #8, extension). In addition, critical control points, such as transportation, required improved cleaning and disinfecting. This included determining and recommending the best disinfectants for killing the virus (participant #4, communication specialist).

## Other

Two additional themes emerged that were outside the general IDEA structure for analysis. These themes were flexible planning and resources.

### Flexible planning.

Although the PEDv crisis hit the American swine industry unexpectedly, participants spoke frequently about how helpful existing plans and communication networks were in responding to the crisis. The participants mentioned how the flexible adaptation of crisis plans in place for other diseases was helpful in addressing PEDv. For example, "having a crisis response plan with the science technology team already in place was a plus." The plan also allowed the "shifting of resources" to PEDv (participant #5, communication specialist).

Specifically, the plans in place for combatting FMD, PRRS, and TGE were particularly helpful. For example, Participant #6 (communication specialist) argued, "PEDv was a good dry run for something like FMD that could be more threatening." In addition, pre-crisis planning for PRRS enabled the swine industry to respond much more quickly to PEDv than it could have without these plans (participant #8, extension; participant #10, veterinarian/academic; participant #12, veterinarian). Participant #6 (communication specialist) summarized the advantage this flexibility in planning gave responders to "move quickly" and to" institute new protocols."

### Resources.

The considerable resources the swine industry was able to devote to researching and combatting PEDv is also important to note. The industry already had in place existing communication networks, access to research facilities, and clearly established biosecurity protocols. PEDv demanded the implementation of all of these resources. Other segments of the animal industry may not be as well prepared for such catastrophic events. Similarly, larger farms experienced greater losses and had more difficulty eliminating the PEDv virus from their facilities, however, they also had more resources at their disposal. Smaller farms lacked these resources and faced greater risk of elimination as a result of the disease (participant #9, extension; participant #13, veterinarian/academic).

## Conclusions and Practical Applications

This analysis of instructional crisis communication during the PEDv crisis gives rise to several important conclusions. Based on these conclusions, we close by proposing a series of practical applications.

### The Interdependence of Explanation

The National Pork Producer's Council and National Pork Board were extremely responsive in communicating the safety of consuming pork products throughout the PEDv crisis. Meeting the needs of their various stakeholders required both speed and consistency. Adapting and sharing these messages with farm workers remains a challenge for many farms. Breaches in biosecurity, committed knowingly or unknowingly, might be addressed through better communication of the internalization components of the IDEA model. Moreover, previous research suggests that explanation (E) without specific actionable instructions (A) reduces receiver efficacy and behavioral intentions (Frisby, Veil, & Sellnow, 2013). This study reveals further that actionable instructions (A) without compelling internalization (I) actually reduces receiver efficacy and behavior. Better internalization may be achieved by a stronger articulation of personal relevance and impact, as well as exemplification. Exemplification is achieved via evocative images, videos, sounds, or phrases that compel receivers to pay attention and serve as easily remembered cognitive shortcuts (Sellnow & Sellnow, 2014). Participant #2 (extension) found the use of an exemplifying picture particularly persuasive. Shocking pictures, such as the photo of euthanized pigs shown to workers by Participant #2 to help them internalize the PEDv risk, can motivate people to take protective behavior (Westerman, Spence, & Lin, X., 2015). Some interview participants, however, cautioned that PEDv was already taking an emotional toll on farm workers. Adding exemplars to messages shared with these emotionally troubled workers would not likely have been helpful. Thus, more research on the potential for exemplification and its limitations in the context of biosecurity is warranted.

### Distribution, Tailoring, and Pre-Crisis Planning

Many channels of communication were available to the swine industry at the outset of PEDv. Legacy media such as magazines, as well as well-established and highly trafficked new media such as web sites and e-mail networks were available throughout the crisis. Swine veterinarians were linked through professional associations and networks that could be adapted immediately. An impressive feature of the information distribution was the weekly calls orchestrated by the National Pork Board. These calls, conducted weekly on Friday mornings, emerged as a valuable means for maintaining openness, rapidly updating people combatting PEDv on the front lines, and for establishing collaboration among key agencies. The ability to adjust content to specifically address the needs of producers in individual regions through the immediacy of e-mail was also noted as a strength by participants. Again, the connectivity and pre-existing channels available to affiliates at all levels of the swine industry was a strength in the PEDv crisis. Consideration of the connectivity available to an industry well before the onset of a crisis is advisable. If connectivity is lacking, industries of all types could benefit from building crisis response networks in advance.

### Explanation as Farm-Level Education

Several participants recommended better pre-crisis education and training, as well as better methods for measuring actual learning achieved from the explanation process. Respondents from

research, communication, veterinary science, and extension mentioned the need to transform mere explanation into instruction. This finding supports previous research suggesting that information-sharing alone is not equivalent to instruction and that successful instruction ought to be measured by learning outcome variable achievement (e.g., Kolb, 2014; Littlefield et al., 2014; Sellnow et al., 2015). Reaching the level of instruction/education as opposed to mere information-sharing was described as beneficial for two reasons. First, education that truly manifests in learning has the potential to improve compliance. Second, a focus on instruction or education can highlight the importance of planning and preparation during periods when no crisis is occurring. Doing so can increase the potential for appropriate actions during an actual risk or crisis event (Coombs, 2014). This finding has implications for both theory and practice. From a theoretical perspective, greater attention to instructional communication is warranted for assessing the extent to which explanation is needed in crisis circumstances. From an applied perspective, subtle changes in message design and attention to the feedback generated by explanatory messages are needed. On both a theoretical and applied basis, more attention is needed for understanding the role of and potential for explanation as a means of pre-crisis planning and instructional crisis communication training.

**Planning in Action**

Biosecurity is simultaneously both essential and fragile. Without biosecurity, there is no hope of preventing the onset or of containing a disease outbreak. Fortunately, the swine industry had exceptional biosecurity protocols in place before the PEDv crisis. Biosecurity, however, is also extremely fragile. Despite the swine industry's commitment to biosecurity, many of the interview participants noted breaches that occurred regularly on farms. Unfortunately, one minor breach can lead to the infection of an entire building or facility. The breaches that occurred during the PEDv crisis were described by participants as largely due to bad habits and a failure to comprehend the potential consequences of risk at hand. These failures were addressed through enhanced protocol recommendations. Improved explanation/education, as described above, was also mentioned as a vital means for reducing breaches. In cases where biosecurity is a vital dimension to crisis planning and prevention, a commitment to understanding and implementing a fully functional line of separation is essential. Organizational learning from observed protocol violations during non-crisis periods may also serve as a clear warning and call for improved pre-crisis education and training. Any biosecurity breaches that occur during non-crisis periods should be noted and serve as lessons learned for better future performance.

**Extending the IDEA Model**

Crisis planning has long been advised as a best practice for crisis communication (Seeger, 2006). The PEDv case extends this understanding of planning by emphasizing the need for flexibility. Several interview participants noted that plans for FMD, PRRS, and TGE were quickly adapted to address PEDv. This example suggests that plans in place for one disease or type of disaster can, and perhaps should, be adapted to meet an unexpected disease. This consideration of adaptability in crisis planning can be generalized to any crisis type. Similarly, resources such as supplies on hand, cash reserves, and existing research or laboratory facilities may all be adaptable to address unanticipated crises. Thus, consideration of how plans and resources might be adapted to accommodate the needs created by both anticipated and unanticipated events is advisable in the crisis planning process.

## Practical Applications

Conclusions from this study also point to several implications for risk and crisis communication and planning that are generalizable across many crisis types. First, the study reveals clear advantages to maintaining flexibility in crisis communication planning. The pork industry had crisis plans and communication networks in place for several severe, known diseases. The agility the industry showed in adapting these plans and networks for an unanticipated disease provides insight for other industries. Second, the PEDv case provides further evidence that audience analysis and adaptation are essential for crisis communication. Respondents in this study emphasized the need for succinct messages that were tailored to meet the needs of each particular audience. Third, adapting succinct messages to fit the needs of specific audiences is of limited success when the messages focus exclusively on protective actions. Multiple participants in this study emphasized the need for workers on the farms threatened by PEDv to understand not only what to do (action), but also why these recommended actions were essential (internalization and explanation). Finally, the need for explaining why certain protocols should be followed alludes to a greater educational need expressed by the respondents in this study. Education about risks and specific response strategies is essential during crises, but such education can and should also take place prior to the onset of an acute crisis event.

## Summary

PEDv was an extreme challenge for all involved in the swine industry. The unprecedented risks created by PEDv required an equally unprecedented research and communication response. The lessons learned by the swine industry will likely serve them well in the future. Hopefully, others in the animal industry will take note and consider the extent to which they are prepared to undertake similar actions related to research and communication. Any time spent now considering the challenges of maintaining biosecurity in a pest or disease incursion is time well spent.


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**ABOUT THE AUTHORS**

Timothy L. Sellnow is a professor in the Nicholson School of Communication at the University of Central Florida

Jason S. Parker is a visiting assistant professor in the School of Environment and Natural Resources at The Ohio State University Mansfield

Deanna D. Sellnow is a professor in the Nicholson School of Communication at the University of Central Florida

Robert S. Littlefield is director and professor in the Nicholson School of Communication at the University of Central Florida

Emily M. Helsel is a graduate research assistant in the Nicholson School of Communication at the University of Central Florida

Morgan C. Getchell is an assistant professor in the Department of Communication, Media & Languages at Morehead State University