

Zoonotic disease communication networks of livestock producers, veterinarians, human health, professionals, and emergency managers

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Abstract

Zoonotic disease epidemics are on the rise with emerging diseases being identified that affect humans and animals alike like the 2019/2020 COVID-19 pandemic. An understanding about communication networks of those involved in managing a zoonotic disease outbreak is necessary to develop a strong communication response in the event of a zoonotic disease outbreak. The purpose of this study was to explore the communication networks of livestock producers, veterinarians, human health professionals, and emergency managers related to zoonotic disease. In-depth interviews were conducted with 41 people within key areas of one state in an effort to understand how communication networks may be activated during a crisis. This study revealed a wide range of information sources that livestock producers, medical professionals, veterinarians, and emergency managers seek information from. The results from this study also highlight the communication gaps, such as veterinarians not communicating with livestock producers, emergency managers not communicating with medical professionals and livestock producers, and a lack of communication between medical professionals and livestock producers. It is recommended that professionals who play a key role in zoonotic disease outbreaks, such as livestock producers, veterinarians, human health professionals, and emergency managers, cultivate and maintain relationships outside their usual professional group beyond times of disease outbreaks.

Keywords

network map, in-depth interviews, qualitative social network analysis

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Introduction and Problem Statement

Zoonotic diseases pose a major threat to society as these are not commonly seen by producers or veterinarians (Moennig, 2000), which makes diagnoses and control of an outbreak difficult. The most effective way of controlling zoonotic diseases is through communication and education (Ashlock et al., 2009; Zinsstag et al., 2007), but gaps exist in what is known about communication networks and the information shared through these networks. Even when information is available, like on the United States Department of Agriculture (USDA) and the Centers for Disease Control and Prevention (CDC) websites, getting to the information can be difficult (Baker et al., 2020). More research is needed related to zoonotic risk and communication (Decker et al., 2010) to better understand how communication would occur during a zoonotic disease outbreak.

Zoonotic diseases make up about 60% of infectious diseases seen in humans (Centers for Disease Control and Prevention One Health, n.d.); there are 196 emerging diseases that infect humans, livestock, and wildlife. Of these diseases, there are 15 deadly zoonotic diseases affecting humans (Gebreyes et al., 2014). In addition to health impacts, zoonotic diseases also pose a significant threat to the economy. The economic impact has several components that should be considered: the potential spread of a zoonotic diseases, the cost to livelihoods, risk management costs, and risk reduction (Narrod et al., 2012). According to Narrod et al. (2012), zoonotic diseases have an estimated cost of \$20 billion to the global economy within the past decade affecting both industrialized and developing countries.

Given the widespread impacts of zoonotic diseases, it is important to understand the avenues in which people seek information about zoonotic diseases to develop more effective communication strategies.

Theoretical and Conceptual Framework

The conceptual framework of crisis communication and social networks guided this study. Crises happen in all industries and require a level of preparedness that allows for successful communication to help minimize the impact. Communication is the most important factor in crisis management (Coombs & Holladay, 2012). Even the most effective crisis response cannot be effective if communication with the public is poor (Sell, 2017); but, communication alone will not be sufficient if trust is not in place prior to and during the crisis (Quinn et al., 2013). Timeliness and transparency help build audience trust (Irlbeck et al., 2013; Reynolds & Quinn, 2008), and trust and credibility should be established with audience groups before a crisis occurs (Kolich, 2014).

The concept of trust is often built through social networks. Social networks are the arrangements in which humans communicate, the messages sent and received, and with whom they are communicating. The information and resources people gather are influenced by their social network (Hawe & Ghali, 2008). These networks also have an impact on both crisis

communication and education (Moolenaar & Daly, 2012). According to Moolenaar and Daly (2012), social networks can impact the ability to obtain quality information and take action during times of crisis. Research in health has revealed social networks inform people about disease control, affect people's decision to seek mental health services (Mahajan & Meyer, 2019), and affect cultural understanding of health issues within communities (Chaklader, 2018). An understanding of social networks is necessary to determine the implementation of innovation practices and how best to reach audience groups. Some previous work has looked at social networks of health care professionals, veterinarians, and agricultural producers.

Previous work from the University of Wisconsin identified the specific challenge of little communication between physicians and veterinarians. Physicians believed veterinarians should play a larger role in controlling, preventing, and providing information about zoonotic diseases (Grant & Olsen, 1999). But patients did not view veterinarians as a reference for zoonotic-disease information. Recommendations from the study suggest greater communication is needed between physicians and veterinarians, physicians contacting state health departments for information, and more training and education for the two groups about risks and prevention (Grant & Olsen, 1999). Other studies have also identified the need for increased collaborations between veterinarians, physicians, public health professionals, and government organizations (Cripps 2000; Kahn, 2006; Lederberg, 2002). The lack of communication between key organizations has been identified as a hindrance in managing a disease outbreak (Kahn, 2006).

Another study conducted in Oklahoma identified social networks of beef producers. Producers in this study sought information from their veterinarians and viewed them as the most trusted source for animal disease information (Ashlock et al., 2009). These producers also preferred information to be distributed by the county Extension departments followed by the internet. The internet was seen as a secondary source of information, but not seen as a highly trusted source compared with in-person communication (Ashlock et al., 2009).

People use multiple social networks as information sources (Israel & Wilson, 2006). Some forms of information sources for agricultural audiences include publications, extension agents, online media, and peers (Breiner et al., 2007; Riley et al., 2012). Livestock producers in previous works identify their primary source of information comes from their veterinarians (Breiner et al., 2007; Israel & Wilson, 2006; Riley et al., 2012).

Purpose

Given the impact and importance of communication within social networks, especially during times of a crisis, the purpose of this study was to explore the communication networks of livestock producers, veterinarians, human health professionals, and emergency managers related to zoonotic disease in an effort to understand how to best communicate with and prepare these audience groups for a potential zoonotic disease outbreak. The following research questions guided this study: What are audiences' communication networks and

related information sources for zoonotic disease?; and How are audiences' communication networks connected?

Methods

Qualitative methodology was selected to answer the research questions because of its ability to learn about the participants' experiences and understand patterns and explanations from the data (Creswell & Poth, 2018). This case study approach allowed researchers to develop a complete picture of communication networks within the state. Initial participants were recruited through purposive sampling through extension agents; purposive sampling is used when a study seeks to understand the experiences of one specific group (Creswell & Poth, 2018). In the case of this study, researchers wanted to identify individuals within livestock producers, veterinarians, human health professionals, and emergency managers. Snowball sampling was used after initial interviews to find participants with specific insight to the county or processes that came up during the interview. Participants were asked, "Is there anyone else we should speak to regarding a zoonotic-disease outbreak?" For the social network analysis, questions were asked about who they sought information and advice from during a crisis and who they were connected to. A total of 40 interviews were conducted during the course of study. Interviews began during March of 2017 and went through July of 2018.

Interviews were recorded and field notes were collected, creating an audit trail. Interviews were conducted and transcribed by a team of seven trained researchers. The method of using a team of interviewers has been seen in multiple studies (Britten, 1995; Jamshed, 2014; McNulty et al., 2017). Validity was established through member-checks, comparing interviewer and assistant interviewer notes, and transcriptions. Validity creates credibility and trustworthiness within a study (Creswell, 2014).

Participants were asked a series of questions regarding information sources and social networks such as: Who are your most trusted sources of information about contagious animal diseases? What other organizations or publications are your most trusted sources? Who do you share information with? How do you share information with the public about zoonotic-disease outbreaks? Researchers followed up with probes to dig deeper into participants responses related to their communication networks and sources.

All identifying information was removed and pseudonyms were assigned based on audience group. Those from the livestock producer category were given names that started with L, veterinarians were assigned V names, medical professionals assumed names beginning with M, and emergency management personnel had E names. Transcripts were imported into Nvivo software and analyzed for major and minor themes according to Glaser's constant comparative method (1965). One primary coder analyzed all of the data looking for major themes and constantly comparing with previous themes to identify new themes as these arose in the data. Major themes were noted when all four audience groups were seen within a response theme and minor themes included three audience groups. Dissent was noted when participants were

different in their thought processes than the overall themes identified in the study. For RQ2, a communication network map was developed through analyzing all 41 transcripts and making note of who people indicated they were communicating with, entities where they sought information from, and all other sources they relied on for this issue whether in-person or virtually. Then, notes were made on the direction of this communication. A communication map of these notes was created to represent all interactions people would have before or during a zoonotic disease outbreak, which is representative of the communication theory developed from this research. The first map included all of the networks described by participants as a true representation of all voices in the study. The researchers collapsed the data from the first map by consolidating groups of networks and sources together for the simplified communication map. Results were reviewed by note takers and secondary researchers to confirm the analysis and triangulate the data.

Findings

The findings are reported in this section by research questions and accompanied by visual representations of the data. Through the case study approach, the 40 in-depth interviews in this study were used to build a theory around how livestock producers, veterinarians, human health professionals, and emergency managers are connected through social networks during a zoonotic-disease outbreak. Findings are described around major themes.

Audiences' social networks and related information sources for zoonotic disease

Major themes emerged of veterinarians and Kansas State University as sources of information and communication for all audiences. Minor themes included government agencies and state veterinarians playing a role in communicating and educating others about zoonotic-disease outbreaks.

Veterinarians

Veterinarians served as the main source of information, communication, and education regarding zoonotic-disease outbreaks for all audience groups in the study. Larson, a livestock producer, said, "Generally, talk with the local vets on that source. Have a couple of other people that I talk to about different things, but I would say, generally local vets." Vale, a veterinarian said he would turn to the USDA trainings, the university, and his peers, "One of the probably most trusted sources I have is the USDA. We do...accreditation modules...to keep our status current as veterinarians...then the university and colleagues would come after that for me". Mark, a medical professional would lean on his counterpart veterinarians, "Yeah, obviously would talk more to my veterinary med colleagues I would think of or animal science."

Kansas State University

Another major theme was the Kansas State University veterinary school as a source of information for all audience groups. Veterinarian, Vincent, relied on university research, "I think the university information is, should be non-biased and backed up by good studies and good people." Emmitt, an emergency manager described the different sources he would use

depending on the type of disease outbreak, “If it’s a traditional communicable disease, our sources of information would be the health department or hospital. If it’s something zoonotic, it would be Kansas State University Vet Med.” Macy, a medical professional also distinguished a difference in sources of information related to the type of disease, “I don’t know if the CDC has anything that still would be a go to. And I would go to the vet school...I know they have infectious disease veterinarians.”

Government Agencies

The Center for Disease Control and Prevention served as a minor theme. Veterinarians, medical professionals, and emergency managers all access the CDC for information about zoonotic diseases. Vance, a veterinarian used several government agencies including the CDC, “The most trusted resource that we refer to is the USDA information. Whether that’s through the CDC or the Future NBAF [National Bio and Agro-Defense Facility].” Medical professional, Megan, turned to the CDC as her trusted source of information, “Well, CDC would be the most trusted one because they’re supposed to have all the pertinent information and they’re mandated to get that out to healthcare providers.” Evan, an emergency manager, relied on several government agencies to provide information including the CDC:

Well, Kansas Department of Health and Environment is an awesome resource that I use a lot both from the emergency management and public health side, and then Center for Disease Control, and you know Kansas Division of Emergency Management sometimes shares that information so we can always look at what they have but primarily Kansas Department of Health, Center for Disease Control as far as animal health I look at the Kansas Division of Animal Health website. I’ve looked some at the World Health Organization’s website for issues when I’m doing presentations or gathering information those are probably the ones I use most often.

State Veterinarians

State veterinarians were a minor theme with livestock producers, emergency managers, and veterinarians turning to the state veterinarian for information about disease outbreaks. Livestock producer, Larry, utilizes the publications produced by the state veterinarian, “For information, would be the pamphlets and things that would come from the state vet here in Kansas. You know, livestock commissioners and the state vet.” Eric an emergency manager discussed resources that would be used during an outbreak, “Resource wise, we’d be calling, use our available resources and then be calling in the state resources. Your state veterinarian, I’m sure would already be involved.”

Veterinarian, Vance, prioritized his communication network based on types of outbreaks:

I think the reasons for prioritizing it depends on what we’re dealing with. You know, if we’re dealing with something with, such as foreign animal disease, we’re calling our state veterinarian and getting the state involved and turning control over to them. If it’s over zoonotic potential, we’re coordinating with government regulations, but then we’re also coordinating very heavily with the feed yard managers.

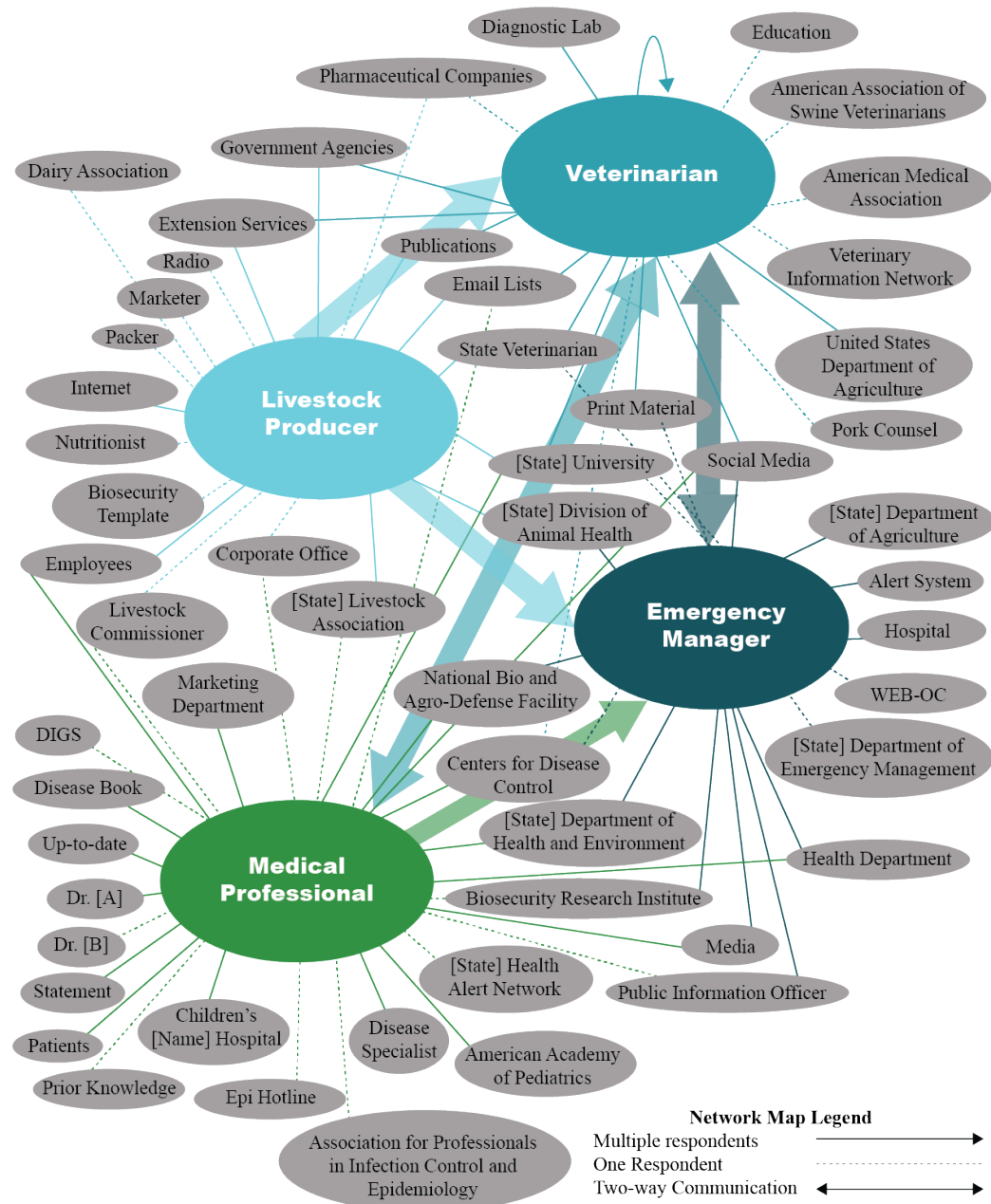
Audiences' Communication Networks and Connections

Researchers were interested in more than identifying major communication networks and sources, but also wanted to see how these networks connected. A complete communication network map was developed through the process of analyzing the data to see where the audiences in-person and virtual networks connected and the direction of these networks. A complete picture of the communication network map is in Figure 1. Audience group communication with other audience groups are designated with larger, colored arrows. Arrows going to and from audience groups display the two-way communication that occurs between groups. Solid lines going in one direction indicated multiple members from that audience group use that source. Dashed lines indicate only one participant from the audience group uses that source. Lastly, the arrow looping around indicates a participant citing other colleagues within the same audience group as a source.

Themes identified in the communication network map (Figure 1) show veterinarians and Kansas State University served as the two major sources of information and communication for all audience groups. Other frequently used sources by veterinarians, medical professionals, and emergency managers were the CDC and state veterinarians. Communication gaps between audience groups are: 1) veterinarians not communicating with livestock producers, 2) emergency managers not communicating with medical professionals or livestock producers, and 3) no communication between medical professionals and livestock producers.

Figure 1

Model of the Social Network Map of livestock producers, veterinarians, human health professionals, and emergency managers

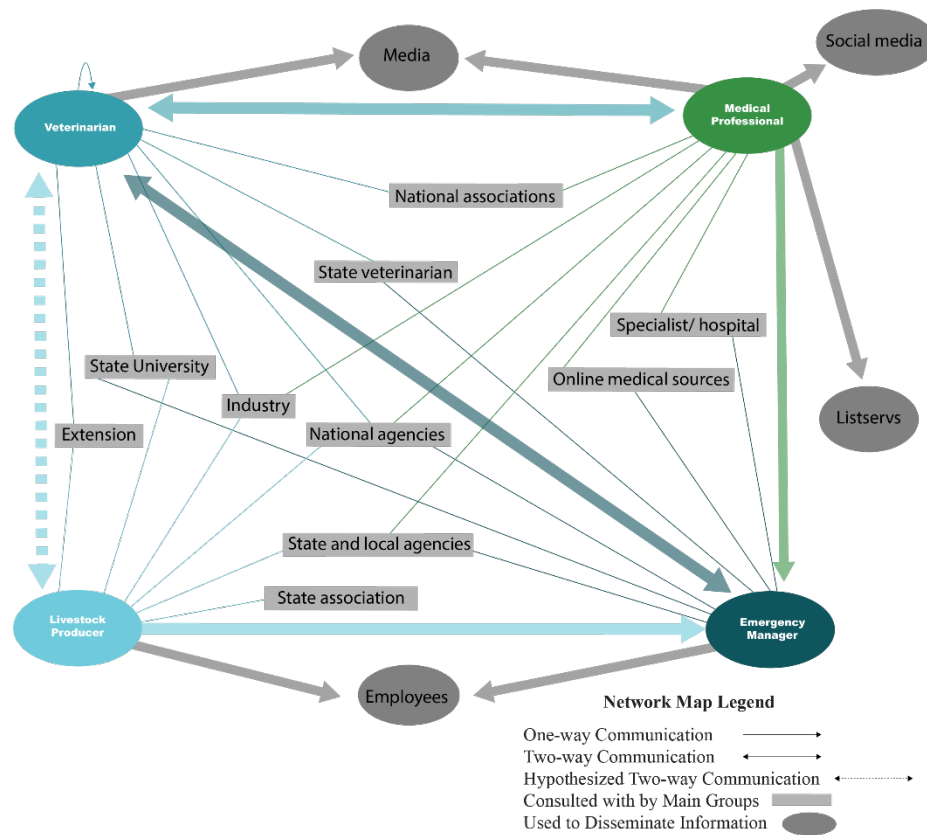


The communication networks identified in this data allowed researchers to analyze data in real time to continuously build the model that emerged from this data. While Figure 1 represents a map of all communication networks during this time, Figure 2 represents the simplified model that emerged from the data to explain how groups would communicate with each other during a zoonotic disease outbreak. The colored circles represent the groups we collected data from in

this study, livestock producers, veterinarians, medical professionals, and emergency managers. The arrows from these groups to other groups we studied indicate direction of information shared. The gray circles are groups that those we spoke to indicated they would share information with as a part of their response strategy to communicate with their stakeholders and members of the public. The rectangles are groups identified by study participants as groups they would seek information from or collaborate with during a zoonotic disease outbreak (Figure 2).

Figure 2

Simplified model of communication networks during zoonotic disease outbreak



Note. Colored circles indicate the groups interviewed. Grey circles indicate groups the colored circles would share information within an effort to disseminate information in a crisis. Dashed line indicates a hypothesized two-way relationship because previous literature indicates this, even though data in this study only showed a one-way relationship. Rectangles are groups the colored circles would consult with for more information during a crisis.

Conclusions, Discussion, and Recommendations

An understanding of audiences' social networks and where they obtain information adds a greater understanding of communication during a zoonotic disease outbreak. Through asking

livestock producers, veterinarians, human health professionals, and emergency managers where they seek information and who they communicate with, a social network map was developed for future communication dissemination before, during, and after a crisis. The communication network map (Figure 2) emerged through the qualitative approach and is a framework that could be tested to see if this communication network exists in other states and across the United States for zoonotic disease communication.

All audience groups turned to veterinarians and Kansas State University for information and communication related to zoonotic-disease communication. The CDC and state veterinarians served as other sources and emerged as minor themes. Medical professionals, veterinarians, and emergency managers turned to the CDC for a total of nine participants. Eight participants within the livestock producer, emergency manager, and veterinarian audience groups communicated and gather information from the state veterinarian.

Audience groups regularly rely on veterinarians for information regarding zoonotic-disease outbreaks. This aligns with several previous studies (Ashlock et al., 2009; Israel & Wilson, 2006; Riley et al., 2012). Ashlock et al. (2009) identified veterinarians as livestock producers' primary source of information about diseases. Kahn (2006), discussed the emphasis medical professionals place on veterinarians in communicating and educating about diseases (2006). The current study indicated a total of 20 (50%) participants from all audience groups seek information from or communicate with veterinarians.

The vast social network may indicate the audience groups do not know where to gather information about zoonotic-disease outbreaks. Moolenaar and Daly (2012) indicated that social networks impact the quantity and quality of information that is obtained; but, a more streamlined approach to seeking information related to zoonotic-disease outbreaks may help improve the quality of information that is shared. However, the large information networks identified in the present study confirms work by Israel and Wilson (2006) that multiple networks are used by people to complete their understanding of complex topics.

This study also highlights communication gaps. The first major gap in communication occurred when veterinarians did not communicate with other audience groups. Throughout the study, veterinarians identified sharing information with medical professionals and emergency managers, but not livestock producers, despite veterinarians being livestock producer's top source of information in previous research (Breiner et al., 2007; Israel & Wilson, 2006; Riley et al., 2012). This highlights a gap in two-way communication in this particular study. Other gaps in communication include veterinarians not communicating with livestock producers, emergency managers not communicating with medical professionals or livestock producers, and no communication between medical professionals and livestock producers. It is assumed veterinarians are communicating and educating livestock producers since livestock producers turned to veterinarians for information; however, in this study, veterinarians did not specifically identify communicating with livestock producers. There was only one-way communication identified with emergency managers and medical professionals and livestock producers. Emergency managers were not seen communicating with these two groups. Lastly, there was

no communication between medical professionals and livestock producers. Prior studies have indicated the need for greater communication among key players, especially between medical professionals and veterinarians (Chomel & Marano, 2009; Cripps, 2000; Kahn, 2006; Meyerholz, 1974; Narrod et al., 2012; Sellnow et al., 2017; Zinsstag et al., 2007). The current study provides continued support for this.

Extension services were a part of the social networks of livestock producers and veterinarians and mentioned specifically as a trusted source. Trust is essential for crisis management and communication (Coombs, 2019) and can increase the strength of social networks. More work should be done to increase the visibility and trust of Extension in other audience groups.

Government agencies, such as the CDC and USDA, were also identified as a trusted source by participants in three audience groups: veterinarians, medical professionals, and emergency managers. Because this trust is already established, online communication from government agencies could serve as linkages between local and state groups during a zoonotic outbreak, however, previous work has identified that finding the large number of resources on the USDA and CDC websites can be difficult (Baker et al., 2020).

Recommendations for future research include determining what education and communication tools help foster relationships between the various audience groups. It is also recommended that relationship indicators are examined to determine how these relationships might influence behavior change when identifying or treating zoonotic diseases.

Professionals who play a key role in zoonotic disease outbreaks, such as livestock producers, veterinarians, human health professionals, and emergency managers, should cultivate and maintain relationships outside their usual professional group beyond times of disease outbreaks. It is recommended that task forces be established prior to a zoonotic disease outbreak so these groups can have established networks in place and form relationships and trust prior to a crisis. By doing so, they are building trust and credibility that can be applied once an outbreak does occur. Additionally, agricultural communication professionals can help foster these relationships by linking audience groups when applicable and by citing multiple sources when communicating about zoonotic disease outbreaks.

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