The Journal of Extension

Volume 53 | Number 6 Article 14

12-1-2015

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Recommended Citation

Van Metre, D. C., & Morely, P. S. (2015). Zoonotic Diseases—Fostering Awareness in Critical Audiences. *The Journal of Extension, 53*(6), Article 14. https://tigerprints.clemson.edu/joe/vol53/iss6/14

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Journal of Extension
www.joe.org

December 2015
Volume 53
Number 6
Article # 6FEA7
Feature

Zoonotic Diseases—Fostering Awareness in Critical Audiences

Abstract

Zoonotic diseases are infectious diseases that are shared between humans and other vertebrate animals. Extension professionals often serve as consultants and educators to individuals at high risk of zoonotic diseases, such as participants in 4-H livestock projects. Effective education about zoonotic diseases begins with an awareness of the multitude of challenges that health care professionals face in diagnosing zoonotic disease. This review describes the factors that influence diagnosis of these diseases, as well as potential methods that the Extension professional can use to convert those challenges into effective educational messages.

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Introduction

Zoonotic diseases (zoonoses) are defined as infectious diseases that can be shared by humans and other vertebrate animals. Of the 1,415 known human pathogens, 868 (61%) are zoonotic (Taylor, Latham, & Woolhouse, 2001). Of the infectious disease agents known to affect livestock and horses, 243 out of 616 (39%) are zoonoses (Cleaveland, Laurenson, & Taylor, 2001). Over the previous decade, zoonotic diseases have been estimated to cost the global economy $20 billion USD in direct economic losses, with another $200 billion USD in indirect costs (World Bank, 2012). Zoonotic disease risk is considered highest in individuals in occupations involving frequent animal contact, such as ranchers and their family members, agricultural workers, veterinarians, veterinary technicians, and slaughterhouse workers (Heponstall, Cockroft, & Smith, 2000). This population of individuals at risk also includes participants in 4-H livestock projects and livestock exhibits at fairs, as well as Extension professionals who serve as livestock consultants (Amass, Schneider, & Kenyon, 2004; Stevenson, Moore, Newman, Schmidt, Smith, Smith, Kerr, Wallace, & Boyes, 2011; Smith & Meehan, 2012).

Awareness and clear communication about zoonotic diseases are considered critical for Extension professionals involved in 4-H livestock programs (Stevenson, Moore, Newman, Schmidt, Smith,

Smith, Kerr, Wallace, & Boyes, 2011) and for youth-based community outreach programs that involve companion animals (Miller & Schmiesing, 2008). Zoonotic disease education has been identified by Extension professionals as an agricultural health and safety topic in need of greater emphasis in adult education programs (Webster, Rogers, & Mariger, 2001). Because Extension professionals are often familiar to participants of these programs, these people are well positioned to deliver messages of caution about zoonotic diseases in the context of more holistic training programs in animal husbandry, health, and biosecurity (Webster, Rodgers, & Mariger, 2001; Stevenson, Moore, Newman, Schmidt, Smith, Smith, Kerr, Wallace, & Boyes, 2011).

To effectively deliver clear messages on zoonotic disease recognition and prevention, we believe that the Extension professional must first gain a perspective on the challenges involved in the diagnosis of zoonotic diseases. With that understanding in place, Extension professional can more effectively craft instructional messages for the target audiences, specifically, the 4-H adult volunteers, 4-H producers involved in livestock production, 4-H participants in projects involving companion animals, and adults seeking education in agricultural health and safety. In this review, we describe the factors that limit the health care professional's capacity to diagnose these diseases and describe potential methods for the Extension professional to convert those limitations into effective educational messages for these target audiences.

Challenges for the Health Care Professional

Symptoms and Exposure History

For the health care professional, diagnosis of zoonotic diseases can be particularly challenging because of their infrequent occurrence and the rarity of definitive signs in affected patients (LeJeune & Kersting, 2010). The zoonosis patient often presents with non-specific symptoms such as fever and flu-like illness (Cleri, Rickett, & Vernaleo, 2007). Pet ownership and animal contact are important historical data that heighten the potential for zoonotic diseases; however, inquiry about these risks may not be consistent among health care professionals. Further, zoonotic pathogens have been linked to 132 animal species (Woolhouse & Gowtage-Sequeria, 2005), which further complicates the health care professional's capacity to associate animal exposure with the patient's illness. Direct animal contact is not the sole means of transmission of these diseases. Zoonotic infections can also be transmitted indirectly via contaminated soil or other surfaces at farms, fairgrounds, or parks, contaminated home environments, food and water, contaminated pet food and treats, and by parasites harbored by animals.

In light of these diagnostic challenges, some physicians have expressed reservations about their own capability to accurately diagnose zoonotic diseases. A survey of physicians in Northeast Ohio about their farmer patients revealed that over 50% were either mostly uncomfortable or strongly uncomfortable with their knowledge of zoonotic diseases (Kersting, Medeiros, & LeJeune, 2009). In a survey of physicians and veterinarians in Wisconsin, Grant and Olsen (1999) found that physicians were not very comfortable with advising patients about the role of animals in zoonotic disease transmission and felt that veterinarians should have a greater or equal role in advising patients about zoonoses. Because the pathogenesis of infectious disease in animals is not emphasized in human medicine, and the clinical aspects of human disease are not emphasized in veterinary

medical curricula, communication between the two professions would appear to be essential for effective clinical management and prevention of zoonoses. However, at the practitioner level, communication between the two professions appears to be infrequent and irregular (Kahn, 2006). Further, veterinarians may fail to consistently communicate with animal owners about these diseases (Lipton, Hopkins, Koehler, & DiGiacomo, 2008).

Unfortunately, the gulf that separates human and veterinary medicine is also reflected in the "fragmented landscape" of surveillance systems for human and animal diseases (Moore & Lund, 2009). From the global to the local level, disease surveillance for human and animal diseases has traditionally been separate and poorly connected. Many zoonotic diseases are not reportable to public health authorities, and those that are reportable vary from state to state. Further, occupational health surveillance systems are not in place to identify and report these illnesses in high-risk occupations (LeJeune & Kersting, 2010). Mild cases of zoonotic disease may go unreported or undetected. Therefore, health care professionals and veterinarians may lack accurate, timely data on the incidence of zoonotic diseases in their region, which lowers clinical awareness and further impairs collaboration.

While there is likely little that the Extension professional can do to foster change in zoonotic disease surveillance systems, he or she can help to mitigate obstacles to diagnosis of these diseases with the following messages for animal-owning audiences.

- Individuals at risk for contracting zoonoses need to understand that the symptoms of these diseases may be vague, such as fever and flu-like signs.
- Prompt consultation with a health care professional is prudent should these symptoms develop in individuals exposed to animals or to their environment.
- When infectious disease is suspected to occur in animals, owners should ask their veterinarian if the disease(s) under consideration has/have zoonotic potential and, if so, what precautions are necessary to prevent transmission to people.
- If a zoonotic disease is suspected, communication between the veterinarian and health care professional should be requested by the patient or the patient's advocate (e.g., the parent).

Season

Certain zoonoses transmitted by livestock show marked variation in the season in which they occur. In the United States, beef cattle, sheep, and goats typically gestate over the winter months to give birth in the late winter or early spring. During this time period, many different species of zoonotic infectious agents may cause abortion, stillbirth, and weak neonates in these livestock species (Menzies, 2011). People may be exposed to these agents directly when handling affected animals during gestation and birthing season.

Q fever is a zoonosis caused by the bacterium *Coxiella burnetii*. This disease brings several important issues to light regarding the influence of season on disease risk. Symptomatic shedding of high numbers of this pathogen may occur in livestock showing abortion or birth of weak newborns.

However, asymptomatic shedding of this bacterium can occur in ruminant livestock at the time of birthing of healthy offspring (Roest, Tilburg, Van Der Hoek, Vellema, Van Zijderveld, Klaassen, & Raoult, 2011). Inhalation of widely dispersed airborne organisms from aborting and recently birthed goats has been implicated as the cause of a recent, large-scale human Q fever epidemic in the Netherlands (Roest, Tilburg, Van Der Hoek, Vellema, Van Zijderveld, Klaassen, & Raoult, 2011).

Influenza-like illness (ILI), pneumonia, and hepatitis are potential manifestations of clinical Q fever infections in humans (Angelakis & Raoult, 2010). In both the Netherlands and the United States, the highest proportion of reported human Q fever cases occur in the late winter and spring (Roest, Tilburg, Van Der Hoek, Vellema, Van Zijderveld, Klaassen, & Raoult, 2011; Centers for Disease Control and Prevention, 2014a). This time period coincides with birthing season in most domestic ruminants. Importantly, these same months also coincide with what is typically the tapering end of the annual winter-spring spike in outpatient visits for ILI in humans (Centers for Disease Control and Prevention, 2014b). Health care professionals, therefore, may be confronted with the ILI patient who has Q fever or another livestock-associated zoonosis at a time period that overlaps with or soon follows a high caseload of seasonal influenza. The health care professional could then make a misdiagnosis of influenza.

The critical messaging opportunity for the Extension professional is to advocate the following precautions for managing livestock during gestation and birthing.

- A veterinarian should be consulted promptly when abortions or stillbirths occur in livestock, so that appropriate hygienic measures and preventive practices can be initiated.

- Persons with conditions that may alter their immune response should consult with their health care professional before working with livestock during the birthing season; these include, but are not limited to, individuals on immunosuppressive medications (e.g., chemotherapy), pregnant women, persons with diseases of the immune system, the elderly, and young children.

- If illness develops in persons working in or near livestock birthing areas, this exposure history should be clearly communicated to the health care professional, owing to the fact that these zoonoses can cause flu-like symptoms, and those zoonoses that are transmitted during birthing season tend to occur during flu season.

Occupational History

For health care professionals, occupational history is a critical component of the diagnostic process. Assessment of occupational risk in farmers and ranchers may be complicated by the fact that, in the United States, more than half of these individuals are employed off of the farm for economic reasons (LeJeune & Kersting, 2010). Therefore, a request for primary occupation or place of employment in a patient's history may not reveal the individual's true risk for zoonoses.

The U.S. agricultural workforce is increasingly comprised of elderly individuals and women, whose immune status may be compromised by advanced age or pregnancy, respectively (LeJeune & Kersting, 2010). Further, this workforce is comprised of individuals who may not be uniformly aware

of their risk for zoonoses. In the Midwest and Western regions, it has been estimated that 90% of the migrant farm workers are Hispanic (Von Essen & McCurdy, 1998). Many of these individuals do not possess a farming background and seek jobs in animal agriculture as an entry-level, often temporary job opportunity (Kirkhorn & Schenker, 2002). The potential risk of zoonotic infection in these individuals is considerable, particularly if these workers are not educated in recognition and prevention of zoonoses. In a survey of western U.S. dairy workers, nearly 20% reported that they received no job safety training upon being hired (Roman-Muniz, Van Metre, Garry, Reynolds, & Wailes, 2006). Additionally, there is the potential for cultural, language, and socioeconomic issues to influence an ill worker's decision to seek health care. Access to health care in certain rural areas can be problematic, regardless of the patient's ethnicity (LeJeune & Kersting, 2010).

With regard to occupational information, therefore, the critical messages for Extension professionals to their audiences involved in raising livestock are simple.

- Livestock owners should be encouraged to identify local health care professionals and maintain the recommended schedule of wellness check-ups and immunizations.
- When health care professionals inquire as to their occupation, livestock owners must be diligent in disclosing their exposure to livestock, regardless of their primary occupation.
- Education about zoonotic diseases should be included into livestock worker safety training.

Opportunities for Zoonotic Disease Education

Extension professionals have been considered to be a pivotal bridge for effective communication of relevant information on zoonoses from human and animal health care professionals to the lay audience, particularly those who are marginalized by economic, geographic, or language factors (Marshall, 2011; Webster, Rodgers, & Mariger, 2001). Rewards such as certificates of completion of short courses, public forums, or projects on zoonotic disease prevention can serve as effective motivators for 4-H participants and youth leaders. On-line educational materials on zoonosis prevention and basic biosecurity practices have been developed for 4-H volunteer leaders; they are available at http://breeze.wsu.edu/diseasepreventioncourse2/event/registration.html (Stevenson, Moore, Newman, Schmidt, Smith, Smith, Kerr, Wallace, & Boyes, 2011). An incremental, three-part livestock biosecurity curriculum designed for beginning 4-H producers is available at http://4h.ucanr.edu/Resources/Curriculum/FREE/Bio-Security_in_4-H_Animal_Science/ (Smith & Meehan, 2014). These educational programs emphasize such fundamental steps as hand washing, pen hygiene, animal health monitoring, visitor traffic control, and proper food hygiene practices. Importantly, these fundamental practices mitigate transmission of disease among animals as well as among animals and humans.

More detailed information on specific zoonotic diseases, developed by the Center for Food Security and Public Health, Iowa State University, is available at http://www.cfsph.iastate.edu/Zoonoses/zoonotic-disease-resources.php. English and Spanish language resources are available at this site. In addition, an on-line course on selected zoonoses for animal or human animal or human healthcare professionals or students is available through this

Center.

In summary, relatively brief critical messages about zoonotic disease prevention and recognition have been provided in this article. We believe that the diagnostic dilemmas surrounding zoonotic diseases must be clarified to critical audiences if those audiences are to be empowered to facilitate the diagnostic process. Extension professionals can deliver these messages to critical audiences at strategic times. For example, newsletters, website postings, or emails that focus on preparation for calving, lambing, or kidding season represent timely opportunities for message delivery about zoonotic risks related to livestock birthing. These messages, along with established educational programs related to agricultural health and safety, may ultimately foster evolution of a culture of prevention, rather than crisis management, in critical audiences (Webster, Rodgers, & Mariger, 2001).

Conclusions

Education of the animal-owning public about zoonotic disease has been long recognized as a core mission of veterinarians and Extension professionals. A fundamental first step in effective public education on zoonotic disease is to have an awareness of the multitude of challenges that health care professionals face when confronted with a patient with zoonosis. Livestock and pet owners must adapt an active role in communication of their potential risks and exposures to their health care professionals. Information about zoonotic disease awareness can be integrated into many forms of communication between Extension professionals and the public. Extension professionals have developed relevant training programs for 4-H volunteers and livestock producers.

Acknowledgement

An earlier version of this manuscript was published previously in Proceedings, 97th Annual Convention, Wisconsin Veterinary Medical Association, Madison, WI, October 11-14, 2012. Those proceedings were not copyrighted.

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