DISSERTATION

DEVELOPING AN INTEGRATED LIVESTOCK-HUMAN INFECTIOUS DISEASE MANAGEMENT FRAMEWORK FOR THE DAIRY FARM ENVIRONMENT

Submitted by

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ABSTRACT

DEVELOPING AN INTEGRATED LIVESTOCK-HUMAN INFECTIOUS DISEASE MANAGEMENT FRAMEWORK FOR THE DAIRY FARM ENVIRONMENT

This research aimed to develop a framework integrating cattle and human infectious disease prevention in the dairy farm environment. Infectious disease dynamics on dairy farms can be complex, with various factors impacting cattle and human health. The advent of the COVID-19 pandemic reminded the world of the complexities of disease dynamics and prevention. Biosecurity is key to infectious disease prevention on dairy farm settings, but preventive efforts might not focus on both cattle and human health. Those trained in veterinary medicine may be especially suited to help bridge this animal-human gap on dairy farms, as these professionals understand disease dynamics and may be trusted to serve in this capacity. Infectious disease risk assessment tools for dairy farms might not fully integrate human health. Developing more integrated risk assessment tools first requires a greater understanding of existing tools and dairy farmer knowledge, attitudes, and practices regarding cattle and human infectious disease prevention. The research described biosecurity, biosafety, and identified potential areas of overlap to create a foundational integrated animal-human infectious disease prevention model. A systematic literature review was conducted on animal producer knowledge, attitudes, and practices regarding personal protective equipment for zoonotic disease prevention. Current biosecurity and biosafety assessment surveys and tools applicable to dairy farm environment were also assessed for structure, content, and degree of human health integration. Assessment of the survey questions and score report from one of these tools included obtaining feedback from a small sample of Front Range Colorado dairy producers. A knowledge, attitudes, and practices questionnaire including elements of cattle and human infectious disease prevention was developed, and data was collected from 50 personnel, including workers and supervisors, across six Front Range Colorado dairy farms. This work found that the word “biosecurity” has many definitions that can vary by profession setting. Many elements of efforts aimed at preventing animal diseases can also be effective in preventing human diseases. Personal protective equipment is an example of such an element. Systematically reviewing literature on personal protective equipment knowledge, attitudes, and practices revealed that animal producers often fail to use preventive measures and may not always perceive zoonoses as a threat. Assessment of existing infectious disease risk assessment tools revealed that none fully and directly integrated human infectious disease prevention. Producer feedback on one tool focusing on cattle health provided valuable feedback on tool design and helped shape recommendations for developing integrated tools. Construction of the integrated knowledge, attitudes, and practices questionnaire was a novel approach to creating a research tool that integrates animal and human infectious disease prevention. Results revealed strengths and weaknesses in knowledge, attitudes, and practices regarding zoonotic disease prevention and helped identify elements that can be addressed to develop a shared understanding between dairy farm supervisors and workers.

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CHAPTER 1: INTRODUCTION

The COVID-19 pandemic highlighted the interrelatedness of biological and social aspects contributing to disease emergence and propagation. Veterinarians have played a major role in the development and advancement of One Health over several decades. Due to their training, they are uniquely poised to contribute to collaborative, multidisciplinary approaches to solving problems such as emerging infectious diseases, food security (Hollier et al., 2014), rural health (Schwabe, 1969a), and biological security (Leighton, 2004). Overlap may exist between biosecurity and biosafety on farms, and both ultimately help preserve animal and human health. Integrated, or One Health approaches may help increase efficiency and maximize health on farms settings. Dairy farms represent a unique setting where animals and humans interact within a confined environment with many direct and indirect health threats to animals, their products, and humans (especially farm workers). While biosecurity tools for dairy farms exist, there may be little integration of animal and human health in these tools. As interdisciplinary approaches such as One Health continue to evolve, the contribution of social factors, including knowledge, attitudes, and practices (KAP) regarding infectious disease prevention have become increasingly apparent. Dairy producer KAP regarding animal and human infectious disease management remains poorly characterized. There exists a need to develop KAP assessment tools that integrate and assess animal and human elements of infectious disease management. Such integrated approaches are a first step toward characterizing infectious disease threats through a One Health approach, improving farm biosecurity/biosafety plans, proposing policy recommendations, and developing integrated assessment tools that include elements of animal and human health for the farm environment. Considering this profession's rich history and recent progress regarding integrated efforts, veterinarians' abilities, and the global context of infectious disease emergence, veterinarians are uniquely poised to tackle construction of an integrated KAP questionnaire for the dairy farm environment and to make recommendations for improved biosecurity plans and human-cattle integrated assessment tools for the dairy farm environment.

Integrating Livestock and Human Infectious Disease Management on Dairy Farms

Dairy farms are unique work environments where cattle, workers, and the overall farm environment overlap and interact in often intensified manners. Workers are at risk for accidents involving machinery, animals, and various chemicals. Infectious agents can persist and spread between cattle, workers, visitors, environmental elements, wildlife, and pests. Workers are at risk for various zoonoses, and disease spread person-person can threaten farm productivity and biosecurity efforts. As recent examples, the advent of the COVID-19 pandemic may have impacted dairy farm biosecurity efforts with direct and/or indirect influences on human and animal health on dairy farms and potential impacts beyond the farm. The 2022 monkeypox outbreak, ongoing highly pathogenic avian influenza within wild and domestic poultry, and continuing circulation of SARS-CoV-2 are reminders that infectious diseases will always pose a threat.

Biosecurity on farms can be considered through the lens of external influences (i.e., preventing pathogens from entering or leaving a farm setting) and internal (i.e., preventing spread of pathogens within a farm setting). However, when considering biosecurity, dairy farmers may place predominant focus on prevention of diseases within their cattle. They may not always consider biosecurity through a holistic, or integrated lens that includes not only their animals' health, but also their own health within the overall farm environment. Differences in culture and language between human populations on a dairy farm setting can hinder communication and influence preventive practices aimed at protecting health of animals and people working on farms. In a keynote address in 2004, Schwabe highlighted the importance of an “integrating mindset.” He argued that success in applying the One Medicine concept requires more than categorizing and differentiating items and events (i.e., left-brain activities). Rather, applying a One Medicine approach also requires right-brain activities of synthesis and creativity. He suggests right-brain activities represent a more integrative or holistic mindset characterized by the ability to see the bigger picture and that varying mindset characteristics can occur within different types of social systems, including folk, agrarian, and industrian (Schwabe, 2004). Nisbett and Miyamoto (2005) suggest perceptual processes can be influenced by culture. Specifically, they contend that Westerners engage in analytic perceptual processes by focusing on relevant objects independent of context, while Asians tend to apply a more holistic perceptual thought process by relationships between objects and their contexts.

Calvin Schwabe argued veterinarians are poised to contribute to rural health, especially on farm settings (Schwabe, 1969a). In the second edition of “Veterinary Medicine and Human Health”, he discusses veterinarians as members of the public health team and points out the typical reluctance of the veterinary profession to advocate for its utility in public health practice. He argues that a public health veterinarian has the obligation to inform other team members of veterinarians’ training and abilities and has a similar obligation to actively learn about backgrounds and abilities of other team members of the public health team representing different professional disciplines (Schwabe, 1969b). He dedicates a chapter to *Homo sapiens* and highlights the point that despite the veterinary profession's thorough comparative study of diseases across animal species, little direct attention is given to humans. He posits that veterinarians engaging in public health should gain greater familiarity with human biology and with the animal *Homo sapiens* (Schwabe, 1969c). In his chapter on rural health, Schwabe identifies veterinarians as uniquely poised and qualified to contribute to the protection of human health on the farm, as they have a relationship with farmers and familiarity with rural life and associated health threats. These causes of farm fatalities and illnesses include accidents involving vehicles, machines, and animals, exposure to toxic plants and chemicals, zoonoses and pathogens from arthropods. He cites advances that some countries made in teaching veterinary students relevant topics in economics, sociology, and community development. He argues that the veterinarian is among the most suited to bridge the gap between public health and agriculture (Schwabe, 1969a). Armed with a comparative medicine foundation and a modern One Health framework, veterinarians should be able to contribute to the design and implementation of recommendations and interventions that integrate or bridge elements of animal and human health in livestock production settings.

As observed during the COVID-19 pandemic, understanding knowledge, attitudes, and practices (KAP) relative to infectious disease prevention is essential, as these elements are related and ultimately shape preventive behaviors (e.g., use of personal protective equipment) and health outcomes. Livestock and human disease prevention on dairy farm may share common elements, but bridging this gap and integrating efforts warrants further exploration (Figure 1.1).

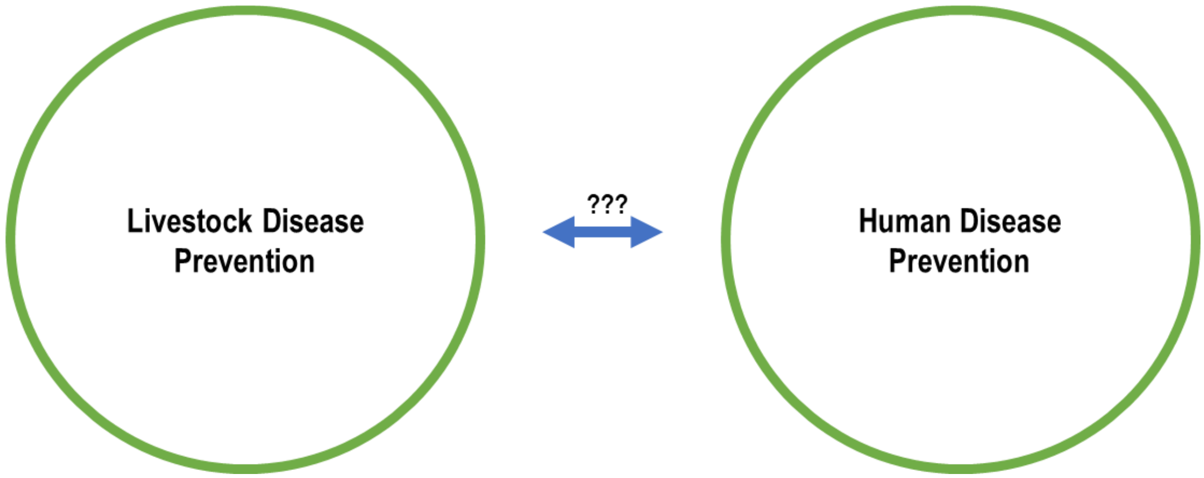

Figure 1.1. Simplistic representation of livestock and human disease prevention on farms as separate efforts highlighting the need to explore factors facilitating their integration.

Infectious disease challenges to the farm could impact livestock and human health. It is important to develop holistic KAP questionnaires that include elements of human and animal disease prevention. Questionnaire development and initial KAP characterization are essential to developing improved KAP questionnaires, effective biosecurity/biosafety recommendations, and to developing integrated biosecurity/biosafety tools that include animal and human health. Therefore, this dissertation's overall goal is to explore the utility and key features of an integrated framework for dairy farm biosecurity and biosafety that includes elements cattle and human infectious disease prevention within the dairy farm environment. This goal is addressed through the following chapters:

Dissertation Chapter 2 aims to provide a basic conceptual framework linking cattle and human health infectious disease prevention in dairy farm settings. It provides initial baseline recommendations toward developing a more holistic approach to biosecurity that includes focus on animal and human health within the dairy farm environment. The third chapter aims to apply a systematic review approach to characterize livestock farmer KAP regarding personal protective equipment (PPE) and occupational infectious disease prevention, with a focus on zoonoses and COVID-19. The goal is to highlight PPE KAP across livestock production settings without geographic restriction. Chapter 4 aims to provide a brief review of selected biosecurity and biosafety surveys and assessment tools relevant to preventing infectious diseases in humans and/or animals on farms, with predominant focus on dairy farms. It attempts to highlight structure and focus areas of these tools and identify those that combine elements of human and animal infectious disease prevention. The chapter also aims to highlight feedback from a small number of Colorado dairy producers on the survey questions and score report from one dairy cattle biosecurity tool. The overall goal is to structure recommendations toward improving dairy farm biosecurity/biosafety tools and contribute to an initial framework for developing integrated farm assessment tools that includes elements of animal and human infectious disease prevention. Building on previous chapters, Chapter 5 aims to construct an integrated biosecurity-biosafety KAP assessment questionnaire that includes elements of infectious disease prevention in cattle and humans for the dairy farm work environment and to pilot it on a small number of Front Range Colorado dairy farms. It aims to address in detail the methodology, including construction of a novel integrated biosecurity-biosafety KAP questionnaire and dairy farm recruitment approaches and obstacles during the COVID-19 pandemic. With predominant focus on zoonoses, this chapter also aims to highlight selected questionnaire results. This chapter also aims to help guide a set of recommendations toward improving future integrated KAP questionnaires, dairy farm recruitment and engagement highlighting utility of veterinarians, dairy farm biosecurity/biosafety programs and training, and contribute to an initial framework for an integrated biosecurity-biosafety assessment tool for the dairy farm environment. This work is synthesized in the conclusion (Chapter 6)

CHAPTER 2: CONSTRUCTING A HOLISTIC MODEL OF HEALTH FOR THE DAIRY FARM ENVIROMENT

Introduction

Agricultural workers are vital to national and global food security but face unique occupational health threats. Recent work has aimed to characterize occupational hazards in this population and to develop effective interventions, but there remains a need to better understand infectious disease threats in agricultural settings. The COVID-19 pandemic forced us to view occupational health through a more comprehensive lens that considers overlapping aspects of human, animal, and environmental health. Farm biosecurity frameworks may provide an opportunity to strengthen cattle and human infectious disease prevention efforts on farms.

The COVID-19 pandemic revealed the dynamic nature of viruses and the influence of animals and humans on local and global disease ecology. As the COVID-19 pandemic began, it was uncertain if cattle could play a major role in SARS-Co-V2 transmission. Although we know now that cattle are not highly susceptible to infection or transmission (Ulrich et al., 2020), the pandemic highlighted the need to view farm health in a more holistic manner. Humans have transmitted the virus to dogs, domestic cats, domestic cats, tigers, and lions (Gollakner & Capua, 2020). Outbreaks of SARS-CoV-2 occurred in farmed mink populations in Europe and the United States (Manes et al., 2020). Evidence suggests that humans transmitted the virus to animals (Manes et al., 2020). Transmission of SARS-CoV-2 from human to mink and back to human on farms has been documented (Oude Munnink et al., 2021) and highlights the dynamicity of this virus. These findings and concerns highlight the need for an integrated approach to farm biosecurity that includes appropriate focus on prevention of human and animal disease and policies and practices that reduce chances of bilateral transmission of pathogens between species. Although cattle do not appear important in COVID-19 disease ecology, future emerging infectious diseases may impact cattle.

Essential Worker Vulnerability and Importance Highlighted during the COVID-19 Pandemic

Safeguarding health of those involved in food production and distribution is crucial to maintaining national and global food safety and food security. Early in the pandemic, COVID-19 outbreaks occurred in US meat processing plants (Waltenburg et al., 2020). Workers in meat processing and agriculture premises may face unique threats due to crowded conditions, housing arrangements, and shared transportation. The physical nature of some types of work may make it more difficult to properly use PPE. Farm workers across the United States face unique risks of contracting and dying from COVID-19, and these risks are influenced by social determinants and independent of poverty, insurance, or linguistic accessibility of COVID-19 health campaigns (Fielding-Miller et al., 2020). Food security is necessary to maintaining stability at local, regional, and global community levels, and it depends on a healthy workforce and healthy food producing animals and crops. Food insecurity has historically been associated with unrest and violence (Brinkman & Hendrix, 2011). The recent war in Ukraine has disrupted regional and global access to food and energy sources (WFP, 2022). These uncertainties also threaten production animal access to feed.

Occupational Health Threats in US Dairy Production Settings

Agricultural workers face many unique exposures and stressors that can affect their physical and mental health. Health threats in dairy farm settings can include exposure to extreme temperatures, pesticides and other chemicals, dusts, various psychological stressors (Menger et al., 2016) and physical injuries (Lindahl et al., 2013). Effects of these health threats may be compounded by increasing age among US farmers (USDA, 2019). Recent trends in animal production are characterized by intensive production that can facilitate increased frequency of microbial exposures for animal producers (Graham et al., 2008). There is a need to understand the physical, environmental, policy, and social factors underlying infectious disease threats in dairy farm settings.

Cattle workers are at risk for zoonoses with potential to affect a variety of systems, including respiratory, gastrointestinal, reproductive, integumentary, and nervous (Fenton et al., 2010; Klous et al., 2016; Palomares Velosa et al., 2020; Salman & Steneroden, 2015; Vayr et al., 2018). Women working in dairy settings can be vulnerable to zoonoses like Q Fever, listeriosis, and brucellosis, which can affect their reproductive health (Fenton et al., 2010). Some pathogens such as *Mycobacterium tuberculosis* and methicillin-resistant *Staphylococcus aureus* (MRSA) are also transmissible from human to animal (i.e., “reverse zoonoses”) (Messenger et al., 2014) and constitute an important infectious disease dynamic on dairy farms. Food system workers may lack adequate knowledge and safety measures to protect their health (Parks et al., 2020). Biosecurity measures are often not fully implemented on dairy farms (Moya et al., 2020). A study on Minnesota and Wisconsin dairy farms suggests measures to prevent COVID-19 among farm workers could have been improved early in the pandemic (Yung et al., 2021). While factors influencing biosecurity implementation on dairy farms are poorly understood, feasibility of implementation is one relevant psychosocial factor (Moya et al., 2020). A diminished or weakened workforce can directly reduce food security by hampering farms' abilities to produce healthy animals and animal products (Stephens et al., 2020).

Infectious diseases transmitted person-to-person like COVID-19 (Yung et al., 2021) can also impact worker health and productivity. Workers living in shared housing and using shared transportation may increase risk for infectious diseases, including COVID-19 and other infectious diseases like seasonal influenza. A summer 2020 phone survey exploring COVID-19 awareness and preparedness of 37 Minnesota and Wisconsin dairy farms found that dairies had introduced, continued, or increased the following biosecurity measures: social distancing (84%), hand hygiene (68%), disinfection and sanitation of common areas and equipment (38%), and use of gloves (24%). However, only 32% of respondents believed employees were using face masks or face coverings more since COVID-19 began. In the same study, only 41% of respondents felt their farm was protected against COVID-19, 68% agreed their farm had an isolation protocol for people with fever and/or respiratory symptoms, 86% believed there was an adequate supply of PPE on the farm, and 24.3% of dairies reported COVID-19 infections on their farms (Yung et al., 2021).

At the national level, the US National Institute for Occupational Safety and Health (NIOSH) promotes agricultural safety through education and research (NIOSH, 2019). However, most of the institute's attention appears to be placed on physical injuries, chemical exposures, and respiratory threats as potential occupational hazards. Most published peer-reviewed literature also focusses on these topics, while occupational threats of infectious diseases including zoonoses receive less attention. The NIOSH Total Worker Health (TWH) program is a developing campaign that employs a holistic approach to prevent worker injury and illness (NIOSH, 2018). To date, there is little direct application of the TWH program to the agricultural sector. However, the AgriSafe Total Farmer Health framework is a recent advancement focusing on agriculture (AgriSafe, 2022). Topics within this framework include weather, healthcare, fitness, social, finances, diet, sleep, cognition, spirituality, and hazard. The hazard topic includes focus on infectious diseases including zoonoses and COVID-19 (AgriSafe, 2022). The TWH holistic approach can constitute a promising framework on which to base integrated approaches involving livestock and worker health. Specific to COVID-19, the Centers for Disease Control and Prevention (CDC) and Department of Labor (DOL) provided guidance for agricultural workers and employers (CDC, 2020a). This includes recommendations on social distancing, disinfecting, training, and application of hierarchy of controls, which involves using source control and a combination of engineering controls, administrative controls (i.e., proper sanitation, cleaning, and disinfection), and personal protective equipment (CDC, 2020a). At the state level, the Colorado Department of Public Health and Environment (CDPHE) based COVID-19 recommendations on CDC guidance and provided additional recommendations on face masks, housing, and car-pooling (CDPHE, 2020). Paid sick leave and agricultural housing policies can shape infectious disease dynamics in farm settings. Upper Midwest Agricultural Safety and Health Center also provided COVID-19 prevention guidelines for agricultural workers, but these guidelines did not significantly differ from those of the CDC (UMASH, 2020).

Developing a Shared Understanding through Common Language

Holistic prevention of infectious diseases requires a One Health approach that integrates aspects of animal, human, and environmental health. As professionals representing a variety of disciplines collaborate to solve complex modern problems, the importance of developing a shared language to ensure efficient communication is increasingly apparent. Buschardt et al., (2021) recently developed a One Health glossary to support communication and information exchange between human health, animal health, and food safety sectors. Recognizing different interpretations of the words “biosecurity” and “biosafety” across and within professional sectors is important. Various parties have created and adapted different definitions of the word “biosecurity” to meet their own needs (Gunn et al., 2008). Developing a shared understanding of their meaning and use is crucial to communication between farmers, veterinarians, industry, government organization, international organizations, the public, and researchers across disciplines. Use of a common term that includes health of humans and animals could facilitate effective communication within and across fields. Similarly, inconsistent use of the term “aerosol” also became problematic in responding to COVID-19.

Closing the Gap between Cattle and Worker Health

The COVID-19 pandemic challenged us to change the way we view and practice biosecurity on farms. Farms may benefit by approaching health through a more holistic lens that also incorporates human health and environmental factors. Health of farm workers involved in animal production is especially important. Decreased incidence and prevalence of animal disease could help reduce chances of zoonotic disease transmission to workers on farms.

The objective of this study was to develop a basic conceptual framework of integrated cattle and human health in dairy farm settings by exploring uses terminology including biosecurity and biosafety in various profession settings, highlighting similarities in preventive actions and concepts relevant to cattle and human health on dairy farms, and proposing an initial set of recommendations toward more thoroughly integrating cattle and human infectious disease prevention.

Methods

We conducted a scoping literature review to provide a summary of existing uses of terms including biosecurity and biosafety across various professional settings, including farms, laboratories, and clinics. We searched for definitions and conceptual explanations of biosecurity, biosafety, and infection prevention and control at academic, government, and international organizations in farm (focusing on livestock), clinical, and laboratory settings to highlight terminology similarities and differences across disciplines. Literature and selected academic, government, and intergovernmental (e.g., United Nations) websites published from year 2002 to 2020 were considered eligible for consideration by the lead researcher (RF) if they provided a definition or conceptual explanation of biosecurity, biosafety, and/or infection prevention and control. We specifically searched for definitions of biosecurity, biosafety, and infection prevention control and prevention within the US Department of Agriculture, Food and Agriculture Organization, World Organization for Animal Health, and Centers for Diseases Control and Prevention. Searches were conducted through Google using search terms including "biosecurity", "biosafety", "infection prevention and control", and respective organization names. We also searched known sources, including a biosecurity text (Dewulf & Van Immerseel, 2018a), the BioCheck.UGent biosecurity dairy tool (BioCheck.UGent, 2020), the journal article series on cattle biosecurity operations (*The Veterinary Clinics of North America*, Food Animal Practice, Volume 18), the Biosafety in Microbiological and Biomedical Laboratories (BMBL) manual (US DHHS, 2020), the University of Washington Module on Infection Prevention and Control on Animal Farms (DEOHS, 2022a) for these definitions. Searches were also conducted via PubMed using terms “biosecurity” and “one health” to identify multidisciplinary definitions. References cited within included websites and publications were evaluated based on title and included if relevant.

A side-by-side comparison of preventive interventions for cattle and human health on the dairy farm settings was constructed. The side by side comparison of preventive intervention for cattle and human health on the dairy farm setting was developed by considering principles of infectious disease transmission and prevention (Dunowska, 2018; Dewulf & Van Immerseel, 2018b; Hoff, 2018; Sarrazin et al., 2018; Van Immerseel et al., 2018), preventive practices focused on dairy health described in the BioCheck.UGent dairy biosecurity tool (BioCheck.UGent, 2020), preventive practices focused on farmer COVID-19 prevention in the CDC Agricultural Employer Checklist for Creating a COVID-19 (CDC, 2020a), preventive practices focused on farmer zoonotic disease prevention in the High Plains Colorado State University High Plains Intermountain Center for Agricultural Health and Safety training modules on zoonotic disease prevention in livestock and dairy operations (HICAHS, 2023), preventive practices focused on farmer and animal health with respect to infectious diseases in farm settings in the University of Washington Training Modules on Infection Prevention and Control on Animal Farms (DEOHS, 2022a).

Finally, a basic conceptual framework highlighting potential impacts of infectious disease introduction into a dairy farm setting and underscoring the preventive role of biosecurity was constructed. This framework was developed through reviewing a known text on farm biosecurity (Dewulf & Van Immerseel, 2018a), the BioCheck.UGent quantitative farm biosecurity assessment tool for dairy cattle (Damiaans et al., 2020; BioCheck.UGent, 2020), the Centers for Disease Control and Prevention (CDC) Agricultural Employer Checklist for Creating a COVID-19 Assessment and Control Plan (CDC, 2020a), University of Washington Training Modules on Infection Prevention and Control on Animal Farms (DEOHS, 2022a), the High Plains Colorado State University High Plains Intermountain Center for Agricultural Health and Safety training modules on zoonotic disease prevention in livestock and dairy operations (HICAHS, 2023), and Total Worker Health concept (NIOSH, 2018).

Results

Terminology: Biosecurity, Biosafety, and Infection Control/Prevention

Table 2.1 summarizes various uses of terms biosecurity, biosafety, and infection prevention/control by discipline or field. Use of the terms "biosecurity" and "biosafety" may be defined rather consistently across organizations. However, definitions of "biosecurity" when applied to contexts outside of a laboratory setting can vary (Table 2.1). Within a farm context, definitions of biosecurity highlighted here tend to include concepts of preventing pathogens from entering an environment, preventing spread of pathogens within an environment, and preventing pathogens from leaving an environment. Within the highlighted definitions, the word "biosafety" does not appear in describing efforts aimed at preventing infectious diseases in workers in farm settings (Table 2.1). Biosecurity can include management and physical measures to reduce risk of introduction, establishment, and spread of animal diseases, infections or infestations to, from, and within animal populations (Erlacher-Vindel, 2018). Dewulf & Van

Immerseel (2018b) classify biosecurity as internal and external. External biosecurity includes measures aimed at preventing introduction of disease into a herd and preventing the disease from leaving a herd. Internal biosecurity refers to practices aimed at preventing disease spread within a herd (Dewulf & Van Immerseel, 2018b). Many highlight the importance of biosecurity in protecting health of humans, animals, and the environment (Dewulf & Van Immerseel, 2018b; Erlacher-Vindel, 2018; FAO, 2007; Renault et al., 2018; Saegerman & Humblet, 2018). Others define biosecurity as the outcome of all activities aiming to prevent introduction of disease agents into an area and designate "biocontainment" as measures taken to control disease agents already present on a farm (i.e., preventing transfer to new groups of animals) (Dargatz et al., 2002). Some advocate for the use of terms like "One Biosecurity" to capture the complex dynamics between animals, humans, and the environment (Hulme, 2020) (Table 2.1).

Table 2.1**.** Commonly used definitions to describe efforts to prevent and control infectious diseases in various populations and professional settings.

	BIOSECURITY	
Setting	**Key Concepts and Terminology**	**Reference**
Animal Production and Veterinary Medicine	Measures preventing infectious agent introduction and spread during animal production and/or care. Depends on attitudes and behaviors aimed at infectious disease prevention. Principles can be applied on small and large scales (e.g., herd and country). Benefits animals, people, environment. **External biosecurity** prevents diseases from entering herd. **Internal biosecurity** prevents disease spread within a herd. **Biocontainment** (preventing herd to herd transmission) is considered part of external biosecurity.	Academic (Europe) (Dewulf & Van Immerseel, 2018b)
Animal Production and Veterinary Medicine	Prevents diseases from animals to animals but also prevents infectious diseases transmission from animal to human and human to animal. A **holistic concept** benefiting human, animal, and environmental health.	United Nations, World Organization for Animal Health (Erlacher-Vindel, 2018)
Dairy Cattle Production	**External biosecurity** includes purchase and reproduction, transport and carcass removal, feed and water, visitors and employees, vermin control and other animals. **Internal biosecurity** includes health management, calving management, calf management, dairy management, adult management, working organization and materials.	Academic (Europe) (BioCheck.UGent, 2020; Damiaans et al 2020)
Farm Animal Production	Efforts to protect farm from pests and animal disease introduction and propagation. Efforts depend on animal species and production, can include footbaths, clean uniforms, PPE, shower-in/shower out, etc.	Academic (North America) (DEOHS, 2022a)
Cattle Production	Preventing introduction of pathogens into an area, which can range in size from a farm to a country. **Biocontainment** is controlling diseases already on a farm.	Academic (North America) (Dargatz et al., 2002)
Cattle Production	Preventing pathogen introduction and transmission via management and hygiene efforts.	Academic (North America) (Callan & Garry, 2002)
Cattle Production	Biosecurity efforts can focus on small to large scale settings, ranging from farms to efforts at international levels. National biosecurity focusses on protecting a national population.	Academic (North America) (Hueston & Taylor, 2002)

Cattle Production	Focuses on preventing infectious agent introduction and spread. A component of **One Health**, important for prevention of zoonotic diseases from cattle to humans and preventing spread of cattle zoonoses into the environment.	Academic (Europe) (Renault et al., 2018)
Dairy Cattle Production	Strategies focused on controlling and preventing losses in animal populations and to public health.	Academic (North America) (Wells et al., 2002)
Poultry	**A team effort** to prevent exposure of poultry, facilities, and humans to pathogens. **Structural biosecurity** focuses on construction and maintenance of facilities, including coops, pens, poultry houses, family farms, and commercial farms. **Operational biosecurity** describes practices and policies.	Government, US Department of Agriculture (North America) (USDA, 2021)
Multiple Livestock Species Including Poultry	Focusses on animal, human, and environmental health, including animal and plant disease and introduction, public health, food safety, zoonotic diseases, pests, invasive species, bio-diversity, forest health, living modified organisms, genetically modified organisms. Uses **integrated** efforts. A **holistic concept**.	United Nations, Food and Agriculture Organization (FAO, 2007)
Veterinary Medicine (Clinical)	Hygienic practices focused on preventing pathogen introduction and spread. Includes focus on prevention in populations and physical facilities, containment, and disinfection. Influenced by many factors, including characteristics of the infectious agents and management practices.	Academic (North America) (Morley, 2002)
Veterinary Medicine (Clinical)	Measures reducing risk of pathogen introduction (**bio-exclusion**) and spread (**biocontainment**). Benefits animal, human, and environmental health. Fucus is on hygiene, preventing transmission, protecting hospitalized individuals through PPE, personal and patient hygiene, use of disposable materials, behavior, minimizing unnecessary patient contact, visitor management, waste management, cleaning and disinfecting protocols, risk communication, refusing patient admission based on criteria.	Academic (Europe) (Saegerman & Humblet, 2018)
Biological Laboratory	Security of microbiological agents and toxins potentially harmful to human health, animal health, environmental health, and the economy via intentional misuse or release. Safeguarding public health from bioterrorism. Focusses on preventing loss, theft, or deliberate misuse of biological material, technology, or research-related information from laboratories. Includes program management, physical security (access control and monitoring), personnel management, inventory and accountability, information security, transport of biological agents, accident, injury, and incident response plans, reporting and	Government, US Department of Health and Human Services (North America) (DHHS, 2020)

	communication, training and practice drills, security updates and re-evaluations, select agents.	
Biological Laboratory	Principles, technologies, and practices for protection, control and accountability of biological materials and/or equipment, skills and data relevant to their handling. Focusses on preventing unauthorized access, loss, theft, misuse or release.	United Nations, World Health Organization (WHO, 2020)
Biological Laboratory	Efforts aimed at preventing loss, theft, misuse, unauthorized access, or intentional release of laboratory biological materials.	United Nations, World Organization for Animal Health (WOAH, 2021)
Biological Laboratory	Preventing unauthorized possession, theft, misuse, diversion, or intentional release of biological agents and toxins from laboratory settings.	Government (National Center for Disease Control and Public Health of Georgia) (Bakanidze et al., 2010)
Biological Laboratory	Focusses on prevention of theft of biological materials from laboratory settings through physical security, personnel security, material control and accountability, transport security, and information security.	Government, Military (US Naval Research Unit) (Zaki, 2010)
Multiple Settings	**"One Biosecurity":** Interdisciplinary approach to biosecurity based on interconnections between human, animal, plant, and environmental health, includes contributions from professionals in social and natural sciences.	Academic (Oceana) (Hulme, 2020)
	BIOSAFETY	
Setting	**Key Concepts and Terminology**	**Reference**
Laboratory	**Containment,** including practices, safety equipment, and facility safeguards to safeguard health of laboratory workers, the environment, and the public from infectious agents. Risk assessment, including laboratory practices, safety equipment, and facility safeguards capable of preventing laboratory-associated infections.	Government, US Department of Health and Human Services (DHHS, 2020)
Laboratory	**Containment** principles, technologies and practices implemented to prevent exposure to biological agents and/or unintentional release.	United Nations, World Health Organization (WHO, 2020)
Laboratory	Principles and practices to prevent unintended exposure to and unintentional release of biological materials	United Nations, World Organization for

		Animal Health (WOAH, 2021)
Laboratory	Laboratory practices and procedures, laboratory design, safety equipment, and occupational health programs aimed at preventing exposure of laboratory workers, members of the public, and the environment, including agriculture, to pathogens and biohazards. Complements biosecurity efforts.	Government (National Center for Disease Control and Public Health of Georgia) (National Center for Disease Control and Public Health of Georgia) (Bakanidze et al., 2010)
Laboratory	Efforts to protect laboratory workers and family members from infectious diseases stemming from laboratory settings. Also protects the environment from pathogens originating in laboratory settings. Focusses on prevention of exposure and release of biohazards. Includes elements such as occupational practices, PPE, and laboratory design. Programs are coordinated by a **biosafety committee** that characterizes and communicates risks, enforces safety standards, reviews protocols, completes inspections, and guides occupational health programs, including training. Includes a **biosafety officer.** Depends on collaboration between several personnel, including biosafety officer, laboratory managers, and laboratory staff.	Government, Military (US Naval Research Unit) (Zaki, 2010)
	INFECTION PREVENTION/CONTROL	
Setting	**Key Concepts and Terminology**	**Reference**
Veterinary Medicine (Clinical)	Includes preventing transmission of zoonotic pathogens between employees and animal patients. Incudes occupational risk assessments based on principles of hierarchy of controls.	Regulatory (North America) (Williams et al., 2015)
Human Medicine (Clinical)	Preventing and controlling infection spread in healthcare settings.	Government (US Centers for Disease Control and Prevention) (CDC, 2020b)

Food Animal Production (Farms)	Preventing diseases in humans and animals on farm settings; preventing zoonoses, "reverse zoonoses" and person-person infectious disease transmission (e.g., COVID-19).	Academic (North America) (DEOHS, 2022a)

Comprehensive livestock biosecurity plans include activities directed at environmental management, as pathogens can be sustained in the environment at adequate levels to result in animal disease (Dargatz et al., 2002). Fundamental biosecurity practices include animal introduction, feed and water quality, wildlife control, risk from caretakers, service providers, and visitors, risk posed by arthropods, roles of equipment in spreading disease agents, and roles of wind in pathogen delivery (Dargatz et al., 2002). While livestock biosecurity programs have traditionally been developed, funded, and enforced via government efforts, voluntary, producer-specific biosecurity programs might be more appropriate (Dargatz et al., 2002).

In laboratory settings, the term "biosecurity" can be used to describe efforts at preventing unlawful possession or intentional theft or use of biological agents (Bakanidze et al., 2010; Zaki, 2010). A laboratory biosecurity plan can include elements of physical security, personnel security (e.g., background checks), material control and accountability to address insider threat and maintain records, transport security to different laboratories or across international borders, and information security (Zaki, 2010). The use of the term "biosafety" in a laboratory context can refer to practices, policies, safety equipment, personal protective equipment, laboratory construction/design, and occupational health programs designed to prevent exposure of laboratory personnel, the public, agriculture, and environment to biological hazards and infectious agents (Bakanidze et al., 2010; Zaki, 2010). In the laboratory context, the use of the word "biosafety" is often observed when describing biosafety levels of laboratories (i.e., biosafety levels 1-4).

Elements of Biosecurity Benefiting Animal and Human Health

The CDC COVID-19 assessment and control plan document is not tailored to animal agriculture or dairy farms in particular but can be applied to the dairy farm environment. The checklist has five sections including risk assessment, control plan based on hierarchy of controls (screening and monitoring workers, access to medical care, managing sick workers, addressing return to work, engineering controls such as airflow, social distancing and hand hygiene, cleaning, disinfection, and sanitation, administrative controls such as training, and PPE), and special considerations for shared housing and transportation, including sanitation and limiting crowding (CDC, 2020a). The BioCheck.UGent dairy cattle tool addresses external biosecurity (purchase and reproduction, transport and carcass removal including vehicle cleaning disinfection and management of carcasses in the farm environment, feed and water, visitors and employees including PPE and hand hygiene, vermin control and other animals) and internal biosecurity (health management including isolation of sick animals, calving management including use of PPE and preventing environmental contamination with birth products, calf management including reducing animal contact, dairy management, adult management including stable cleaning, working organization and materials including hand hygiene and PPE) (BioCheck.UGent, 2020; Damiaans et al., 2020). The University of Washington's Center for One Health Research, Harborview Medical Center, and the Northwest Center for Occupational Health and Safety Continuing Education Program provides training modules and a Farm Infection Prevention and Control (IPC) Plan Template addressing control of transmission of COVID-19 and other infectious diseases between humans and between humans and animals on an animal farm. Focus areas include: a One Health approach to infection prevention and control on animal farms to address COVID-19 and zoonoses, including reverse zoonoses, threats of workers introducing infections from the farm to family members and the community, how to create a

COVID-19 exposure control plan as part of an overall infection prevention and control plan; COVID-19 and other infections on animal farms, including antimicrobial-resistant bacteria, causes of diarrhea; hazard assessment, controlling worker exposure, training, PPE, and controlling transmission of COVID-19 and other aerosols; occupational medicine services and program plans for IPC to address COVID-19 and other infections on animal farms and the components of a farm IPC; and infectious disease emergency response (DEOHS, 2022a). The High Plains Colorado State University High Plains Intermountain Center for Agricultural Health and Safety training modules on zoonotic disease prevention in livestock and dairy operations describes zoonotic disease transmission and prevention (HICAHS, 2023). Main concepts include direct (e.g., Contact with body fluids) and indirect (e.g., contact with environmental elements such as budding) means of zoonotic transmission, PPE, hand hygiene, injection safety, training, environmental contamination, pest control, and vaccinations for animals and people as preventive measures for zoonoses.

Through considering principles of infectious disease transmission and prevention as described in these resources and Table 2.1, a basic comparison of preventive measures and concepts relevant to animal and human infectious disease prevention is presented (Table 2.2). For example, PPE use and availability is essential to livestock biosecurity and worker biosafety, as PPE can both prevent spread of pathogens to animals and protect workers from pathogen arising from animals or from one another. Limiting animal contact and comingling can be functionally compared to social distancing among humans. General farm biosecurity principles and efforts, including isolation, vaccination, limiting crowding, equipment and premises cleaning and sanitation, ventilation, and pest and vermin control, and training can help prevent diseases in animals and/or humans on farm settings. Some interventions to prevent diseases in humans may be unique to humans but share similarities to interventions in animal populations.

Table 2.2. Similarities in prevention measures for cattle and worker infectious diseases in the dairy farm environment

Prevent Cattle Diseases (Endemic, Reverse Zoonoses)	**Prevent Worker Diseases (e.g., Zoonoses, COVID-19, Seasonal Influenza)**
Visitor Policies (PPE, Limit Animal Contact)	Visitor Policies (PPE, Limit on Farm, Screen)
Hand Hygiene, PPE, Footbaths, Injection Safety	Hand Hygiene, PPE, Footbaths, Injection Safety
Vehicle Cleaning/Disinfection	Vehicle Cleaning/Disinfection
Animal Vaccinations	Animal Vaccinations Human Vaccinations (COVID-19, Rabies)
Pest/Vermin Control	Pest/Vermin Control
Animal Disease Surveillance Isolation of New and Sick Animals Farm Personnel Disease Surveillance	Animal Disease Surveillance Farm Personnel Disease Surveillance, Sick Leave Policies
Limiting Animal Density	Social Distancing (Office, Break Room, Housing)
Access to Veterinary Care	Access to Veterinary Care Access to Healthcare
Cleaning/Disinfecting, Ventilation, UV: Animal Housing, Equipment	Cleaning/Disinfecting, Ventilation, UV: Animal Housing, Equipment Cleaning/Disinfecting, Ventilation, Light Exposure: Common Area (Office, Housing, Breakroom, Vehicles)
Personnel Training	Personnel Training
Transboundary Animal Disease Response	Pandemic Response

A Conceptual Holistic Framework of Dairy Farm Infectious Disease Dynamics and Prevention .

Based on previously described findings, (Tables 2.1 and 2.2), a basic holistic framework of infectious disease dynamics and prevention can be constructed with biosecurity at its center and essential to preventing infectious diseases in animals and people while preventing environmental pathogen persistence (Figure 2.1).

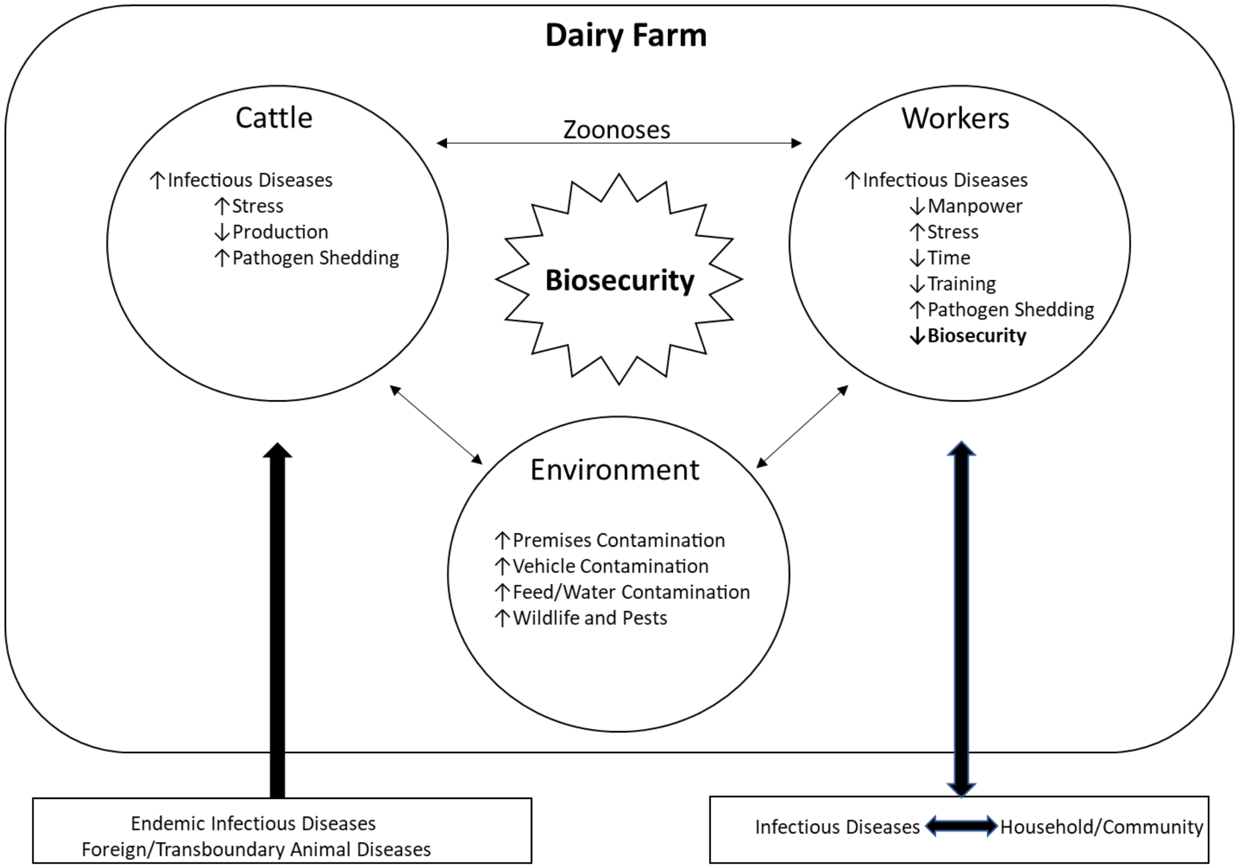

Figure 2.1. Basic infectious disease framework on a dairy farm depicting potential links between cattle, humans, and the farm environment. Biosecurity efforts are needed to prevent diseases in cattle and humans while controlling environmental factors. Up arrows indicate an increase in number or severity.

Biosecurity functions at the intersection of all components influencing cattle, human, and environmental health on a dairy farm. Strong biosecurity implementation is essential to maintaining overall health on dairy farms. Worker health is especially important to maintaining cattle and environmental health, increased infections could reduce manpower and increase stress, leading to reduced time for training and biosecurity efforts. A reduced or stressed workforce due to infectious diseases could hamper biosecurity efforts, which can diminish prevention of cattle diseases and environmental contamination. Farm workers can also be impacted by infectious disease exposures occurring outside of the workplace and bring these agents back to the farm where co-workers and potentially livestock may become infected. Similarly, farm workers may also contract infectious diseases from cattle and/or colleagues and spread those pathogens to family and the community.

Discussion

Preventive efforts central to biosecurity are important to cattle and human health on dairy farms. Strengthening this holistic approach may help reduce the severity of ongoing and future infectious disease threats to cattle and humans on dairy farms.

Recommendations for strengthening integration of livestock biosecurity with worker biosafety in the context of dairy production are as follows:

1. *Understand Dairy Farmer Knowledge, Attitudes, and Practices (KAP) regarding cattle and worker infectious disease prevention.* A thorough KAP questionnaire should be developed and validated via pilot study on dairy farms to begin understanding KAP and to inform effective recommendations, interventions, and integrated assessment tools that include elements of worker and livestock health.
2. *Evaluate and improve training programs.* Training programs must be delivered in an understandable language, reflect adult learning principles, and delivered in modalities that lend themselves to evaluation of learning comprehension. Programs must assess KAP of workers, management, and owners. Discrepancies in KAP between these groups must be discussed and addressed to ensure all parties are aligned in their approaches. Training should aim to highlight the relevance of interaction between biosecurity and biosafety so that farm personnel on all levels buy into the benefits of viewing infectious diseases through a more holistic lens.

3. *Identify and mitigate professional and philosophical silos by identifying obstacles and creating shared One Health and biosecurity languages.* These efforts depend on improving communication between animal and human sectors contributing to One Health collaborations. The term "One Health" may have different meanings to collaborators depending on their professional organizations, and this meaning may have changed for many during the COVID-19 pandemic. In addition to clarifying the One Health definition, we must work to identify the various legal, technical, cultural, and philosophical barriers to collaboration and actively address them. Understanding of terms "biosecurity" and "biosafety" may differ across professional settings. These differences can hinder effective communication between dairy farmers, researchers, industry, and the public. It is important to use consistent terminology or to develop new terminology to capture the spirit of biosecurity-biosafety integration guided by a general One Health approach. Some advocate for the use of terms like "One Biosecurity" to capture the complex synergistic dynamics of animal, human, and environment (Hulme, 2020). Rather than creating novel terminology that may further clutter common lexicon, advocating for the use of the term "biosecurity" to describe efforts to prevent infectious diseases in animals and humans may prove most effective. Including terms "biosafety" and "biocontainment" within the biosecurity umbrella may help solidify perceptions of biosecurity as capturing elements of human health in the dairy farm setting. Further integrating the term biosecurity into Total Worker Health may help bridge professional divides and facilitate effective communication. Pilot studies deploying KAP questionnaires should aim to explore perceived definition (i.e., knowledge) of words like "biosecurity" and "biosafety", and "One Health" among dairy farmers, researchers,

industry, government, and the public both domestically and internationally. Other approaches should explore perceived definition of these words among other stakeholders who might collaborate with dairy farmers.

4. *Improve farm biosecurity plans through comparison to common laboratory biosecurity protocols and principles of agroterrorism and food defense.* As demonstrated in the highlighted definitions of farm biosecurity, current concepts of farm biosecurity may lack specific focus on intentional introduction of potentially harmful animal, human, or plant pathogens onto a farm (i.e., agroterrorism). This finding is relevant to food defense, which focuses on preventing intentional introduction of contaminants and/or pathogens into food products. This concept can be applied toward preventing introduction of highly contagious livestock and/or zoonotic pathogens, including those causing foreign animal diseases such as foot and mouth disease (FMD). While laboratory biosecurity includes policies and practices aim to prevent intentional introduction or theft of biological agents, farm biosecurity definitions highlighted here lack such a focus. A 2005 study found that Intermountain US dairy farms may be vulnerable to bioterrorist attacks because most farmers did not believe it was important to establish on-farm security policies (Buttars et al., 2006). Intentional contamination of food producing animals and/or their products represents another realistic threat that may be overlooked (Lopes et al., 2020). Dairy farms may be particularly susceptible to intentional introduction of pathogens into food products, into animal populations (i.e., Foot and Mouth Disease), and/or into human populations. Introduction of pathogens may have a devastating effect on the workers, animal populations, and farm productivity. Little recent research has explored dairy farmers' knowledge, attitude, and practices regarding prevention of bioterrorist acts, or

intentional introduction of pathogens onto farms. The Food Safety Modernization Act includes requirement for food defense (FDA, 2017). Dairy farms can be especially vulnerable considering potentially inadequate external security, high visitor frequency, high staff turnover, and potential for misunderstanding between owners, managers, and workers due to culture and language differences. There is room to better integrate elements of agroterrorism prevention and food defense into farm biosecurity programs. While dairy farms and laboratories face their own unique threats, dairy farms biosecurity can be improved through applying some of the concepts and practices used in laboratory settings and through agroterrorism and food defense lens. Where possible, farms should try to expand on existing biosecurity practices or frameworks that might have been established to prevent unintentional pathogen introduction and/or removal. These include greater focus on security measures designed to prevent intentional introduction of potentially harmful pathogens into a dairy farm setting. Important elements include requiring visitors to sign logs and wear farm-specific clothing. Use of farm specific clothing, including PPE among farm workers also helps identify workers on the farm. Farms should also apply the laboratory practice of assigning personnel responsibility for biosecurity and biosafety and developing standard operating procedures.

5. *Promote the Total Worker Health concept*. This is a holistic approach to worker well-being that includes study of illnesses (including mental health) and injuries. Framing integrated biosecurity-biosafety approaches and goals in the context of Total Worker Health may help provide a generally understood concept on which to think and act.
6. *Identify and work with commonalities between biosecurity and biosafety in the dairy farm environment.* As highlighted here, farm biosecurity practices that may be more often

considered for animal health are often directly relevant to human health or can be adapted to preserve human health. Focusing on systems and shared routes of infection can underscore opportunities where shared approaches can efficiently prevent livestock and worker diseases in the farm settings. Focus on common modes of infectious disease transmission, including respiratory and fecal-oral (gastrointestinal) routes. Focus on training programs and roles and responsibilities on the farm. A substantial portion of infectious diseases on farms stem from pathogens affecting respiratory and gastrointestinal systems.

7. *Develop an integrated biosecurity-biosafety assessment tool for the dairy farm work environment.* Farm biosecurity tools may be disease and/or species specific and may not provide quantitative outputs upon which recommendations and improvements can be made (Dewulf et al., 2018; Damiaans et al., 2020). These tools may not fully integrate livestock biosecurity with worker biosafety (Dissertation Chapter 4). Dairy farmers may be more likely to adopt biosecurity measures if they are perceived as effective and economical (Brennan et al., 2016). Integrated tools should provide quantitative output that is of practical and financial use to farmers. Studies of KAP should explore perceived effectiveness and financial payoff of efforts takes to prevent animal and human diseases. Developing an integrated infectious disease assessment tool can help farms quantify results of preventive practices and identify associations between animal health and human health on farms. Such tools can provide quantitative scores that can demonstrate associations, for example, between livestock biosecurity performance and incidence of animal diseases and zoonotic diseases in farm personnel. Quantifying overall farm biosecurity scores (human and animal health) can help identify areas for improvement

and demonstrate the value of preventive practices and financial support for them. Incorporating this approach with the context of Total Worker Health can spark interest across disciplines and provide a platform of funding and expertise to motivate long term commitment and change benefiting cattle and worker health.

Integrated tools should be user-friendly and flexible but standardized to a degree that enables output comparison between farms, states, and regions. They should facilitate focus on diseases of concern to individual farms and appropriately accommodate different farm sizes. The tools should incorporate a One Health framework without diluting important technical concepts relevant to animal and human health preservation. They should be created with input from subject matter experts representing dairy producers, veterinary medicine, human medicine, public health, agricultural sciences, sociology, behavioral sciences, economics, law, computer science, and epidemiology. They should be based on KAP studies regarding prevention of animal and human diseases on farms. It should include components of foreign animal disease preparation and response, back up of animals on farms (i.e., animal storage and carcass disposal), emergency planning in the event of disease outbreaks among farmworkers, and pandemic planning and response. Language and terminology should reflect that used within respective countries and production systems. Within the United States, immigrants constitute approximately 75% of agricultural farm labor (USDA, 2020). In 2015, migrants constituted 51% of the US dairy workforce, and dairies that employed immigrant labor produced 79% of the US milk supply (Adcock et al., 2015). There is also increasing diversity of Hispanic workers representing cultures and linguistic dialects that might be less familiar to dairy farm owners and managers (Rodriguez et al., 2020). Training, management, and leadership efforts may not be ideally tailored toward the migrant workforce (Hagevoort et al., 2013). Where possible, parallels should be drawn between COVID-19, other infectious diseases, and zoonoses, some of which may be transmitted from person-to-person. It should incorporate rapid risk assessment to quickly provide a summary of threats and options for action formulated with risk mitigation steps.

8. *Demonstrate the benefit of integrated biosecurity-biosafety programs.* This benefit can lie in feasibility, financial incentive, and/or desire to maintain or surpass professional standards. Financial incentive may be the most appealing incentive. Evidence should be supported with facts linking interventions to profit, production, and other desirable outcomes.

Study Limitations

This effort represents a basic and exploratory approach to presenting a conceptual framework for integrated cattle-human infectious disease prevention on dairy farm settings. Results and recommendations are based on a small body of findings that were not quantified.

Conclusions

Livestock production settings such as dairy farms provide an opportunity to evaluate infectious disease threats through a more holistic lens. Implementing this framework depends on developing a commonly understood language, increasing efficiency by focusing on practices useful to preventing cattle and worker diseases, and applying a biosecurity approach more firmly grounded in interdisciplinary principles. In addition to directly safeguarding animal and human health on farms, such approaches may strengthen food security on national and global levels.

CHAPTER 3: KNOWLEDGE, ATTITUDES, AND PRACTICES ON PERSONAL PROTECTIVE EQUIPMENT FOR PREVENTING OCCUPATIONAL INFECTIOUS DISEASES AMONG LIVESTOCK FARMERS: A SYSTEMATIC REVIEW

Introduction

Little is known about livestock farmer knowledge, attitudes, and practices (KAP) regarding Personal Protective Equipment (PPE) and the prevention of occupational infectious diseases. Improved understanding of this issue can form the foundation on which interventions will be effective in reducing incidence of infectious diseases among farmers. Agricultural workers are vital to global food security but face many unique threats that can compromise their health and productivity. Such threats can include extreme temperatures, pesticides, chemicals, dusts, physical injuries, and various psychological stressors associated with working with animals (Menger et al., 2016). Farmers working with animals can be especially vulnerable to infectious diseases treats, including zoonoses, pathogens maintained in the environment, and diseases transmitted from person-to-person (e.g., COVID-19). As reviewed by Klous et al., (2016), several studies have demonstrated high seroprevalence of various zoonotic agents in farmers in contact with livestock. It is often difficult to determine the exact conditions under which the exposures occurred, especially in less developed countries (Klous et al., 2016). Little is known about farmer knowledge, attitudes, and practices (KAP) relevant to PPE for the prevention of occupational infectious diseases on farm settings. The physical nature of some types of work may make it more difficult to properly use PPE. A review of four studies on Minnesota backyard poultry, Minnesota swine, Wisconsin backyard poultry, and Thailand poultry settings found PPE (i.e., mask, glove, and footwear) use was low among workers in direct contact with animals, flock owners, and veterinarians (Odo et al., 2015). A recent systematic review (Youssef et al., 2021) examined effectiveness of biosecurity measures, including use of PPE, in reducing bacteria transmission from livestock to humans on farms. The study highlighted that in some cases, PPE use in small ruminant and dairy cattle production may be associated with lower odds of *Coxiella burnetii* seropositivity. The COVID-19 pandemic has highlighted the importance of better understanding how KAP can influence infectious disease prevention and control efforts. For example, knowledge impacted attitudes (e.g., perceived risk) and preventive practices (e.g., personal hygiene and social distancing) during the COVID-19 pandemic (Lee et al., 2021).

Zoonoses and other infectious diseases can directly impact health of agricultural workers, reduce income, and lead to production losses (Burniston et al., 2015). Zoonoses among agricultural workers are often misdiagnosed and under-reported (Burniston et al., 2015), which can complicate prevention and control efforts. Recent trends in animal production have been characterized by increasingly intensive production settings that facilitate increased microbial exposures for farm personnel and their families (Graham et al., 2008). Infectious diseases incidence may be especially high in less developed countries that might experience inadequate disease surveillance, pest control, sanitation, and access to medical and veterinary care (Rohr et al., 2019). Backyard farmers or smaller scale farmers in less developed countries may spend more time interacting with farm animals (Klous et al., 2016). Infectious diseases on farm settings can also be transmitted from people to animals (Messenger et al., 2014) and back to humans, as evidenced by SARS-CoV-2 transmission cycles between humans and farmed minks (Oude Munnink et al., 2021). Maintaining animal health on farms can also help prevent transmission of zoonoses from livestock to farm personnel (Nahar et al., 2015).

Essential workers on agriculture premises may face unique threats due to crowded conditions of their work, housing arrangements, and shared transportation. These factors can influence transmission of infectious diseases among co-workers. A 2020 study of Minnesota and Wisconsin dairy farms found that one-quarter of dairies reported COVID-19 infections on their farm (Young et al., 2021). A recent study exploring social determinants of COVID-19 mortality found that farm workers across the United States may face unique risks of contracting and dying from COVID-19 and that these risks are independent of poverty, insurance, or linguistic accessibility of COVID-19 health campaigns (Fielding-Miller et al., 2020).

Although knowledge and attitudes can influence human behavior, preventive efforts might not always occur even in the presence of knowledge and/or supportive attitudes. Similarly, knowledge of a disease and its transmission may not always lead to attitudes supportive of its prevention. These situations can manifest as knowledge-practice gaps, attitude practice gaps, and knowledge-attitude gaps. A systematic review of PPE KAP among healthcare workers with respect to COVID-19 prevention revealed a generally good level of knowledge, positive attitude, but preventive poor practices (Fadilah et al., 2021).

Perceptions, circumstances, and motivators can influence programs controlling zoonoses in animals on farms. These include social norms, self-efficacy, lack of knowledge, and cultural and economic pressures (Ellis-Iverson et al., 2010). Farmer KAP toward prevention of occupational zoonoses and infectious disease transmitted person-person on farms may be influenced by similar factors. Food animal production is necessary to maintain food security for a growing global population. In this systematic review, we aimed to summarize the KAP of livestock farmers regarding PPE and the prevention of occupational infectious diseases, including those transmitted from animal to human and person-to-person. This effort will characterize strengths and weaknesses in food animal production settings, identify research gaps, and provide evidence to inform policy interventions at the farm level.

Methods

Search Strategy and Selection Criteria

We searched Web of Science, CAB Abstracts, and PubMed, including NIH COVID Pre-Prints for peer-reviewed articles addressing knowledge, attitudes, and/or practices on animal farmer PPE in the context of preventing occupational zoonotic and infectious diseases transmitted human-to-human (e.g., COVID-19). Publications included farmers involved in animal production across all production systems and sizes. We specified a date range of publication between January 1, 1980, and March 16, 2021, was specified and did not limit by geography. There was no geographic limitation. We examined references of included publications to detect additional publications for inclusion. We removed duplicate articles and used Zotero (www.zotero.org) as reference software. Since this research was a systematic review of published articles, approval from an ethical review board was not required.

Publications were excluded on title/abstract evaluation and full text evaluations for the reasons described in Figure 3.1.

We searched for the following terms in both the title and abstract fields in Web of Science, CAB Abstracts, and PubMed:

(zoonotic OR zoonosis OR zoonoses OR infection OR "infectious diseases" OR "infectious disease" OR anthroponosis OR anthroponotic OR "communicable disease" OR "communicable diseases" OR Coronavirus OR COVID-19 OR COVID19 OR SARS-CoV-2 OR COVID) AND (animal$ OR livestock OR cattle OR cows OR bovine OR pig$ OR swine OR chicken$ OR turkey$ OR poultry OR sheep OR goat$ OR duck$ OR ruminants OR horse$ OR equine OR "farm animal" OR ruminant$ OR herd OR "food animal" OR feedlot OR hog OR dairy) AND ("agriculture workers" OR "agricultural workers" OR "farm workers" OR farmworkers OR farmworker OR farmhands OR "farm hands" OR "farming population" OR farmers OR producers) AND (knowledge OR attitudes OR awareness OR practice$ OR perception$ OR behavior OR behaviour OR beliefs)) AND (biosecurity OR biosafety OR biohazard OR occupation OR occupational OR risk factor OR risk OR "infection prevention" OR "infection control")) AND ("personal protective" OR "personal protection" OR PPE OR hygiene OR biosecurity OR biosafety OR biohazard OR occupation OR occupational OR risk factor OR risk OR "infection prevention" OR "infection control")

We searched for the following terms in NIH COVID Pre-Prints:

(agriculture OR farm* OR livestock) AND (employee OR worker OR producer) (farmhand OR farmworker)*

Screening and Data Extraction

We organized data in a Microsoft Excel table under the following categories: publication author, country and year in which the study was conducted, farming population, production setting and main animals, main infectious diseases/agents, study type, and main outcomes separated by knowledge, attitude, and practice findings. Data were included in results if they reflected percentages regarding knowledge, attitudes, and/or practices. We also included results from studies exploring vector-borne diseases if the infectious disease of interest could include livestock in its life cycle. Qualitative data including livestock producer quotations were also included. Data were included in results if they were obtained from questionnaire, survey, researcher direct observation, and/or focus group discussion. We managed citations in Zotero reference management software (www.zotero.org). Three independent reviewers (RF, TW, and SR) evaluated publications based on title/abstract and full text inclusion criteria and collected relevant KAP data. The lead author (RF) made the final decision on publication inclusion.

Data Analysis

We organized findings into categories of knowledge, attitudes, and practices and by production setting. We also highlighted individual papers demonstrated gaps between knowledge, attitudes, and/or practices. Microsoft Excel and PowerPoint were used to create figures and tables. Microsoft Excel was used to calculate infectious diseases frequencies and quantify publications according to their focus countries and results categories (i.e., knowledge, attitudes, and/or practices).

Results

Study Selection and Outcomes:

A total of 72 publications met the search criteria and are included in results. An overview of search results is provided in Figure 3.1.

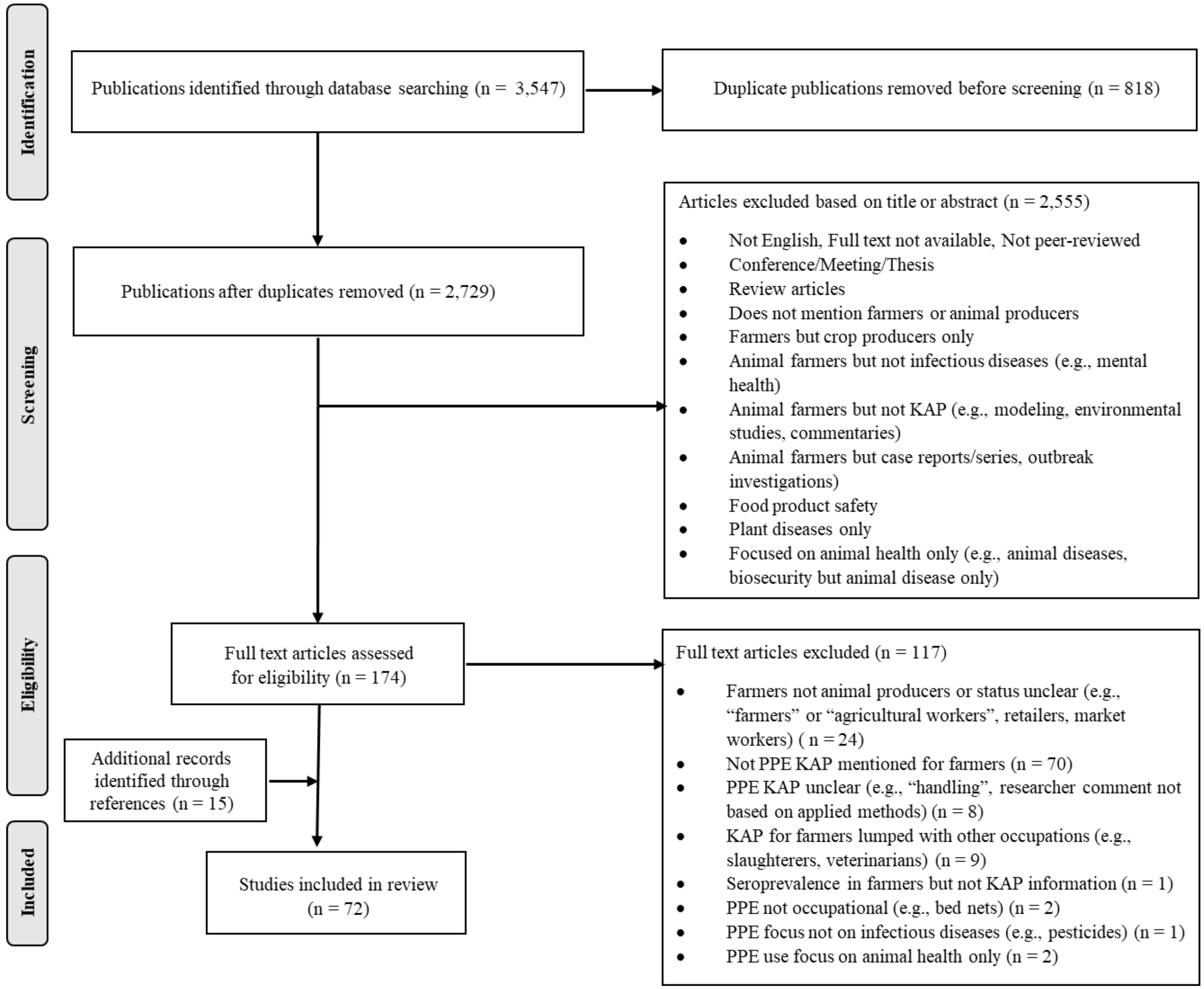

Figure 3.1: Flow diagram of selection steps after search filtering procedures with CAB Abstracts, Web of Science, PubMed, and NIH COVID Pre-Prints.

The 72 Publications meeting inclusion criteria spanned 36 countries (Table 3.1) representing 6 global regions.

Table 3.1. Summary of included publications.

Author, Country, Year Conducted	Farming Population	Production Setting and Main Animals	Main Diseases/Agent(s)	Study Type	Main Outcomes	
Abbate et al., 2006, Italy (2005-2006)	257 poultry workers across 110 poultry farms	Commercial poultry	Avian Influenza (H5N1)	Face to face questionnaire (closed)	K	Identified measures that can protect poultry workers from avian influenza: Face mask 68.5%, gloves 61.5%, outer garments 61.1%, boots or boot covers 56%, eye protection 43.2%.
					P	Always wore outer garments 82.9%, wore boots or protective boot covers 82.9%, wore gloves 59.9%, wore face masks 59.9%, wore eye protection 24.5%. Always wore PPE and washed hands 24.1%.
Abdi et al., 2015, Kenya (2013)	392 pastoralist herd owners (one per household)	Pastoralists (Cattle, sheep, goats, donkeys)	Rift Valley Fever	Face to face questionnaire (closed)	P	4.34% used any form of protection when handling sick animals.
Arif et al., 2017, Pakistan (2015)	420 dairy farmers (1/farm)	Smallholder dairy farms, (less than 10 cattle and buffaloes)	Brucellosis (*B. abortus*)	Face to face questionnaire (closed and open)	P	25% cover hand cuts during animal contact, 17% have direct contact with placental membrane during parturition.
Asakura et al., 2018, Tanzania (2016)	124 pastoralist farmer owners (1/farm)	Agro-pastoralists (cattle), 99.2% conducted semi/free grazing, 75.8% kept cattle with sheep and goats	Brucellosis (*B. abortus*)	Face to face questionnaire (closed)	P	10% used gloves during delivery.
Awosanya et al., 2013, Nigeria (2010)	75 piggery farmers and 82 attendants	Small-scale piggeries (4-6 growers at each farm)	Influenza A (H3N2, H1N1)	Face to face questionnaire (closed)	P	Majority of farmers and farm attendants did not use PPE. 100% changed their clothes before and after working.
Ayim-Akonor et al., 2020a, Ghana (2016-2017)	150 swine farmers across 87 farms	Swine farms, majority small scale (less than 200), 24.14% less than 50 pigs, 62.07% 50-200	Various swine zoonoses, including Influenza A (H3N2, H1N1)	Face to face questionnaire (closed and open)	K	73.08% who were aware of possibility of becoming infected with pathogens from swine named at least one farm practice that could minimize farmer risk. Most frequently identified out of 10: surgical mask (1), protective footwear (2), gloves

		pigs, 13.79% more than 200 pigs				(3), dedicated farm clothing (4), goggles (7).
					P	95.33% changed their clothes to dedicated farm clothing before attending to swine (4.67% did not). 4% wore gloves when working (96% did not). 98% did not wear a surgical mask when working (2% did).
Ayim-Akonor et al., 2020b, Ghana (2016-2017)	152 poultry farm workers across 76 poultry farms	Poultry farms: breeders, layers, and broilers. 90.8% farms had multiple flocks. 72.4% farms kept only chickens. 27.6% kept other animals, including pigs (57.1%), ruminants (33.3%), free range chickens, guinea fowl, turkeys. Bird range (50-more than 10,000). Farms with less than 5,000 birds (72.4%), 5,000-10,000 birds (17.1%), more than 10,000 birds (10.5%).	Various poultry zoonoses, including Newcastle disease, avian influenza, Salmonellosis	Face to face questionnaire (closed and open)	K	When asked to name ways to protect themselves from being infected with pathogens from poultry, most frequently identified out of 13: nose masks (1) , boots (2), gloves (3), overalls (4), goggles (9), and washing farm clothing (13).
					P	97.4% changed clothes before working (of these, 2.7% wore overalls, 97.3% wore own clothes, including-shirt, shorts, and/or trousers). 100% changed clothes before exiting farm. 48.7% wore protective footwear. 99.3% changed footwear before leaving farm. 0% wore gloves. 2.0% wore nose mask.
Bat-Erdene et al., 2018, Mongolia (2014)	485 livestock herders across 240 nomadic camps	Nomadic, unspecified livestock	*Brucella* spp.	Face to face questionnaire (closed)	P	Use during any of the following contexts: handling aborted fetuses, handling placenta and birth products, delivering complicated newborn, preparing raw livestock products. 34.4% use masks, 65.6% do not. 40.6% use gloves, 59.4 do not. 15.3% use aprons, 84.7% do not.
Beaudeau et al., 2021,	176 cattle farmers (72	Cattle farms (Dairy 72%, beef 17%, dual purpose 11%) in	Q Fever *(Coxiella burnetii)*	Self-administered questionnaire (closed)	P	49% wore specific boots. 51% wore specific work coat: Wore gloves during milking: Beef herd (no milking): 17%,

France (2017-2018)	dairy, 30 beef, 19 both)	high density cattle regions				often or always 20%, Never or occasionally 63%. Wore gloves during calving: Often or always 42%, Never or occasionally 58%.
Cakmur et al., 2015, Turkey (2013)	151 livestock farmers	Rural sheep, goat, cattle farms	Various: Anthrax, Brucellosis, Crimean-Congo Hemorrhagic Fever, Rabies, Toxoplasmosis, Hydatid Disease, Giardiasis, Tuberculosis.	Face to face questionnaire (closed)	A	Believed gloves should be used while contacting animals: 92.1%. Believed using a mask was necessary: 84.1%. Believed wearing water resistant boots during animal contact is necessary: 89.4%.
					P	Wore gloves while contacting animals: 35.8%. Used mask: 6.6% (all women used scarf over mouth). Wore boots: 42.4%.
Cao Ba et al., 2020, Vietnam (2019)	218 livestock farmers (1/farm)	Small households, backyards, small-scale farms in midland mountainous area. 218 households raising at least one category of livestock of pig, cattle/buffalo, goat, dog, and poultry: 120 medium scale farms, 98 small scale farms. Most farmers raised livestock and crops (e.g., tea). 73.4% farms raised more than one type of livestock. Avian and pig most common (raised in 95% and 67% of households, respectively). More than 75% households raised	Various: Avian influenza, rabies, *Streptococcus suis* and foodborne bacterial infections	Face to face questionnaire (closed, n=218) and in-depth interviews (n=8)	A	PPE (gloves, boots, face mask) are important in preventing zoonoses: Agree 98.6%, Disagree 1.4%. In depth interviews, reasons for not using PPE: uncomfortable, not worth pay for it, being too rushed to wash hands and equipment with disinfectant. "Because it is uncomfortable. It does not worth much money, each of it just tens of thousands" (small scale farmer).
					P	Do not wear gloves often/always 60.1%, sometimes 6%, never/seldom 33.9%. Do not wear mask often/always 57.8%, sometimes 6%, never/seldom 36.2%. Do not wear boot often/always 29.8%, sometimes 12.4%, never/seldom 57.8%. Handled aborted fetus or placenta, amniotic fluid and other discharge with bare hands: often/always 32.1%, sometimes 7.3%, never/seldom 60.6%.

		livestock in backyards.				
Carnero et al., 2018, Peru (2011-2012)	11 swine farmers, 4 backyard swine farmers (1/farm)	Urban farms (average 29 swine per farm) and backyard	Unspecified swine zoonoses	Face to face questionnaire (closed), direct observation	P	Direct observations while feeding chicken viscera to swine: 80% do not use cap, 20% use fabric cap, 0% use surgical cap. 13.13% use face mask. 40% use gloves. 6.67% use plastic or cloth apron. 20% wear sandals. 26.7% wear closed footwear (not boots). 53.3% wear boots.
Cediel et al., 2012, Italy (2016-2017)	105 workers in agro-livestock industry (Italians and immigrants)	Livestock commercial industry (breeding dairy cows, fattening calves, pigs, horses).	Unspecified	Face to face questionnaire (closed and open)	P	2.86% worked without PPE. One said, "My hands are my gloves."
Chaussade et al., 2013, France (2011-2012)	306 pig farm workers	Pig farms (50% <540 pigs, 50% >540 pigs)	Hepatitis E	Face to face questionnaire (closed)	P	Wore coveralls: Yes 29.4%, No 70.6%. Wore gloves: Yes 67.3%, No 32.7%.
Chinchwadkar and Panda 2020, India (NS)	56 female dairy farmers (1/household)	Peri-urban smallholder household dairies	Unspecified	Face to face questionnaire (closed) and observation checklist	P	Direct observation: 81.7% actively helped the cattle during reproduction but 90% did not wear protective gloves.
Cui et al., 2017, China (2013-2014)	297 chicken farmers	Commercial urban chicken farms (300 to 25,000 chickens, median 4,000)	Avian Influenza (H7N9)	Face to face questionnaire (open and closed)	P	87.9% of farmers wore protective clothes during poultry husbandry to protect against A/H7N9, 73.4% wore protective hats, 57.2% wore gloves, 32.3% wore face mask, and 20.5% wore protective shoes.

Cui et al., 2019a, China (2016-2017)	25 chicken farmers	Commercial chicken farms (range: 1,000-30,000, median 5,000)	Avian Influenza (H7N9)	Face to face in-depth interview (open)	A	"I am sure those measures, particularly wearing face mask, are enough to protect me from A/H7N9 infection. Because the mask can prevent A/H7N9 from entering my body." "It was said that A/H7N9 viruses spread by air, and they are so small. The masks we used are not specially designed to prevent AI viruses, the gap of the mask is big enough for A/H7N9 viruses to go inside. On the other hand, we did not wear professional protective glasses, the A/H7N9 viruses can also go into our body from our eyes." Most perceived high self-efficacy for taking protective measures, but the main purpose of adopting this measure was for keeping away dust and chicken excrement during farm work rather than for reducing risk of A/H7N9 infection. "There isn't any trouble for us to war mask, gloves, hat and coat when we work in chicken farm. We can do it if we want to." "Though we all have masks and gloves at hand in chicken farms, but it is annoying to remember wearing mask and gloves whenever I go into the chicken house, I often forget to do it." "I'm used to wearing mask, gloves, hat, and coat when I work in my chicken farm. But the purpose of wearing mask and hat was for dust proof, not for preventing me away from A/H7N9 infection, although it may have already played a role in A/H7N9 prevention."
					P	PPE use while working in poultry house: protective clothing 88%, protective hat 76%, gloves 60%, face mask 32%.

Cui et al., 2019b, China (2017)	426 chicken farmers	Commercial chicken farms, mostly medium scale farms (8.9% farms less than 300 chicken, 12.7% farms 301-1,000, 56.6% farms 1001-10,000, 21.8% farms >10,001)	Avian influenza (H5N1, H7N9)	Face to face questionnaire (closed)	P	Wear protective clothes: Never (4.2%), sometimes (5.4%), often (7.7%), usually (23%), always (59.6%). Wear face mask: Never (6.8%), sometimes (11.7%), often (15.5%), usually (26.1%), always (39.9%). Wear protective hat: Never (4%), sometimes (11.7%), often (16.9%), usually (15.7%), always (51.6%). Wear protective shoes: Never (2.8%), sometimes (7.5%), often (12.9%), usually (22.3%), always (54.4%). Wear gloves: Never (4.9%), sometimes (12.9%), often (16.4%), usually (26.3%), always (39.4%).
Dang-Xuan et al., 2017, Vietnam (2016)	1,082 livestock owners (subset of Chi Linh Health and Demographic Surveillance System cohort)	Small-scale mostly rural (67.4%) and suburban (32.6%) swine (27%), poultry (30%), swine and poultry (22%), other (21%, including cattle, dogs, swine, poultry)	Unspecified	Face to face questionnaire (closed)	P	55% wore PPE (boots, gloves, masks) while handling manure for fertilizing, 45% did not.
de St Maurice et al., 2018, Uganda (2016)	228 livestock farmers, 33 herdsmen across 34 villages	Village small-scale production (goats, cattle, pigs, sheep, poultry)	Rift Valley Fever	Face to face questionnaire (closed and open)	P	Use of any PPE when handling animals: Farmers: 12% using any kind of PPE, 1% using gloves, 11% using gumboots, and 0% using masks, eye protection, or aprons. Herdsmen: Any PPE (44%), gloves (6%), gumboots (44%), masks (0%), eye protection (0%), aprons (6%).

Deka et al., 2020, India (2015-2016)	534 dairy farmers (1/household)	Dairy farming households. Small farms (1-3 animals, 77.7%), medium farms (4-10, 16.5%), large farms (>10, 5.8%). 59.2% fully stall fed (zero-grazing). 40.8% partially stall fed. 46.3% (n = 247) rural, 46.3% (n = 247) urban, 7.4% (n = 40) peri-urban.	Brucellosis (*B. abortus*)	Face to face questionnaire (closed)	P	1/534 farmers reported using protective clothing like gloves while handling aborted materials.
Dhakal et al., 2012, Nepal (2011)	100 pig farmers (1/farm)	Family business swine farms (1-300 pigs, average of 26). 85% raised pigs on leased land, 15% on land they owned. Mostly confined	Japanese Encephalitis Virus	Face to face questionnaire (open and closed)	P	40% wore full-length clothes for mosquito protection.
Dhakal et al., 2014, Nepal (2011-2012)	400 pig farmers (1/farm) across 4 districts	Most small family operations with free range or open-air pens, average range of pigs in each of the 4 districts: 4, 6, 8, 26. Free range or open-air pens common. 15.5% had domestic ducks and 57% had duck farms within 1km.	Japanese Encephalitis Virus	Face to face questionnaire (closed and open)	P	24.5% wore clothes that fully cover the body.
Farrell et al., 2015, Vietnam (2011)	63 poultry farmers	Village semicommercial poultry farms. Mostly duck farming, some chicken farming. Mostly free range.	Avian Influenza (H5N1)	Semi-structured focus group discussions (FGD) and in-depth interviews	K	Did not own or know where to purchase respiratory protection aside from fabric masks. Protective equipment like gloves and impermeable clothing were unavailable at village level.

		50-3,000 intermittently housed or free-roaming birds (meat and eggs).				
Fatiregun & Saani 2008, Nigeria (2007)	140 poultry workers across 25 farms (1-29 workers interviewed on each farm)	Commercial poultry farms (200-25,000 on each farm, median 5,000).	Avian influenza (H5N1)	Face to face questionnaire (closed)	K	Knew that wearing a facemask (65.7%), overalls (67.9%), boots or boot covers (64.3%) and eye protection (57.9%) can prevent human infection.
					P	11.4% always used face mask, gloves (10.7%), boots or boot covers (16.4%), eye protection (0.7%), outer protective garments (60%).
Goodwin et al., 2011, Malaysia (2009)	50 farmers and 70 managers across 35 pig farms	Unspecified	Swine Influenza (H1N1)	Face to face questionnaire (closed)	K	Identified ways to protect self against swine flu (10 options): 40% selected "wear gloves and mask."
Gunther et al., 2019, Australia (2016)	106 goat farmers	Commercial dairy goat farms and smallholder producers. Average number of goats 52 (range: 4-2,500, median 12)	*Coxiella burnetii* (Q-fever)	Online questionnaire (short closed, semi-closed and open-ended questions) for 96 producers, follow-up semi-structured qualitative interviews for 14 producers	P	Questionnaire: Staff members on your farm (including yourself) wear any protective clothing when assisting with milking, birthing, or for disposal of cases/bedding/birthing materials?: Always (52%). 57% did not use any PPE for the disposal of deceased animal carcasses, assisting in birthing, or the disposal of birthing materials and bedding. 48% do not use PPE while milking goats. Farmers that wear PPE mostly used gloves (16/42, 38.1%). Among glove users, (7/16, 43.75%) always wore gloves while milking goats. Qualitative interviews: 3/14 (21.4%) used PPE for assisting with kidding or handling birthing materials.
Hamza et al., 2013, Algeria (2010-2013)	105 livestock farmers (breeders) (1/farm)	Sheep, goats, cattle	Unspecified zoonoses associated with ruminant abortive fluids	Face to face questionnaire (closed)	P	31% of farmers used protective gloves and masks when handling an abortion.

Hegazy et al., 2016, Egypt (2014)	26 shepherds across 10 villages	Village sheep flocks	Ovine brucellosis (*B. mellitensis*)	Face to face questionnaire (closed and open)	P	0% wore protective gloves or masks when assisting with parturition or slaughtering sheep
Holt et al., 2011, Egypt (2009)	107 livestock rearers (males) and 107 dairy processors (females) from 214 households	Village small scale production. Households with lactating cattle and buffalo, 80% households kept cattle or buffalo, 30% kept sheep or goats	*Brucella* spp.	Face to face questionnaire (closed)	P	Questionnaire: 100% believed villagers never wore gloves or masks when assisting with parturition or abortion or while handling placentas or aborted fetuses. Direct observation: 100% never wore protective gloves or masks when assisting with parturition or abortion of animals or while handling placentas or aborted fetuses
Hossain et al., 2015, Bangladesh (2012)	120 poultry workers (96 owners, 24 workers)	Commercial poultry	Avian influenza (H5N1)	Face to face questionnaire (closed)	K	31.67% knew that AI transmission to humans could be prevented by use of PPE during poultry care.
					P	57.5% used any PPE. Among those who reported using PPE: Used gloves only: 43.5%. Used mask only: 36.2%. Used gloves and mask: 20.3%. Overall: 25% used gloves, 20.8% used mask. 11.7% used gloves and mask.
Hundal et al., 2016, India (2015)	250 livestock farmers	Livestock (unspecified), 79.6% small scale farmers (herd size less than 10 animals, 16% with 11-30 animals)	Various: Rabies, brucellosis, tuberculosis, anthrax, and bird flu	Face to face questionnaire (open and closed)	P	Conducted without wearing gloves: Disposed of aborted fetuses (39.6%), infected placenta (35.6%), feces from diarrheic animals (56.4%), gave intrauterine medication (23.3%).
Kansiime et al., 2014, Uganda (2012)	371 pastoralist household heads	Pastoralists: Farmers, (settled, crops only), Agro-pastoralists (Cattle and crops), pastoralists/semi-nomads (only cattle with permanent shelters but move in dry season). Villages	*Brucella* spp	Face to face questionnaire (closed)	K	74.2% did not know that wearing gloves when delivering animals could prevent brucellosis. 28.8% knew.

Kant et al., 2018, India (2015-2016)	Buffalo and cattle keepers across 1200 cattle sheds	Small scale cattle sheds/buffalo sheds (cattle and buffalo) (1-3 animals on each farm). containing at least buffalo (not cattle alone)	*Brucella* spp.	Face to face questionnaire (closed and open)	P	Disposed aborted fetus with naked hands: Yes 24%, No 76%, Sometimes 0%, Don't know 0%. Disposed placenta with naked hand: Yes 24%, No 76%, Sometimes 0%, Don't know 0%. Applied intrauterine medication with naked hands after abortion: Yes 45%, No 50%, Sometimes 5%, Don't know 0%.
Kauber et al., 2017, USA (2014)	49 poultry owning households	Urban backyard chicken flocks, average layer flock size 5 hens, range 2-21, 90% flocks had 8 or fewer birds.	*Salmonella* spp.	Face to face questionnaire (closed) and observation (video)	P	Questionnaire: PPE while cleaning chicken coop: 72% rarely or never wear a mask, 28% always/often/sometimes wear a mask. 43% do not wear gloves. Observation: Some entered home with flock shoes.
Kebede & Megerrsa, 2018, Ethiopia (2016-2017)	100 dairy farmers	Smallholder urban dairy farms (93% managed own cattle intensively, 7% semi-intensively)	Various: Tuberculosis, Mastitis, Anthrax, Brucellosis and Salmonellosis	Face to face questionnaire (closed)	P	51% used PPE, 49% did not use PPE.
Khattak et al., 2016, Pakistan (2015)	50 livestock farmers	Unspecified livestock	Bovine tuberculosis *(M. bovis)*	Face to face questionnaire (closed)	P	10% used gum boots, 2% used gloves during animal handling and cleaning of animal shed.
Kimani et al., 2012, Kenya (NS)	1,539 dairy farmers from 296 dairy households	Urban small scale dairy household dairies	*Cryptosporidium parvum*	Interactive participatory approach with focus group discussions, key informant interviews. Face to questionnaire (closed)	A	FGDs revealed that the purpose of protective clothing was often seen as "protecting the clothes they wore underneath" (prevented them from getting dirty) rather than protecting themselves and milk from contamination.
					P	70% wore protective clothing when engaged in dairy activities (of which 59% said they wore it always and 41% occasionally). Overall: 41.3% wore always, 28.7% wore occasionally. Direct observation: 14% wore protective clothing.
Li et al., 2020, China (2015)	153 pig farmers across 147 farms	Commercial farrow to finish, farrow to wean, and fattening swine farms (range 1,000-13,000)	Swine Influenza (H1N1)	Face to face questionnaire (closed)	P	Wear gloves/masks when have contact with pigs at work? No: 39.9%, Always: 37.9%, Sometimes: 22.2%.

Lindahl, 2015, Tajikistan (2011)	441 cattle farmers (households 6-10 people)	Urban and peri-urban small-scale dairy cattle farms (1-3 cattle per household)	Brucellosis (*B. abortus*)	Face to face questionnaire (closed and open)	P	21% used gloves when dealing with cows having an abortion or with aborted materials.
López-Robles et al., 2012, Mexico (2007-2008)	62 swine workers across 15 farms	Urban commercial swine farms, farrowing, weaning, fattening	Swine influenza (H1N1)	Face to face questionnaire (closed)	P	Use PPE when work with swine: Boots, coveralls, gloves, hand disinfection: 12.9%. Boots and coveralls: 71%, Boots 16.1%.
Lower et al., 2017, Australia (NS)	52 livestock farmers	Rural beef, dairy and sheep farms	Q fever *(Coxiella burnetii)*	Individual phone interviews or focus group discussions (25 farmers), community meeting (27 farmers)	A	"It's not practical to be putting gloves on and off while I'm doing the job and I guess maybe I paid the price; I've had Q-fever." "I must admit I don't take any precautions whatsoever. “They're horrible (gloves). I Can't stand them.”
					P	When assisting with calving: "I wear gloves and try to avoid contact, and wash fairly thoroughly after I've done the job….Whether that's actually effective or not, I don’t know."
Mahon et al., 2017, Ireland (2015)	1044 livestock farmers	Various: Dairy, suckler, beef, sheep, pigs, poultry, and other. 57% farmers practiced one type of farming, rest practiced more than one type.	Unspecified	Self-administered paper survey (closed, partially closed, and open)	P	Wear gloves when working? Yes 87.4%, Sometimes/never: 12.6%. Dairy Yes 97%, Sometimes/never 3%, Suckler Yes 81.6%, sometimes/never 18.4%. 31.9% did not wear a boiler suit/wet gear while working.
McCune et al., 2012, Peru (NS)	36 swine farmers (1/farm)	Semi-urban "Small-scale confined pig production" (corralled, n=20) and rural "low-investment" (corralled and free range, n = 16). 36% farms had mixed farming with swine and chickens.	Swine Influenza (H1N1)	Direct observation (primary) with open-ended observation guide and face-to-face questionnaire (closed and open) with key-informants	P	Observations: Corralled (20 farms): 0% barefoot, 40% wore flip-flops, 0% wore closed-toed, not boots, 60% wore boots. 5% wore gloves, 95% bare hands. 0% wore face masks. Corralled and free range (16 farms): 25% barefoot, 62.5% wore flip-flops, 12.5% wore closed-toed, not boots, 0% wore boots. 0% wore gloves, 100% bare hands. 0% wore face mask.

Mulema et al., 2020, Ethiopia (2018-2019)	928 livestock keepers	Rural, mixed crop-livestock dominated by crops, mixed crop-livestock. Predominantly sheep, then cattle and poultry	Unspecified	Community conversations, face to face questionnaire (closed) before/after educational intervention	A	Questionnaire: Use of protective equipment reduces disease transmission risk. Before intervention: Females agree (72.2%), neutral (8.3%) disagree (19.4%). Males agree (63%), neutral (4.3%), disagree (32.6%). After intervention: Females agree (100%), neutral (0%), disagree (0%). Males agree (97.6%), neutral (2.4%), disagree (0%).
					P	Questionnaire: Slaughter domestic animals with protective equipment. Before intervention: Females often (13.9%), sometimes (25%), never (61.1%). Males often (14.9%), sometimes (12.8%), never 72.3%). After intervention: Females often (48.7%), sometimes (23.1%), never (28.2%). Males often (48.8%), sometimes (20.9%), never (30.2%). Community conversation: Male after intervention "I will now use gloves when I assist in births. I will buy and use clean gloves, boots, and masks when cleaning barns and handling sick animals.' Some changes to practices after intervention included using plastic bags to cover hands (due to lack of access to gloves) when handling sick animals.
Munisamy et al., 2017, India (NS)	100 dairy farmers (68 laborers, 21 supervisors, 19 milkers, 11 others)	Small scale dairy farmers (53% less than 5 dairy cows, 59% used semi-intensive method)	Various: Rabies, bovine tuberculosis, anthrax, brucellosis, taeniasis, hydatidosis	Self-administered questionnaire (closed)	P	62% do not use PPE to prevent zoonoses. 38% used PPE. Among those using PPE, 36.8% used gloves, 18.4% face mask, 0% apron, 31.5% gumboot, 76.3% head cap. Overall, 14% used gloves, 7% face mask, 0% apron, 12% gumboot, 29% headcap.
Musa et al., 2013, Nigeria (2009, 2011-2012)	30 poultry farmers (1/farm)	Small scale poultry farms (commercial and backyard rural flocks)	Highly Pathogenic Avian Influenza	Face to face questionnaire (closed)	P	9% of households used protective clothing during dead bird disposal.

Musallam et al., 2015, Jordan (2013)	537 livestock farmers rearing and processing milk (1/household). 333 small ruminant flocks and 204 cattle herds	Small ruminant and cattle household dairy farms	*Brucella* spp.	Face to face questionnaire (closed and open)	P	Wear protective gloves when helping with parturition: Most 5.6%, some 13%, None 81.4%. Wear protective mask when help with parturition: Most farmers 5%, some farmers 13%, None 82%. Wear protective gloves when disposing aborted fetus: Most 5.8%, some 23%, none 71.2%. Wear protective mask when disposing aborted fetus: Most 5%, some 30%, None 65%.
Netrabukkana et al., 2016, Thailand (NS)	98 swine farmers	Rural small scale swine farms, mostly farrow-to-wean (7 pigs per farm on average). 93.6% raised pigs with free-range chickens. mixed farming with rice (77.6%) and pigs (97.9%).	Swine Influenza (H1N1)	Face to face questionnaire (closed)	P	77.9% wore protective boots, 9.5% wore gloves, 6.3% wore masks, 22% did not use any protective clothing.
Neupane et al., 2012, Nepal (2009)	96 poultry farmers (60 owners, 36 workers) across 10 farms (1-5 participants on each farm)	Farms sizes: 50-30,000 chickens	Avian influenza (H5N1)	Face to face questionnaire (closed and open)	K	Knew was protective against AI (percentage who named the practice when asked to list all protective practices against AI): Face masks 53.1%, Gloves 68.8%, Special boots or boot covers 15.6%, Special body garments 8.3%.
					P	Always or often use: face masks 27.1%, gloves 30.2%, Special boots or boot covers 7.3%, special body garments 3.1%.

Nicholson et al., 2020, USA (2018)	106 poultry (74), swine (15) or both (17) owners	Backyard poultry and swine farms. Median poultry 15.5, median swine 3. Most poultry farms for egg, followed by pets, and meat. Most swine for meat (62.5%), show/exhibition (37.5%), and other reasons (6.3%). (69.8% farms for poultry, 14.2% for swine, 16% for both)	Various: Poultry: Avian Influenza, Salmonellosis/fowl typhoid, E. coli/colibacillosis, Ringworm, Botulism/limberneck, Virulent Newcastle disease, Campylobacteriosis, Chlamydiosis/psittacosis, Cryptosporidiosis. Swine: Swine influenza, Ringworm, Rabies, Leptospirosis, Salmonellosis, Brucellosis (*B. suis*), *Streptococcus suis*, Swine erysipelas	Web-based and paper (mail in) survey (closed and open)	P	Poultry and swine owners. Wore while handling animals or manure: Gloves Always 15.4%, usually 12.5%, sometimes 10.6%, rarely 32.7%, never 28.9%. Protective nose and mouth coverings such as dust masks, handkerchief and surgical mask Always 6.7%, usually 6.7%, sometimes 10.5%, rarely 18.1%, never 57.1%.
Ntivuguruzwa et al., 2020, Rwanda (2018-2019)	212 dairy cattle herd owners (1/herd)	Dairy farms near national parks (wildlife-livestock-human interface, 198 herds) and peri-urban district (14 herds).	*Brucella* spp.	Face to face questionnaire (closed and open)	P	76.9% assisted calving without wearing protective equipment or clothing.
Obi, 2016, Nigeria (2015)	215 livestock farmers and 169 herdsmen	Urban (23.4%), peri urban (14.1%), and rural (62.5%) livestock settings	Various: Anthrax, Brucellosis, Rabies, Salmonellosis, Bovine Tb, Taeniasis, Echinococcosis, Avian influenza, Dematophytosis, Trypanosomiasis, Toxoplasmosis	Face to face questionnaire (closed)	P	67.7% wear protective clothing, 26.3% walk barefooted in animal's pen, 81% have skin-to-skin contact with animals on daily basis, 64.6% have contact with animal placenta.

Ogendi et al., 2013, Kenya (2011)	385 livestock and poultry producing households (head of household or mature household member) Cattle (229 farmers), sheep (43 farmers), goats (164 farmers), pigs (8 farmers), poultry (275 farmers)	Smallholder cattle (mean animals 2.2), sheep (mean animals 43), goats (mean animals 3.2), pigs (mean animals 7.3), poultry (mean animals 16). Free range, zero grazing, and tethering. 98.5% mixed farming.	*Toxoplasma gondii*	Face to face questionnaire (closed)	P	Farmers whose livestock aborted: 0% wore gloves when handling aborted fetuses and fetal membranes. Mixed farmers who used livestock manure for cropping: 1.2% mixed farmers used gloves when handling livestock manure, 98.8 % used bare hands.
Onono et al., 2019, Kenya (2015)	38 pastoralists, 33 peri-urban/agro-pastoralists	Rural pastoralists and peri-urban/agro-pastoralist communities	*Brucella* spp.	Six focus groups (males and females), two focus groups (each gender separately)	P	Handling birth products without gloves occurred very often in rural communities and regularly to very rarely in peri-urban communities.
Ortiz et al., 2006, Peru (2006)	132 chicken workers on one farm	Industrial poultry farms (large)	Avian influenza	Self-administered survey (closed)	P	Used PPE when working with sick or dead poultry: gloves sometimes (7.7%), most of the time (2.6%), always (2.6%), never (87.2%); mask sometimes 7.8%, most of the time 2.6%, always 7%, never 82.6%, apron sometimes 4.3%, most of the time 1.7%, always 2.6%, never 91.4%; glasses sometimes 2.6%, always 1.7%, never 95.7%.
Osadebe et al., 2013, USA (2009-2010)	35 owners, 35 managers, 9 workers across 35 pig farms	Commercial pig farms (small) (23% large with 50-99 pigs), rest medium (25-49 pigs) or small (<25 pigs)	*Staph aureus*	Face to face questionnaire (closed)	P	100% workers (9/9) wore cloth gloves, rubber boots, and designated farm shoes. 44% had designated farm overalls, one of these used disposable overalls, others left overalls on the farm. 90% laundered their farms clothes at home. 25% of these washed clothes daily, while others washed at least 3 times per week. Farm clothes laundered separately. 90% washed rubber boots at end of farm tasks.

Özlü et al., 2020, Turkey (2016-2017)	1,045 cattle farmers	Cattle farms: 46.9% dairy, 18.4% fattening, 34.7% mixed (dairy and fattening). Average 39 cattle, range 3-600. 150 farms also had sheep and goats.	Various: Anthrax, brucellosis, tuberculosis, rabies, Crimean-Congo hemorrhagic fever, hydatid cyst, toxoplasmosis and giardiasis	Face to face questionnaire (closed)	A	73.2% thought gloves should be used in animal contact, 56.1% thought masks were necessary, 86.4% thought boots necessary, 89.7% thought should avoid animal contact with cut hands.
					P	65.8% used gloves while in contact with animals, 23.9% used masks, 78.3% used boots, 80.2% avoided animal contact with cut hands.
Peck et al., 2019, Thailand (2016)	51 goat farmers (1/farm) responsible for daily management	Rural and peri-urban small scale goat farms (200 or fewer goats), average 31 goats (range 1-200). 92% raised goats on household property	Brucellosis (*B. melitensis*)	Face to face questionnaire (closed)	A	Primary reason for not using PPE: 93% selected "there is no need for this equipment."
					P	During contact with livestock: 92% wear at least one piece of PPE. Long-sleeve shirt (92%), Gloves (24%), Boots (82%), Pants (51%), Protective mask (73%), Gloves (24%), Goggles (6%).
Ramirez et al., 2006, USA (2004-2005)	49 swine workers	Swine confinement (industry)	Swine influenza (H1N1)	Face to face questionnaire (closed)	P	When working with sick or diseased swine, how often do you wear gloves? Occasionally or never: 70.8%. Usually or always: 29.2%.
Rinchen et al., 2019, Bhutan (2017)	562 cattle owners (1/household)	Rural small scale cattle operations with at least one cattle	Rabies	Face to face questionnaire (closed and open)	P	Among those interacting with their cattle, 18% used minimal PPE while dressing carcasses, 26% used PPE while dressing cattle wounds, 23% while assisting parturition, 22% while examining oral cavities, 25% while handling sick animals.
Robert et al., 2007, Indonesia (2007)	495 poultry farmers across 12 farms, 94.7% lived on farm where work	Rural poultry farms, 200 native chickens broilers to 500,000 commercial layers	Avian influenza (H5N1)	Face to face questionnaire (closed)	P	14% always wore masks, 32% sometimes, 54% never. 10% always wore gloves, 25% sometimes, 65% never.
Sahin et al., 2005, Turkey (NS)	49 farmers	Rural animal husbandry	Superficial mycoses	Face to face questionnaire (closed)	P	Shoes: Rubber (64.4%), other (35.6%). Socks: Nylon (56.6%), other (43.4%).
Schimmer et al., 2014, the Netherlands (2010-2011)	Dairy cattle farmers. Dairy farmers and up to 2 family	Commercial dairy cattle farms	*Coxiella burnetii* (Q-fever)	Self-administered questionnaire (closed)	P	Work clothes available for own personnel: Yes 75.5%, No 24.5%.

	members or farm employees >/= 12 years old. 736 people across 308 farms.					
Sichewo et al., 2020, South Africa (2017)	150 producers: household head (33), women belonging to households owning cattle (41), herdsmen (46), dip tank committee members (30)	Rural small scale cattle producers (crop-livestock farming) near game and nature reserves (wildlife-livestock-human interface)	Bovine tuberculosis (*M. bovis*)	Focus group discussions	A	"This is not a human corpse that has AIDS." Dip tank committee member who attended a past educative meeting on bovine TB: "Back when we grew up that used to be the case, but now wearing sandals during slaughtering is no different than not wearing gloves. From all the meetings and information sessions we attend, the advice we get is 'wear your protective clothing and gloves if you have' and what is also different is that you have an animal inspected prior to it being slaughtered. In the olden days even, a sickly-looking animal was not spared."
					P	Herdsmen did not wear protective clothing during slaughtering: "We handle the meat with these bare hands (shows hands), we don't wear gloves for this."
Singh et al., 2019, India (2015-2016)	859 livestock farmers	Rural village small scale livestock farmers with cattle, buffalo, sheep, goat, pigs. 98.13% owned cattle, 4.54% owned sheep or goats. Number of animals: 0-5 (60.3%), 6-20 (35.38%), greater than 20 (4.3%).	Various: Brucellosis, rabies, tuberculosis, plague, swine flu, taeniosis, hydatidosis, toxoplasmosis, ringworm	Self-administered survey (closed)	P	45.98% preferred walking bare foot at farm.
Tebug et al., 2015, Senegal (2013)	222 pastoralist cattle farmers, 70.3% household heads	Pastoral and agro-pastoral cattle farms. Many also kept sheep, goats,	Various: Rabies, Bovine Brucellosis, Anthrax, Ringworm	Face to face questionnaire (closed)	P	70.3% regularly assist animals during parturition and abortion. Among these, 98.1% did not use gloves.

		donkeys, chicken, horses, dogs				
Tialla et al., 2020, Burkina Faso (2016-2017)	73 pig farmers across 41 pig farms	21 semi-intensive pig farms (herd average 250.8, range 44-504), 20 extensive farms (herd average 23.3, range 11-36). Poultry also present on all farms: Extensive range 8-518, semi-intensive range 12-1002.	Swine Influenza (H1N1)	Face to face questionnaire (closed)	P	Wore boots (86.3%), dedicated clothes (0%), gloves (0%), mask (0%).
Traoré et al., 2021, Mali (2018)	119 livestock farmers (mostly agropastoralists and pastoralists)	Small ruminant (sheep and goats). 52.1% mixed (sheep and goat), 33.6% only sheep, 14.3% only goats. Average herd size: 37.1. 78.1% farmers owned other animals such as cattle, poultry, equines, swine. Most agro-pastoral (43.7% farms), then pastoral systems (31.1%), then peri-urban semi-sedentary (17.6%) and urban small farms with less than 10 head (7.5%) in cities.	*Brucella spp.*	Face to face questionnaire (closed) and direct observation	P	40.3% assisted female animals during delivery without any protection.
Tukana & Gummow, 2017, Fiji (2013)	81 cattle farmers (1/farm)	97% dairy cattle farms, 3% beef. Average 134 cattle per farm (range 15-951)	Brucellosis (*B. abortus*)	Face to face questionnaire (closed)	P	15% use PPE for routine farm work. 10% use PPE during high risk situations (e.g., when delivering calves).

Yendell et 2012, USA (2007-2008)	150 backyard poultry flock owners	150 backyard domesticated fowl flocks (chickens, ducks, geese, pheasants, turkeys, and pigeons). Chicken meat and egg breeds most common. Median chicken flock size 100 birds (range 12-800). Median pheasant flock size 320, pigeon 300. Most common reasons: Meat or eggs for personal use, fun, hobby.	Low-pathogenicity avian influenza	Phone survey (closed)	P	Special footwear, Protective clothing, mask or respirators, gloves: 'Always' (16%, 6.7%, 0%, 6.7%), 'Sometimes' (17.3%, 8%, 26%, 44.7%), and 'Never' (66.7%, 85.3%, 74%, 48.7%), respectively.
Zhao & Davey, 2017, China (2014)	25 pig and poultry farmers, Dai population (ethnic minority)	Smallholder pig and poultry (family plots for consumption and income, family labor, lived in close proximity to animals, with cattle below house, pigs in backyard). Also subsistence crops.	Avian (H7N9) and swine influenza (H1N1)	Face to face questionnaire (closed and open) and focus group discussions	K	Unaware of preventive behaviors such as wearing facemasks.

Most included papers represent Asian and African countries (Table 3.2).

Table 3.2: Publication representation based on global region.

Region	**Count**
Africa	22
Asia	34
Caribbean	0
Central America	0
Europe	6
North America	6
Oceana	1
South America	3
TOTAL	**72**

Among included publications, 59 used face-to-face questionnaires either alone (50) or in combination with other data collection methods. A total of 33 studies used closed ended face to face questionnaires alone, while 17 used face-to-face questionnaires with open and closed questions. The phone interview method was used in two studies. Eight studies collected data through self-administered questionnaires. Community discussions and focus group discussions were included as data collection methods in 2 and 5 studies, respectively. Researcher direct observation was included as a data collection method in 5 studies. Overall, nine studies used more than one data collection method.

Knowledge, Attitudes and Practices of PPE among Livestock Farmers

Of the 72 included publications, 5 contained information only relevant to PPE knowledge, 1 only to attitude, and 53 only to practices. None of those papers contained relevant information on knowledge, attitudes, and practices or on knowledge and attitudes. Seven of the total contained relevant information on knowledge and practices, and 8 contained relevant information attitudes and practices.

Included publications covered an array of pathogens and disease (Figure 3.2). Avian influenza, swine influenza, and brucella species were among the top three pathogens focused on. Several (7/72) publications did not specify a disease focus but focused on zoonoses broadly. Several (12/72) publications included more than two disease/pathogen focuses. Among these were combinations or two or more of the following: Anthrax, brucellosis, tuberculosis, rabies, Crimean-Congo hemorrhagic fever, hydatid cyst, toxoplasmosis, giardiasis, plague, swine flu, taeniosis, hydatidosis, toxoplasmosis, ringworm, Avian Influenza, Salmonellosis, E. coli/colibacillosis, Ringworm, Botulism/limberneck, Virulent Newcastle disease, Campylobacteriosis, Chlamydiosis/psittacosis, Cryptosporidiosis, Swine influenza, Leptospirosis, *Streptococcus suis*, and Swine erysipelas.

Search results included no publications that met search criteria for PPE KAP focused on preventing infectious disease transmitted from person-to-person, including COVID-19 and seasonal influenza.

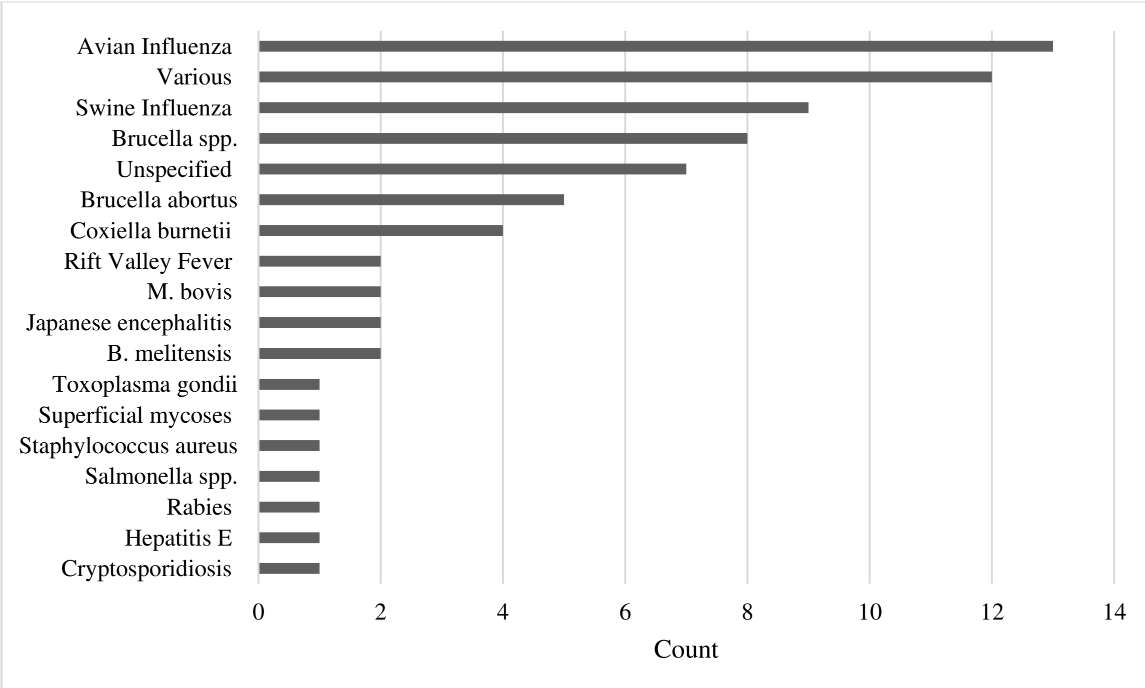

Figure 3.2. Distribution of 72 publications across various infectious agents/diseases.

Included publications predominantly highlight findings for relevant practices alone (54 publications/72 total publications) with fewer publications providing relevant findings for knowledge alone (3/72), and attitudes alone (0/72), knowledge and practices (6/72), attitudes and practices (8/72), attitudes and knowledge (0/72), and knowledge, attitudes, and practices (0/72). Included publications cover a range of production systems, including household/backyard, pastoralist, and commercial systems rearing a variety of animal species, including livestock (dairy and beef cattle, sheep, goats, swine) and poultry (including chickens, ducks, and other waterfowl).

A comprehensive results summary by author, production system, main infectious agent/disease, and relevant knowledge, attitudes, and/or practice findings relevant to PPE is provided in Table 3.1.

Knowledge

Ten studies provided evidence of farmer knowledge on PPE for prevention of various zoonoses. Six were combined with practices, zero with attitudes, and 4 only knowledge. The studies including knowledge (10/72) of the studies on knowledge of PPE focused on poultry farmers (6/10), followed by swine farmers (2/10), poultry and swine farmers (1/10), and pastoralists (1/10).

Pastoralists

A study among pastoralists with cattle in Uganda found that 74.2% did not know that wearing gloves when delivering animals could prevent brucellosis, while 28.8% knew gloves could prevent brucellosis transmission (Kansiime et al., 2014).

Small-Scale Swine Production

A study (Ayim-Akonor, et al., 2020a) among small scale pig farmers (most with less than 200 pigs) in Ghana found that 73.08% of farmers who were aware of the possibility of becoming infected with pathogens from swine named at least one farm practice that could minimize farmer risk. The most frequently identified out of 10 were surgical mask (1), protective footwear (2), gloves (3), dedicated farm clothing (4), goggles (7). A study in China using face-to-face questionnaire and focus group discussions on small scale mixed swine and poultry farms concluded that farmers were unaware of preventive behaviors such as wearing facemasks in the context of swine influenza prevention (Zhao & Davey, 2017).

Larger Scale Commercial Poultry Production

In a study of commercial poultry farms in Bangladesh by Hossain et al., 2015, 31.67% of the farmers knew that avian influenza transmission to humans could be prevented by using PPE during poultry care. Abbate et al., 2006 studied KAP of commercial poultry famers in Italy and found that 68.5% of workers identified face masks as the top measure that can protect poultry workers from avian influenza, followed by 61.5% who identified gloves, 61.1% outer garments, 56% boots or boot covers, and 43.2% eye protection. When asked to identify ways to prevent human avian influenza infection from poultry, the four most frequently identified methods among workers in commercial poultry farms in Ghana were nose masks, boots, gloves, and overalls. Goggles were the 9th most frequently mentioned protective method (Ayim-Akonor et al., 2020b). In a study on commercial poultry farms in Nigeria, 65.7% of farmers knew that wearing a facemask (percentage here?), overalls (67.9%), boots or boot covers (64.3%) and eye protection (57.9%) can prevent human avian influenza infection (Fatiregun & Saani, 2008). In a Nepal study exploring avian influenza prevention KAP on commercial farms with 50-30,000 chickens, the following proportions of workers and owners knew that each respective PPE item was protective against avian influenza: Face masks 53.1%, Gloves 68.8%, Special boots or boot covers 15.6%, special body garments 8.3% (Neupane et al., 2012). On semi-commercial poultry farms in Vietnam, Farrell et al., 2015 concluded that poultry farmers did not know where to purchase respiratory protection aside from fabric masks. Protective equipment like gloves and impermeable clothing were unavailable at village level. Study of managers and farmers across 35 pig farms in Malaysia asked participants to identify ways to protect themselves against swine influenza. When given ten options, 40% selected "wear gloves and mask" (Goodwin et al., 2011).

Small Scale Poultry Production

A study with the Dai ethnic minority household poultry farmers in China found through questionnaires and focus group discussions that farmers were unaware of avian influenza preventive behaviors such as wearing facemasks (Zhao & Davey, 2017). A study in China using face-to-face questionnaire and focus group discussions on small scale mixed swine and poultry farms concluded that farmers were unaware of preventive behaviors such as wearing facemasks in the context of avian influenza prevention (Zhao & Davey, 2017).

Practices

Sixty studies provided results relevant to farmer PPE practices for prevention of various zoonoses. Fifty-four publications provide relevant results on PPE practices only, while six publications provided relevant results on practices and knowledge. The studies including practices (60/72) relevant to PPE focused on poultry farmers (14/60), followed by swine farmers (12/60), cattle farmers (16/60), pastoralists (5/60), farmers with unspecified livestock (5/60), farmers with small and large ruminants (5/60), farmers with various livestock, including some combination of poultry, ruminants and/or swine (9/60), goat farmers (2/60), sheep farmers (1/60), and sheep and goat farmers (1/60).

Preventing Livestock Pathogens Transmitted via Milk and Tissues/Fluids associated with Parturition

Several papers address PPE specifically with respect to KAP relevant to potential pathogens transmitted via placenta and birth fluids, including *brucella* species, *Coxiella burnetti*, and Rift Valley Fever.

Dairy Cattle Operations

In Pakistan, only 25% of smallholder dairy farmers reported covering hand cuts during animal contact, and 17% reported direct contact with placental membrane during parturition (Arif et al., 2017). Among dairy farming households in India, 1/534 (0.19%) farmers reported using protective clothing like gloves while handling aborted materials (Deka et al., 2020). In another study in India, small scale livestock farmers did not use gloves during disposal of aborted fetuses (39.6%), infected placenta (35.6%), and intrauterine medication administration (23.3%) (Hundal et al., 2016). Small scale buffalo and cattle keepers in India frequently handled reproductive materials without gloves, as 24% disposed of aborted fetuses and placentas with bare hands, and 45% applied intrauterine medication with bare hands (Kant et al., 2018). A study on small scale female dairy farmers in India found through researcher direct observation that 81.7% of female farmers actively helped cattle during reproduction but 90% did not wear protective gloves (Chinchwadkar & Panda, 2020). Rinchen et al., 2019 found that among rural small-scale dairy households, 87% assisted cattle during parturition and that only 23% of respondents used PPE while doing so. A study on small scale dairy cattle farmers in Egypt found that 100% of participants believed villagers never wore gloves or masks while assisting with parturition or abortion or handling placentas and aborted fetuses. Direct researcher observation confirmed that 100% of farming villagers did not wear gloves or masks while conducting these tasks (Holt et al., 2011). Similarly, a study in Jordan among small dairy households (small ruminant and cattle) found that villagers believed 81.4% of farmers did not wear gloves when helping with parturition, 82% did not wear masks, 71.2% did not wear gloves when disposing of aborted fetuses, and 65% did not wear masks when disposing aborted fetuses (Musallam et al., 2015). Among small-scale dairy farms in Rwanda, 76.9% of farm owners assisted calving without wearing protective equipment or clothing (Ntivuguruzwa et al., 2020). In Tajikistan, only 21% of small-scale dairy cattle farmers used gloves when dealing with cows having an abortion or with aborted materials (Lindahl et al., 2015). A study of small and medium scale predominantly dairy cattle farms in Fiji found that 15% use PPE for routine farm work and only 10% use PPE during high-risk situations (e.g., when delivering calves) (Tukana & Gummow, 2017). On a commercial dairy cattle farm in the Netherlands, 75.5% of respondents said work clothes were available for the farm's own personnel, while 24.5% responded that such clothes were not available (Schimmer et al., 2014)

Mixed Livestock, Shepherds, Herders, Breeders, and Goat Farmers

Among small and medium-scale mixed livestock producers in Vietnam, 32.1% often/always handled aborted fetuses, placentas, or amniotic fluids with bare hands while 7.3% engaged in this practice sometimes and 60.6% never/seldom, respectively (Cao Ba et al., 2020). Only 31% of small ruminant and cattle breeders in Algeria used protective gloves and masks when handling an abortion (Hamza et al., 2013). A study among shepherds in Egypt reported that 0% wore protective gloves or masks when assisting with sheep parturition (Hegazy et al., 2014). Among livestock herders in Mongolia, the majority of respondents did not use PPE during handling aborted fetuses, placentas, or birth products; only 34.4% used masks, 40.6% used gloves, and 15.3% used aprons (Bat-Erdene et al., 2018). A study on livestock herders and farmers in Nigeria found that 64.6% have contact with animal placentas (Obi et al., 2016). A study among small-scale livestock farmers and herdsmen in Uganda focused on Rift Valley Fever and found that while handling animals, only 12% of farmers use any kind of PPE, 1% use gloves, 11% use gumboots, and 0% use masks, eye protection, or aprons. Only 44% of herdsmen use any PPE, 6% use gloves, 44% gumboots, 0% use masks, 0% use eye protection (0%), and 6% use aprons (de St Maurice et al., 2018).

Beaudeau et al., 2020 reported on practices of dairy cattle, beef cattle, and dual-purpose cattle farmers in France relevant to *Coxiella burnetii* prevention. The authors found that 20% of farmers reported using gloves often/always during milking, while 63% never or occasionally used gloves during milking. During calving, 42% of respondents often/always wore gloves, while 58% never/occasionally wore gloves. In their study on *Coxiella burnetti* KAP among small and medium scale goat producers in Australia, Gunther et al., 2019 found that 21.4% of producers used PPE for assisting with kidding or handling birthing materials. Only 52% of staff members on the farm always wore protective clothing when assisting with milking, birthing, or for disposal of carcasses/bedding/birthing materials. Fifty-seven percent did not use any PPE for the disposal of deceased animal carcasses, assisting in birthing, or the disposal of birthing materials and bedding. Forty-eight percent of respondents did not use PPE while milking goats. Farmers that wore PPE mostly used gloves (38.1%). Among glove users, 43.75% always wore gloves while milking goats. Another study in Australia focusing on rural dairy cattle, beef cattle, and sheep farms captured practices regarding Q-fever prevention via focus group discussion and community meetings (Lower et al., 2019):

When assisting with calving: *"I wear gloves and try to avoid contact, and wash fairly thoroughly after I've done the job….Whether that's actually effective or not, I don't know."*

A brucellosis KAP study with rural and peri-urban small scale goat farmers in Thailand found that 92% of respondents reporting wearing at least one form of PPE during contact with goats. Ninety two percent wore longs sleeve shirts, 24% gloves, 82% boots, 51% pants, 73% protective masks, and 6% goggles (Peck et al., 2019). One study focused on *Toxoplasma gondii* risk factors among 385 mixed livestock producing households in Kenya. If found that among small scale livestock and small ruminant farmers whose livestock aborted, 0% reported wearing gloves when handling aborted fetuses and fetal membranes (Ogendi et al., 2013).

Pastoralists

A study in Tanzania among pastoralists with cattle, sheep, and goats found that only 10% used gloves during animal delivery (Asakura et al., 2018). Focus group discussions among pastoralists in Kenya revealed that handling birth products without gloves occurred very often in rural communities and regularly to very rarely in peri-urban communities (Onono et al., 2019). In a Senegal study, 70.3% pastoralists reported regularly assisting animals during parturition and abortion. Among these, 98.1% did not use gloves (Tebug et al., 2015). In Mali, 40.3% of pastoralists with sheep and goats assisted animals during delivery without any protection (Traoré et al., 2021). In a study exploring Rift Valley Fever prevention KAP among pastoralists with cattle and small ruminants in Kenya, Abdi et al., 2005 found that only 4.34% used any form of protection when handling sick animals.

Other Preventive Practices in Cattle and Small Ruminant Settings

General PPE Practices

In Italy, Cediel et al., 2012 studied commercial livestock industry workers working with various combinations of mostly breeding dairy cows, fattening calves, and pigs. They found that 2.86% of respondents worked without PPE. One said, "My hands are my gloves." Among 1,045 small and medium scale dairy and beef cattle farmers in Turkey, 65.8% used gloves while in contact with animals, 23.9% used masks, 78.3% used boots, 80.2% avoided animal contact with cut hands (Ozlu et al., 2020). A study on livestock herders and farmers in Nigeria found that 67.7% wear protective clothing and 81% have skin-to-skin contact with animals on daily basis (Obi et al., 2015). In the context of bovine tuberculosis (*M. bovis*), Khattak et al., 2016 found that 10% of 50 livestock farmers from unspecified production systems reported to use gum boots, while 2% used gloves during animal handling and cleaning of animal shed.

In Turkey, 35.8% of rural small ruminant and cattle farmers wore gloves while contacting animals, 42.4% wore boots, and 6.6% used masks. Among female mask users, all used a scarf over their mouth as a mask (Cakmur et al., 2015).

Handling Sick Animals, Carcasses, and Slaughtering

Rinchen et al., 2019 found that among rural small scale dairy households interacting with their cattle, 18% of cattle owners used minimal PPE while dressing carcasses, 26% used PPE while dressing cattle wounds, 22% while examining oral cavities, 25% while handling sick animals. Sichewo et al., 2020 studied small scale cattle producers in South Africa, including 150 producers: household heads, women belonging to households owning cattle, herdsmen, and dip tank committee members. Regarding PPE and bovine tuberculosis, one herdsmen stated they did not wear protective clothing during slaughtering and handle meat with their “bare hands.” A study evaluating an educational intervention among rural, predominantly sheep and cattle farmers in Ethiopia assessed male and female PPE use during livestock slaughter. Before intervention, 13.9% of females and 14.9% of males reported often slaughtering animals with PPE. After intervention, 48.7% of females and 48.8% of males often slaughtered with PPE (Mulema et al., 2020). Among livestock herders in Mongolia, the following PPE usage was reported while preparing raw livestock products: 34.4% use masks, 65.6% do not. 40.6% use gloves, 59.4% do not. 15.3% use aprons, 84.7% do not (Bat-Erdene et al., 2018).

Preventing Poultry Pathogens, Including Avian Influenza

Commercial and Large-Scale Poultry Operations

A study of commercial poultry farmers in Italy found that 82.9% always wore outer garments, boots, or protective boot covers, 59.9% always wore face masks, and 24.5% always wore eye protection (Abbate et al., 2006). Cui et al., published three relevant papers on commercial poultry famers and avian influenza prevention in China. Cui et al., 2017 found that 87.9% of farmers wore protective clothes during poultry husbandry to protect against A/H7N9, 73.4% wore protective hats, 57.2% wore gloves, 32.3% wore face mask, and 20.5% wore protective shoes. In a similar study, Cui et al., 2019 found commercial chicken farmers in China practice the following to protect themselves against avian influenza: Wear protective clothes: Never (4.2%), always (59.6%); Wear face mask: Never (6.8%), always (39.9%); Wear protective hat: Never (4%), always (51.6%); Wear protective shoes: Never (2.8%), always (54.4%). Wear gloves: Never (4.9%), always (39.4%) (Cui et al., 2019b). In a similar study using a face-to-face in-depth interview approach, Cui et al., 2019a found that among 25 commercial chicken farmers, 88% reported using protective clothing while working, 76% protective hat, 60% gloves, 32% face mask in the context of avian influenza prevention.

In Ghana, commercial poultry farmers reported the following practices: 97.4% changed clothes before working (of these, 2.7% wore overalls, 97.3% wore personal clothes, including-shirt, shorts, and/or trousers). 100% changed clothes before exiting farm. 48.7% wore protective footwear. 99.3% changed footwear before leaving farm. 0% wore gloves, and 2.0% wore a nose mask (Ayim-Akonor et al., 2020b). In Nigeria, commercial poultry farmers reported the following practices: 11.4% always used face mask , gloves (10.7%), boots or boot covers (16.4%), eye protection (0.7%), outer protective garments (60%) (Fatiregun & Saani, 2008).

In a study involving 120 commercial poultry workers in Bangladesh, only 57.5% of farmers used PPE. Among those who reported using PPE, 43.5% used gloves only, 36.2% mask only, and 20.3% used gloves and mask. Out of all participants in this study, 25% used gloves, 20.8% used masks, and 11.7% used gloves and mask (Hossain et al., 2015). In their study focusing on commercial poultry farmers on one farm in Peru, Ortiz et al., 2006 found that farmers conducted the following while working with sick or dead poultry: 2.6% always wore gloves, 87.2% never wore gloves; 7% always wore a mask, 82.6% never wore a mask; 1.7% always wore glasses, 95.7% never wore glasses. In a Nepal study exploring avian influenza prevention KAP on commercial farms with 50-30,000 chickens, participants always or often use the listed PPE items with corresponding frequencies: face masks 27.1%, gloves 30.2%, special boots or boot covers 7.3%, special body garments 3.1% (Neupane et al., 2012). In a study with semicommercial duck and chicken farmers in Vietnam using focus group discussion and in-depth interviews, it was revealed that protective equipment like gloves and impermeable clothing were unavailable at the village level (Farrell et al., 2015). On Rural poultry farms in Indonesia with a range of 200 native chickens broilers to 500,000 commercial layers, 14% always wore masks, 32% sometimes, 54% never, while 10% always wore gloves, 25% sometimes, 65% never (Robert et al., 2007).

Household and Small-Scale Poultry in Lower- and Middle-Income Countries

A study in Nigeria on exploring KAP on prevention of highly pathogenic avian influenza (HPAI) among small-scale household poultry producers found that 9% of households used protective clothing during dead bird disposal (Musa et al., 2013).

Preventing Swine Pathogens, Including Swine Influenza

Larger Commercial Swine Operations

Li et al., 2020 explored risk of swine influenza to commercial pig farm workers on farms in China with a range of 1,000-13,000 pigs). When asked if they wear gloves/masks when in contact with pigs at work, 39.9% replied “no”, 37.9% “always”, and 22.2% “sometimes.” A study of urban commercial swine farms in Mexico found that 12.9% of workers wore boots, coveralls, and gloves, 71% wore boots and coveralls, and 16.1% wore boots (López-Robles et al., 2012). A study focusing on Hepatitis E among commercial swine farms (50% farms <540 pigs, 50% farms > 540 pigs) in France found that 29.4% of farmers reported to wear coveralls, while 70.6% did not, and 67.3% wore gloves, while 32.7% did not (Chaussade et al., 2013). A study in the United States focused on swine confinement workers and swine influenza. It found that 70.8% of workers reported occasionally/never wearing gloves while working with sick or dead swine and 29.2% usually/always wore gloves during these tasks (Ramirez et al., 2006). A study across 35 commercial swine farms in the United States focusing on *Staphylococcus aureus* found that 100% of workers reported to wear cloth gloves, rubber boots, and designated farm shoes. Forty four percent of workers had designated farm overalls, and workers within this group used disposable overalls while all others left overalls on the farm. Ninety percent washed their rubber boots at end of farm tasks (Osadebe et al., 2013).

Smaller Scale Commercial and Household Swine Operations

A swine influenza serological study including workers from 41 pig farms (semi-intensive with herd average 250.8 and extensive with average 23.3) in Burkina Faso found that 86.3% reported wearing boots, 0% dedicated clothes, 0% gloves, and 0% masks (Tialla et al., 2020). A study of small-scale piggeries in Nigeria found that the majority of farmers and farm attendants reported not using PPE, but 100% reported to change their clothes before and after working (Awosanya et al., 2013). Another study (Ayim-Akonor et al., 2020a) among small scale pig farmer (most with less than 200 pigs) in Ghana found that 95.33% reported to change their clothes to dedicated farm clothing before attending to swine (4.67% did not), 4% wore gloves when working (96% did not), and 98% did not wear a surgical mask when working (2% did). A study of urban (average 29 swine per farm) and backyard pig farms in Peru found that through researcher observation while feeding chicken viscera to swine: 80% of farmers did not use caps, 20% used fabric caps, and 0% used surgical caps. Researchers also observed that 13.13% used face masks, 40% used gloves, 6.67% use plastic or cloth aprons, 20% wore sandals, 26.7% wore closed footwear (not boots), and 53.3% wore boots (Carnero et al., 2018). Another study in Peru examined swine influenza prevention KAP among farmers from semi-urban "small-scale confined pig production" (corralled) and rural "low-investment" (corralled and free range) farms.

Through direct observation, researchers noted that on corralled farms, 0% of farmers were barefoot, 40% wore flip-flops, 0% wore closed-toed, not boots, 60% wore boots. 5% wore gloves, 95% worked with bare hands, 0% wore face masks. On corralled and free-range farms, 25% were barefoot, 62.5% wore flip-flops, 12.5% wore closed-toed shoes that were not boots, 0% wore boots. 0% wore gloves, 100% worked with bare hands, 0% wore face mask (McCune et al., 2012). Among rural small-scale farmers in a study in Thailand, 77.9% farmers reported wearing protective boots, 9.5% gloves, 6.3% masks, and 22% reported not using any protective clothing while working with swine (Netrabukkana et al., 2016).

Preventing Pathogens in Backyard Settings in High Income Countries

Three studies explored backyard poultry and swine farming in the United States. In a study on urban backyard chicken flocks in the United States, 72% flock owners rarely or never wore a mask, 28% always/often/sometimes wore a mask, and 43% did not wear gloves while cleaning the chicken coop. (Kauber et al., 2017). In a study on backyard fowl flock (including combinations of chickens, ducks, geese, pheasants, turkeys, and pigeons) owners in the United States, special footwear was worn by 16% of owners always, 17.3% sometimes, 66.7% never. Protective clothing was worn by 6.7% of owners always, 8% sometimes, 85.3% never. Masks or respirators were worn by 0% always, 26% sometimes, 74% never. Gloves were worn by 6.7% of owners always, 44.7% sometimes, and 48.7% never. Another study in the United States included owners of backyard chicken, and/or swine farms (106 poultry farms, 15 swine farms, and 17 farms with poultry and swine). Regarding poultry and swine owners, 15.4% always wore gloves while handling animals, 12.5% usually, 10.6% sometimes, 32.7% rarely, 28.9% never. While handling animals, 6.7% always wore protective nose and mouth coverings such as dust masks, 10.5% sometimes, 18.1% rarely, 57.1% never (Nicholson et al., 2020).

Preventing Environmental Exposures

Smaller Scale Livestock and Poultry Settings

A study on *Toxoplasma gondii* risk factors among 385 mixed livestock producing households in Kenya found that among mixed farmers who used livestock manure for cropping, 1.2% used gloves when handling livestock manure and 98.8 % used bare hands (Ogendi et al., 2013). Also in Kenya, a study with urban small scale dairy household dairies explored Cryptosporidiosis risk factors on the farm through interactive participatory approaches with focus group discussions, key informant interviews and a face-to-face questionnaire. Seventy percent of participants wore protective clothing when engaged in dairy activities, and of these 59% said they wore it always and 41% occasionally. Based on researcher observation, only 14% wore protective clothing (Kimani et al., 2012). In Vietnam, only 55% of small-scale swine and/or poultry producers used PPE (boots, gloves, or masks) while handling manure for fertilizing, while the remaining 45% used no PPE (Dang-Xuan et al., 2017). In the United States, owners of backyard chicken and/or swine farms (106 poultry farms, 15 swine farms, and 17 farms with poultry and swine) infrequently used PPE while handling manure. Regarding poultry and swine owners, 15.4% always wore gloves while handling manure, 12.5% usually, 10.6% sometimes, 32.7% rarely, 28.9% never. While handling manure, 6.7% always wore protective nose and mouth coverings such as dust masks, 10.5% sometimes, 18.1% rarely, 57.1% never (Nicholson et al., 2020). A study in India among rural small-scale livestock farmers with cattle (predominantly) and/or buffalo, sheet, goats, and pigs found that 45.98% of farmers preferred walking in bare feet at the farm (Singh et al., 2019). A study on livestock herders and farmers in Nigeria found that 26.3% walk barefoot in animal pens (Obi et al., 2016). A study on superficial mycoses in rural animal husbandry workers in Turkey found that 64.4% reported to wear rubber shoes, 35.6% wore shoes of other material, 56.6% wore nylon socks, and 43.4% wore socks of other material (Sahin et al., 2005). Finally, in India, 56.4% of small-scale livestock farmers did not use gloves during disposal of feces from diarrheic animals (Hundal et al., 2016).

Preventing Mosquito-Borne Pathogen Exposure

Small-Scale Swine Production

Search results produced two papers relevant to preventing occupational (i.e., farming-related) vector-borne infectious diseases. Both papers studied focused on small-scale pig farmers in Nepal and Japanese Encephalitis. Dhakal et al., 2014 and 2012, found that 24.5% and 40% of farmers were clothes covering the body while working on the farm.

Attitudes

Nine studies provided relevant results regarding attitudes on PPE for preventing infectious diseases in livestock farmers. Nine publications provided relevant results on PPE attitudes and practices, and no publications provided relevant results on attitudes and knowledge or attitudes only. The studies including attitudes (9/72) relevant to PPE focused on cattle farmers (3/9), farmers with small and large ruminants (2/9), farmers with various livestock, including some combination of poultry, ruminants, and/or swine (2/9), goat farmers (1/9), and poultry farmers (1/9).

Small and Medium Scale Livestock Farmers

The majority (8/9) of the publications providing information on attitudes papers represented ruminant farmers focusing wholly or in part of ruminant production and represent a variety of countries, including Turkey, Vietnam, Thailand, Ethiopia, Kenya, and South Africa. Among small and medium-scale mixed livestock producers in Vietnam, 98.6% agreed that gloves, boots, and face mask are important in preventing zoonoses. A study evaluating an educational intervention among rural, predominantly sheep and cattle farmers in Ethiopia assessed beliefs on PPE efficacy among males and females. Before intervention, 72.2% of females and 63% of males agreed that PPE reduced zoonotic disease transmission risk. After intervention, 100% of females and 97.6% of females agreed (Mulema et al., 2020). Through in-depth interviews, farmers described reasons not to use PPE, which included discomfort, belief that it's not worth the money, and being too busy (Cao Ba et al., 2020). In Turkey, 92.1% of rural small ruminant and cattle farmers believed gloves should be used while contacting animals, and 84.1% and 89.4% believed using a mask or water-resistant boots, respectively, is necessary (Cakmur et al., 2015). A study in Australia focusing on rural dairy cattle, beef cattle, and sheep farms regarding Q-fever prevention highlighted comments from one farmer who cited the impracticality of donning and doffing gloves while working, stating that gloves are "horrible" and that he cannot "stand them" (Lower et al., 2019). Focus group discussions on urban small-scale household dairies in Kenya revealed that farmers often viewed the purpose of protective clothing as "protecting the clothes they wore underneath" (preventing them from getting dirty) rather than protecting oneself from contamination (Kimani et al., 2012). A brucellosis KAP study with rural and peri-urban small-scale goat farmers in Thailand asked why farmers did not use PPE, and 93% selected "there is no need for this equipment" (Peck et al., 2019). Among 1,045 small and medium scale dairy and beef cattle farmers in Turkey, 73.2% farmers thought gloves should be used in animal contact to prevent zoonoses, 56.1% believed masks were necessary, 86.4% believed boots necessary, and 89.7% believed one should avoid animal contact with cut hands (Ozlu et al., 2020). Sichewo et al., 2020 studied small scale cattle producers in South Africa, including 150 producers: household heads, women belonging to households owning cattle, herdsmen, and dip tank committee members. Regarding PPE and bovine tuberculosis, one respondent indicated that the community's culture had become more supportive of PPE usage during slaughter since receiving educational interventions on bovine TB.

Commercial Poultry Farmers

Studying commercial poultry famers and avian influenza prevention in China through in-depth interviews, Cui et al., 2019a provided a quotation indicating the respondent believed face masks are effective at preventing the A/H7N9 causative agent from entering the body. Another respondent believed the avian influenza virus could pass through face masks, which they believed were not designed to prevent avian influenza. Other respondents commented that wearing masks, gloves, and hats while working in chicken farms isn't "any trouble" and can be accomplished if the individual wants to. One respondent commented that while gloves and masks are readily available, it is "annoying" regarding wearing these items when entering chicken houses. Another respondent indicated they are accustomed to wearing masks, gloves, and hats in chicken farms, but that the purpose of these items is more for preventing dust exposure rather than preventing avian influenza.

Knowledge-Attitudes-Practices Gaps

Four studies identified gaps between knowledge and practice or between attitudes and practice. While poultry farmers in Ghana commonly named footwear, masks and gloves as PPE items to protect themselves against poultry pathogens, 48.7%, 2%, and 0% of farmers reported to wear protective footwear, nose masks, or gloves, respectively (Ayim-Akonor et al., 2020b). Among poultry farmers in Nepal, 53.1%, 68.8%, 15.6%, and 8.3% knew that face masks, gloves, boots or boot covers, and special body garments could protect against avian influenza. However, only 27.1%, 30.2%, 7.3%, and 3.1% of respondents used these items, respectively (Neupane et al., 2012). Among rural small ruminant farmers in Turkey, most study participants believed gloves, masks or boots should be worn during animal contact. However, only 35.8%, 6.6%, and 42.4% of participants reported to wear gloves, masks, or boots while contacting animals (Cakmur et al., 2015). Among 1,045 cattle farmers in Turkey, 73.2% believed gloves should be worn during animal contact, while 56.1% believed masks were necessary, 86.4% thought boots were necessary, and 89.7% believed one should avoid animal contact with cut hands. In practice, 65.8% reported using gloves while in contact with animals, 29.3% used masks, 78.3% used boots, and 80.2% avoided animal contact with cut hands (Ozlu et al., 2020).

Discussion

The current study represents the first attempt to systematically characterize on a global level and across production systems the KAP centered on PPE at the animal farm setting. Results highlight several gaps in knowledge and practices among farmers representing various production systems and global regions. Studies shedding light on attitudes highlight some factors (e.g., comfort or perceived efficacy) that might influence practices among farmers. This study lays the foundation on which recommendations and training programs can be implemented to change knowledge, attitudes, and practices within this workforce so essential to preventing emergence of infectious diseases in humans and animals at the farm level and crucial to maintaining global food security. This study revealed few results characterizing farmer knowledge of PPE in the context of infectious disease prevention. However, the included studies did indicate deficiencies in PPE knowledge among farmers. Future studies should aim to better characterize this knowledge, including which forms of PPE are most useful for various pathogens under given conditions. The review also highlighted the existence of gaps between knowledge and practice and attitudes and practices. Further exploration factors influencing these gaps can help guide training, education, and policy interventions.

There remains a need to better understand factors impacting infectious disease prevention in food animal production settings. On smaller farms, the decision to use PPE may be based on knowledge, attitudes, and beliefs regarding health rather than company policy (Carpenter et al., 2002). While some reviews have characterized PPE practices on farm settings (Odo et al., 2015; Youssef et al., 2021), there have been no attempts to systematically review farmer PPE KAP in the context of prevention of zoonoses and diseases transmitted person-person (e.g., COVID-19) in global food animal agricultural settings. A review of four studies on Minnesota backyard poultry, Minnesota swine, Wisconsin backyard poultry, and Thailand poultry settings found PPE (i.e., mask, glove, and footwear) use was low among workers in direct contact with animals, flock owners, and veterinarians (Odo et al., 2015). The study found that mask use was least commonly practiced (1% in Thailand to 26% among Minnesota backyard poultry farmers). Masks were always or sometimes used by Minnesota poultry and swine farmers 26% of the time, whereas gloves were used 51% or 49% of the time by Minnesota or poultry farmers, respectively

(Odo et al., 2015). The authors concluded that observed differences in PPE use by region could be influenced by norms in each region (Odo et al., 2015). A study with United States Midwestern crop and livestock farmers found that PPE usage except for welding masks was low. Usage while handling animals in confinement housing was very uncommon. Occasional use of heavy gloves was most likely, but fewer than 3% reported wearing respiratory protection most or all the time (Carpenter et al., 2002). A study with California farmers examined PPE use with respect to dust, sun exposure, noise, pesticides, and tractor use. Over 93% of farmers used PPE around pesticides, but less than 33% consistently used PPE around other hazards. The authors concluded that risk perception was strongly associated with behavior. Specifically, farmers were more likely to use PPE if they were concerned about specific health problems (Schenker et al., 2002). Several studies have highlighted low risk perception (Lowenstein et al., 2016) and poor knowledge regarding zoonoses transmission (Ameni & Erkihun, 2007; Mateus et al., 2016) and KAP on prevention in both less developed and more developed countries across various production systems (Chikerema et al., 2013; Nahar et al., 2012; Ntirandekura et al., 2018, Wiley et al., 2019). Farmers may lack knowledge about zoonoses and their prevention (Perez Ruano & Zambrano Aguayo, 2017), lack access to PPE (Ntirandeukura et al., 2018), and infrequently use PPE (Van Kerhove et al., 2008).

Understanding attitudes is essential to structuring effective policies and guidance resulting in favorable and sustainable behavior change. To accomplish this, researchers must attempt to understand nuances in culture and pockets of culture within geographic locations. In countries such as the United States (US), immigrants constitute a large portion of farm labor (USDA, 2020). Recent US trends highlight greater proportions of Hispanic workers and an increasing diversity of workers within this group, representing cultures and linguistic dialects that might be less familiar to dairy farm owners, managers, and non-Hispanic workers (Rodriguez et al., 2020). Access to healthcare, willingness to seek it, and cultural and language factors might influence infectious disease perception and preventive behaviors relevant to animal disease and diseases affecting humans. Cultural differences within the US H-2A guest visa worker program might influence incidence of work-related injuries (Flocks, 2020). Limited field sanitation and housing quality can increase risk of COVID-19 transmission among US crop workers (Fan & Pena, 2021). Food animal producers may experience similar vulnerabilities.

The perceived utility of PPE is closely linked to practices among those on farms. Personal protective equipment can help prevent zoonoses in personnel working with animals in veterinary (Williams et al., 2015) and farm settings (OSHA, 2022). While Youssef et al., 2020 described efficacy of various biosecurity, interventions, including PPE, in reducing transmission of bacteria from livestock to humans on farms, future studies should explore PPE efficacy in transmission of other types of pathogens, including viruses and fungi. Such findings can be used at farm levels to motivate change. However, while data suggest use of PPE can be helpful, farmers may not consider this potential benefit worth the time, money, or energy required to acquire and use various forms of PPE. Future studies should further explore factors influencing attitudes related to PPE efficacy and importance. Some studies have explored these attitudes relevant to farmer biosecurity programs focusing on animal health (Moya et al., 2020). The approaches, lessons, and behavioral theories relevant to these studies can in some cases be applied to the more holistic approach of biosecurity that includes the crucial element of biosafety. Indeed, biosafety should be considered as an important component of a farm’s overall biosecurity program.

The study highlighted infrequent and inconsistent use of PPE in the context of disease like brucellosis, Q-fever, and Rift Valley Fever that can be transmitted via reproductive fluids and tissues. Infectious diseases like brucellosis may be associated with adverse reproductive outcomes in pregnant women (Liu et al., 2020). Bat-Erdene et al., 2018 showed that with respect to the study of nomadic livestock farms in Mongolia, gender was significantly associated with use of mask use. Kebede and Megerrsa 2018 suggested that PPE use was associated with age. Future research should explore associations between factors like gender and age as collaborators conceptualize programs aiming to influence change. Finding “model citizens” within a community can be a starting point to motivate change amongst an otherwise stubborn populous.

One limitation of this study is that findings did not include PPE KAP with respect to COVID-19 on farms. The absence of published COVID-19 articles during the time this systematic review was conducted likely explains this finding. The authors eliminated two COVID-19 papers from findings since it was not apparent that the farmer participants were animal farms; rather, they were more likely all involved in crop production. Publication bias may have impacted the results of this review, as it is conceivable that studies highlighting KAP deficiencies or certain geographic areas or production systems may have received publication preference. Therefore, results of this review must be interpreted with an understanding of this potential. Finally, this review did not attempt to evaluate methodological quality of publications included in results. So, results from individual included publications cannot be differentiated based on respective study quality.

Finally, through including household production systems in lower and middle income countries as well as “backyard” production systems within the United States, this review reminds the reader that production systems can be varied within a given country and that trends in KAP gaps relevant to preventive measures can persist across the global spectrum of income and setting. Indeed, despite the wide and celebrated variation in human behaviors across culture and settings, knowledge, attitude, and practices among humans can be quite homogenous and predictable. This understanding, too, should be help inform our interventions and training programs.

Conclusion

This systematic review summarized livestock farmer KAP regarding PPE for the prevention of occupational infectious diseases in the farm setting. The results of this study can guide future research toward better understanding KAP of livestock farmers regarding prevention of occupational infectious diseases. KAP results summarized in this review may help inform effective training and intervention programs aimed at changing preventive practices among livestock farmers. Reduced incidence of occupational infectious diseases on farm settings can help prevent future pandemics and ensure food security by safeguarding heath of essential workers. These implications are increasingly apparent during times characterized by regional and potentially global conflict that can disrupt food supply chains, starting at the farm level. While the scope included all production systems at the global level, this review did identify important deficiencies that can compromise producer health and food security. Results highlight some unfavorable practices across livestock production systems with respect to handling tissues and fluids associated with parturition. Implications may be relevant to women living and/or working on livestock farms.

CHAPTER 4: DAIRY FARM BIOSECURITY AND BIOSAFETY ASSESSMENT TOOLS: EVALUATION TO IMPROVE EXISTING TOOLS AND DEVELOP AND A FRAMEWORK FOR AN INTEGRATD HUMAN-CATTLE TOOL

Introduction

Farm biosecurity is necessary to prevent introduction of infectious diseases onto farms, prevent the spread of diseases within a farm and prevent diseases from leaving a farm. These measures can help prevent endemic cattle diseases (e.g., mastitis) and foreign animal diseases (e.g., foot and mouth disease). Biosecurity measures can also help prevent rodent and wildlife introduction of pathogens into animal feed (Renault et al., 2018), zoonoses in humans on farms (Youssef et al., 2020), and "reverse zoonoses" such as *Methicillin-resistant Staphylococcus aureus* (Messenger et al., 2014) transmitted from humans to animals. Agricultural workers can be exposed to variety of zoonoses and infectious diseases transmitted person-to-person, including COVID-19. As highlighted during the pandemic, many Latino/a agricultural workers live in larger or shared housing conditions, which can prevent social distancing and many may lack access to culturally appropriate social support systems (Quandt et al., 2022). Practices related to tradition farm biosecurity approaches, including hand hygiene and personal protective equipment (PPE) may also be helpful in preventing transmission of infectious diseases between humans on farms.

The COVID-19 pandemic provided an opportunity to view dairy farm biosecurity in a more holistic, integrated manner that considered a more complex disease ecology. Early in the pandemic, the impacts of the pandemic on essential workers, particularly those contributing to food production and distribution, were laid bare to the public. Suddenly essential workers received public attention and praise, and political support for the wellbeing materialized. Outbreaks of COVID-19 in food production and processing settings gained widespread media attention and threatened food security. The sensitivity of the food supply chain from farm to table became particularly apparent. As the pandemic unfolded, concerns about PPE availability for essential workers involved in food production. Studies showing SARS-CoV-2 transmission from humans to farm minks and back to humans on farm (Oude Munnink et al., 2021), from humans to captive zoo animals at the Bronx Zoo (McAloose et al., 2020), from humans to companion animals (Leroy et al., 2020), and propagation within white tailed deer populations (Palmer et al., 2021) highlighted the dynamic nature of this virus and the importance of applying a holistic approach to understanding infectious disease dynamics. Biosecurity is essential to animal, human, and environmental health in a farm setting and ultimately helps safeguard food production systems and food security at national, regional, and global levels.

While several biosecurity and biosafety assessment tools for the dairy farm environment exist, little work has characterized the structure and content of these tools regarding their focus on animal and human health. The aims of this chapter are to review selected biosecurity tools applicable to the dairy farm environment and to collect feedback acquired from a small number of Front Range Colorado dairy producers on one existing tool (BioCheck.UGent) that has not been widely used in the United States. Based on these findings, recommendations are provided for assessment tool improvement and for the basic design of an integrated tool that includes elements of cattle and human infectious disease prevention for the dairy farm environment.

Methods

Review of Selected Biosecurity and Biosafety Assessment Tools

We attempted to identify novel and innovative tools focusing on preventing diseases within dairy cattle by conducting PubMed and Google searches using the search terms "biosecurity", "tool", "cattle", and "dairy." We also monitored Daily News Alert summary emails from the US Animal Health Association (USAHA) from June of 2001 to November of 2022. Further efforts were made to identify relevant tools through poster and verbal presentation attendance at major conferences, including annual conferences of USAHA, Conference of Research Workers in Animal Diseases (CRWAD), Colorado Livestock Association (CLA). Cattle biosecurity tools were considered for inclusion only if they were freely accessible and based on a risk-based scoring system that provided quantitative score reports. Tools without a specific focus on dairy cattle operations were not considered for evaluation.

We attempted to identify novel and innovative tools focusing on prevention of zoonoses and/or diseases transmitted person-to-person including COVID-19 within dairy farm settings. We identified biosafety tools by conducting PubMed and Google searches using the search terms "biosafety", "infection prevention and control", "farm" "cattle." We also monitored USAHA Daily News Alert summary emails from June of 2001 to November of 2022 and monitored regular emails from the Upper Midwest Agricultural Safety and Health Center (UMASH), and the One Health Commission. We also searched Centers for Disease Control and Prevention (CDC) websites and attended regular presentations and conferences including CDC Zoonoses and One Health Updates (ZOHU), the international Society for Agricultural Safety and Health (ISASH) and Agricultural Safety and Health Council of America (ASHCA). Tools for this purpose could include qualitative or quantitative checklists, training modules for a farm plan, and interactive risk assessments regardless structure or output. The lead researcher (RF) summarized select tools representing animal health and occupational health by describing species focus, content, structure, and scoring, if applicable.

BioCheck.UGent Evaluation: Dairy Producer Feedback

Field Research Tools

We accessed the free BioCheck.UGent survey questions for the dairy tool (BioCheck.UGent 2020) and copied and pasted the questions into a Microsoft Word file and included a brief paragraph to describe the research and provide instructions. After each BioCheck.UGent question, we inserted three questions to assess producer feedback. The first question assessed importance of each question by asking, "How important is this question to livestock biosecurity" with a scale of Not at all important, Slightly important, Moderately important, Very important, and Extremely important. The second question focused on clarity of each question by asking, "I believe this question is written in a way that makes sense" with answer options of "Yes" or "No." The third question asked producers to provide comments and recommendation for question improvement. For purposes of question evaluation, all "Farm Characteristics" courses considered one question. Accounting for multipart questions (e.g., 2.1-2.4), the evaluation tool organized BioCheck.UGent questions into 130 separate questions. After creating the English language version (Appendix 1), a Spanish language version (Appendix 2) was created using the Spanish survey available on the BioCheck.UGent website. Two Spanish translators added the three questions to assess importance, question clarity, and comments and recommendations.

A short survey was created to assess producers' overall perceptions of the dairy BioCheck.UGent tool. This short assessment consisted of seven questions, with four structured as Likert scale type questions and three as open-ended questions to gather free response feedback. Likert scale-type questions focused on tool utility, whether the producer would use the tool on their farm, whether it covered all topics relevant to their farm, and whether questionnaire results were presented in a useful way. Open ended questions asked producers to recommend topics for inclusion or exclusion, recommendations for improving the results summary, and an opportunity to provide any additional feedback on the BioCheck.UGent tool. This short tool was constructed in English (Appendix 3) and then translated into Spanish (Appendix 4) by two translators.

Recruitment and Data Collection

Through email, phone calls, and farm visits, we recruited five Front Range Colorado dairy farms to complete the BioCheck.UGent dairy biosecurity assessment and provide feedback on each of the 130 questions and share their thoughts via the overall utility assessment consisting of seven questions. The farm sampling frame was based on a network of farms currently or previously collaborating with members of our research team or our university affiliates on other research efforts. An English language recruitment email (Appendix 5) with an attachment (Appendix 6) was sent to main point of contact owners and/or managers at each farm. Participating farms included two organic farms (farms 1 and 2) and three conventional farms (farms 3, 4, and 5) with a herd size ranging from 600 to 10,000. Only farm managers and owners were asked to participate. Farm and participant combinations are labeled as R for "Respondent" followed by the farm number. Recruitment and data collection occurred from June 2020 to August 2021. All procedures for this research were conducted following a protocol approved by the Colorado

State University Institutional Review Board (Protocol Number: 20-10327H). Verbal informed consent was obtained from potential research participants in either English (Appendix 7) or Spanish (Appendix 8) before their participation in this study. A hard copy of the English or Spanish BioCheck.UGent dairy survey questions was given to a manager or owner, and they were asked to answer the BioCheck.UGent biosecurity questions and the three questions below each biosecurity question. Participants were asked to complete the three assessment questions under each BioCheck.UGent question even if the respective question was skipped based on answers to previous questions. After completing these questions, the research entered the answers into the BioCheck.UGent dairy tool without using any farm identifiers to generate a farm score report. Score report format is presented by Damiaans et al., 2020, with a breakdown of scores by internal and external biosecurity. This includes individual scores by subtopic within both categories, scores for internal and external biosecurity, and an overall score. All of these scores are presented in comparison to a world average (Damiaans et al., 2020). On the second page of the score report, the same type of score report is depicted via two spider web graphs, one for internal and one for external biosecurity (Damiaans et al., 2020). The researcher then emailed this score report to the respective farm manager or owner along with the copy of the seven-question overall utility assessment and asked the producer to return the overall utility assessment via email.

Results

Biosecurity and Biosafety Tools

Dairy Cattle Health

BioCheck.UGent

Note: For the purposes of this research, only the dairy cattle survey questions, basic score report, and free features of BioCheck.UGent were used and described. The advanced version of BioCheck.UGent contains many additional features including training modules and advice based on selected answers that were not accessed during this research and are not described here. Therefore, the short description of the BioCheck.UGent dairy survey and score output provided below is not a comprehensive description or depiction of the dairy tool features or of BioCheck.UGent. BioCheck.UGent is a farm biosecurity tool developed by the Unit for Veterinary Epidemiology at Ghent University in Belgium (BioCheck.UGent, 2023a). The tool focusses on animal health. The system offers free and paid advanced versions of quantitative biosecurity tools for swine, poultry, and cattle operations. Cattle biosecurity tools include veal, beef, and dairy. The dairy survey used in this study consists of questions on farm characteristic and 124 biosecurity questions organized by external and internal biosecurity (BioCheck.UGent, 2020). Farm characteristics questions focus experience of the person in charge based on number of years, herd size, and number of animals within age and production groups. External biosecurity questions include purchase and reproduction, transport and carcass removal, feed and water, visitors and farmworkers, vermin control and other animals. Internal biosecurity questions include health management, calving management, calf management, dairy management, adult cattle management, working organization and equipment. The dairy questionnaire is available in eight languages, including English and Spanish (BioCheck.UGent, 2023b). Responses are entered into the BioCheck.UGent website, and quantitative scores ranging from 0-100 are generated for each subcategory, for external biosecurity, and for internal biosecurity. An overall biosecurity score is also generated. Higher scores indicate better biosecurity. BioCheck.UGent developers applied weights to subcategories based on a literature review and input from an expert panel (Damiaans et al., 2020). Score reports also compare individual farm scores to those representing the world average. If the tool has been used at least 40 times in a given country, a country comparison is also available (BioCheck.UGent, 2023a).

Occupational Health: Zoonoses

Online Interactive Risk Assessment

The Online Interactive Risk Assessment (OIRA) is a web platform that facilities creation of occupational health risk assessment tools in any language in a standardized manner. It was developed and is maintained by the European Agency for Safety and Health at Work. The OIRA tool generator is free to occupational sector partners and authorities at the European Union (EU) and national levels. Representatives can use the OIRA tool generator to make risk assessment tools tailed to any industry that then become available to micro and small enterprises (OIRA, 2022a).

A wide variety of tools are available and can be searched by country, language, and professional sector. Within the "agriculture, forestry, and fishing" category, 19 tools are available across plant and animal agriculture. Accessing the tools requires establishment of an account with username and password. The agricultural tool combines animal and plant agriculture and covers 15 different risk categories. These include occupational safety and health management, buildings and yards, installations and confined spaces, machinery and work equipment, agricultural vehicles, exposure to hazard substances, psychosocial risks, work organization, outdoor work, lone working, working in warehouses, sorting, and packing facilities, working in greenhouses, working in orchards, working on crop fields, and handling animals. A wide variety of topics are covered, including noise, mental health, vehicles, health/sun exposure, injuries, animal handling, zoonoses, PPE, and basic principles of biosecurity. Animal species addressed include dairy cattle, pigs, horses, sheep/goats, poultry. The focus is on occupational health rather than animal health. The section on handling cattle includes 17 questions covering zoonoses prevention, PPE, sanitation and hygiene, farm design, and injury prevention related to noise exposure, animal interactions, and machinery use. Each of the 17 questions asks if a particular practice is implemented on the farm and if measures already implemented are sufficient (i.e., is the remaining risk acceptable?). Each question also includes a description of the issue and links to resources and information. For example, question 15.1.15 is "Workers are informed on the risk of contracting zoonoses" and asks the user to select measures already implemented on the farm, including limiting exposure and providing information on zoonoses. A "training card" is generated under each question based on measures the user has identified as not implemented on the farm. Users can also write notes under each question. After identifying all risks among the 17 questions in the tool, the tool generates a report, an action plan template on which users can prioritize their risks and set timelines for mitigation, and an overview of risks that can be electronically saved and shared. A training slideshow is also provided. This tool does not provide a numerical score. It does not specifically address COVID-19 or other infectious diseases transmitted person-to-person (OIRA, 2022b).

Occupational Health: COVID-19

Centers for Disease Control and Prevention (CDC) Agricultural Employer Checklist for Creating a COVID-19 Assessment and Control Plan.

The CDC created a checklist for creating a COVID-19 assessment and control plan based on the Agriculture Workers and Employers Interim Guidance from the CDC and US Department of Labor. The document is not tailored to animal agriculture or dairy farms in particular but can be applied to the dairy farm environment. The checklist has five sections including risk assessment, control plan based on hierarchy of controls (screening and monitoring workers, managing sick workers, addressing return to work, engineering controls, cleaning, disinfection, and sanitation, administrative control, and PPE), special considerations for shared housing, transportation, and children. The checklist consists of a series of implementation statements regarding specific measures aimed at preparation, prevention, and management of COVID-19 in agricultural work settings. After each statement, there exists a status column in which users can select "completed", "ongoing", "not started", or "N/A." A notes/comments column space is provided after statement. The assessment section contains 10 items focused in part on considering unique worksite conditions or tasks that can impact the farm's assessment and control of COVID-19, ensuring access to information, designating a workplace coordinator responsible for COVID-19 assessment and control planning, providing workers with information about where to get COVID-19 testing, and conducting regular worksite assessments to identify COVID-19 risks and prevention strategies. The section on screening and monitoring workers contains 17 items, the managing sick workers section contains 21 items, the addressing return to work section contains five items, the engineering controls section contains seven items, the cleaning, disinfection, and sanitation section contains 23 items, and the administrative controls section contains 37 items, the PPE sections contains 14 items, the special consideration for shared housing contains 45 items, the special considerations for shared transportation section contains 7 items, and the special considerations for children section contains 5 items. The checklist does not generate a score or provide additional information by question (CDC, 2020a).

Upper Midwest Agricultural Safety and Health Center

The Upper Midwest Agricultural Safety and Health Center (UMASH) published two checklists related to COVID-19. One focuses on the farm COVID-19 health and safety program. It consists of nine potential hazards and users are to check “yes” or “needs correction” after each item. A section for notes and dates of correction is included after each item. The questions focus on education, plans for preventing and controlling COVID-19 on the farm, communication with workers, social distancing, PPE, training, posters, emergency contact, and whistleblower protection. The checklist does not generate a score, but it provides additional COVID-19 resources at the end of the document (UMASH, 2020a). A second UMASH checklist focusses on COVID-19 infection prevention. It is written in the same format as the checklist on health and safety programs but includes 12 questions. These questions focus on knowledge of COVID-19 symptoms, screening, information, PPE, training, shared housing, shared vehicles, socials distancing, hand sanitation, and surface disinfection. The checklist does not generate a score, but it provides additional COVID-19 resources at the end of the document (UMASH, 2020b).

Occupational Health: One Health, Zoonoses, and COVID-19

University of Washington Farm Infection Prevention and Control Plan

The University of Washington's Center for One Health Research, Harborview Medical Center, and the Northwest Center for Occupational Health and Safety Continuing Education Program developed five training modules and a Farm Infection Prevention and Control (IPC) Plan

Template. The IPC Plan is a basic plan for controlling transmission of COVID-19 and other infectious diseases between humans and between humans and animals on an animal farm. The training modules provide information to users leading up to the creation of a farm IPC. Module one focusses on a One Health approach to infection prevention and control on animal farms to address COVID-19 and other infections and how to create a COVID-19 exposure control plan as part of an overall infection prevention and control plan. Module 2 focusses on COVID-19 and other infections on animal farms, including antimicrobial-resistant bacteria, causes of diarrhea. Module 3 focusses on hazard assessment, controlling worker exposure, PPE, and controlling transmission of COVID-19 and other aerosol. Module 4 focusses on occupational medicine services and program plans for IPC to address COVID-19 and other infections on animal farms and the components of a farm IPC. Module 5 focusses on infectious disease emergency response. (DEOHS, 2022a). The training prepares the user to create their own farm infection IPC template. This template (DEOHS, 2022b) and instructions (DEOHS, 2022c) are provided on the website.

The IPC plan aims to prevent infectious diseases in humans and animals in the farm setting and is mean to supply any farm biosecurity plan. It is not specific to the dairy farm environment but can be applied there. The template provides guidance on hazard assessment to identify infectious disease hazards to employees on the farm. This includes recommended use of a hazard assessment appendix that provides users space to identity farm tasks/activities and their corresponding hazards/sources, identify potential consequences of exposure, and identify and establish respective controls (DEOHS, 2022b). This hazard assessment is meant to capture infectious diseases between people such as COVID-19 and zoonoses (DEOHS, 2022c). The basic hazard assessment structure serves as the risk assessment tool. As presented here, the hazard assessment does not generate a score; rather, it serves as basic approach to identify, characterize, and begin to mitigate infectious disease risks on the farm.

Other sections of the template help with the following: establishing a one health team and collaborators across human and animal health entities to develop and implement the IPC plan; identifying exposure control measures based on the hierarchy of controls; establishing occupational medicine and employee health programs; developing a system of record keeping for human health; special infection control considerations relevant to housing, shared transportation, and children on the farm (DEOHS, 2022b).

Occupational Health: Sharps

Upper Midwest Agricultural Safety and Health Center

The UMASH published a checklist on sharps handling. It consists of eight questions, and users are to check "yes" or "needs correction" after each item. A section for notes and dates of correction is included after each item. The questions focus on training, disposal, and compliance with state and local requirements for disposal. The checklist does not generate a score, but it provides additional resources at the end of the document (UMASH, 2020c).

Producer Feedback on BioCheck.UGent

Producer Feedback on BioCheck.UGent Questions: Importance

Eleven producers, including 10 managers and one owner across five farms (2 organic and 3 conventional) provided feedback the clarity of questions within the BioCheck.UGent tool (Table 4.1). No producers opted to receive the Google Forms version of the BioCheck.UGent questions.

For 22.3% (29/130) questions, at least one respondent indicated the question was not at all important to livestock biosecurity. The remaining 77.7% (101/130) of questions were considered slightly or more important by all respondents. BioCheck.UGent subcategories with the greatest proportion of questions considered not at all important by at least one respondent included Dairy management (10/18 questions), Adult cattle management (3/4 questions), and Working organization and equipment (6/7 questions). The questions with greatest percentage of respondents indicating they were not at all important include those within the internal biosecurity category. This includes question 102 (Dairy management subcategory) at 22.22%, question 112 (Calf management subcategory) at 27.27%, and question 121 (Working organization and equipment subcategory) at 27.27%.

Producers indicated several questions were extremely importance. All questions were considered extremely important by at least one producer. Questions producers identified extremely important at high proportions included the following within the external biosecurity category” question 32 (Feed and water subcategory) at 72.73% and question 53 (Vermin control and other animals subcategory) at 63.64%. Questions producers identified extremely important at high proportions included the following within the internal biosecurity included question 62 at 70%, question 69 at 81.2% (within the Health management subcategory), question 77 at 72.73% (within the Calving management subcategory), question 84 at 72.73%, question 90 at 81.82%, question 91 at 72.73%, question 94 at 72.73% (within the Calf management subcategory).

Table 4.1: Producer feedback on importance of BioCheck.UGent dairy questions. The full BioCheck.UGent questionnaire with complete questions is available at: https://biocheck.ugent.be/sites/default/files/2020-02/Dairy_EN.pdf.

BioCheck.UGent Dairy Questions	**Importance of Question** *"How important is this question to livestock biosecurity?"*				
	Not at all	**Slightly**	**Moderately**	**Very**	**Extremely**
Farm characteristics (N=11)	0%	0%	27.27%	54.55%	18.18%
EXTERNAL BIOSECURIY					
A. Purchase and reproduction					
1. Are cattle being purchased? (N=11)	0%	9.09%	18.18%	36.36%	36.36%
2.1. How often a year are pregnant cows bought? (N=11)	0%	9.09%	54.55%	9.09%	27.27%
2.2. How often a year are lactating cows bought? (N=10)	0%	10.00%	60.00%	20.00%	10.00%
2.3. How often a year are calves or non-pregnant heifers bought? (N=11)	0%	9.09%	36.36%	18.18%	36.36%
2.4. How often a year are bulls for reproduction bought? (N=11)	0%	18.18%	27.27%	27.27%	27.27%
3. Are your cattle during the past 2 years always bought from the same original source? (N=11)	0%	9.09%	18.18%	36.36%	36.36%
4. Before the cattle arrive on your farm, is contact between your cattle and animals from different farms possible (direct or indirect contact)? (N=11)	0%	0%	27.27%	36.36%	36.36%
5. Whenever cattle are bought from another farm, is proof requested to ensure that the sanitary statute and health management of the farm of origin is equal or higher than your own farm? (N=11)	0%	9.09%	9.09%	27.27%	54.55%
6. Is the level of maternal immunity checked when buying calves? (N=11)	0%	18.18%	18.18%	54.55%	9.09%
7. Are the cattle tested for specific diseases when entering the farm (i.e. entering protocol or other tests)? (N=11)	0%	0%	9.09%	36.36%	54.55%
8. Are all new cattle put into quarantine? (n=11)	0%	9.09%	9.09%	27.27%	54.55%
9. What is the minimum duration (in days) of the quarantine period? (N=11)	0%	0%	27.27%	18.18%	54.55%
10. Are ... before entering the quarantine? (N=11)	0%	18.18%	36.36%	27.27%	18.18%
11. Is the quarantine empty after an animal has been in quarantine? (N=11)	0%	9.09%	36.36%	36.36%	18.18%

12. Is the quarantine ... before the introduction of new cattle? (N=11)	0%	0%	27.27%	54.55%	18.18%
13. Are the newly introduced cows milked separately during their quarantine period? (N=11)	0%	0%	27.27%	36.36%	36.36%
14. Is a milk sample from the newly introduced cows taken and tested, before they are introduced or at the start of lactation in the quarantine stable? (N=11)	0%	9.09%	27.27%	36.36%	27.27%
15. Are there any cattle that leave the farm and return afterwards? (N=11)	0%	0%	36.36%	27.27%	36.36%
16. Are these returning cattle put into quarantine like described before? (N=11)	0%	0%	36.36%	18.18%	45.45%
17. Are the cattle on your farm bred? If yes, how? (N=11)	18.18%	0%	18.18%	27.27%	36.36%
18. Has the bull's semen been tested for sexually transmitted diseases? (N=11)	0%	18.18%	18.18%	27.27%	36.36%
19. Does the semen, used for artificial insemination/embryo transplantation, come from a farm/institution with a health status known to be higher or equal than your own farm? (N=11)	0%	9.09%	45.45%	18.18%	27.27%
B. Transport and carcass removal					
20. Do all vehicles have to pass through clean transport baths before entering the farm? (N=11)	0%	9.09%	36.36%	36.36%	18.18%
21. Do external transport vehicles and transporters have access to any of the areas where cattle are kept? (N=11)	0%	0%	63.64%	9.09%	27.27%
22. When cattle are delivered to the farm, are only the animals that are supposed to be delivered to your herd in the transport vehicle? (N=11)	0%	9.09%	18.18%	54.55%	18.18%
23. Is the transport vehicle for the cattle empty on arrival at the farm? (required) (N=11)	9.09%	0%	27.27%	54.55%	9.09%
24. Is the transport vehicle always cleaned and disinfected before entering the farm? (N=11)	0%	9.09%	9.09%	72.73%	9.09%
25. Is there a separate carcass storage space with a hard surface floor present? (N=11)	9.09%	9.09%	27.27%	9.09%	45.45%
26. Is this carcass storage space cleaned and disinfected after each use? (N=11)	0%	9.09%	45.45%	18.18%	27.27%

27. Is the carcass storage space protected from vermin, cats and dogs? (N=11)	0%	9.09%	9.09%	36.36%	27.27%
28. Can the carcasses be removed by the rendering company without them entering the premises of the farm? (N=11)	9.09%	9.09%	18.18%	27.27%	36.36%
29. Are carcasses manipulated with gloves, or are hands cleaned and disinfected after manipulation of carcasses? (N=11)	0%	0%	0%	45.45%	54.55%
30. Is all the material used for the manipulation of carcasses cleaned and disinfected? (N=11)	0%	0%	18.18%	45.45%	36.36%
C. Feed and water					
31. Are the feed storage facilities (e.g. ensilaged feed, feed mixer, concentrates, …) protected from pets and vermin? (N=11)	0%	18.18%	18.18%	27.27%	36.36%
32. Are feeding utensils used only for feed (e.g. there's no double use for manure)? (N=11)	0%	0%	9.09%	18.18%	72.73%
33. Is the quality of the drinking water checked every year at the source or at the storage tank by means of a bacteriological analysis? (N=11)	0%	0%	9.09%	36.36%	54.55%
34. Is the quality of the drinking water checked every year at the main outlets (i.e. where the cattle drink) by means of a bacteriological analysis? (N=11)	0%	9.09%	18.18%	18.18%	54.55%
D. Visitors and farmworkers					
35. Are visitors obliged to notify you of their presence before entering the stables (e.g. visitor's register)? (N=11)	0%	0%	9.09%	36.36%	54.55%
36. Is there a separate space available for changing boots and clothes and washing hands/putting on gloves? (N=11)	0%	9.09%	18.18%	36.36%	36.36%
37. Are there any farmworkers who also work at (or frequently visit) other farms? (N=11)	0%	18.18%	9.09%	27.27%	45.45%
38. Upon entering the farm, does the farm personnel ...use farm-specific boots? ...use farm-specific clothes? ...wash their hands/use gloves before entering? (N=11)	0%	9.09%	9.09%	36.36%	45.45%
39. Upon entering the farm, does the veterinarian ...use farm-specific boots? ...use farm-specific clothes?	0%	0%	0%	54.55%	45.45%

...wash their hands/use gloves before entering? (N=11)					
40. Does the artificial insemination technician come to the farm? (N=11)	9.09%	18.18%	18.18%	18.18%	36.36%
41. Upon entering the farm, does the artificial insemination technician ...use farm-specific boots? ...use farm-specific clothes? ...wash their hands/use gloves before entering? (N=11)	0%	0%	27.27%	36.36%	36.36%
42. Does the cattle salesman come to the farm? (N=11)	9.09%	9.09%	27.27%	36.36%	18.18%
43. Upon entering the farm, does the cattle salesman ...use farm-specific boots? ...use farm-specific clothes? ...wash their hands/use gloves before entering? (N=10)	0%	0%	30.00%	40.00%	30.00%
44. Does the hoof trimmer come to the farm? (N=10)	0%	10.00%	20.00%	20.00%	50.00%
45. Upon entering the farm, does the hoof trimmer ...use farm-specific boots? ...use farm-specific clothes? ...wash their hands/use gloves before entering? (N=10)	0%	0%	20.00%	40.00%	40.00%
46. Are there any other visitors (e.g. feed supplier, advisors, milk collector, any others) that enter the farm and come into contact with the cattle? (N=11)	0%	0%	18.18%	63.64%	18.18%
47. Upon entering the farm, do these other visitors (e.g. salesman, feed supplier, advisors, milk collector, any others) ...use farm-specific boots? ...use farm-specific clothes? ...wash their hands/use gloves before entering? (N=11)	0%	9.09%	18.18%	54.55%	18.18%
E. Vermin control and other animals					
48. Is an insect control programme present on the farm? (N=11)	0%	0%	18.18%	45.45%	36.36%
49. Is a rodent control programme present on the farm? (N=11)	0%	0%	18.18%	36.36%	45.45%
50. Is a bird control programme present on the farm (e.g. netting to keep birds out)? (N=11)	0%	0%	27.27%	27.27%	45.45%
51. Do your cattle, including the youngstock, have access to the outside? (N=11)	0%	9.09%	18.18%	18.18%	54.55%
52. When your cattle go outside, do they have access to natural water bodies (e.g. brooks and ponds)? (N=11)	0%	9.09%	9.09%	36.36%	45.45%

53. Is it possible for your cattle to come into contact with animals from other farms? (N=11)	0%	9.09%	9.09%	18.18%	63.64%
54. Are there other commercially exploited cattle present on the farm? (N=11)	9.09%	9.09%	0%	36.36%	45.45%
55. Can these other commercially exploited cattle come into contact with the dairy cows? (N=11)	0%	18.18%	18.18%	9.09%	54.55%
56. Are any other farm animals being kept? (N=11)	0%	9.09%	18.18%	45.45%	27.27%
57. Do pets have access to the stables? (N=11)	0%	27.27%	27.27%	27.27%	18.18%
58. Is manure from other farms being spread on farmlands within a 500-meters radius (0.3 miles) of your farm and pastures? (N=11)	9.09%	9.09%	36.36%	18.18%	27.27%
INTERNAL BIOSECURITY					
F. Health management					
59. Are the sick cattle physically isolated from the healthy cattle? (N=11)	0%	9.09%	9.09%	18.18%	63.64%
60. Are there equipment and materials (e.g. buckets, thermometer, cleaning and feeding utensils, gastric tubes, …) specific for the sick cattle in the hospital pen? (N=11)	0%	9.09%	9.09%	36.36%	45.45%
61. Is this specific equipment cleaned and disinfected before a new animal enters the hospital pen? (N=11)	0%	9.09%	0%	36.36%	54.55%
62. Are the cattle in the hospital pen fully separated from the other cattle? (N=10)	0%	10.00%	10.00%	10.00%	70.00%
63. Are …compartment-specific boots used …compartment-specific clothes used …hands washed/(new) gloves used before entering the hospital pen? (N=11)	0%	9.09%	0%	36.36%	54.55%
64. Is the hospital pen empty after each use? (N=11)	0%	18.18%	18.18%	27.27%	36.36%
65. Is the hospital pen …cleaned …disinfected ...dry before each new introduction of sick cattle? (N=11)	0%	9.09%	9.09%	36.36%	45.45%
66. Are the sick cattle taken care of before or after the healthy cattle? (N=11)	0%	18.18%	18.18%	27.27%	36.36%
67. Can a unit of sick cattle be completely separated from the other cattle in case of a disease outbreak? (N=11)	0%	9.09%	9.09%	18.18%	63.64%
68. Is a register with the animal health data being kept? (N=11)	0%	18.18%	0%	27.27%	54.55%

69. Are there written protocols for vaccination, disease treatment and hygiene procedures? (N=11)	0%	0%	0%	18.18%	81.82%
70. What happens to the disease carriers that are detected? (N=11)	0%	0%	18.18%	18.18%	63.64%
71. Are there dedicated injection needles that are specific to each age group available? (N=11)	0%	18.18%	36.36%	9.09%	36.36%
G. Calving management					
72. Are there maternity pens and/or a box for C-sections available on the farm? (N=11)	0%	18.18%	18.18%	18.18%	45.45%
73. Is the maternity pen either ever used to house the sick cattle or is the maternity pen adjacent to the sick cattle? (N=11)	0%	9.09%	18.18%	9.09%	63.64%
74. Are cattle in the maternity pen fully separated from the other animals? (N=11)	0%	0%	27.27%	18.18%	54.55%
75. Are ...compartment-specific boots used …compartment-specific clothes used …hands washed/(new) gloves used before entering the materinity pen? (N=11)	0%	9.09%	9.09%	36.36%	45.45%
76. Is the maternity pen …cleaned …disinfected ...dry before each new introduction of cattle? (N=11)	0%	9.09%	18.18%	27.27%	45.45%
77. When helping with the calvings/abortions, are the hands and the used obstetric materials always cleaned and disinfected before and after each calving/abortion? (N=11)	0%	9.09%	18.18%	0%	72.73%
78. Are the cow's hindquarters (including the udder) always cleaned and disinfected before each calving? (N=11)	0%	27.27%	18.18%	18.18%	36.36%
79. When does the separation of the calf from the mother take place? (N=11)	0%	9.09%	18.18%	9.09%	63.64%
80. If an abortion takes places, is the cow tested afterwards (i.e. abortion protocol)? (N=11)	0%	27.27%	9.09%	36.36%	27.27%
81. Where are the foetal membranes and tissues disposed of after a calving/abortion? (N=11)	0%	9.09%	18.18%	27.27%	45.45%
H. Calf management					
82. How many litres of colostrum are administered to the calf within the first six hours of birth? (N=11)	9.09%	9.09%	0%	18.18%	63.64%
83. Is the colostrum given from either the mother (provided that she	0%	9.09%	9.09%	27.27%	54.55%

has enough milk) or frozen colostrum from healthy cows from your own farm? (N=11)					
84. Is it checked if the colostrum quality is sufficient? (N=11)	0%	9.09%	0%	18.18%	72.73%
85. Is there a frozen or artificial reserve of colostrum present, in case that either the mother does not provide enough milk or the colostrum is of insufficient quality? (N=11)	0%	9.09%	18.18%	27.27%	45.45%
86. If the colostrum is not administered to the calf directly after milking, is the colostrum stored in the refrigerator? (N=11)	0%	9.09%	9.09%	27.27%	54.55%
87. Are the materials used for colostrum administration (e.g. tubes, bottles, etc.) cleaned and disinfected after each use? (N=11)	0%	0%	9.09%	27.27%	63.64%
88. Are the calves housed in individual calf boxes or hutches? (N=11)	0%	9.09%	18.18%	27.27%	45.45%
89. Are the individual calf boxes/hutches empty after each use? (N=11)	0%	9.09%	0%	27.27%	63.64%
90. Are the individual calf boxes/hutches …cleaned …disinfected ...dry before each new introduction of calves? (N=11)	0%	9.09%	0%	9.09%	81.82%
91. Is contact possible with calves in different hutches/boxes? (N=11)	0%	9.09%	9.09%	9.09%	72.73%
92. Are milk feeding buckets/teats reused between calves during the same feeding session? (N=11)	0%	9.09%	9.09%	18.18%	63.64%
93. Are the calves ever fed with waste milk (i.e. milk that is not suitable for the milk tank)? (N=11)	0%	18.18%	9.09%	27.27%	45.45%
94. Are the feeding buckets cleaned after each feeding? (N=11)	0%	9.09%	0%	18.18%	72.73%
95. How large (number of animals) are the groups of calves that are regrouped from individual hutches to group pens? (N=10)	0%	10.00%	30.00%	30.00%	30.00%
96. Is the group housing empty after each use? (N=11)	9.09%	9.09%	18.18%	27.27%	36.36%
97. Is the group housing (including the "babyboxes") …cleaned …disinfected ...dry before each new introduction of calves? (N=10)	0%	10.00%	0%	30.00%	60.00%
I. Dairy management					
98. Are the cows milked with a milking robot or manually? (N=10)	20.00%	10.00%	0%	30.00%	40.00%

99. How many times per year is a static measurement of the milking equipment performed? (N=10)	10.00%	10.00%	30.00%	20.00%	30.00%
100. How many cows are milked on average? (N=10)	20.00%	30.00%	10.00%	0%	40.00%
101.1. How often a day do you milk? (N=11)	18.18%	18.18%	36.36%	9.09%	18.18%
101.2. What is the average number of milkings per cow per day on your farm? (N=10)	20.00%	20.00%	10.00%	10.00%	40.00%
102. How many milking clusters are there in the milking parlour? (N=9)	22.22%	11.11%	33.33%	0%	33.33%
103. Do you use rubber or silicone teat cup liners? (N=11)	18.18%	27.27%	9.09%	18.18%	27.27%
104. After how many months are the teat cup liners replaced? (N=10)	20.00%	0%	20.00%	20.00%	40.00%
105. Are milking clusters being disinfected between cows (by yourself during milking or the robot)? (N=10)	0%	20.00%	20.00%	20.00%	40.00%
106. How are the milking clusters between cows disinfected? (N=10)	0%	10.00%	30.00%	10.00%	50.00%
107. Are the teats cleaned before milking? If yes, how? (N=11)	0%	9.09%	18.18%	27.27%	45.45%
108. Is the foremilk examined during fore-stripping? (N=11)	0%	9.09%	9.09%	18.18%	63.64%
109. Are the teats disinfected after the teat cups are removed? (N=10)	0%	10.00%	0%	20.00%	70.00%
110. Are cows kept upright for a period after milking? (N=11)	18.18%	0%	36.36%	27.27%	18.18%
111. Are the cows milked in a specific order? (N=11)	0%	18.18%	27.27%	0%	54.55%
112. Are the udders of the lactating cows clipped? (N=11)	27.27%	18.18%	36.36%	9.09%	9.09%
113. Are the tails of the lactating cows clipped? (N=11)	0%	36.36%	9.09%	18.18%	36.36%
114. Is there a regular (i.e. minimum once per year) bacterial examination of the udder of all cows? (N=11)	0%	9.09%	27.27%	27.27%	36.36%
J. Adult cattle management					
115.1. How often a year is the adult stable cleaned? (N=11)	9.09%	9.09%	36.36%	0%	45.45%
115.2. How often a year is the adult stable disinfected? (N=11)	9.09%	18.18%	27.27%	9.09%	36.36%
116. In which of the following groups are the cows on your farm divided? (N=11)	9.09%	9.09%	18.18%	0%	63.64%
117. Do the cows have to regularly pass through a hoof disinfection footbath? (N=11)	0%	18.18%	9.09%	18.18%	54.55%

K. Working organisation and equipment					
118. Are the cattle grouped per age category in the stable? (N=11)	18.18%	9.09%	36.36%	9.09%	27.27%
119. Has a full separation between age groups been established? (N=11)	18.18%	9.09%	27.27%	18.18%	27.27%
120. Are ......compartment-specific boots changed …compartment-specific clothes changed …hands washed/(new) gloves changed between age groups? (N=11)	18.18%	9.09%	27.27%	27.27%	18.18%
121. Is farm work performed in a specific order? (N=11)	27.27%	9.09%	36.36%	18.18%	9.09%
122. Has there clearly recognisable, separate material been foreseen for each age group? (N=10)	20.00%	0%	50.00%	10.00%	20.00%
123. Is there any material being shared with other farms that enters the stables and/or has contact with your cattle? (N=11)	9.09%	9.09%	18.18%	18.18%	45.45%
124. What measures do you take before this shared material enters your stable or comes into contact with your cattle? (N=11)	0%	0%	18.18%	27.27%	54.55%

Producer Feedback on BioCheck.UGent Questions: Clarity

Eleven producers, including 10 managers and one owner across five farms (2 organic and 3 conventional) provided feedback the clarity of questions within the BioCheck.UGent tool (Table 4.2). The majority of questions were considered written in a way that makes sense by all producers. Producers believed 100% of the external biosecurity questions on “Vermin control and other animals” were written in a way that makes sense. Four of the tool’s subtopics, including “Transport and carcass removal”, “Dairy management”, “Adult cattle management”, and “Working organization and equipment” all contained at least one question that was not clear according to at least 27% of respondents. Five questions (25, 26, 100, 101.1, and 114) were unclear to 27.7% of respondents. Three questions (110, 115.2, and 122) were unclear to 36.36% of respondents. Three questions (99, 102, and 115.1) were unclear to 45.45% of respondents.

Table 4.2: Producer feedback on whether or not BioCheck.UGent dairy questions are written in a way that makes sense. The full BioCheck.UGent questionnaire with complete questions is available at: https://biocheck.ugent.be/sites/default/files/2020-02/Dairy_EN.pdf.

BioCheck.UGent Dairy Questions	**Question Clarity** *"I believe this question is written in a way that makes sense"*	
	Yes	**No**
Farm characteristics (N=11)	81.82%	18.18%
EXTERNAL BIOSECURIY		
A. Purchase and reproduction		
1. Are cattle being purchased? (N=11)	90.91%	9.09%
2.1. How often a year are pregnant cows bought? (nN11)	100.00%	0%
2.2. How often a year are lactating cows bought? (N=10)	100.00%	0%
2.3. How often a year are calves or non-pregnant heifers bought? (N=11)	100.00%	0%
2.4. How often a year are bulls for reproduction bought? (N=11)	100.00%	0%
3. Are your cattle during the past 2 years always bought from the same original source? (N=11)	100.00%	0%
4. Before the cattle arrive on your farm, is contact between your cattle and animals from different farms possible (direct or indirect contact)? (N=11)	81.82%	18.18%
5. Whenever cattle are bought from another farm, is proof requested to ensure that the sanitary statute and health management of the farm of origin is equal or higher than your own farm? (N=11)	100.00%	0%
6. Is the level of maternal immunity checked when buying calves? (N=11)	90.91%	18.18%
7. Are the cattle tested for specific diseases when entering the farm (i.e. entering protocol or other tests)? (N=10)	100.00%	0%
8. Are all new cattle put into quarantine? (N=10)	100.00%	0%
9. What is the minimum duration (in days) of the quarantine period? (N=10)	100.00%	0%
10. Are ... before entering the quarantine? (N=11)	90.91%	9.09%
11. Is the quarantine empty after an animal has been in quarantine? (N=11)	81.82%	18.18%
12. Is the quarantine ... before the introduction of new cattle? (N=11)	90.91%	9.09%
13. Are the newly introduced cows milked separately during their quarantine period? (N=11)	100.00%	0%
14. Is a milk sample from the newly introduced cows taken and tested, before they are introduced or at the start of lactation in the quarantine stable? (N=11)	90.91%	9.09%
15. Are there any cattle that leave the farm and return afterwards? (N=11)	100.00%	0%
16. Are these returning cattle put into quarantine like described before? (N=11)	100.00%	0%
17. Are the cattle on your farm bred? If yes, how? (N=11)	100.00%	0%
18. Has the bull's semen been tested for sexually transmitted diseases? (N=11)	100.00%	0%
19. Does the semen, used for artificial insemination/embryo transplantation, come from a farm/institution with a health status known to be higher or equal than your own farm? (N=11)	100.00%	0%
B. Transport and carcass removal		

20. Do all vehicles have to pass through clean transport baths before entering the farm? (N=11)	90.91%	9.09%
21. Do external transport vehicles and transporters have access to any of the areas where cattle are kept? (N=11)	90.91%	9.09%
22. When cattle are delivered to the farm, are only the animals that are supposed to be delivered to your herd in the transport vehicle? (N=11)	100.00%	0%
23. Is the transport vehicle for the cattle empty on arrival at the farm? (required) (N=11)	100.00%	0%
24. Is the transport vehicle always cleaned and disinfected before entering the farm? (N=11)	100.00%	0%
25. Is there a separate carcass storage space with a hard surface floor present? (N=11)	72.73%	27.27%
26. Is this carcass storage space cleaned and disinfected after each use? (N=11)	72.73%	27.27%
27. Is the carcass storage space protected from vermin, cats and dogs? (N=11)	90.91%	9.09%
28. Can the carcasses be removed by the rendering company without them entering the premises of the farm? (N=11)	100.00%	0%
29. Are carcasses manipulated with gloves, or are hands cleaned and disinfected after manipulation of carcasses? (N=11)	100.00%	0%
30. Is all the material used for the manipulation of carcasses cleaned and disinfected? (N=11)	100.00%	0%
C. Feed and water		
31. Are the feed storage facilities (e.g. ensilaged feed, feed mixer, concentrates, …) protected from pets and vermin? (N=11)	100.00%	0%
32. Are feeding utensils used only for feed (e.g. there's no double use for manure)? (N=11)	100.00%	0%
33. Is the quality of the drinking water checked every year at the source or at the storage tank by means of a bacteriological analysis? (N=11)	90.91%	9.09%
34. Is the quality of the drinking water checked every year at the main outlets (i.e. where the cattle drink) by means of a bacteriological analysis? (N=11)	100.00%	0%
D. Visitors and farmworkers		
35. Are visitors obliged to notify you of their presence before entering the stables (e.g. visitor's register)? (N=11)	90.91%	9.09%
36. Is there a separate space available for changing boots and clothes and washing hands/putting on gloves? (N=11)	100.00%	0%
37. Are there any farmworkers who also work at (or frequently visit) other farms? (N=11)	100.00%	0%
38. Upon entering the farm, does the farm personnel ...use farm-specific boots? ...use farm-specific clothes? ...wash their hands/use gloves before entering? (N=11)	100.00%	0%
39. Upon entering the farm, does the veterinarian ...use farm-specific boots? ...use farm-specific clothes? ...wash their hands/use gloves before entering? (N=11)	100.00%	0%
40. Does the artificial insemination technician come to the farm? (N=11)	100.00%	0%
41. Upon entering the farm, does the artificial insemination technician ...use farm-specific boots? ...use farm-specific clothes? ...wash their hands/use gloves before entering? (N=11)	100.00%	0%
42. Does the cattle salesman come to the farm? (N=11)	100.00%	0%
43. Upon entering the farm, does the cattle salesman ...use farm-specific boots? ...use farm-specific clothes? ...wash their hands/use gloves before entering? (N=11)	100.00%	0%
44. Does the hoof trimmer come to the farm? (N=10)	100.00%	0%
45. Upon entering the farm, does the hoof trimmer ...use farm-specific boots? ...use farm-specific clothes? ...wash their hands/use gloves before entering? (N=10)	100.00%	0%

46. Are there any other visitors (e.g. feed supplier, advisors, milk collector, any others) that enter the farm and come into contact with the cattle? (N=11)	100.00%	0%
47. Upon entering the farm, do these other visitors (e.g. salesman, feed supplier, advisors, milk collector, any others) ...use farm-specific boots? ...use farm-specific clothes? ...wash their hands/use gloves before entering? (N=11)	100.00%	0%
E. Vermin control and other animals		
48. Is an insect control programme present on the farm? (N=11)	100.00%	0%
49. Is a rodent control programme present on the farm? (N=11)	100.00%	0%
50. Is a bird control programme present on the farm (e.g. netting to keep birds out)? (N=11)	100.00%	0%
51. Do your cattle, including the youngstock, have access to the outside? (N=11)	100.00%	0%
52. When your cattle go outside, do they have access to natural water bodies (e.g. brooks and ponds)? (N=11)	100.00%	0%
53. Is it possible for your cattle to come into contact with animals from other farms? (N=11)	100.00%	0%
54. Are there other commercially exploited cattle present on the farm? (N11)	100.00%	0%
55. Can these other commercially exploited cattle come into contact with the dairy cows? (N=11)	100.00%	0%
56. Are any other farm animals being kept? (N=11)	100.00%	0%
57. Do pets have access to the stables? (N=11)	100.00%	0%
58. Is manure from other farms being spread on farmlands within a 500-meters radius (0.3 miles) of your farm and pastures? (N=11)	100.00%	0%
INTERNAL BIOSECURITY		
F. Health management		
59. Are the sick cattle physically isolated from the healthy cattle? (N=11)	100.00%	0%
60. Are there equipment and materials (e.g. buckets, thermometer, cleaning and feeding utensils, gastric tubes, …) specific for the sick cattle in the hospital pen? (N=11)	100.00%	
61. Is this specific equipment cleaned and disinfected before a new animal enters the hospital pen? (N=11)	100.00%	0%
62. Are the cattle in the hospital pen fully separated from the other cattle? (N=10)	100.00%	0%
63. Are …compartment-specific boots used …compartment-specific clothes used …hands washed/(new) gloves used before entering the hospital pen? (N=11)	100.00%	0%
64. Is the hospital pen empty after each use? (N=11)	90.91%	9.09%
65. Is the hospital pen …cleaned …disinfected ...dry before each new introduction of sick cattle? (N=11)	100.00%	0%
66. Are the sick cattle taken care of before or after the healthy cattle? (N=11)	100.00%	0%
67. Can a unit of sick cattle be completely separated from the other cattle in case of a disease outbreak? (N=11)	90.91%	9.09%
68. Is a register with the animal health data being kept? (N=11)	90.91%	9.09%
69. Are there written protocols for vaccination, disease treatment and hygiene procedures? (N=11)	100.00%	0%
70. What happens to the disease carriers that are detected? (N=11)	90.91%	9.09%
71. Are there dedicated injection needles that are specific to each age group available? (N=11)	100.00%	0%
G. Calving management		

72. Are there maternity pens and/or a box for C-sections available on the farm? (N=11)	90.91%	9.09%
73. Is the maternity pen either ever used to house the sick cattle or is the maternity pen adjacent to the sick cattle? (N=11)	90.91%	9.09%
74. Are cattle in the maternity pen fully separated from the other animals? (N=11)	100.00%	0%
75. Are ...compartment-specific boots used …compartment-specific clothes used …hands washed/(new) gloves used before entering the materinity pen? (N=11)	100.00%	0%
76. Is the maternity pen …cleaned …disinfected ...dry before each new introduction of cattle? (N=11)	81.82%	18.18%
77. When helping with the calvings/abortions, are the hands and the used obstetric materials always cleaned and disinfected before and after each calving/abortion? (required) (N=11)	100.00%	0%
78. Are the cow's hindquarters (including the udder) always cleaned and disinfected before each calving? (N=11)	81.82%	18.18%
79. When does the separation of the calf from the mother take place? (N=11)	100.00%	0%
80. If an abortion takes places, is the cow tested afterwards (i.e. abortion protocol)? (N=11)	100.00%	0%
81. Where are the foetal membranes and tissues disposed of after a calving/abortion? (N=11)	100.00%	0%
H. Calf management		
82. How many litres of colostrum are administered to the calf within the first six hours of birth? (N=11)	100.00%	0%
83. Is the colostrum given from either the mother (provided that she has enough milk) or frozen colostrum from healthy cows from your own farm? (N=11)	100.00%	0%
84. Is it checked if the colostrum quality is sufficient? (N=11)	90.91%	9.09%
85. Is there a frozen or artificial reserve of colostrum present, in case that either the mother does not provide enough milk or the colostrum is of insufficient quality? (N=11)	100.00%	0%
86. If the colostrum is not administered to the calf directly after milking, is the colostrum stored in the refrigerator? (N=11)	100.00%	0%
87. Are the materials used for colostrum administration (e.g. tubes, bottles, etc.) cleaned and disinfected after each use? (N=11)	100.00%	0%
88. Are the calves housed in individual calf boxes or hutches? (N=11)	100.00%	0%
89. Are the individual calf boxes/hutches empty after each use? (N=11)	100.00%	0%
90. Are the individual calf boxes/hutches …cleaned …disinfected ...dry before each new introduction of calves? (N=11)	100.00%	0%
91. Is contact possible with calves in different hutches/boxes? (N=11)	100.00%	0%
92. Are milk feeding buckets/teats reused between calves during the same feeding session? (N=11)	100.00%	0%
93. Are the calves ever fed with waste milk (i.e. milk that is not suitable for the milk tank)? (N=11)	90.91%	9.09%
94. Are the feeding buckets cleaned after each feeding? (N=11)	100.00%	0%
95. How large (number of animals) are the groups of calves that are regrouped from individual hutches to group pens? (N=11)	81.82%	18.18%
96. Is the group housing empty after each use? (N=11)	100.00%	0%
97. Is the group housing (including the "babyboxes") …cleaned …disinfected ...dry before each new introduction of calves? (N=10)	100.00%	0%
I. Dairy management		

98. Are the cows milked with a milking robot or manually? (N=10)	80.00%	20.00%
99. How many times per year is a static measurement of the milking equipment performed? (N=11)	54.55%	45.45%
100. How many cows are milked on average? (N=11)	72.73%	27.27%
101.1. How often a day do you milk? (N=11)	72.73%	27.27%
101.2. What is the average number of milkings per cow per day on your farm? (N=10)	90.00%	10.00%
102. How many milking clusters are there in the milking parlour? (N=11)	54.55%	45.45%
103. Do you use rubber or silicone teat cup liners? (N=11)	90.91%	9.09%
104. After how many months are the teat cup liners replaced? (N=9)	100.00%	0%
105. Are milking clusters being disinfected between cows (by yourself during milking or the robot)? (N=10)	90.00%	10.00%
106. How are the milking clusters between cows disinfected? (N=10)	100.00%	0%
107. Are the teats cleaned before milking? If yes, how? (N=11)	100.00%	0%
108. Is the foremilk examined during fore-stripping? (N=11)	90.91%	9.09%
109. Are the teats disinfected after the teat cups are removed? (N=10)	100.00%	0%
110. Are cows kept upright for a period after milking? (N=11)	63.64%	36.36%
111. Are the cows milked in a specific order? (N=11)	100.00%	0%
112. Are the udders of the lactating cows clipped? (N=11)	90.91%	9.09%
113. Are the tails of the lactating cows clipped? (N=11)	90.91%	9.09%
114. Is there a regular (i.e. minimum once per year) bacterial examination of the udder of all cows? (N=11)	72.73%	27.27%
J. Adult cattle management		
115.1. How often a year is the adult stable cleaned? (N=11)	54.55%	45.45%
115.2. How often a year is the adult stable disinfected? (N=11)	63.64%	36.36%
116. In which of the following groups are the cows on your farm divided? (N=11)	100.00%	0%
117. Do the cows have to regularly pass through a hoof disinfection footbath? (N=11)	100.00%	0%
K. Working organisation and equipment		
118. Are the cattle grouped per age category in the stable? (N=11)	90.91%	9.09%
119. Has a full separation between age groups been established? (N=11)	81.82%	18.18%
120. Are ......compartment-specific boots changed …compartment-specific clothes changed …hands washed/(new) gloves changed between age groups? (N=11)	90.91%	9.09%
121. Is farm work performed in a specific order? (N=11)	81.82%	9.09%
122. Has there clearly recognisable, separate material been foreseen for each age group? (N=11)	63.64%	36.36%
123. Is there any material being shared with other farms that enters the stables and/or has contact with your cattle? (N=11)	81.82%	18.18%
124. What measures do you take before this shared material enters your stable or comes into contact with your cattle? (N=11)	100.00%	0%

Producer Feedback on BioCheck.UGent Questions: Comments and Recommendations

Four managers and one owner representing five farms provided comments and/or recommendations for improvement on individual BioCheck.UGent questions (Table 4.3). With the exception of the “Vermin control and other animals” subcategory within external biosecurity, producers provided comments or recommendations for all subcategories. Producers provided most feedback on questions within the “Dairy management” subcategory within the internal biosecurity topic. Producers provided feedback on 15 questions within this subcategory. Producers provided 27 comments relating to question content. This includes comments on specific farm practices not reflected in the question as written and comments on inadequate question detail. They provided 14 comments related to terminology and one comment related to question syntax. Almost all comments related to terminology focused on the words “stable”, “milking cluster”, or “baby boxes.”

Table 4.3. Producer comments and recommendations onBio Check.UGent dairy question categorized by themes. The full BioCheck.UGent questionnaire with complete questions is available at: https://biocheck.ugent.be/sites/default/files/2020-02/Dairy_EN.pdf.

BioCheck.UGent Dairy Questions	**Comments/Recommendations for Question Improvement**	**Theme**
Farm characteristics	No responses	N/A
EXTERNAL BIOSECURIY		
A. Purchase and reproduction		
1. Are cattle being purchased? (N=1)	R1: *“Purchase versus movements between facilities.”*	Content (Detail)
6. Is the level of maternal immunity checked when buying calves? (N=1)	R1: *“N/A, we don’t buy calves”*	Content (Practices)
7. Are the cattle tested for specific diseases when entering the farm (i.e. entering protocol or other tests)? (N=1)	R1: *“Tested for what?”*	Content (Detail)
14. Is a milk sample from the newly introduced cows taken and tested, before they are introduced or at the start of lactation in the quarantine stable? (N=1)	R2: *“Stable is an odd word. Here we use the word pen. Seems most dairies use pen and not stable.”*	Terminology
B. Transport and carcass removal		

22. When cattle are delivered to the farm, are only the animals that are supposed to be delivered to your herd in the transport vehicle? (N=1)	R3: *"Depends on the type, show cattle yes, commercial no."*	Content (Detail)
25. Is there a separate carcass storage space with a hard surface floor present? (N=1)	R1: *"Compositing, burying, differences?"*	Content (Detail)
C. Feed and water		
31. Are the feed storage facilities (e.g. ensilaged feed, feed mixer, concentrates, …) protected from pets and vermin? (N=1)	R1: *"Are there any pets/vermin?"*	Content (Detail)
33. Is the quality of the drinking water checked every year at the source or at the storage tank by means of a bacteriological analysis? (N=1)	R4: *"Water supply is municipal (treated water)."*	Content (Practices)
D. Visitors and farmworkers		
35. Are visitors obliged to notify you of their presence before entering the stables (e.g. visitor's register)? (N=1)	R3: *"Verbiage used (stables)."*	Terminology
40. Does the artificial insemination technician come to the farm? (N=1)	R1: *"Not clear if own employee or outside labor."*	Content (Detail)
44. Does the hoof trimmer come to the farm? (N=1)	R1: *"Own employee?"*	Content (Detail)
E. Vermin control and other animals	No Responses	N/A
INTERNAL BIOSECURITY		
F. Health management		
64. Is the hospital pen empty after each use? (N=1)	R1: *"Never empty, important how often its cleaned?"*	Content (Practices)
66. Are the sick cattle taken care of before or after the healthy cattle? (N=1)	R3: *"Depends on dairy size and tasks on dairy."*	Content (Practices)
70. What happens to the disease carriers that are detected? (N=1)	R1: *"Depends on the disease."*	Content (Detail)
G. Calving management		
73. Is the maternity pen either ever used to house the sick cattle or is the maternity pen adjacent to the sick cattle? (N=1)	R4: *Wording "either ever" is weird.*	Syntax
76. Is the maternity pen …cleaned …disinfected ...dry before each new introduction of cattle? (N=1)	R3: *"So much depends on dairy size, larger ones very rarely use separate pens."*	Content (Practices)
H. Calf management		
82. How many litres of colostrum are administered to the calf within the first six hours of birth? (N=1)	R3: *"Measurements used."*	Terminology
97. Is the group housing (including the "babyboxes") …cleaned …disinfected ...dry before each new introduction of calves? (N=1)	R3: *"Terms used (babyboxes)."*	Terminology
I. Dairy management		
98. Are the cows milked with a milking robot or manually? (N=2)	R1: *"No option for both manually and robotic, rephrase to majority of cows?*	Content (Detail)

	Does manually mean parlor or stripping by hand?" R5: *"Robots, milk machine, or by hand? Not specific enough."*	Content (Detail)
99. How many times per year is a static measurement of the milking equipment performed? (N=1)	R4: *Static measurement?"*	Terminology
100. How many cows are milked on average? (N=1)	R2: *"Average day/hour/week/year?"*	Content (Detail)
101.1. How often a day do you milk? (N=2)	R1: *"Confusing question, covered in 101.2?"* R5: *"Milking 23/7 all the time."*	Content (Detail) Content (Practices)
101.2. What is the average number of milkings per cow per day on your farm? (N=1)	R2: *"Seems like 101.1. Asked this already."*	Content (Detail)
102. How many milking clusters are there in the milking parlour? (N=3)	R1: *"Does this include robots?"* R4: *"Milking clusters?"* R2: *"I don't know what a milking cluster is."*	Content (Detail) Terminology Terminology
103. Do you use rubber or silicone teat cup liners? (N=1)	R1: *"Difference between parlor (rubber) and robots (silicone)?"*	Terminology
104. After how many months are the teat cup liners replaced? (N=2)	R1: *"How many milking's is more important."* R3: *"Most dairies are weeks or days."*	Content (Detail) Content (Practices)
105. Are milking clusters being disinfected between cows (by yourself during milking or the robot)? (N=1)	R2: *"Not sure what milking clusters are."*	Terminology
106. How are the milking clusters between cows disinfected? (N=1)	R2: *"Not sure what milking clusters are."*	Terminology
107. Are the teats cleaned before milking? If yes, how? (N=1)	R3: *"Should add the scrubber."*	Content (Practices)
109. Are the teats disinfected after the teat cups are removed? (N=1)	R3: *"Should ask about robot spray."*	Content (Practices)
110. Are cows kept upright for a period after milking? (N=1)	R4: *"Upright?"*	Terminology
112. Are the udders of the lactating cows clipped? (N=1)	R3: *"Should add singe."*	Content (Practices)
114. Is there a regular (i.e. minimum once per year) bacterial examination of the udder of all cows? (N=1)	R1: *"All cows as a group or individually?"*	Content (Detail)
J. Adult cattle management		
115.1. How often a year is the adult stable cleaned? (N=3)	R1: *"Wording (stable) is unclear".* R4: *"Different housing style."* R5: *"Corrals are cleaned every day, bedding is changed bi-weekly."*	Terminology Terminology Content (Practices)
K. Working organisation and equipment		
124. What measures do you take before this shared material enters your stable or comes into contact with your cattle? (N=1)	R3: *"Is stable referring to individual pens or farms as a whole?"*	Terminology

Short BioCheck.UGent Utility Assessment

Ten producers representing five farms (two organic and three conventional) completed all or part of the short BioCheck.UGent utility assessment. This included nine managers and one owner. Four participants (managers at one organic farm) completed the Spanish language version of this assessment. Nine managers provided answers to Likert scale type questions in the BioCheck.UGent short utility assessment (Figures 4.1-4.4).

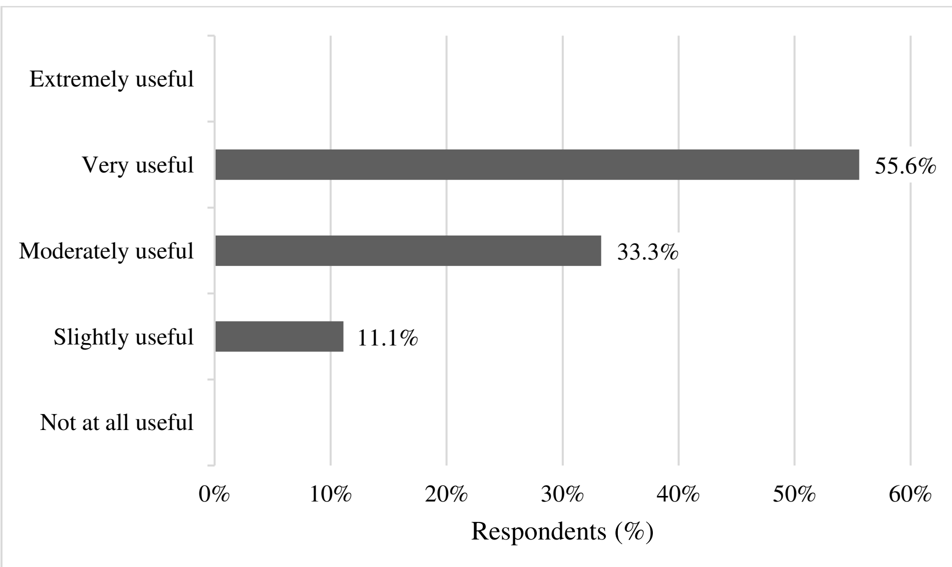

Figure 4.1. Manager responses to the question, “How useful is the BioCheck.UGent tool you?” (N = 9, with 9 managers, 0 owners representing four farms 1, 2, 4 and 5).

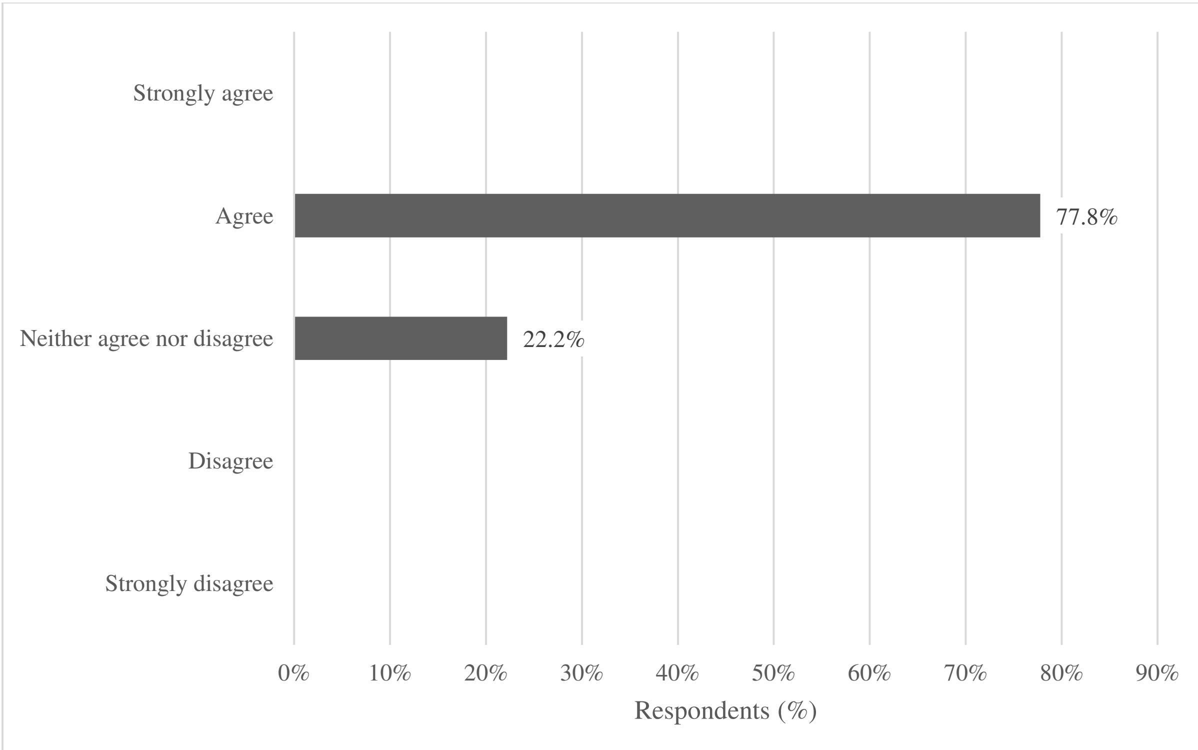

Figure 4.2. Manager response to the statement, "I would use this tool to assess livestock biosecurity on my farm" (N = 9, with 9 managers, 0 owners representing four farms 1, 2, 4 and 5).

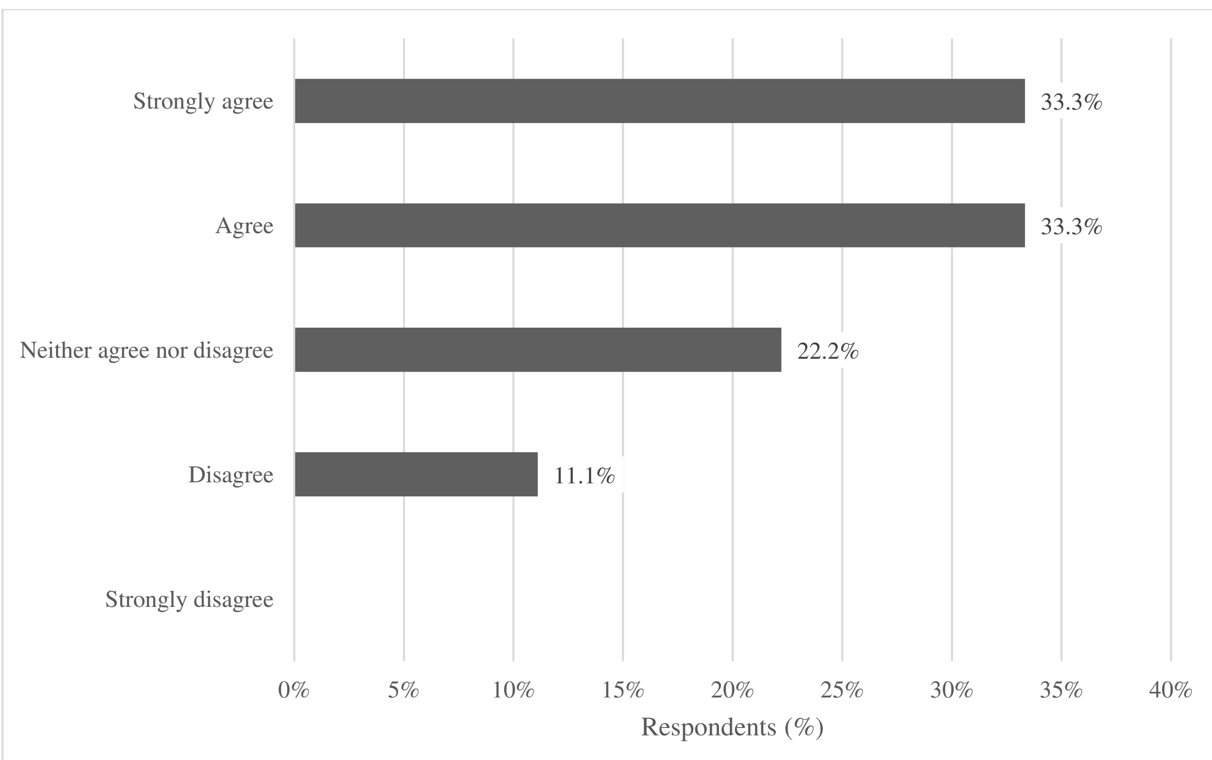

Figure 4.3. Manager response to the statement, “I believe the BioCheck.UGent checklist summary presented results in a way that is useful to me” (n = N, with 9 managers, 0 owners representing four farms 1, 2, 4 and 5).

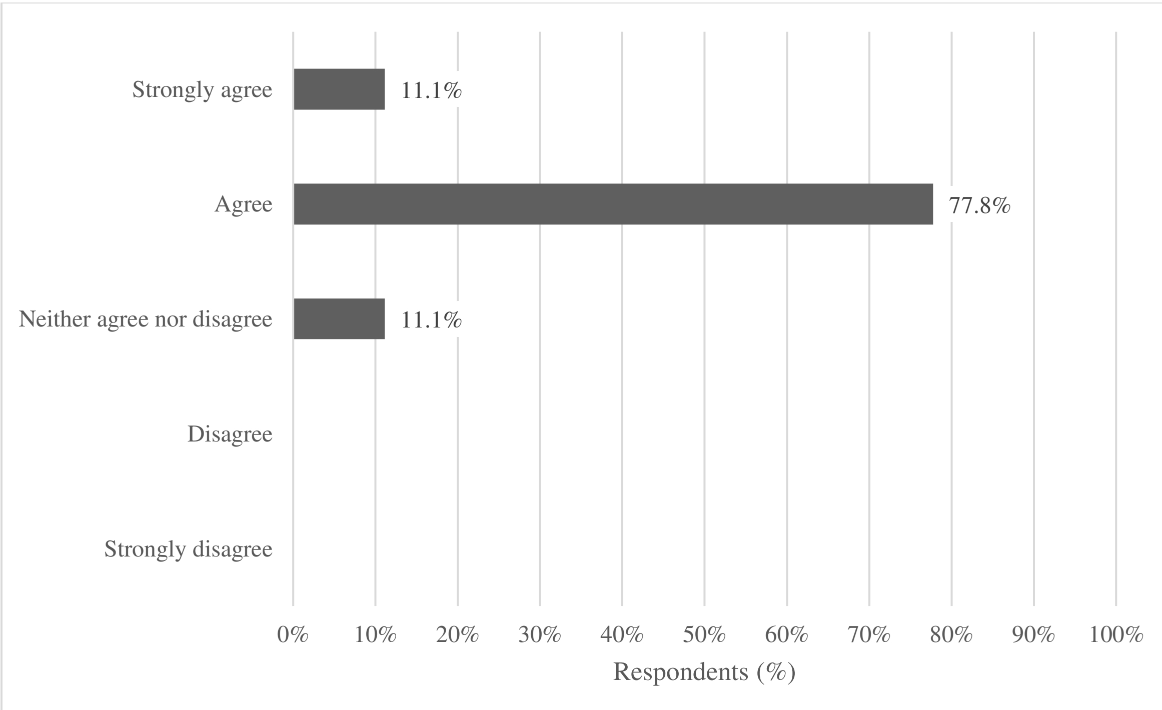

Figure 4.4. Manager response to the statement, “I believe the BioCheck.UGent checklist covered all livestock biosecurity topics that are relevant to my farm” N = 9, with 9 managers, 0 owners representing four farms, 1, 2, 4 and 5).

Six producers, including 5 managers and one owner across five farms provided feedback on the open-ended questions for the BioCheck.UGent short utility assessment. These comments are coded by theme (Table 4.4).

Table 4.4: Farm manager and owner feedback on the BioCheck.UGent tool as whole after research participants completed the BioCheck.UGent checklist and received a results report. Qualitative feedback was provided by four farms, with 5 managers and 1 owner sharing perspectives.

Question	Comments	Themes
Recommendations for topics that should be added to or removed from the checklist	R5: *“Some topics are not totally relevant to particular farms. It is hard to cater a survey to each individual farm. Sometimes you need to focus on certain diseases or topics of interest/need to a particular farm.”*	Farm variation

Recommendations for improvement on results summary	R1: *"Make sure questions are relevant to any size dairy"* R2: *"To give a short summary of what the categories are or to provide what caused a low score specifically. It is great to see where we scored compared to the world average, but there were so many questions it is hard to remember which ones applied to which area. I would like to know where specifically what drove a lover score and how we can improve it."* R5: *"Compare to state and country would be useful information to have."*	Farm size Understanding of scoring system Desire for actionable feedback Relative standing
Please provide any additional feedback on the BioCheck.UGent tool as a whole	R1: *"Good tool, I just think it's hard to quantify biosecurity with a number based on some questions. A Y/N question on disinfecting something doesn't include the whole story of how well and consistent they disinfect. A lot of variables are left out, but not sure myself how to improve it."* R6: *"Some of the wording should be changed when they were talking about calf pens. On some of the questions, you should be able to mark not done on your farm if you are looking at results because it could lower or higher your score on what you put, depending on how you grade all questions."* R4: *"Should include 'not sure' on all questions."* R2: *"It would be nice to be able to log in to the website and create actions plans to see year over year data from our farm."* R3: *"The tool can't capture all farm sizes. A 600-cow farm is different than a 5,000-cow farm"* R5: *"Cool tool to see where your dairy stands and how knowledgeable in each area you are regarding day-to-day operations."*	Value of quantification Lack of question detail Terminology Farm variation Structure Actionable feedback and progress Farm size General

Discussion

The tools described here provide some basis on which to develop integrated tools that incorporate cattle and human health in the dairy farm environment. The generation of quantitative scores and score report summaries, guidance on action plan development, provision of useful resources, are all factors that can be incorporated into future integrated tools.

The BioCheck.UGent tool is unique in that it deviates from typical biosecurity assessment tools, which are often simple checklists without quantitative scoring systems based on weights. While the advanced, paid version of BioCheck.UGent was not accessed or evaluated in this research, it includes other features such as additional feedback, training modules, and opportunity to track progress over time (BioCheck.UGent, 2023a). Front Range Colorado dairy producer feedback on the free features of the BioCheck.UGent tool represents useful feedback from producers on the ground. Producers generally believed that most questions were at important to livestock biosecurity (Table 4.1). With the exception of some questions using terminology like “miking clusters”, “babyboxes”, and “stables”, most questions were considered to be written in a way that makes sense (Table 4.2). These terminology findings could be related to the fact that this tool was developed by European researchers. Producers provided most constructive feedback on the dairy management questions within the internal biosecurity category. Much of the feedback is related to terminology (e.g., milking clusters), lack of specific detail within questions, and pointing out farm practices that might differ from those reflected in the actual questions (Table 4.3). Despite these comments, most producers found BioCheck.UGent useful, would use it on their farms, believed it covered all topics relevant to their farms, and believed the results were presented in a useful way (Figures 4.1-4.4). Some producers stated that specific disease concerns on a given farm are important and might not be captured by such a biosecurity tool. One producer expressed desire to have country and state score comparisons. (Table 4.4). Country comparisons are available after the tool has been used 40 times in a given country. One producer also expressed a desire to have reports with action plans and the ability to track progress over time. These features are available in the advanced, paid version of BioCheck.UGent. A limitation of this research is that the producers did not actually use the BioCheck.UGent website or experience any of the advanced features. Therefore, their responses and feedback should be interpreted within the context of their participation in this research and exposure only to the dairy survey questions and their score reports.

The findings of this research can help inform construction of biosecurity tools aiming to more directly integrate human and animal infectious disease prevention in dairy farm settings. Future biosecurity tools could include the following elements and characteristics, many of which exist within the BioCheck.UGent tool and others focused on occupational health:

- Lay and technical terminology closely reflecting what producers use during day-to-day practices
- Specific questions that minimize uncertainty
- Questions that reflect dairy practices by size and operational intensity
- Ability to focus on specific diseases or production topics of concern to individual farms
- A manageable number of questions
- Results providing feedback with specific information sources relevant to the user's country and industry
- Results providing actionable feedback and progress reports that can be compiled and evaluated over time
- Results that compare scores of individual farms to state, region, and country averages
- Quantitative results broken down by major category (e.g., internal and external biosecurity) and subcategory

Development of integrated tools aiming to prevent infectious diseases in cattle and humans on dairy farms should include the above elements and characteristics but also the following:

- Tools should be designed with the producer in mind regarding terminology, platform (e.g., phone apps), and ease of use, as producers are often very busy
- Results should include practical and financially feasible recommendations whose application can lead to some quantifiable impact on animal and human infectious disease burden and where possible, financial gain
- To maximize efficiency, topic areas and questions should be developed based on common factors underlying animal and human infectious disease persistence, routes of transmission, and prevention on dairy farms (e.g., use of PPE to prevent disease transmission in animals and humans)
- To maximize efficiency, proposed interventions should be based on hierarchy of controls and should attempt to identify areas of redundancy that can be combined into streamlined efforts (e.g., the farm representative responsible for emergency prevention such as foot and mouth disease can apply many of the same concepts and adapt protocols to preventing and controlling infectious disease outbreaks among humans working on the farms)
- Findings should identify deficiencies and recommendations should aim to streamline training programs and interventions that address animal and human infectious disease issues on an individual basis and their overlap where feasible
- Questions should attempt to identify factors related to social determinants of health, including equity and cultural elements that can shape preventive practices among workers

- Tool producers should invite subject matter experts from fields and agencies such as veterinary medicine, human medicine, public health including occupational and environmental health, anthropology, sociology, psychology, economics, CDC, USDA, universities, and local and state health departments in developing questions, applying weights, and formulating industry and culturally appropriate recommendations based on findings
- The tool should be flexible and responsive to the needs of individual farms with respect to the burden of infectious disease in animals, humans, and pathogen persistence in the environment

The limitations of this work include the very small sample size of Front Range Colorado dairy producers. Considering this small sample size, the summary of findings regarding perceptions of the BioCheck.UGent dairy tool cannot be interpreted to represent those of Front Range Colorado dairy producers or those of the US dairy industry. The producers in this work did not go through the steps of using the BioCheck.UGent tool from start to finish, as this research focused on obtaining their feedback on the dairy questions rather than the tool as a whole. Therefore, producer opinions on the BioCheck.UGent tool may not represent their overall viewpoints on the utility of the tool. Furthermore, the producers in this study did not access additional advanced features of BioCheck.UGent, including e-learning modules and more specific feedback.

CHAPTER 5: CONSTRUCTING AND PILOTING AN INTEGRATD BIOSECURITY-BIOSAFETY KNOWLEDGE, ATTITUDES, AND PRACTICES QUESTIONNAIRE ON FRONT RANGE COLORADO DAIRY FARMS DURING THE COVID-19 PANDEMIC

Introduction

Dairy farms are unique work environments where cattle, workers, and the overall farm environment overlap and interact in often intensified manners. Infectious agents can persist and spread between cattle, workers, visitors, environmental elements, wildlife, and pests (Damiaans et al., 2019; Damiaans et al., 2020). Livestock workers are at risk for various zoonoses (Klous et al., 2016; Palomares Velosa et al., 2020), and diseases spread person-person (e.g., COVID-19, seasonal influenza) could threaten farm productivity and biosecurity efforts. Farm workers may also face health threats stemming from shared housing and transportation and lack of access to medical care (Flocks, 2020). Farm personnel can also transfer several infectious diseases to farm animals (Messenger et al., 2014). Differences in culture and language between human populations on farms can hinder communication and influence training and preventive health practices (Arcury et al., 2010). As the COVID-19 pandemic began, it was uncertain how the pandemic would affect worker health, animal health, and overall farm operations, including biosecurity efforts. The role of livestock such as cattle in SARS-Co-V virus transmission was initially poorly understood.

Dairy farmer KAP regarding prevention of diseases in animals and prevention in themselves is poorly characterized. Knowledge and attitudes can drive preventive practices, but this is not always the case. Gaps can exist between biosecurity knowledge, attitudes, and practices in livestock production settings (Ritter et al., 2017). Biosecurity measures are often not fully implemented on dairy farms (Moya et al., 2020). Cattle farmer biosecurity implementation can be influenced by many factors, including farm norms, traditions, time, space (Moya et al., 2020), perceived efficacy (Renault et al., 2018; Renault et al., 2021), number of animals on the farm, communication with agricultural, veterinary, or government organizations (Paquette et al., 2020). The Health Belief Model, which considers perceived susceptibility and severity, cues to action, self-efficacy, barriers, and benefits (Janz & Becker, 1984) can be applied to understanding preventive behaviors focused on animal (Renault et al., 2021) and human (Abdollahzadeh & Sharifzadeh, 2021; Cui et al., 2019) health.

At the advent of the COVID-19 pandemic, little was known about cattle farmer KAP regarding occupational infectious disease prevention. Farmer knowledge, attitudes, and practices aimed at preventing infectious diseases (e.g., zoonoses and/or person-person) are often inadequate with respect to personal protective equipment (Odo et al., 2015; Dissertation Chapter 3). Social norms, self-efficacy, lack of knowledge, and cultural and economic pressures can influence programs controlling zoonoses in animals on farms. (Ellis-Iverson et al., 2010). Understanding KAP can help guide recommendations and interventions (WHO, 2008), and understanding may be important for integrating animal-human prevention efforts at the farm level. However, few comprehensive assessment tools exist to capture dairy farm KAP regarding prevention of infectious disease in cattle or farm workers. No integrated KAP or assessment tools exist that capture dairy farmer infectious disease prevention KAP with respect to the overlap of animal and human infectious diseases.

As described in dissertation Chapters 2 and 4, biosecurity on farms can be considered through the lens of external influences (i.e., preventing pathogens from entering or leaving a farm setting) and internal (i.e., preventing spread of pathogens within a farm setting). When considering biosecurity, dairy farmers may place predominant focus on prevention of diseases within their cattle. They may not always consider biosecurity through a holistic, or integrated lens that includes not only their animals' health, but also their own health within the overall farm environment. Biosecurity practices on farm settings can be associated with many positive outcomes, including improved animal health (Barkema et al., 2015), reduced antimicrobial usage (Laanen et al., 2013, and reduced odds of zoonotic disease in farm personnel (Youssef et al., 2021). Personal protective equipment, for example, can help prevent infectious diseases in animals and people on the farm (Youssef et al., 2021).

The objective of this study is to develop and use a novel integrated biosecurity-biosafety KAP questionnaire that can be used as part of an integrated risk assessment tool for dairy farms. This chapter describes KAP questionnaire construction, use on a small sample of Front Range Colorado dairy farms, and highlights selected results, including those related to zoonotic disease prevention. Results can guide recommendations for biosecurity improvement and inform improved development of integrated risk assessment tools for the dairy farm environment. Understanding KAP can help shape useful recommendations with the potential to prevent infectious diseases in animals and humans on farms. Understanding farmer KAP with regarding to infectious disease prevention can also help inform construction of integrated tools that provide quantifiable output with recommendations for policy and practice change at the farm level. Considering cultural and language differences on dairy farms, it is important to determine owner, manager, and worker understanding of words like biosecurity, biosafety, and zoonotic disease. Do producers consider biosecurity only relevant to preventing animal diseases, or do they also see elements applicable to preventing diseases in themselves (i.e., "biosafety.")? Indeed, KAP questionnaire construction, use, and data collection and analysis reflecting results from a small population of producers may help develop a framework integrating livestock and human health in the dairy farm environment.

Methods

KAP Questionnaire Construction

KAP Questionnaire Construction

A recently published biosecurity text (Dewulf & Van Immerseel, 2018a) and the BioCheck.UGent dairy tool were used to guide formation of most biosecurity concepts and questions focused on KAP. Infectious disease concepts and definitions of terms including biosecurity and biosafety (Dissertation Chapter 2) also informed KAP questionnaire concepts and content. Literature and Internet searches were conducted to identify risk assessment tools (Dissertation Chapter 4) peer-reviewed publications and risk assessment tools relevant to dairy farm biosecurity, biosafety, zoonoses, and COVID-19 KAP and threats on farm settings. PubMed and Google searches were conducted to identify relevant dairy farm biosecurity publications using search terms "biosecurity", "cattle", "knowledge", "attitudes", "practices." Zoonotic disease papers were searched for in PubMed and Google using terms, "zoonotic", "farm workers", "knowledge", "attitudes", "practices." Relevant publications included any that addressed cattle farmer zoonotic disease threats, obstacles to prevention, or KAP. The High Plains Intermountain Center for Agricultural Health and Safety (HICAHS) website was also used as a source for zoonotic disease prevention on dairy farms. The university of Washington Farm Infection Prevention and Control Plan and training modules (Dissertation Chapter 4) were also consulted for information on zoonoses and concepts of integrating animal-human prevention efforts. As the COVID-19 pandemic continued to develop, we identified biosafety (e.g., COVID-19) prevention) publications and checklists by conducting PubMed and Google searches using the search terms "COVID-19" and "farms." Relevant publications included any that addressed farmer COVID-19 disease threats or KAP, including both plant and livestock agriculture without restriction to species. Centers for Disease Control and Prevention and USDA websites were also regularly searched for updates on COVID-19 guidance for farmers, and we attended presentations and conferences including CDC Zoonoses and One Health Updates (ZOHU). Relevant publications were identified, and potentially relevant references within these publications were reviewed.

Where possible similarities between concepts and practices relevant to preventing animal and humans infectious diseases guided question formation in both the biosecurity and biosafety sections of the KAP questionnaire. For example, PPE, vaccinations, ventilation, lighting, and training are all relevant to animal and human health on dairy farms (Dissertation Chapter 2). Where applicable, terms including livestock biosecurity and PPE were defined to ensure participants understand intended definitions of these words within subsequent questionnaire sections.

Based on infectious disease dynamics and principles of biosecurity within the cattle farm setting (Damiaans et al., 2019; Damiaans et al., 2020; Sarrazin et al., 2018), levels of implementation, constraints, and weaknesses of biosecurity on cattle farms (Renault et al., 2018), overlapping concepts of infectious disease prevention in cattle and workers in this setting (Dissertation Chapter 2), and developing understanding of COVID-19 threats to agricultural workers (Flocks, 2020), a hypothetical framework for COVID-19's impact on biosecurity operations and human and animal health was developed (Figure 5.1).This framework helped guide KAP questionnaire content.

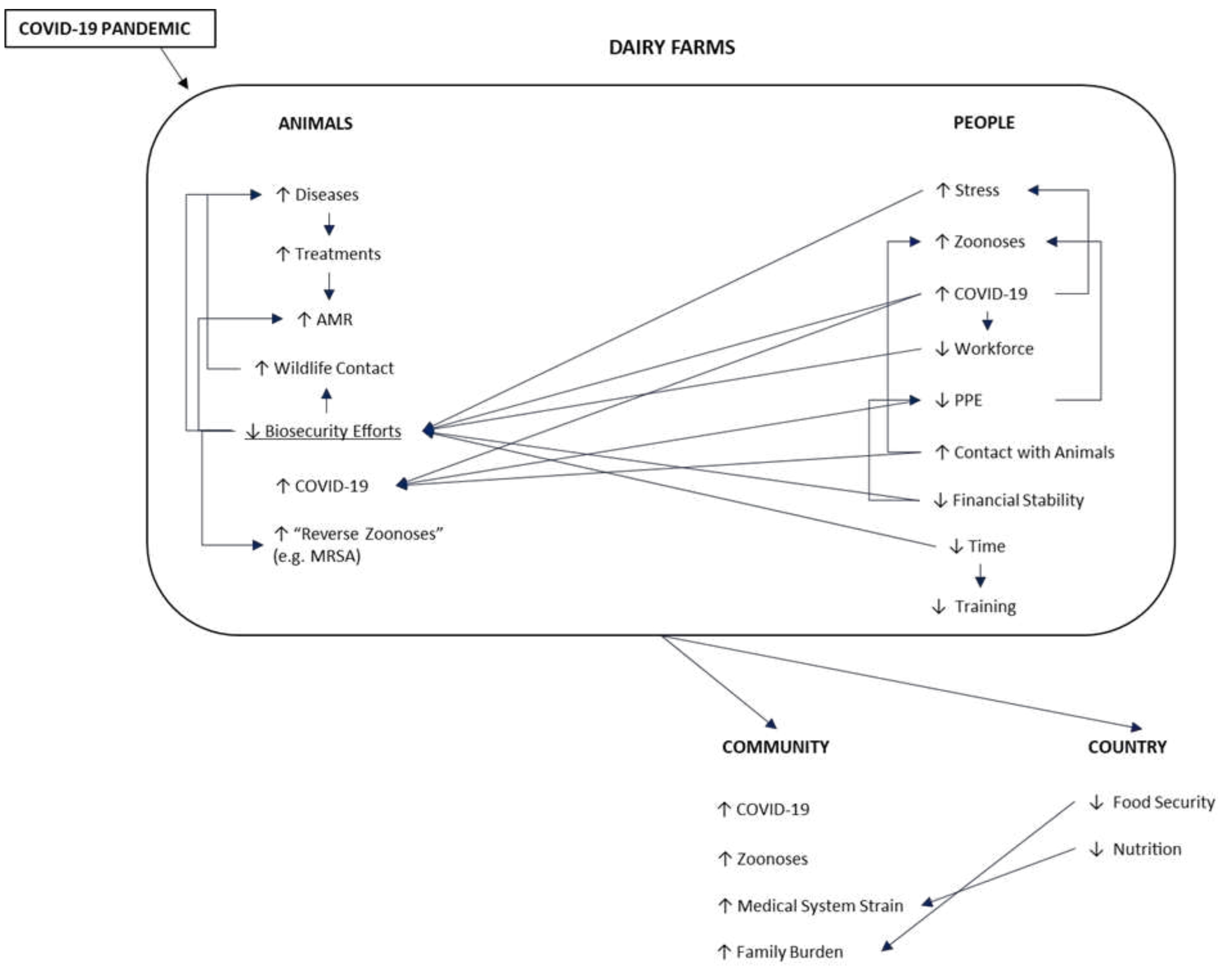

Figure 5.1. Hypothesized framework for the impact of the COVID-19 pandemic on human and animal health within the dairy farm environment to guide KAP questionnaire topics and focus areas

A general KAP questionnaire topic framework was developed (Figure 5.2). It was based mainly on inputs including the principle of the Health Belief Model (Janz & Becker, 1984), principles of internal and external biosecurity and principles of infectious disease dynamics on dairy farms (BioCheck.UGent, 2020; Damiaans, et al., 2020; Sarrazin et al., 2018), perceived efficacy, feasibility, and usefulness of preventive practices focused on cattle disease prevention (Brennan & Christley, 2013; Denis-Robichaud et al., 2019; Renault et al., 2018; Shortall et al., 2016), trusted and used sources of livestock biosecurity information (Brennan et al., 2016; Moya et al., 2020), obstacles to biosecurity (e.g., time) (Brennan et al., 2016; Moya et al., 2020), and farm policies (e.g., visitors) (Kristensen & Jakobsen, 2011). The livestock biosecurity questionnaire was created first. Based on basic principles of livestock biosecurity, the biosafety questionnaire was developed. This questionnaire was designed to general mirror the livestock biosecurity in concepts and correlating subject matter (e.g., PPE). Questions related to zoonoses were informed by publications focusing on KAP relevant to zoonoses (but not limited to dairy cattle settings) and other published articles on zoonoses in farm or veterinary clinical settings, including Salman & Steneroden, 2014; Messenger et al., 2014; Klous et al., 2016, and Ellis-Iverson et al., 2010; Wright et al., 2008). The university of Washington Farm Infection Prevention and Control Plan and training modules (Dissertation Chapter 4), and HICAHS training modules on zoonotic disease prevention (HICAHS, 2023) provided information zoonotic disease threats and individual and farm level practices and policies for zoonotic and reverse zoonotic disease prevention. Questionnaire construction was also guided by principles of the hierarchy of controls, which posits that administrative and engineering controls are more effective than PPE. Development of COVID-19 questions was based largely on Centers for Disease Control and Prevention (CDC) Agricultural Employer Checklist for Creating a COVID-19 Assessment and

Control Plan, the Upper Midwest Agricultural Safety and Health Center (UMASH), University of Washington Farm Infection Prevention and Control Plan (Dissertation Chapter 4). Principles within the Total Worker Health concept (Dissertation Chapter 2) were also used to guide integrated questionnaire construction and provide insight into topics such training, cultural and language barriers relevant to occupational health, and paid sick leave. Finally, KAP questionnaire content and structure were also informed by input from subject matter experts in veterinary epidemiology (MS and SR) and dairy animal science (NRM).

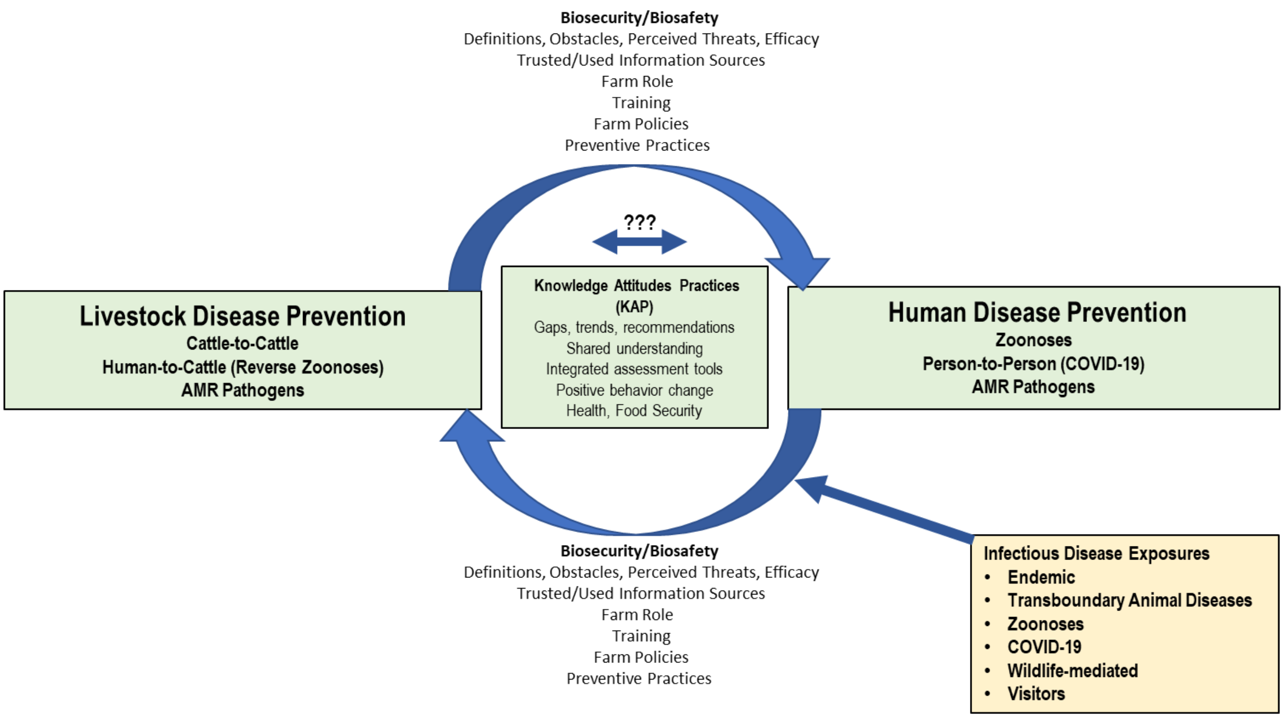

Figure 5.2. Shared infectious disease dynamics between livestock and humans in dairy farm settings and principles guiding development of the knowledge, attitudes, and practices (KAP) questionnaire.

Biosecurity topics included foreign animal diseases, antimicrobial resistance, internal and external biosecurity, obstacles to biosecurity, efficacy of biosecurity measures, motivation for practicing biosecurity measures, personal protective equipment, impact of COVID-19 on biosecurity measures, hygiene, pest control, visitors policies, trusted and used sources of information, and training. Biosafety topics were developed to align with the biosecurity topics where possible. Biosafety topics included zoonoses and “reverse zoonoses”, COVID-19, availability and perceived efficacy of PPE, dynamics of infectious disease transmission, concern with zoonoses and COVID-19, perceived threat of zoonoses and COVID-19, obstacles to preventing infectious diseases in people on the farm, PPE interference with job, social distancing, reporting illnesses, COVID-19 and zoonoses training, trusted and used sources of information, sick leave, COVID-19 programs, carpooling, farm policies on PPE and hygiene, personal practices for PPE and hygiene, and visitors policies.

Initially, the KAP questionnaires were structured according to biosecurity and biosafety sections. A background and demographics section was included within each of these sections (Appendices 9 and 10). At the top of the biosecurity and biosafety questionnaires, an “objectives” statement was included. The biosecurity section contained a background and demographics section with 15 questions. The biosecurity KAP questionnaire contained a total of 61 questions, consisting of multiple-choice questions (MCQs), Likert scale type questions, fill in the blank questions, yes/no/I don’t know questions, and ranking questions in which the participant had to write in a number to assign relative rank of importance, motivation, trust, or frequency of a practice. The biosafety KAP questionnaire contained 14 background and demographic questions. Overall, the questionnaire contained 83 questions and structured in a similar manner as the biosecurity KAP questionnaire. Before each sub-section, the question, “Is it okay to proceed?” was written. The questionnaire was translated into Spanish by a native speaking graduate assistant in November 2020. Construction of KAP questionnaire began in April of 2020. Questionnaires underwent several minor revisions for content, structure, and terminology through November of 2020 as the COVID-19 pandemic continued to evolve.

KAP Questionnaire Pilot Testing and Subsequent Modifications

The English and Spanish versions of the initial and KAP questionnaires were pilot tested on at Farm 1 on November 18th, 2020. Researchers followed CDC guidance and individual farm desires during all farm visits conducted during this research. One English speaking owner and two Spanish speaking workers completed the questionnaires and were asked to provide feedback on the questions. One research assistant fluent in Spanish interviewed the workers, while the graduate student interviewed the owner. Pilot testing with the owner took approximately 80 minutes, while piloting testing for each worker took approximately 60 minutes. The researchers summarized worker and owner feedback by content, structure, and terminology.

The researchers asked a PhD student with experience on Front Range Colorado dairy farms to provide general feedback on the English version of biosecurity and biosafety questionnaires in February and March of 2021, respectively. Minor revisions were made based on these recommendations.

KAP Questionnaire Pilot Testing

During pilot testing, the workers and owner at Farm 1 provided substantial feedback, which is summarized in Appendix 14. The PhD student provided comparatively minor feedback, which focused on reducing number of answer options and combining similar topics into grouped questions.

The KAP questionnaire was modified according to main findings from pilot testing. Ranking questions requiring participants to write numbers were modified. Answer options were reduced where possible, and many questions were grouped into similar themes. The structure of many questions, including Likert scale type questions, was changed so participants could make tick marks rather than circling letters as answers. Additional content relevant to infectious diseases prevention, including PPE, social distancing, shared housing and transportation, vaccinations, understanding of biosecurity and biosafety, reporting zoonoses and COVID-19, and training was added as the COVID-19 pandemic progressed. Objectives and question numbers were also removed to reduce content on pages. The “Is it okay to proceed” questions before sub-sections were also removed to reduce text. Background and demographics questions were combined into one section and added to the end of the questionnaire. Therefore, overall KAP questionnaire would start with biosecurity, then biosafety, then background and demographics.

Final KAP Questionnaire Structure and Content

The final English (Appendix 11) and Spanish (Appendix 12) KAP questionnaire versions are included in this chapter. Many questions have multiple components. When counted within their groups, total question count is 106, with 27 questions on biosecurity, 63 on biosafety, and 16 questions on background and demographics. When individual questions within groups are counted, total question count is 515, with 16 on background and demographics, 168 on biosecurity, and 331 on biosafety. A summary of question breakdown is provided in Table 5.2 to demonstrate the number of questions within each main section (Biosecurity, biosafety, background and demographics) and number of questions by general question type. Most questions were scale questions, including Likert scale type questions with agree/disagree scales or scales of importance, efficacy, or frequency of preventive practices (Table 5.1). A KAP questionnaire summary by topic and frequency is presented in Table 5.2 to demonstrate the wide variety of topics addressed. The biosafety section contained most questions. Within both the biosafety and biosecurity sections, the attitudes subsection contained most questions.

Table 5.1. Summary of final KAP questionnaire questions by section and subsection and by question type. Multiple choice questions (MCQ) are categorized according to whether the question asked respondents to select "all that apply" (All), one option, or three options. Yes, No, I don't know questions are indicated by "Y/N/IDK."

	MCQ Select			**Scale**	**Y/N/IDK**	**Fill In**	**TOTAL**
	All	**One**	**Three**				
Biosecurity							
K	4	0	0	0	3	1	**8**
A	0	0	2	63	19	0	**84**
P	1	0	0	10	65	0	**76**
Section Total	*5*	*0*	*2*	*73*	*87*	*1*	**168**
Biosafety							
K	7	1	0	0	3	1	**12**
A	0	0	4	143	23	0	**170**
P	4	1	0	43	101	0	**149**
Section Total	*11*	*2*	*4*	*186*	*127*	*1*	**331**
Background and Demographics							
Section Total	*3*	*5*	*0*	*0*	*4*	*4*	**16**
TOTAL	**19**	**7**	**6**	**259**	**218**	**6**	**515**

Table 5.2. Summary of final KAP questionnaire question by topics and number.

SECTION AND SUBSECTION	**N**
Biosecurity	
Knowledge	
Term definition (Biosecurity)	1
Diseases transmission among cattle (conditions and mechanisms)	1
Antibiotic use	1
Foreign animal diseases	1
Human-animal disease transmission	2
COVID-19 transmission from people to animals	1
COVID-19 vaccine in cattle	1
Sub-Section total	***8***
Attitudes	

Importance of livestock biosecurity	6
Efficacy of livestock biosecurity (cattle and human disease prevention)	3
Farm rules and expectations (livestock biosecurity)	1
Belief in ability to prevent cattle diseases	1
Overall COVID-19 impact on biosecurity	1
Concern about foreign animal diseases	1
Importance of preventing antimicrobial resistance	1
Belief that humans can infect cattle with COVID-19 virus	1
Concern about human-cattle COVID-19 transmission	1
Trusted sources of biosecurity information	1
Used sources of biosecurity information	1
Specific impacts of COVID-19 on the farm	10
Livestock biosecurity training (accuracy, value, feedback ability, preferred language)	4
Specific factors preventing livestock biosecurity on the farm	18
Efficacy of specific practices in preventing cattle infectious diseases (hand hygiene, PPE, animal and human disease surveillance, isolating sick animals and people, vaccinating cattle and people, animal and human access to medical care, control of farm visitors, pest/vermin/wildlife control, ventilation, sunlight, cleaning and disinfecting animal and worker shared spaces, injection safety)	34
Sub-Section total	***84***
Practices	
Factors that would increase time willing to spend on livestock biosecurity	10
Farm visitor policies (farm access, hand hygiene, PPE, animal contact, vehicles)	9
Farm PPE and personal hygiene policies	8
Specific farm livestock biosecurity practices	17
Farm livestock biosecurity administration (person in charge, written plans, SOPs, written records, foreign animal diseases preparedness and response, assessments, media communication)	8
Farm livestock biosecurity training occurrence and frequency	2
Specific farm livestock biosecurity training topics (carcass storage and disposal, animal quarantine and isolation, visitor policies, pest/vermin/wildlife threats, cattle diseases, reporting cattle diseases, foreign animal diseases, zoonoses, COVID-19, hand hygiene, cleaning and disinfecting, ventilation, antimicrobial resistance, dynamics of animal disease spread, vaccination, PPE, sunlight)	22
Sub-Section total	***76***
Biosecurity total	***168***
Biosafety	
Knowledge	
Term definition (Biological safety)	1
Term definitions (Zoonosis)	1
Disease transmission from animals to people (mechanisms)	1
Zoonotic disease identification	2
Specific characteristics of one zoonosis (salmonellosis)	1
COVID-19 transmission mechanisms in people (general)	2
COVID-19 symptoms in people	1
COVID-19 prevention in people	1
COVID-19 transmission from animals to people	1
COVID-19 vaccine in people	1
Sub-Section total	**12**
Attitudes	

Perceived risks of zoonoses, COVID-19, seasonal influenza, accident	4
Perceived harm of zoonoses, COVID-19, seasonal influenza, accident	4
Concern about COVID-19 from cattle	1
Efficacy of specific practices preventing zoonotic diseases from cattle on farms (hand hygiene, PPE, animal and human disease surveillance, isolating sick animals and people, vaccinating cattle and people, animal and human access to medical care, control of farm visitors, pest/vermin/wildlife control, ventilation, sunlight, cleaning and disinfecting animal and worker shared spaces, injection safety)	34
Efficacy of specific practices preventing person-person diseases on farms ((hand hygiene, PPE, animal and human disease surveillance, isolating sick animals and people, vaccinating cattle and people, animal and human access to medical care, control of farm visitors, pest/vermin/wildlife control, ventilation, sunlight, cleaning and disinfecting animal and worker shared spaces, injection safety)	34
Specific factors preventing zoonoses, person-person infectious diseases on farm	17
Importance of preventing infectious diseases in people on the farm	6
Efficacy of policies to prevent infectious diseases in people on the farm	2
Understanding of rules and expectations for zoonoses and infectious disease prevention	2
Impact of COVID-19 on zoonotic disease prevention priority	1
Impact of COVID-19 on zoonotic disease frequency	1
Belief in ability to prevent COVID-19 among people on farm	1
Belief in ability to prevent cattle zoonoses among people on farm	1
Belief that people on dairy farms are at increased COVID-19 risk	1
Knowledge to protect oneself from zoonoses while on the farm	1
Knowledge to protect oneself from COVID-19 while on the farm	1
Belief in access to healthcare provider	1
Trusted sources of information to prevent zoonoses	1
Used sources of information to prevent zoonoses	1
Trusted sources of information to prevent person-person infectious diseases	1
Used sources of information to prevent person-person infectious diseases	1
PPE availability	2
Efficacy of PPE in preventing zoonoses and COVID-19	2
Cloth face covering efficacy in preventing COVID-19	2
Cloth face covering efficacy in preventing zoonoses	1
Cloth face covering efficacy in preventing other infectious diseases from people	1
Cloth face covering interference with job	1
Cloth face covering overall utility	1
Access to personal hygiene equipment and supplies	2
Social distancing efficacy	2
Social distancing difficulty	2
Social distancing perception of co-workers attempts to perform	1
Social distancing need to enforce	1
Access to COVID-19 vaccine	1
COVID-19 vaccine efficacy	4
COVID-19 vaccine safety	1
Access to COVID-19 test	1
Seasonal influenza vaccine safety	1
Seasonal influenza vaccine efficacy	1
Concern about visitors introduction diseases onto the farm	1
Infectious disease prevention training (accuracy, value, feedback ability, preferred language)	4
Preferred methods of training	6
Comfort reporting illness (general) to supervisors	1
Understanding sick leave policies	1
Belief of penalty for taking sick leave due to COVID-19	1
Belief of encouragement to stay home if had COVID-19	1

Belief of encouragement to stay home if had cattle zoonosis	1
Know cattle zoonosis symptoms	1
Know COVID-19 symptoms	1
Belief that zoonoses are under-reported on farm	1
Belief in tendency to self-report zoonoses to supervisors	1
Belief in tendency to self-report COVID-19 to supervisors	1
Believe ever sickened from person working on farm	1
Believe ever sickened rom animals on farm	1
Belief that cattle can infect people with COVID-19 virus	1
Belief that people can infect cattle with COVID-19 virus	1
Ever known a person with COVID-19	1
Ever known a person with zoonotic disease from animal on farm	1
Sub-Section total	***170***
Practices	
Farm use of ventilation	1
Farm use of sunlight	1
Farm visitor polices (COVID-19 screening, temperate check, zoonoses information)	3
Farm sick leave policies	2
Farm encouragement to stay home if sick	1
Farm encouragement to report diseases (zoonoses and COVID-19)	2
Farm encouragement to report unsafe practices	1
Farm encouragement for vaccination (COVID-19 and seasonal influenza)	2
COVID-19 posters present	1
Farm hand hygiene equipment and supply availability	2
Farm hand hygiene policies	2
Farm COIVD-19 and zoonoses prevention administration (person in charge, worker health screenings, risk assessments, written plans, SOPs, written records, preparedness and response, assessments, media communication)	16
Farm zoonotic disease training occurrence and frequency	2
Farm COVID-19 training occurrence and frequency	2
Frequency of simultaneous biosafety and biosecurity training	1
Frequency of individual practices (PPE, personal hygiene)	15
Use of cloth face coverings	1
COVID-19 pandemic influence on infectious training frequency and mode	3
Farm cleaning and disinfection policies and practices (vehicles, common areas, animal housing)	6
Farm social distancing practices	5
Farm face covering and face mask policies	5
Frequency less than 6 feet away from others in breakroom and workstation	2
Frequency wear cloth face covering or face mask in various farm areas	5
Frequency of waring various face coverings (bandana, cloth, surgical, N-95)	4
Frequency eat, drink, smoke, chew tobacco or dip at work	4
Drink raw milk from cattle on the farm	1
Frequency in shared areas (breakroom, shared vehicle)	2
Farm policies for working with sick animal (PPE, personal hygiene)	7
Existence of farmworker housing on farm	1
Characteristics of farmworker housing (isolation of sick individuals, social distancing, cleaning sanitation supplies, face cover policies, information poster availability, ventilation)	9
Carpooling (use on farm, vehicle cleaning, disinfection, hand hygiene, health screens, face covers)	6
Willingness to try a new infectious disease evaluation tool (based on effect on animal health, zoonoses, COVID-19, integration of animal and human health, farm business sustainability, time)	8
Specific farm biosafety training topics (sick leave, reporting illnesses, symptoms of infectious diseases in people and cattle, cleaning and disinfection, ventilation, vaccinations, PPE, social distancing, carpooling, sunlight, needle safety)	25

Techniques used in training to prevent infectious diseases in people	1
Sub-Section total	***149***
Biosafety Total	***331***
Background and Demographics	
Education	1
Experience	4
Farm size	1
Farm housing	1
Farm domestic animals and wildlife	2
Language	1
Gender	1
Age	1
Personal housing situation	2
Work description	2
Section total	**16**
Total KAP Questionnaire Questions	**515**

Farm Recruitment

Through email, phone calls, and in-person farm visits, attempted to recruit Front Range Colorado dairy farms to complete KAP questionnaire. From June of 2020 to June 2021, we contacted 18 Front Range Colorado dairy farms in efforts to enroll farms in this research (Table 5.3). This included three organic and 15 conventional dairy farms. Ten of the farms were actively or had recently participated in research collaborations with CSU. An English language recruitment email (Appendix 5, Chapter 2) with an attachment (Appendix 6, Chapter 2) was sent to main point of contact owners and/or managers at each farm if their email was known. To identify other Front Range farms interested in participating, we also emailed two local clinical veterinarians with known dairy farm professional contacts. Farms are represented by letter "F" and corresponding number.

We created a Spanish language field guide (Appendix 13) to facilitate clear Spanish language communication between researchers and research participants. The guide framework was constructed by the research team before initiating data collection on farms, and content was reviewed for relevance over the course of the field season. The guide consists of 3 introductory phrases, 15 words related to farm animals and husbandry, six words related to farm roles and occupations, three words related to biosecurity, 26 words related to infectious diseases and COVID-19, two words related to farm administration, 16 words related to animal and human infectious diseases, and 10 words related to personal protective equipment and hygiene.

Data Collection and Analysis

KAP questionnaire data collection occurred from June 2020 to August 2021. All procedures for this research were conducted following a protocol approved by the Colorado State University (CSU) Institutional Review Board (Protocol Number: 20-10327H). Verbal informed consent was obtained from potential research participants in either English (Appendix 7) or Spanish (Appendix 8) before their participation in this study. Researchers followed CDC COVID-19 prevention guidelines and any preferences of the farms during data collection. Participants completed the questionnaires in the farm meeting or break room. Considering the length of the questionnaire, research participants were provided with a hard copy in the language of their choice so they could read through the questions and write their response. An English speaking and Spanish speaking researcher were always present in the room. When the participants returned the questionnaire to the researcher, the researcher briefly checked for missing answers and asked the participants in their preferred language if they would like to answer the missing answers and reminded participants there was obligation to continue. After turning in the questionnaire, workers were offered a $40 gift card of their choosing from either King Soopers or Walmart. Managers and owners (supervisors) were given a CSU coffee mug.

Several responses from the same nine workers and two managers were omitted for F2 due to a translation error on Spanish KAP questionnaire versions. The first question ("What does biosecurity mean to you?") of the Spanish version indicated "livestock biosecurity" rather than simply "biosecurity". Similarly, responses from the same participants for the four subsequent knowledge questions were omitted because the option "I prefer not to answer" rather than "I don't know" was included in the Spanish version. Responses for the question, "Attitudes toward livestock biosecurity. How much do you agree with the following statements?" were also omitted for this group of participants because a different Likert scale was used. Finally, responses for the question, "Sources of livestock biosecurity information" for this group of participants were omitted because the answer options did not match the English version. This situation was likely due to inadvertent printing of an older Spanish version of the KAP questionnaire.

Spanish responses to free response questions were translated into English and transcribed onto the original paper KAP questionnaires. All responses were entered into a Microsoft Excel file. Each farm and each participant within it were given a survey ID. Summaries of knowledge, attitudes, and practice findings were descriptively summarized with predominant focus on zoonotic diseases and overlapping elements of biosecurity and biosafety relevant to zoonotic disease prevention. Where applicable, various pairings of knowledge, attitudes, and practices were analyzed via Chi-Square or Fisher's Exact Test. Microsoft Excel® was used to summarize data and create tables and figures. Statistical analyses, including test of statistical significance with Fishers Exact Test or Chi-Square Test, and computation of odds ratios and 95% confidence limits were performed using the StatCalc program (Tables) within EpiInfo version 7.2.5.0.

Results

Farm Recruitment

Six farms, including two organic and four conventional farms agreed to participate, resulting in 33.3% farm recruitment success. Of the six farms successfully recruited, five had recently or were currently participating in other CSU research projects. For farms that agreed to participate, it took between 3 and 9 contacts via email, phone call, text, and/or in-person visit before farms agreed to participate.

Twelve of the contacted farms did not participate in this study (Table 5.4). Ten of these farms provided reasons for why they declined to participate. The most frequently cited reasons related to lack of time (cited by five respondents) and lack of perceived benefit to participation (cited by three respondents). Other reasons given included none (two respondents), plans to sell the farm (two respondents), confidentiality concerns stemming from public misunderstanding of animal welfare (two respondents). Less common reasons given included belief that incentive card amount was insufficient, disagreement with the university position on a proposed animal welfare initiative, dissatisfaction with university veterinary services on the farm, manpower concerns, manager unavailable due to personal reasons, KAP questionnaire too long, and previous university collaborations were overly time consuming.

None of the two local private practice veterinarians responded to our emails that asked them to help identify potential dairy Front Range dairy farms we would contact in an effort to increase study enrollment.

Table 5.3. Summary of farm recruitment efforts to reach farm decision

	Farm Participation Decision		
Recruitment Summary	**Agreed to Participate N=6**	**Declined to Participate N=12**	**Total N=18**
	N (%)	N (%)	N (%)
Initial point of contact			
Owner	2 (33.33)	4 (33.33)	6 (33.33)
Manager	2 (33.33)	3 (25)	5 (27.78)
Office staff	1(16.67)	5 (41.67)	6 (33.33)
Main point of contact			
Owner	1 (16.67)	7 (58.33)	8 (4.44)
Manager	5 (83.33)	4 (33.33)	9 (50)
Office staff	0 (0)	1 (8.33)	1(5.56)
Farm contact methods to reach farm decision			
Email	6 (100)	4 (33.33)	10 (55.56)
Text	1 (16.67)	6 (50)	7 (38.89)
Phone call	4 (66.67)	7 (58.33)	11 (61.11)
In-person farm visit	5 (83.33)	9 (75)	14 (77.78)
Number of farm contacts to reach farm decision			
1-3	3 (50)	6 (50)	9 (50)
4-6	2 (33.33)	4 (33.33)	6 (33.33)
7-9	1 (16.67)	2 (16.67)	3 (16.67)
	Max 9, Min 3	*Max 8, Min 1*	*Max 9, Min 3*
Made final participation decision			
Owner	1 (16.67)	8 (66.67)	9 (50)
Manager	5 (83.33)	3 (25)	8 (44.44)
Office staff	0 (0)	1 (8.33)	1(5.56)
Past or current CSU research collaborator?			
Yes	5 (83.33)	5 (41.67)	10 (55.56)
No	1 (16.67)	7 (58.33)	8 (44.44)
Farm Type			
Organic	2 (33.33)	1 (8.33)	3 (16.67)
Conventional	4 (66.67)	11 (91.67)	15 (83.33)

KAP Questionnaire Results

Farm Characteristics and Participant Roles

Table 5.4 summarizes farms by type, size, existence of shared worker housing, participant numbers including a breakdown for owners, managers, and workers, and dates of KAP questionnaire completion. Tables 5.4 and 5.5 provide an overall farm summary.

Table 5.4. Individual Farm Characteristics

Farm	**Type**	**Size** (Milking Cows)	**Shared Worker Housing Present**	**Participants by Role** Owner (O) Manager (M) Worker (W)				**Date of KAP Questionnaire Completion and (N, Role)**
				O	**M**	**W**	**Total**	
F1	Organic	1,350	Yes	1	2	4	**7**	07 JUN 2021 (4W, 1M) 12 AUG 2021 (1M) 25 SEP 2021 (1O)
F2	Organic	11,325	Yes	0	7	9	**16**	19 MAR 2021 (10W, 2M) 22 APR 2021 (4M)
F3	Conventional	5,500	No	0	2	3	**5**	03 JUN 2021 (4W) 08 JUL 2021 (1M)
F4	Conventional	700	Yes	1	0	11	**12**	09 APR 2021 (11W) 12 APR 2021 (1O)
F5	Conventional	4,200	No	0	2	6	**8**	04 JUN 2021 (6W, 2M)
F6	Conventional	1,050	Yes	0	0	2	**2**	07 APR 2021 (2W)
				2	**13**	**35**	**50**	

Table 5.5. All participating farm characteristics

Characteristic	**N (%)**
Farm Type	
Organic	2 (33.33)
Conventional	4 (66.67)
Size (Milking)	
Range	700-11,325
Median	2,775
Shared Housing	
Present	4 (66.67)
Absent	2 (33.33)
Role	
Owner	2 (4)
Manager	13 (26)
Worker	35 (70)

Demographics and Background

Table 5.6: Demographic characteristics for all participants

Variable		**N (%)**
Gender N=49	Male	37 (75.5)
	Female	12 (24.5)
	Prefer not to answer	0 (0)
Preferred language N=50	English	9 (18)
	Spanish	41 (82)
	An indigenous language	0 (0)
Age (years) N=50	18-27	13 (26)
	28-37	16 (32)
	38-47	12 (24)
	48-57	9 (18)
	Average 35.62, Max 57, Min 18	
Highest education N=48	Less than middle school	2 (4.17)
	Middle school	4 (8.33)
	High school	18 (37.5)
	Technical education	3 (6.25)
	Associate degree	3 (6.25)
	Bachelor’s degree	14 (29.17)
	Master’s degree	4 (8.33)
	Doctoral degree	0 (0)
Role on farm N=50	Owner	2 (4)
	Manager	13 (26)
	Worker	35 (70)
Predominant work location N= 47	Dairy parlor	11 (23.4)
	Calf yard	6 (12.77)
	Cow pens	10 (21.28)
	Maternity	0 (0)
	Hospital	1 (2.13)
	Office	5 (10.64)
	Machinery room	4 (8.51)
	Other	6 (12.77)
	All locations	*2 (4.25)*
	Reproduction room *Farming*	*1 (2.13)*

	Preparing food for cows *Shop* *Washing rubber teat sucking devices and tanks*	*1 (2.13)*
		1 (2.13)
		1 (2.13)
		1 (2.13)
Live on the farm ? N=46	Yes	8 (17.39)
	No	38 (82.61)
Live with anyone else? N=48	With spouse or significant other	11 (21.92)
	With my kid(s)	3 (6.25)
	With other farm workers	8 (16.67)
	I live alone	4 (8.33)
	With other family members	4 (8.33)
	With spouse or significant other and kids	16 (33.33)
	With spouse of significant other and other family members	1 (2.08)
	Without spouse or significant other and kids and other family members	1 (2.08)
Ever worked on a farm when it had to cull animals due to an animal disease outbreak? N= 48	Yes	4 (8.33)
	No	44 (9.67)
	I don't know	0 (0)
	Prefer not to answer	0 (0)
Ever worked in other dairies? N=50	Yes	31 (62)
	No	19 (38)
How long worked on current dairy farm? (years) N=50	<1	7 (14)
	1-5	28 (56)
	6-10	7 (14)
	>10	8 (20)
	Average 5.13, Max 25, Min 0.125	
How long worked in in a dairy job/environment? (years) N=50	*<1*	7
	1-5	16
	6-10	13
	>10	14
	Average 8.19, Max 32, Min 0.019	

Domestic and Wild Animals on the Farm

Dogs and small birds were present on all farms. Cats and mice/rats were present on almost all farms. Only 66.7% of farms indicated presence of minks/weasels, and 50% indicated presence of deer. Animals with most access to animal housing among the farms included dogs, cats, mice/rats, and small birds. Farms 1 and 2 had the greatest variety of animals present and greatest presence of animals with access to animal housing (Table 5.7).

Table 5.7. Summary of species present on farm and those with access to animal housing.

	All Farms N=6 Present Yes Housing Yes		**Individual Farms** Solid = Present on farm or access to animal housing (based on confirmation from at least one participant)											
Animal	(%)	(%)	**F1**		**F2**		**F3**		**F4**		**F5**		**F6**	
	P	H	P	H	P	H	P	H	P	H	P	H	P	H
Dogs	100	66.7	■	■	■	■	■	■	■	■	■		■	
Cats	83.3	66.7	■	■	■	■		■	■	■	■		■	
Minks/Weasels	66.7	50	■		■	■			■	■	■			■
Mice/Rats	83.3	66.7	■	■	■	■	■	■	■	■			■	
Raccoons	50	50	■	■	■	■			■					■
Prairie Dogs	50	50	■	■	■	■	■			■				■
Deer	50	50	■	■	■	■					■			■
Small birds	100	66.7	■	■	■	■	■	■	■	■	■		■	
Large birds	66.7	50	■	■	■	■	■				■			■

Knowledge

When asked about the meaning of “biosecurity”, the most commonly selected option was “Preventing animal pathogens and diseases from entering the herd” followed by “Preventing humans from getting diseases from animals on the farm” and “Preventing animal pathogens and diseases from spreading within the herd.” Respondents tended to consider biosecurity as related to prevention of both animal disease and human disease in a farm setting (Figure 5.3). Two respondents provided “other definitions” of the term, including “Using good hygiene to avoid causing diseases” and “avoid contact with calves.”

Answers options are grouped according to all answer combinations and proportion of supervisors (managers and owners) or workers answering with each combination. A wide variety of answer combinations was selected. A greater proportion of supervisors than workers tended to select more comprehensive definitions of biosecurity including options ABCDEF, ABDEF, and ABCEF. Workers (3) were the only respondents to select “I am not sure I understand the meaning.”

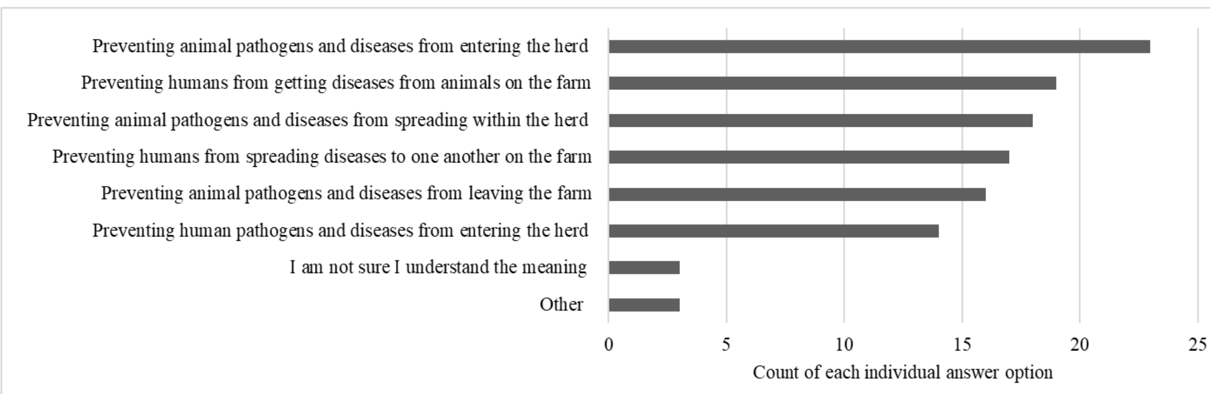

Figure 5.3. “What does biosecurity mean to you? Select all that apply” N=38.

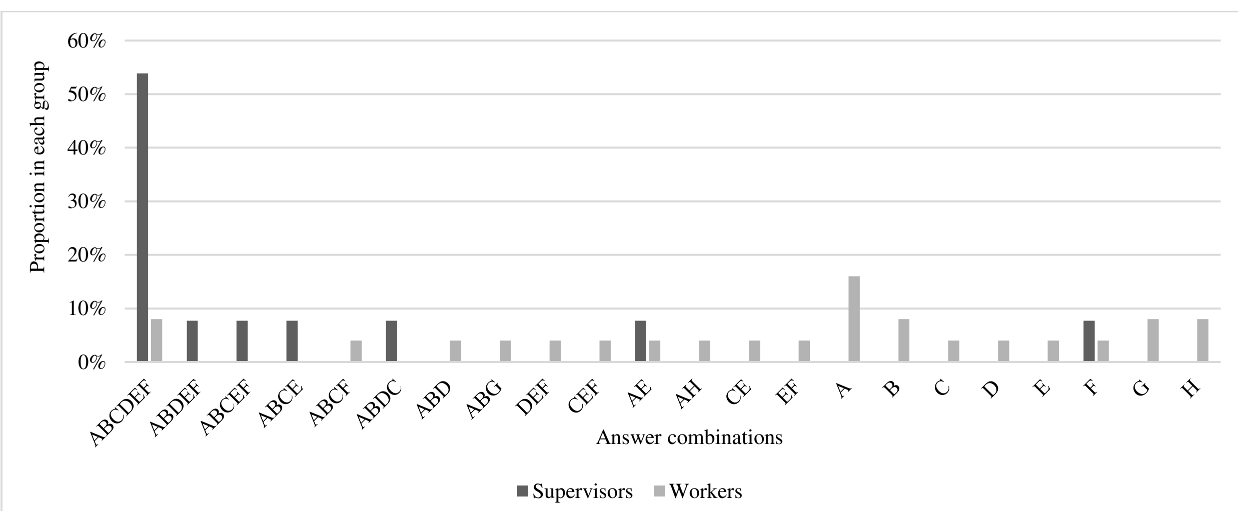

Figure 5.4. “What does biosecurity mean to you? Select all that apply”. N=38. Answer options are described: A. Preventing animal pathogens and diseases from entering the herd; B. Preventing animal pathogens and diseases from spreading within the herd; C. Preventing animal pathogens and diseases from leaving the farm; D. Preventing human pathogens and diseases from entering the herd; E. Preventing humans from getting diseases from animals on the farm; F. Preventing humans from spreading diseases to one another on the farm; G. Other; H. I am not sure I understand the meaning.

Analysis was conducted to examine association between knowledge of biosecurity definition and factors including farm personnel and various training elements (Table 5.8). Farm supervisors had a significantly (at $p < 0.05$) higher likelihood of selecting all answer options for the definition of livestock biosecurity compared to farm workers. Respondents who reported their farms provide training on preventing COVID-19 in people had a significantly lower likelihood of selecting all answer options for the definition of livestock biosecurity compared to respondents who reported their farms did not provide such training. Respondents who reported they receive training on infectious disease spread from people to people had a significantly lower likelihood of selecting all answer options for the definition of biosecurity compared to respondents who reported they did not receive such training. There were some significant associations between other explored training factors, including frequency of integrated biosecurity-biosafety training (Table 5.8)

Table 5.8. Definition of biosecurity and association with factors of farm personnel and training. *Significant at $p < 0.05$.

What does biosecurity mean to you?							
Factor	Category	n	Outcome: Selected all answer options	Outcome: Did not select all answer options	Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
Farm Personnel	Supervisor	13	7	6	13.42 (2.2, 82.0)	0.0034*	
	Worker	25	2	23	Ref		

Training on preventing diseases in people same time as livestock biosecurity training	Yes (Sometimes-Always)	21	5	16	0.86 (0.19, 3.94)	1	
	No (Rarely-Never)	15	4	11	Ref		
Farm provides livestock biosecurity training?	Yes	20	3	17	0.29 (0.06, 1.44)	0.15	
	No/IDK	16	6	10	Ref		
Farm provides training on preventing zoonoses from animals to people?	Yes	10	5	5	3.50 (0.67, 18.5)	0.21	
	No/IDK	18	4	14	Ref		
Farm provides training on preventing COVID-19 in people	Yes	14	7	7	7.0 (1.14, 42.98)	0.046*	
	No/IDK	16	2	14	Ref		
Receive training on infectious diseases spread from people to people	Yes	28	4	24	0.13 (0.02, 0.72)	0.023*	
	No/IDK	9	5	4	Ref		
Receive training on purpose of PPE items	Yes	25	8	17	4.71 (0.51, 43.4)	0.22	
	No/IDK	11	1	10	Ref		

When asked about the meaning of "biological safety", the most commonly selected option was "Preventing people from getting diseases from animals on the farm." Respondents tended to consider biological safety as related to prevention of both animal disease and human disease in a farm setting. Fourteen respondents indicated that biological safety had the same meaning as biosecurity (Figure 5.5). Two respondents provided "other definitions" of the term, including "Preventing animals from contracting diseases from other animals" and "All of the methods of necessary hygiene to reduce the risk of disease." Answers options are grouped according to all answer combinations and proportion of supervisors (managers and owners) or workers answering with each combination. A greater proportion of supervisors than workers tended to select a more comprehensive definition of biological safety including options BCDE. Workers (7) were the only respondents to select "I don't know."

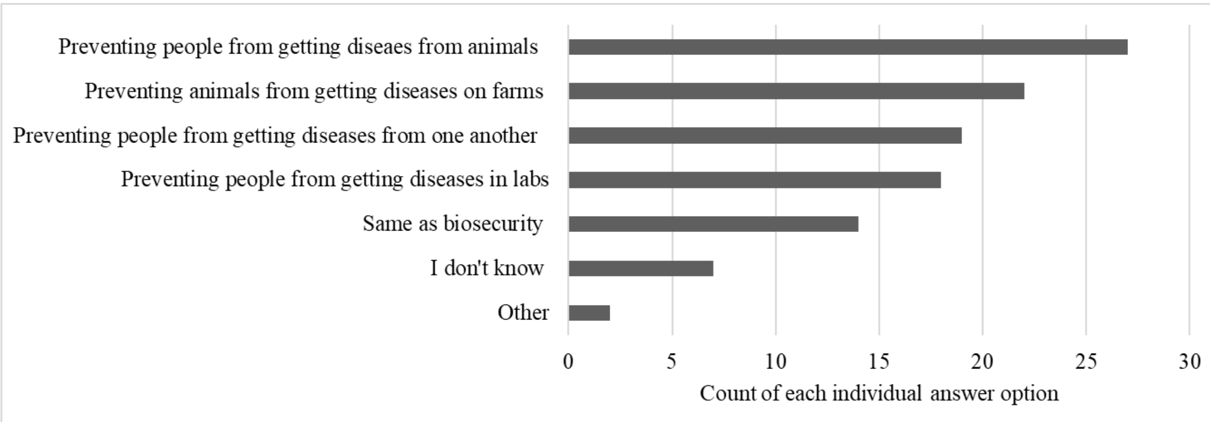

Figure 5.5. "What does biological safety mean to you? Select all that apply" Count of all individual answer options selected. N=48.

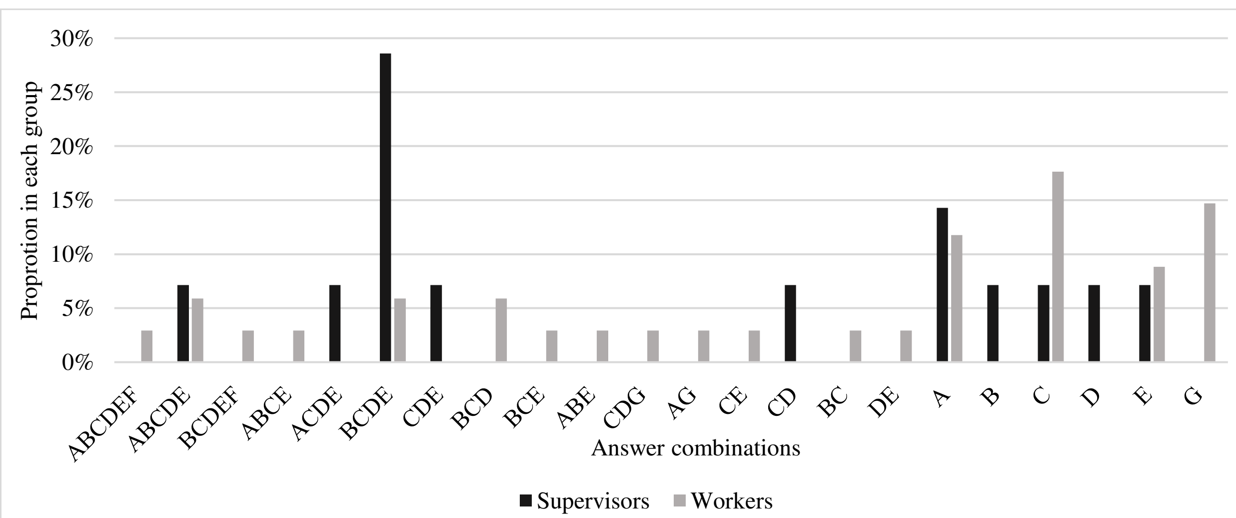

Figure 5.6. "What does biological safety mean to you? Select all that apply" N=48 (14 owner/managers, 34 workers). Answer options are described:
A. Same as biosecurity; B. Preventing people from getting diseases in labs; C. Preventing people from getting diseases from animals on farms; D. Preventing people from getting diseases from one another on farms; E. Preventing animals from getting diseases on farms; F. Other (Specify); G. I don't know.

Analysis was conducted to examine association between knowledge of elements of biological safety definition and factors including farm personnel and frequency at which livestock biosecurity training and biosafety training occur together. Supervisors did not have a significantly greater likelihood of include answer options CDC compared to workers (Table 5.9).

Table 5.9. Definition of biological safety and association with factors of farm personnel and training. *Significant at p <0.05.

What does biological safety mean to you? Included C in answer (Preventing people from getting diseases from animals on farms)							
Factor	Category	n	Outcome: Included C	Outcome: Did not include C	Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
Farm Personnel	Supervisor	15	9	5	1.42 (0.39, 5.14)		0.83
	Worker	19	19	15	Ref		
What does "biological safety" mean to you? Included CDE in answer (C. Preventing people from getting diseases from animals on farms; D. Preventing people from getting diseases from one another on farms; E. Preventing animals from getting diseases on farms).							
Factor	Category	n	Outcome: Included CDE	Outcome: Did not included CDE	Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
Farm Personnel	Supervisor	14	7	7	4.67 (1.19, 18.35)		0.053
	Worker	34	6	28	Ref		
Training on preventing diseases in people same time as livestock biosecurity training	Yes (Sometimes-Always)	28	10	18	2.4 (0.55, 10.52)	0.31	
	No (Never-Rarely)	16	3	13	Ref		

Zoonoses, including "Reverse Zoonoses"

Overall, only 44.7% of respondents said that humans can give some diseases to animals, while 21.1% did not believe this was possible, and 34.2% did not know.

There was no significant association between knowledge that people can transmit diseases to animals and training on infectious disease spread from animals to people, farm role, or integrated biosecurity-biosafety training (Table 5.10).

Table 5.10. Knowledge of potential for humans to give some diseases to animals and association with factors of farm personnel and training. *Significant at $p < 0.05$.

Can humans give some diseases to animals? Yes/No/I don't know							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Yes	No/IDK			
Receive training infectious disease spread from people to animals	Yes	10	4	6	0.56 (0.13, 2.52)	0.71	
	No/IDK	24	13	11	Ref		
Farm Personnel	Supervisor	13	7	6	1.75 (0.45, 6.8)		0.64
	Worker	25	10	15	Ref		
Training on preventing diseases in people same time as livestock biosecurity training	Yes (Sometimes-Always)	20	10	10	1.14 (0.3, 4.4)		1
	No (Rarely-Never)	15	7	8	Ref		

Participants were asked to provide an example of a disease humans can give to animals. Only 17/50 participants attempted to provide an example of a zoonotic disease that can be transmitted from humans to animals. Only 5/15 supervisors (managers and owners) provided a response. One supervisor wrote COVID-19 as a zoonotic agent from cattle. Only 12/35 workers attempted to provide a response. Tuberculosis, “fever”, and COVID-19 were the most commonly cited examples (Figure 5.8). When asked if humans can infect some animals with the virus that causes COVID-19, 21.6% of respondents said yes, 29.7% said no, and 48.6% said they did not know (N=37).

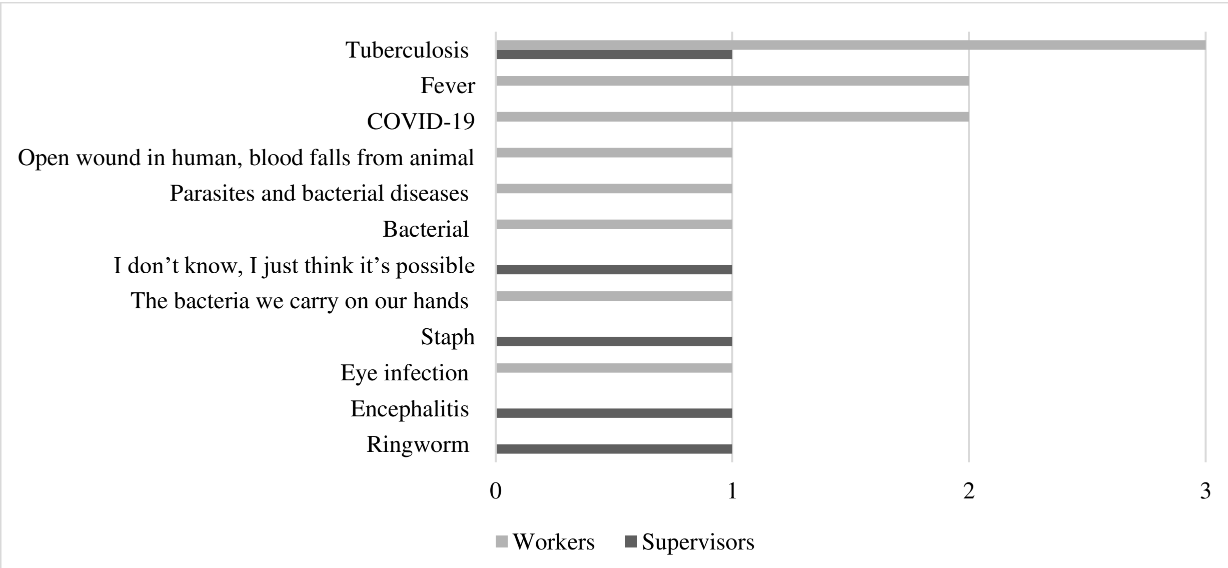

Figure 5.7. Provide an example of a disease humans can give to animals. N=17 (5 managers/owners and 12 workers).

When asked about the meaning of “zoonotic disease”, the most frequently selected answer was the option defining the term as spread of disease between animals and people. Only 10 participants selected the answer with unidirectional spread of disease from animal to human. Many participants (19) indicated they did not know the definition of zoonotic disease (Figure 5.8). One worker selected “Other” and answered, “Sickness that spreads from animals to people or people to animals.” When answers are presented by answer combination and occupational group, it is apparent that a greater proportion of workers selected “I don’t know” than did supervisors.

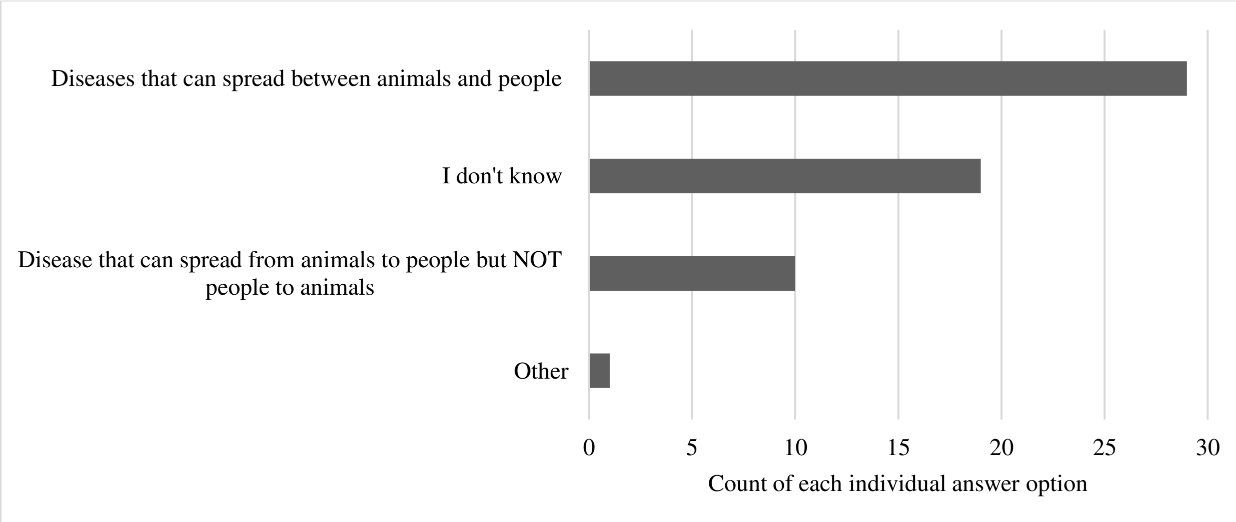

Table 5.8. “What is a zoonotic disease? Select all that apply” Count of all individual answer options selected. N=50.

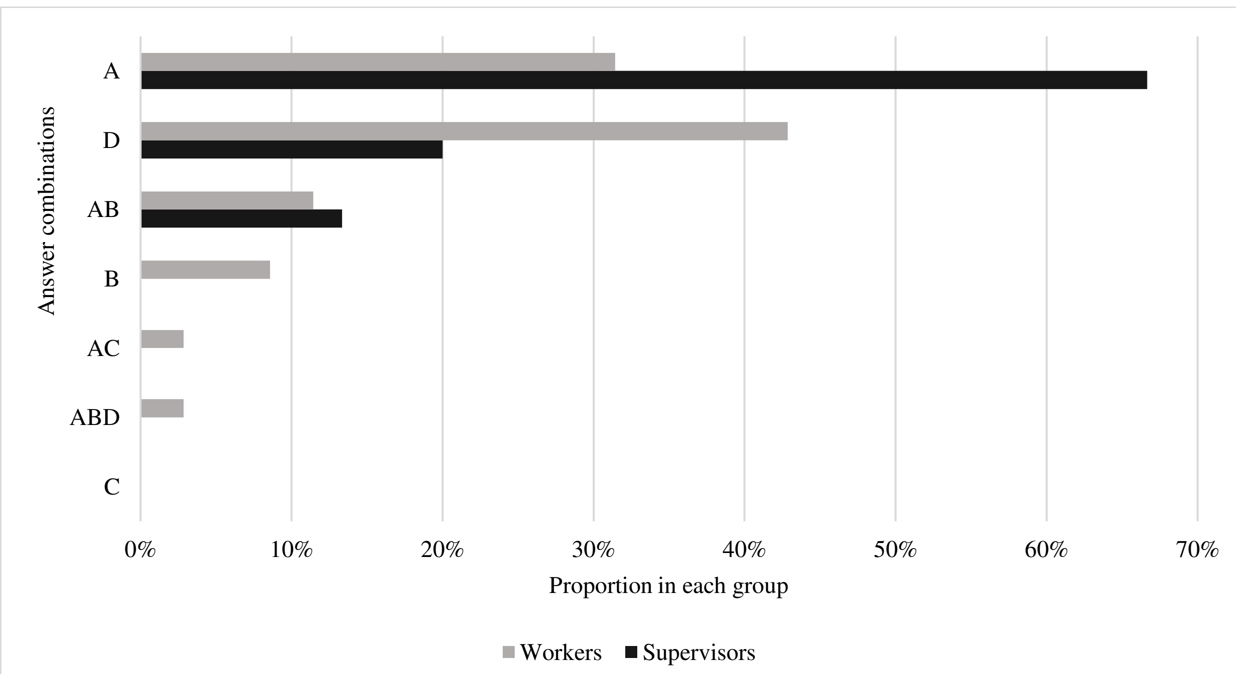

Figure 5.9. “What is a zoonotic disease? Select all that apply.” Answer options are described: A. Disease that can spread between animals and people; B. Disease that can spread from animals to people but NOT people to animals; C. Other (Specify); D. I don’t know. N=50 (15 owners/managers, 35 workers).

When asked to select the definition of zoonotic disease (i.e., disease that can spread between animals and people), supervisors had a significantly greater likelihood of identifying the correct definition of zoonotic disease compared to workers. Respondents who receive training on infectious disease spread from people to animals had a significantly greater likelihood identifying the correct definition of zoonotic disease compared to those who do not receive this training (Table 5.11).

Table 5.11. Definition of zoonotic disease and association with training and farm role. *Significant at p <0.05.

What is a zoonotic disease?							
Factor	Category	n	Outcome: Correctly identified definition (A)	Outcome: Incorrectly identified definition	Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
Training on preventing diseases in people same time as livestock biosecurity training	Yes (Sometimes-Always)	30	15	15	1.0 (0.30, 3.4)		1
	No (Never-Rarely)	16	8	8	Ref		
Receive training on zoonotic disease spread from animals to people	Yes	25	11	14	0.71 (0.22, 2.29)		0.79
	No/IDK	21	11	10	Ref		
Farm Personnel	Supervisor	15	10	5	4.36 (1.2, 15.8)		0.05
	Worker	35	11	24	Ref		
Receive training on infectious disease spread from people to people?	Yes	31	14	17	0.72 (0.21, 4.48)		0.84
	No/IDK	15	8	7	Ref		

Receive training on purpose of PPE items?	Yes	33	18	15	2.4 (0.60, 9.56)	0.31	
	No/IDK	12	4	8	Ref		
Receive training on infectious disease spread from people to animals?	Yes	15	11	4	5 (1.28, 19.49)	0.027*	
	No/IDK	31	11	20	Ref		

Only 24/50 participants attempted to provide an example of a zoonotic disease that can be transmitted from cattle to humans. Only 10/15 supervisors (managers and owners) provided a response. One supervisor wrote COVID-19 as a zoonotic agent from cattle. Only 14/35 workers attempted to provide a response, and 4 of these wrote, “I don’t know.” Brucellosis was the most frequently mentioned zoonotic disease.

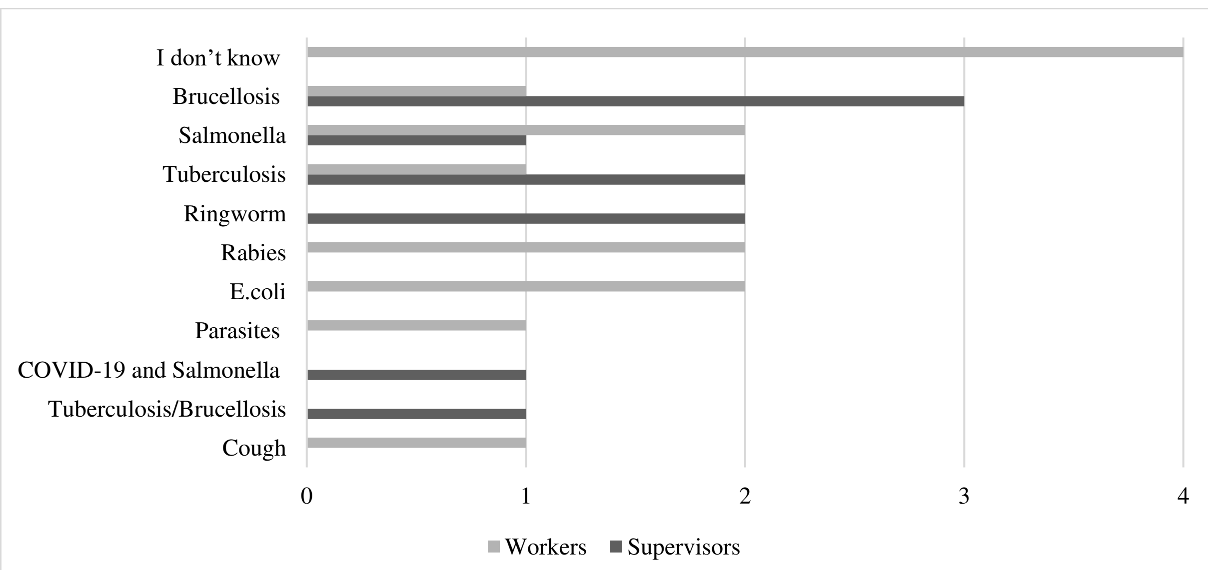

Figure 5.10. Name a zoonotic disease people can get from cattle. Participants were asked to name a zoonotic disease people can get from cattle. N=24 (10 managers/owners, 14 workers).

When asked to provide a name of a zoonotic disease people can get from cattle, respondents who indicated they receive training on zoonotic disease spread from animal to people had a significantly greater likelihood of naming a zoonotic disease than did respondents who do not receive this training. Similarly, supervisors had a significantly greater likelihood of naming a zoonotic disease than workers (Table 5.12).

Table 5.12. Ability to correctly provide a name of zoonotic disease from cattle and association with training and farm role. *Significant at $p < 0.05$.

Name a zoonotic disease people can get from cattle							
Factor	Category	n	Outcome: Named zoonotic disease	Outcome: Did not name zoonotic disease	Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
Farm provides training on preventing zoonoses from animals to people	Yes	27	11	16	1.18 (0.35, 3.9)		1
	No/IDK	19	7	12	Ref		
Receive training on zoonotic disease spread from animals to people?	Yes	18	15	3	21.3 (4.1, 110.7)	0.00009*	
	No/IDK	21	4	17	Ref		
Training on preventing diseases in people same time as livestock biosecurity training	Yes (Sometimes-Always)	30	13	17	1.3 (0.37, 4.4)		0.95
	No (Never-Rarely)	16	6	10	Ref		
Receive training on symptoms of cattle zoonoses in people	Yes	21	10	11	1.8 (0.54,6.1)		0.5
	No/IDK	24	8	16	Ref		
Farm Personnel	Supervisor	15	10	5	5.8 (1.6, 21.5)		0.016*
	Worker	35	9	26	Ref		

When asked to select zoonoses from a provide list of diseases, participants most frequently selected tuberculosis, salmonella, and rabies. Cryptosporidiosis and MRSA were the least frequently selected. Ten participants selected foot and mouth disease, and 11 selected “I don’t know” as a single selection or in addition to their other selections (Figure 5.11). A small proportion of respondents selected eight correct answers (Figure 5.12).

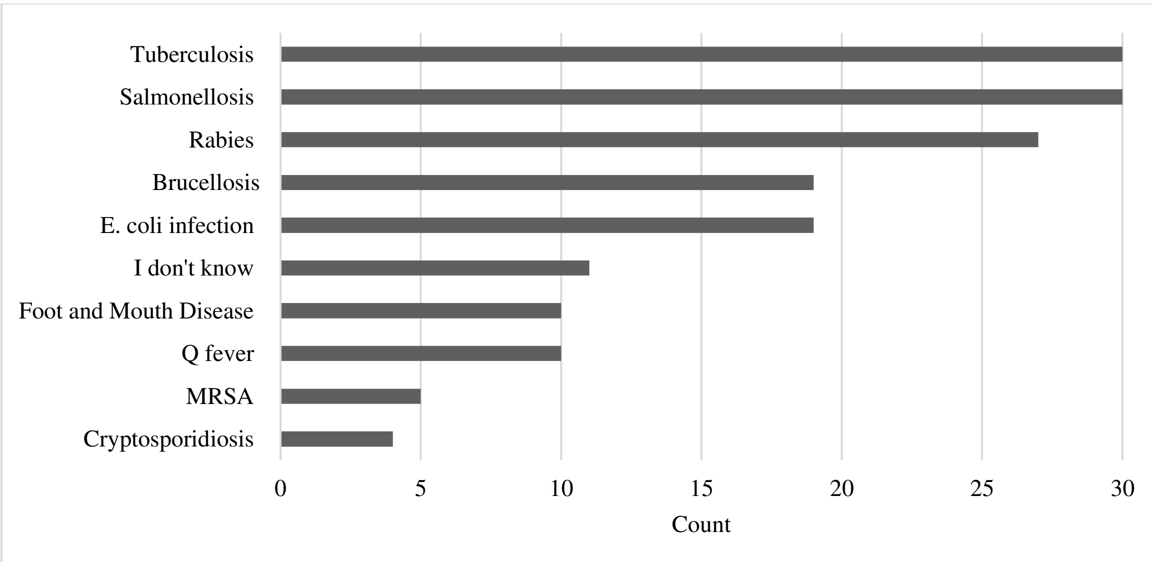

Figure 5.11. “Zoonotic diseases are disease that can be spread between animals and people. Which are diseases people can get from cattle? Select all that apply.” N=50.

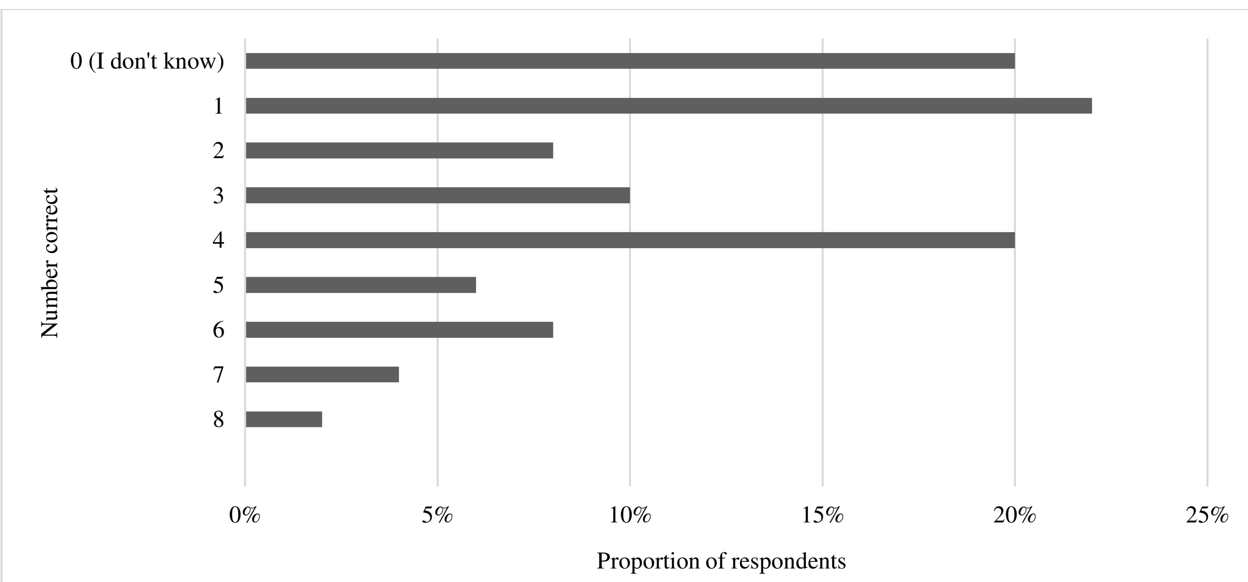

Figure 5.12. “Zoonotic diseases are disease that can be spread between animals and people. Which are diseases people can get from cattle? Select all that apply.” N=50.

When asked to identify zoonotic diseases people can get from cattle, supervisors had a greater likelihood of correctly identifying at least 75% (6/8) from the list provided compared to workers, but the association between farm role and identification was not significant (Table 5.13).

Table 5.13. Ability to identify at least 75% of zoonoses from a provided list and association with training and farm role. *Significant at p <0.05.

Which are diseases people can get from cattle?							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Identified 75%	Identified less than 75%			
Receive training on symptoms of cattle zoonoses in people?	Yes	22	3	19	1.16 (0.21, 6.43)	1	
	No	25	3	22	Ref		
Farm Personnel	Supervisor	15	4	11	6.0 (0.96, 37.4)	0.058	
	Worker	35	2	33	Ref		
Training on preventing diseases in people same time as livestock biosecurity training	Yes (Sometimes-Always)	30	3	27	0.48 (0.09, 2.7)	0.41	
	No (Rarely-Never)	16	3	13	Ref		

When asked to select all routes of disease transmission from animals to people, exposure to blood was the most frequently selected answer option. Transmission through air was the least commonly selected answer options (Figure 5.13). When broken down number of correct answers selected, only 20% of respondents selected all correct methods of disease transmission from animals to people. Only 32% of respondents selected 70% or more of the correct answers (Figure 5.13).

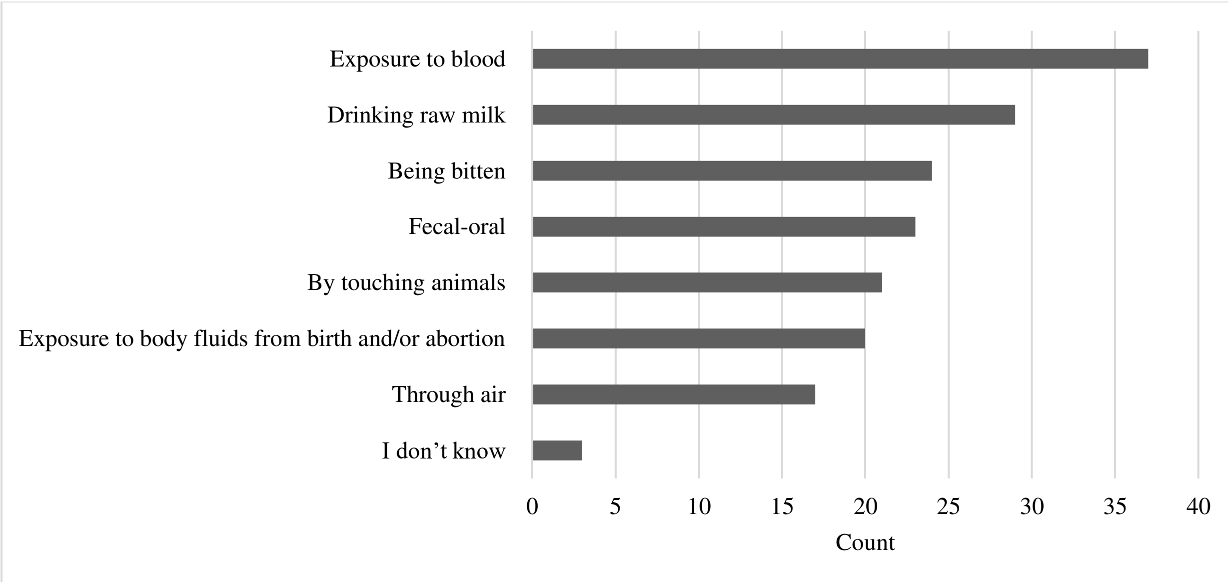

Figure 5.13. “How can diseases be transmitted from animals to people? Select all that apply.” N=50.

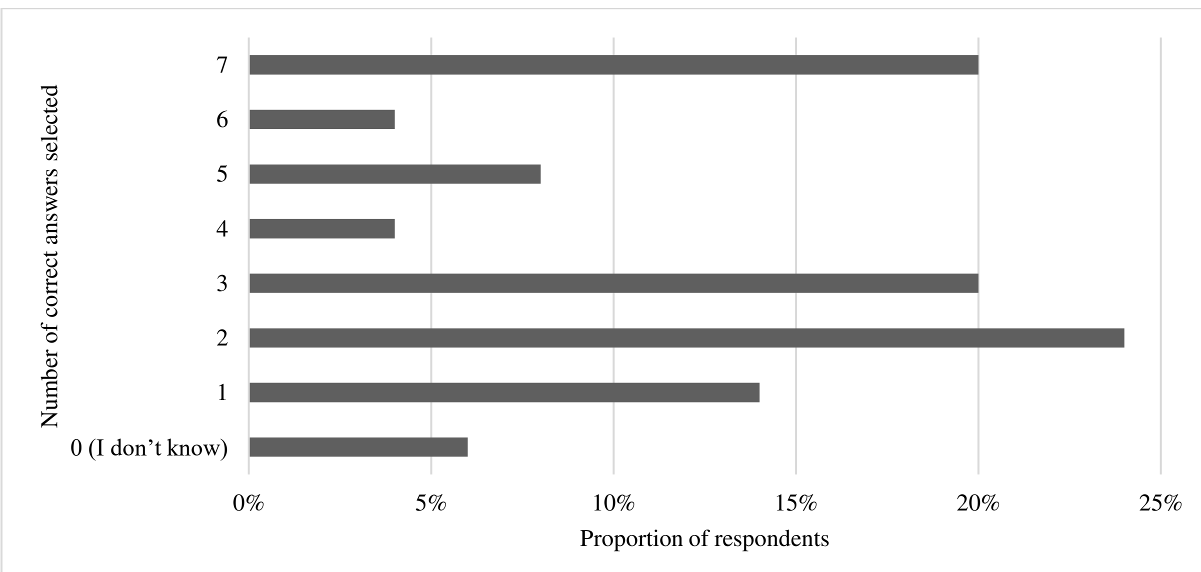

Figure 5.14. “How can zoonotic diseases be transmitted from animals to people? Select all that apply.” Based on answer options in Figure 5.13. N=50.

When asked to identify means by which zoonotic diseases can be transmitted from animals to people, supervisors had a significantly greater likelihood of identifying all means compared to workers (Table 5.14).

Table 5.14. Ability to identify all means of zoonotic disease transmission from a provided list and association with training and farm role. *Significant at p <0.05.

How can diseases be transmitted from animals to people?							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Identified all	Did not identify all			
Receive training on zoonotic disease spread from animals to people	Yes	25	3	22	0.43 (0.09, 2.10)	0.44	
	No/IDK	21	5	16	Ref		
Farm Personnel	Supervisor	15	6	9	11 (1.9, 64.1)	0.006*	
	Worker	35	2	33	Ref		
Training on preventing diseases in people same time as livestock biosecurity training	Yes (Sometimes-Always)	29	4	25	0.34 (0.08, 1.5)	0.24	
	No (Never-Rarely)	16	5	11	Ref		

When asked to identify true statements about salmonellosis, the most commonly selected answer was that it can cause clinical signs and symptoms in humans. Only 14 respondents knew that cattle can be infected without showing signs. Eight respondents selected “I don’t know” in their answers (Figure 5.15) Only 34.1% of respondents selected 70% or more of the correct answers (Figure 5.16).

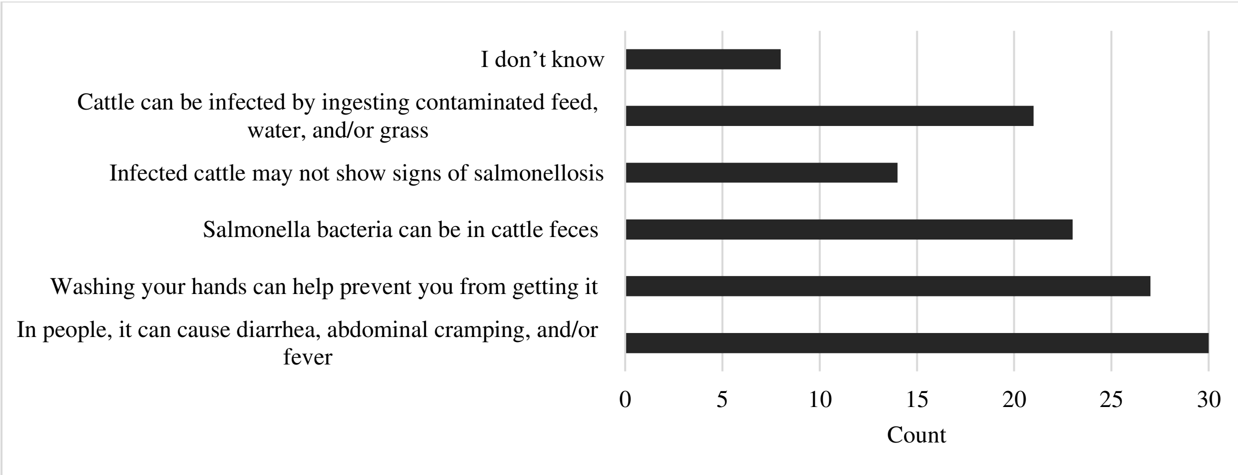

Figure 5.15. “What is true about salmonellosis? Select all that apply.” N=47.

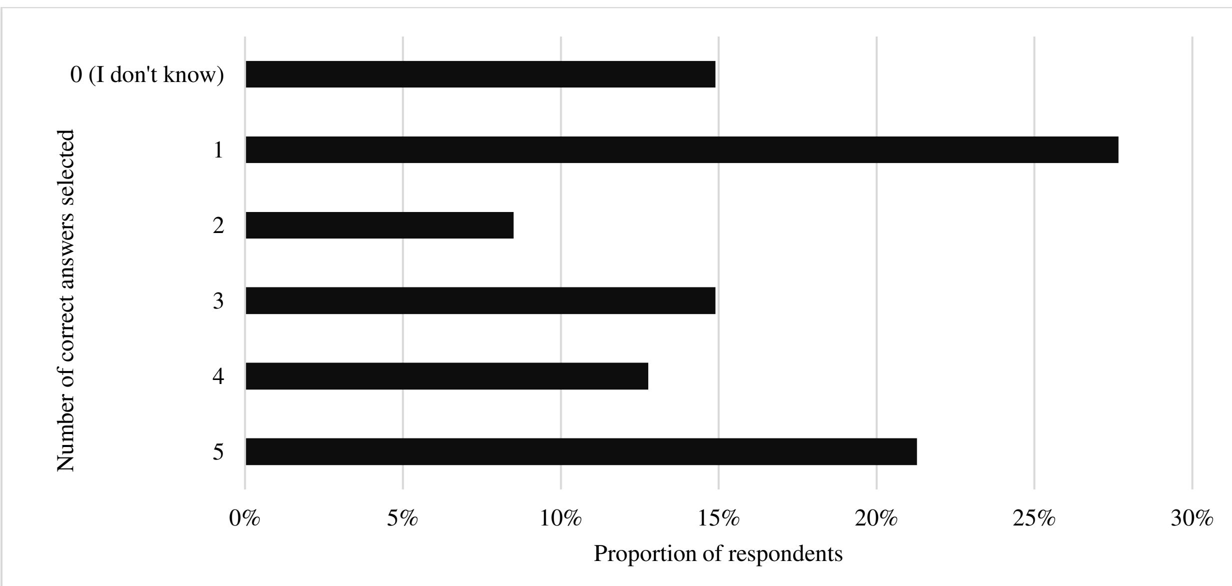

Figure 5.16. “What is true about salmonellosis? Select all that apply.” Based on answer options in Figure 5.15. N=47.

When asked to identify all true statements about salmonellosis, respondents who reported their farm provides training on preventing zoonoses from animals to people had a statistically greater likelihood of identifying all correct options compared to respondents who reported their farms do not provide such training. Respondents who said their farms provide integrated biosecurity-biosafety training had a smaller likelihood of identifying all correct options, but this finding was not significant (Table 5.15).

Table 5.15. Ability to identify all true statements about salmonellosis from a provided list and association with training and farm role; Ability to identify salmonellosis symptoms in people from a provided list and association with training and farm role. *Significant at p <0.05.

What is true about salmonellosis? Identified all correct answers							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Identified all correct	Did not identify all			
Receive training on zoonotic disease spread from animals to people?	Yes	23	5	18	0.89 (0.22, 3.64)		1
	No	21	5	16	Ref		
Farm Personnel	Supervisor	15	5	10	2.7 (0.64, 11.35)		0.32
	Worker	32	5	27	Ref		
Training on preventing diseases in people same time as livestock biosecurity training	Yes (Sometimes-Always)	29	6	23	0.72 (0.17, 3.07)	0.71	
	No (Never-Rarely)	15	4	11	Ref		
Farm provides training on preventing zoonoses from animals to people?	Yes		6	8	7.13 (1.18, 43.15)	0.039*	
	No/IDK		2	19	Ref		
What is true about salmonellosis? Identified symptoms in people (In people, it can cause diarrhea, abdominal cramping, and/or fever)							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Correctly identified symptoms in people	Did not identify symptoms in people			

Receive training on symptoms of cattle zoonoses in people	Yes	20	14	6	1.5 (0.42, 5.35)		0.76
	No/IDK	23	14	9	Ref		
Farm Personnel	Supervisor	15	10	5	1.2 (0.33, 4.36)		1
	Worker	22	20	12	Ref		

Attitudes

Impact of COVID-19 on Livestock Biosecurity

Several questions addressed the impact of the COVID-19 pandemic biosecurity. Workers tended to agree more than supervisors that the pandemic made it more difficult to practice livestock biosecurity (Figure 5.17).

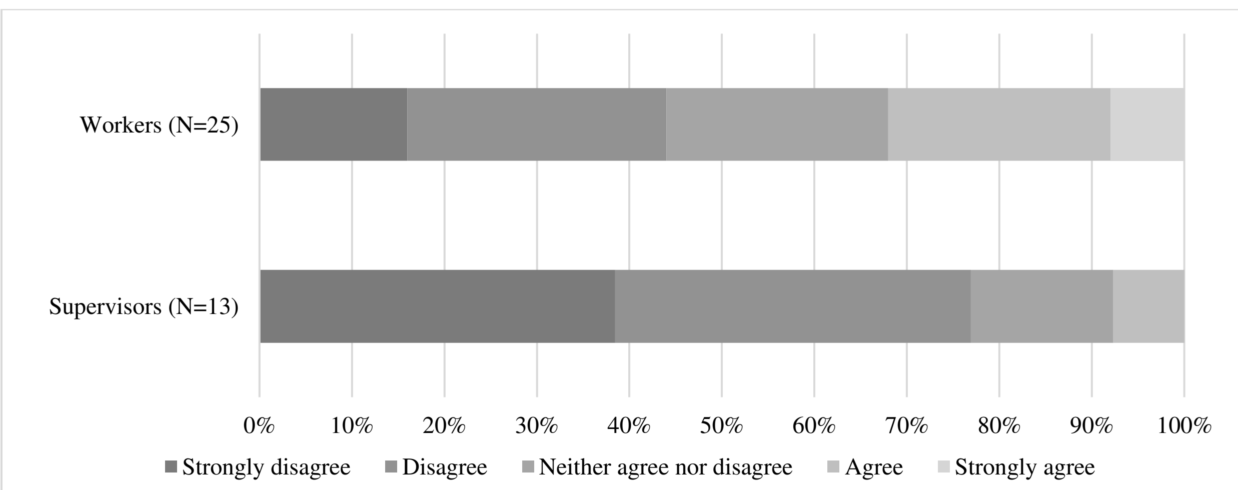

Figure 5.17. Attitudes toward livestock biosecurity. “How much do you agree with the following statement? The COVID-19 pandemic has made it more difficult for my farm to practice livestock biosecurity”

Over 50% of respondents agreed or strongly agreed that livestock biosecurity became more of a priority since the advent of COVID-19. Approximately 30% of respondents agreed or strongly agreed that maintaining manpower became more of a challenge. Approximately 23% of respondents agreed or strongly agreed that finding PPE had become more difficult since the start of COVID-19.

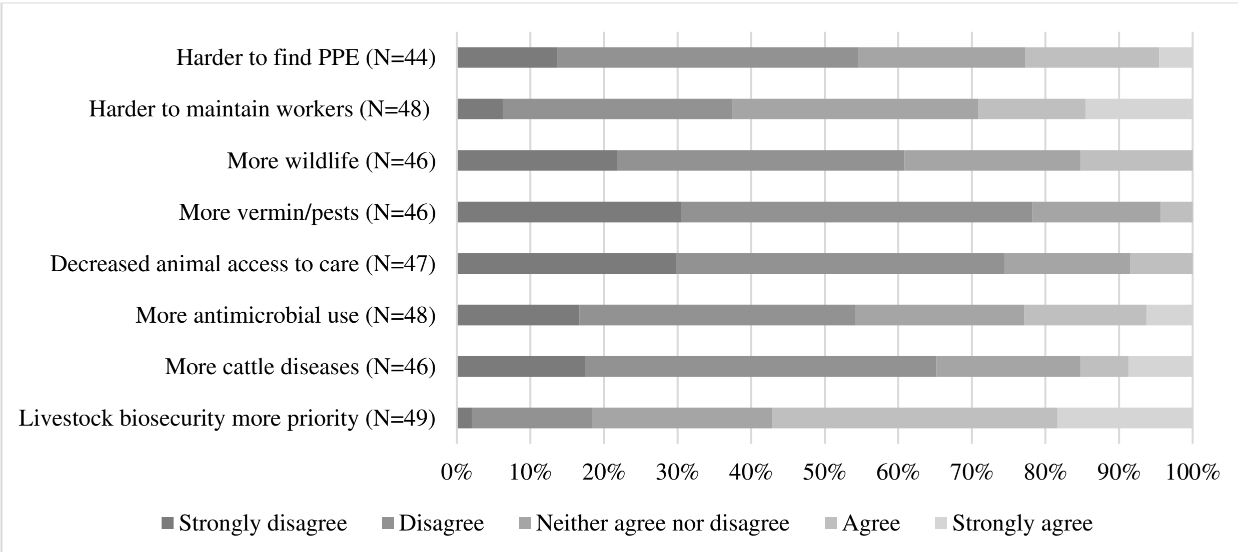

Figure 5.18. COVID-19 impact on the farm. “How much do you agree with the following statements? Since the COVID-19 pandemic began…”

Importance of Cattle and Human Disease Prevention

Most respondents found preventing zoonoses and preventing infectious diseases in cattle (i.e., livestock biosecurity) very to extremely important (Figure 5.19).

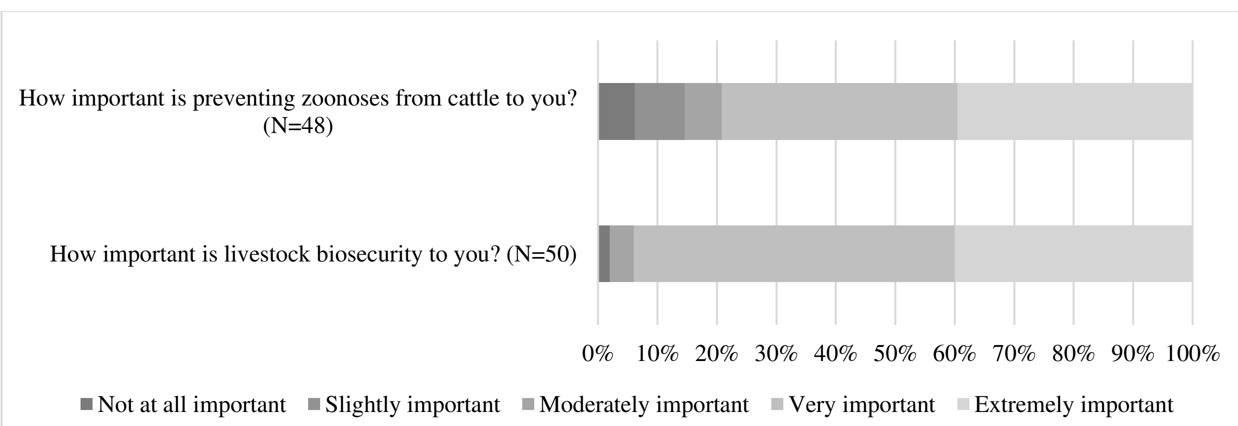

Figure 5.19. Importance of preventing zoonoses and importance of livestock biosecurity.

Impact of Livestock Biosecurity on Cattle and Human Health

Most respondents agreed that livestock biosecurity could prevent infectious diseases in both cattle and people on the farm. However, a greater proportion of respondents agreed that livestock biosecurity could prevent diseases in cattle than respondents agreed that it could prevent diseases in people (Figure 5.20).

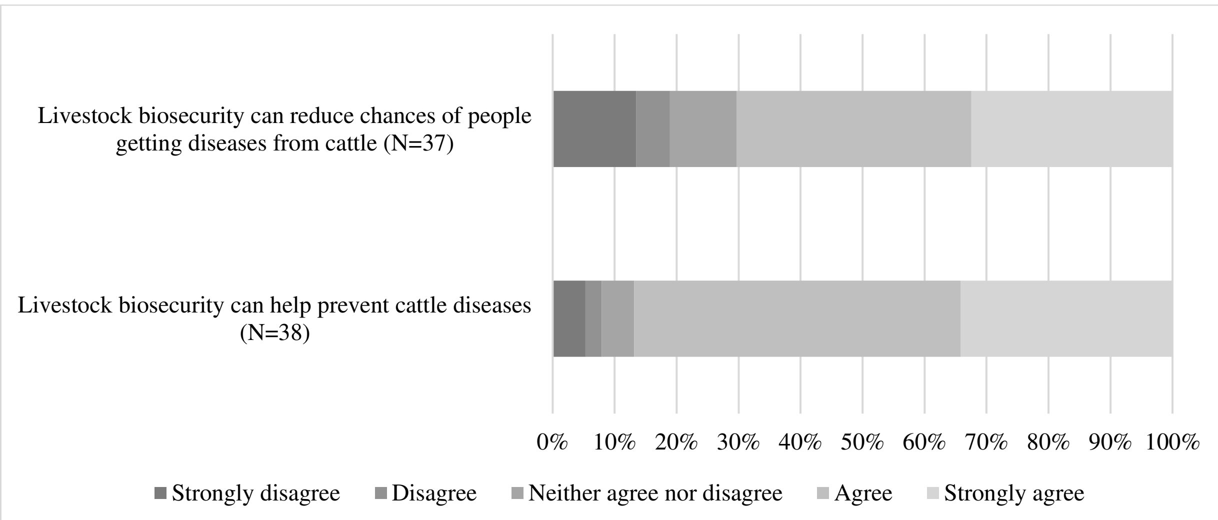

Figure 5.20. Attitudes toward livestock biosecurity. "How much do you agree with the following statements?"

Perception of Health Risks and Health Impacts

All participants were asked to score their perception of health risks for cattle zoonoses, COVID-19, seasonal influenza and farm accidents with respect to perceived likelihood (Figure 5.21) and health impact (Figure 5.22). Overall, participants scored seasonal influenza and COVID-19 as the most likely health occurrences. They scored getting a zoonotic disease from cattle as the least likely. However, when asked to score perceived impact of these health events, 69.4% of participants scored zoonotic diseases from cattle as very harmful to extremely harmful to their health, behind COVID-19 (75.5%), and accidents (72%).

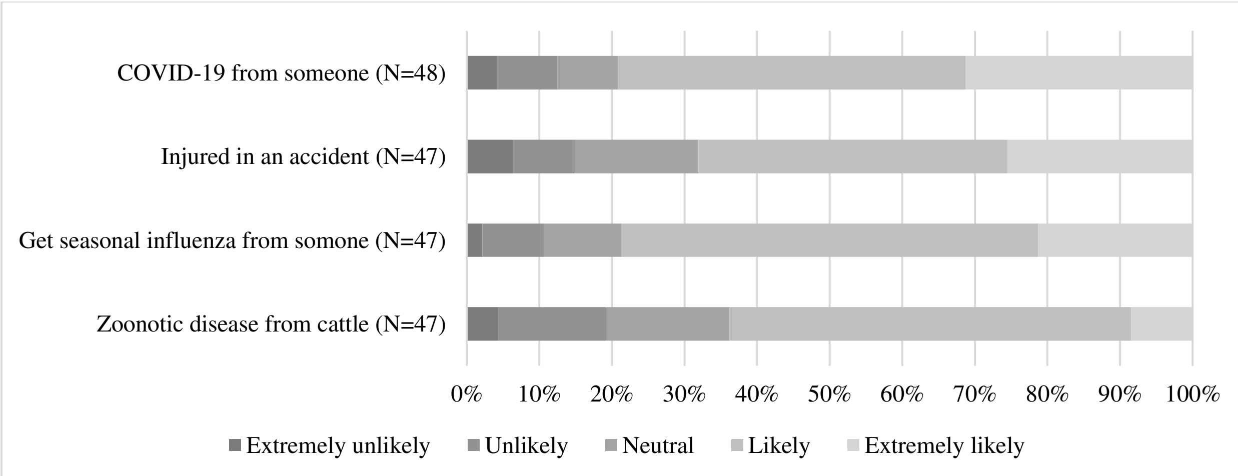

Figure 5.21. “Zoonoses are infectious diseases transmitted between animals and people…How likely are you to…”

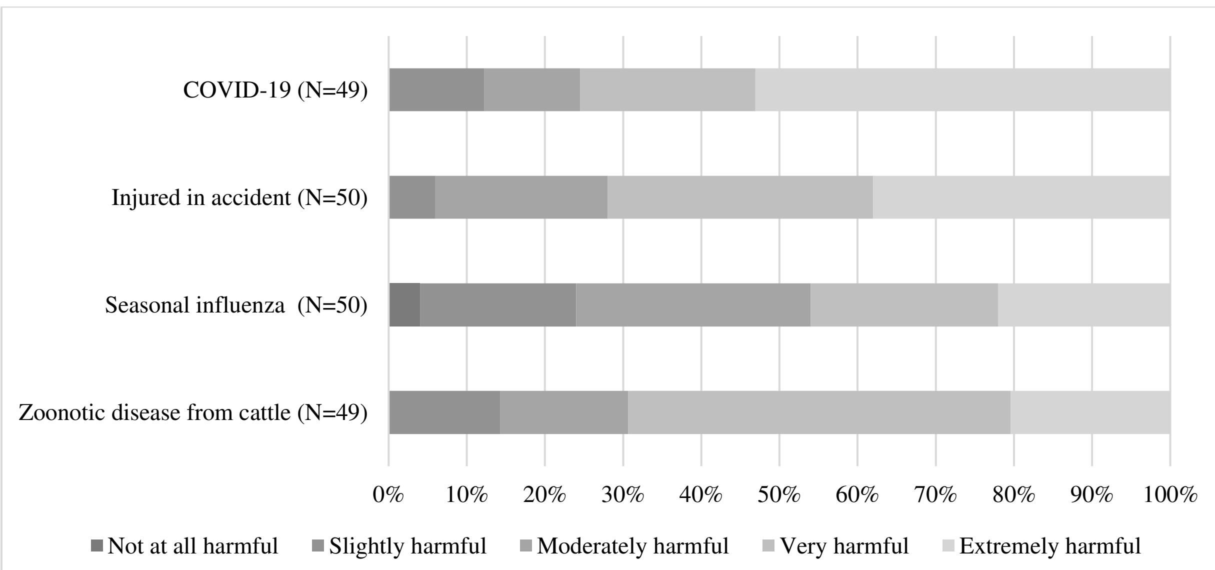

Figure 5.22. “If you got X on the farm, how harmful would it be to your heath?”

COVID-19 and Cattle

Participants were asked to rank their concern about getting COVID-19 from cattle. The majority (56%) of respondents were concerned (ranging from slightly concerned to extremely concerned) about getting COVID-19 from cattle.

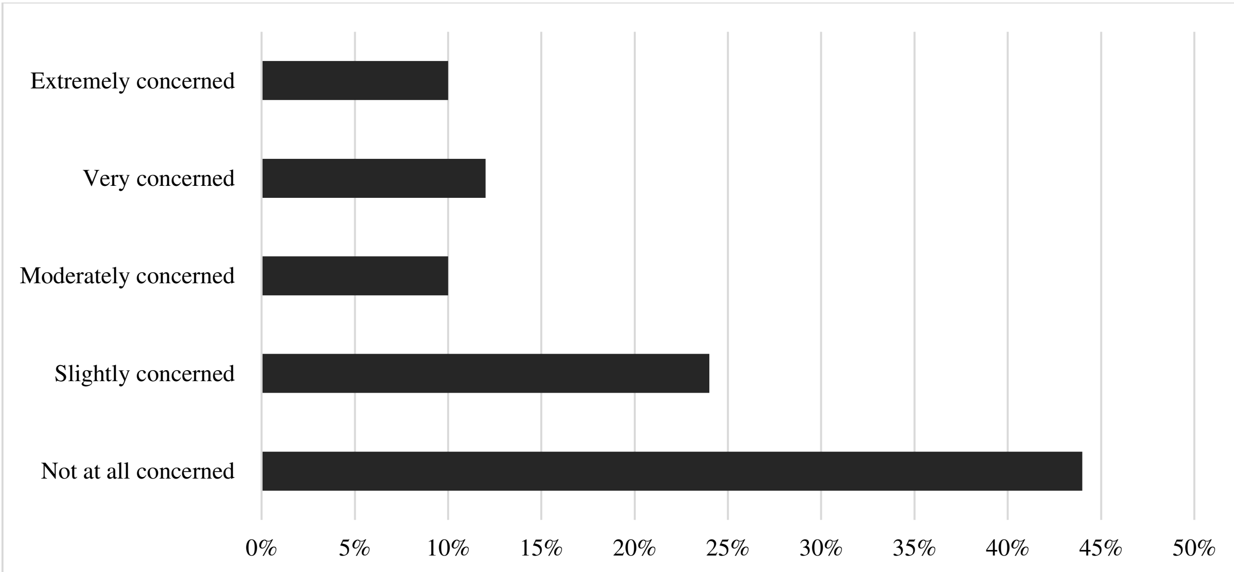

Figure 5.23. How concerned are you about getting COVID-19 from cattle? N=50.

When asked if they believed humans could infect cattle with the COVID-19 virus, 19.1% responded yes, 42.6% no, and 38.3% did not know (N=47). Most respondents indicated they were at least slightly concerned that humans on the farm would infect cattle with the COVID-19 virus (Figure 5.24).

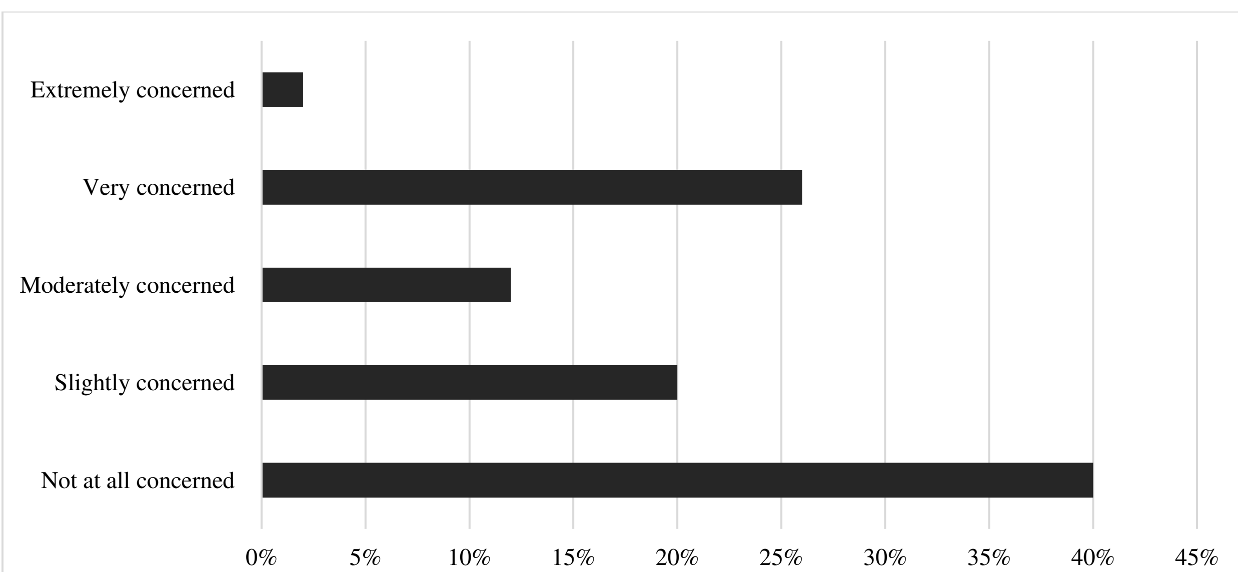

Figure 5.24. "How concerned are you that humans on the farm will infect cattle with the COVID-19 virus?" N=50.

Most Trusted and Used Sources for Information on Disease Prevention

Livestock Biosecurity

Private veterinarians were selected as the most frequently used and most trusted information sources for livestock biosecurity information among respondents. Dairy owners and dairy managers were also selected as among the most used and trusted. Close to 30% of respondents indicated that they most frequently use university researchers, but only 20.5% of respondents selected university researchers as the information source they would most trust. A greater proportion of respondents selected farm training as a used information source than as a trusted source (Figure 5.25).

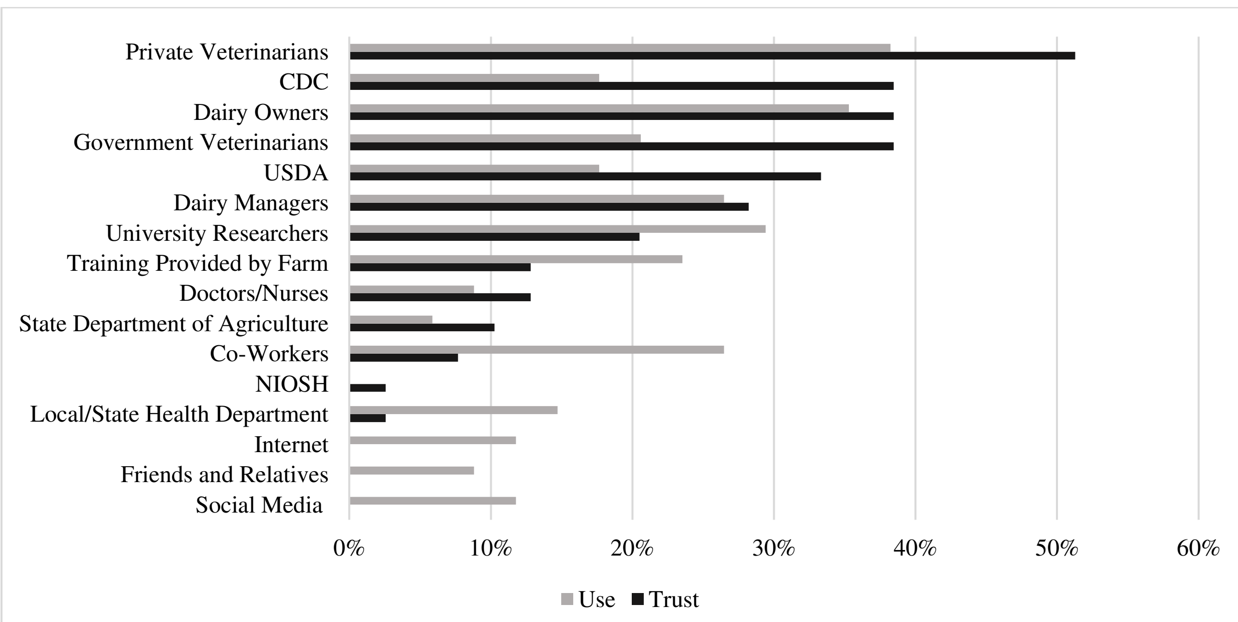

Figure 5.25. Percentage of respondents who most frequently use (N=39) and would trust (N=34) information sources for livestock biosecurity information. Participants were asked to select three sources for use and for trust among a provided list.

Animal-to Human Zoonotic Disease Prevention

Over half (51.3%) of respondents selected private veterinarians among their top three trusted sources for accurate information on preventing farm zoonotic diseases in people. However, only

29.3% of respondents indicated private veterinarians are among their top three used sources for this information. A high proportion of respondents also selected government veterinarians as trusted (25% of respondents) and used (17.1% of respondents) information sources. Doctors and nurses were second to private veterinarians as the most trusted sources but were selected with greatest frequency as most used. Regarding CDC and dairy owners, 35.4% of respondents selected each among their top three trusted information sources. However, a greater proportion of respondents selected dairy owners as the top three trusted information sources than they selected CDC. A greater proportion of respondents selected university researchers as a most frequently used source than they did as a most trusted source. Internet and social media were frequently used among respondents but infrequently selected as a top trusted information source. A small proportion of respondents selected farm training among the most trusted or most used information sources (Figure 5.26).

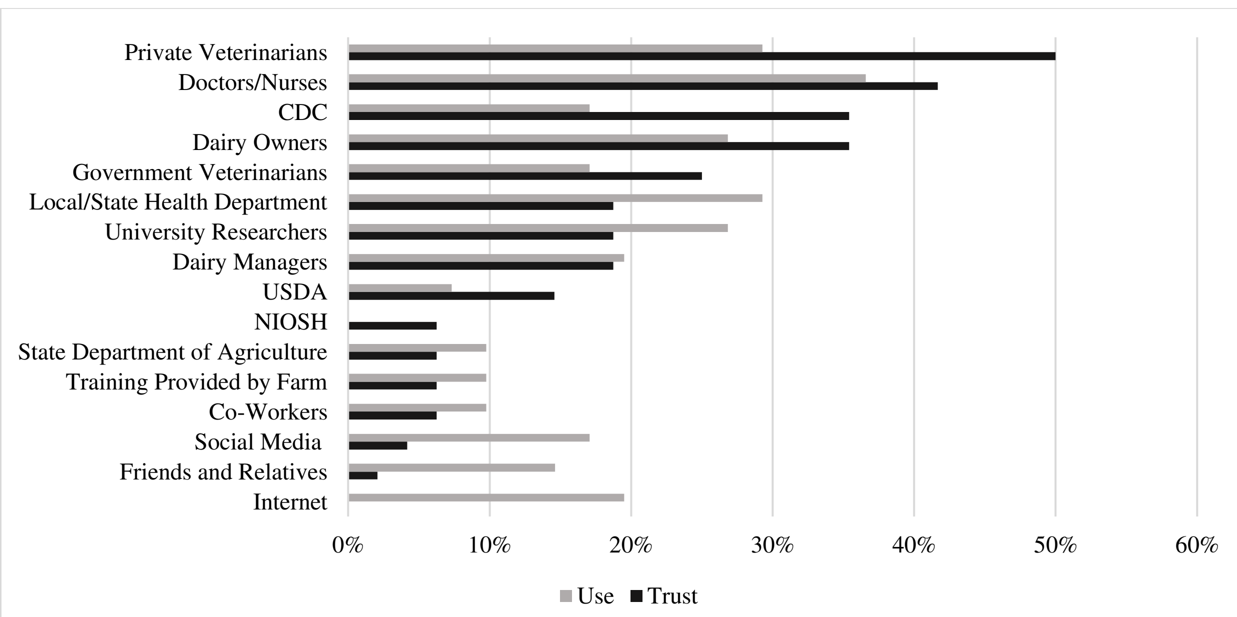

Figure 5.26. Percentage of respondents who most frequently use (N=41) and would trust (N=48) information sources for animal to human zoonotic disease information. Participants were asked to select three sources for use and for trust among a provided list.

Person-Person Diseases (COVID-19 and Seasonal Influenza)

Doctors and nurses were selected by the greatest proportion of respondents as trusted and used sources of information on communicable diseases like COVID-19 and seasonal influenza. This was followed by the CDC and local/state health departments. Private veterinarians were selected by 23.9% of respondents as a trusted information source, but only 2.5% of respondents selected private veterinarians as a most frequently used information source. Approximately 28% of respondents selected university researchers as used information sources, but only 17.4% of respondents indicated they would most trust university researchers. A high proportion of respondents selected internet and social media as used sources of information, but few respondents considered these among their top three trusted sources. A small proportion of respondents selected farm training as a most frequently used or trusted information source.

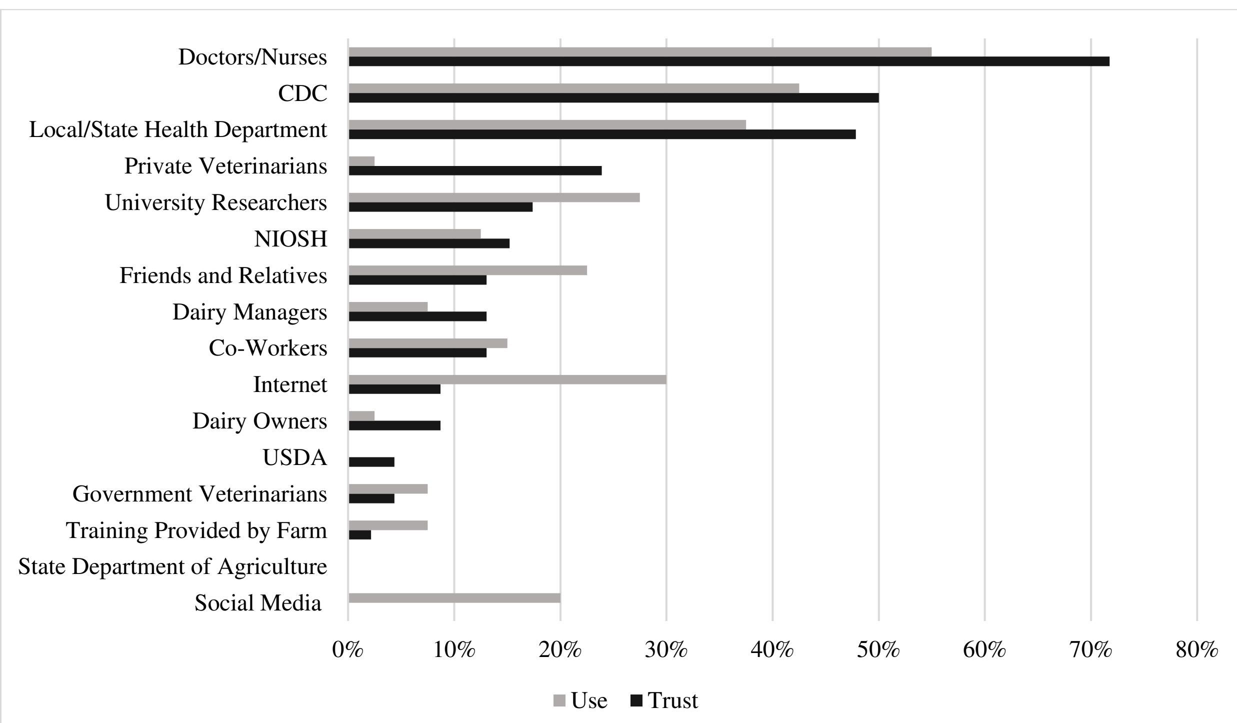

Figure 5.27. Percentage of respondents who most frequently use (N=40) and would trust (N=46) information sources for information on infectious diseases transmitted person to person. Participants were asked to select three sources for use and for trust among a provided list.

Obstacles to Practicing Stronger Livestock Biosecurity and Infection Prevention and Control

The top five most frequently identified factors preventing the farm from practicing stronger livestock biosecurity included lack of animal isolation/quarantine space, lack of farm concern about cattle infectious diseases, lack of personnel biosecurity policy compliance, lack of livestock disease prevention knowledge, and lack of labor availability. Less than 40% of respondents ranked PPE availability as a factor (Table 5.16)

Table 5.16. "Do you think the following prevent the farm from practicing stronger livestock biosecurity?"

Question	Yes (%)	No (%)
Not enough space for animal isolation or quarantine (N=45)	48.89	51.11
Lack of farm concern about cattle infectious diseases (N=42)	47.62	52.38
Not enough farm personnel compliance with biosecurity policies (N=42)	47.62	52.38
Not enough knowledge about livestock diseases and how to prevent them (N=41)	46.34	53.66
Not enough labor/manpower (N=46)	45.65	54.35
Not enough time (N=45)	42.22	57.78
Not enough communication from leadership about livestock biosecurity expectations (N=45)	42.22	57.68
Not enough space to prevent animals from crowding (N=43)	41.86	58.14
Not enough carcass storage and disposal ability (N=41)	41.46	58.54
Not enough handwashing stations with soap and water (N=44)	40.91	59.09
Inability to control pests/vermin or wildlife (N=42)	40.48	59.52
Lack of farm belief that livestock biosecurity is worth the time/effort (N=42)	40.48	59.52
Shortages of cleaning and disinfecting equipment/agents (N=39)	38.46	61.54
Not enough enforcement of biosecurity policies (N=42)	38.1	61.9
Not enough space for animal housing (N=45)	37.78	62.22
Not enough PPE (N=40)	37.5	62.5
Not enough money (N=42)	28.57	71.43

Poor ventilation (N=42)	16.67	83.33

When analyzed by farm role, supervisors compared to workers had significantly less likelihood of believing PPE availability, lack of personnel biosecurity compliance, and lack of farm concern about cattle infectious diseases prevented the farm from practicing stronger livestock biosecurity (Table 5.17).

Table 5.17. Belief that a factor prevents the farm practicing stronger livestock biosecurity and association with farm role *Significant at p <0.05.

Question	Categories	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Yes	No			
Lack of space to prevent animal crowding	Supervisor	12	3	19	0.38 (0.09,1.66)	0.3	
	Worker	32	15	17	Ref		
Lack of belief livestock biosecurity worth time/effort	Supervisor	13	3	10	0.32 (0.73,1.41)	0.18	
	Worker	19	14	15	Ref		
Inadequate airflow/ventilation	Supervisor	13	1	12	0.32 (0.03, 2.97)	0.4	
	Worker	29	6	23	Ref		
Lack of handwashing stations with soap/water	Supervisor	14	3	11	0.26 (0.06, 1.10)	0.1	
	Worker	31	16	15	Ref		
PPE availability	Supervisor	13	1	12	0.07 (0.01, 0.68)	0.013*	
	Worker	27	14	13	Ref		
Lack of personnel biosecurity compliance	Supervisor	13	2	11	0.11 (0.02,0.60)	0.007*	
	Worker	29	18	11	Ref		
Inadequate biosecurity policy enforcement	Supervisor	12	2	11	0.19 (0.04, 1.04)	0.08	

	Worker	29	14	15	Ref		
Lack of supervisorship communicating livestock biosecurity expectations	Supervisor	13	3	10	0.30 (0.07, 1.30)	0.18	
	Worker	32	16	16	Ref		
Lack of farm concern about cattle infectious diseases	Supervisor	13	2	11	0.11 (0.02, 0.60)	0.007*	
	Worker	29	18	11	Ref		
Lack of cleaning and disinfecting equipment/agents	Supervisor	12	2	10	0.22 (0.04, 1.17)	0.08	
	Worker	27	13	14	Ref		
Lack of livestock disease prevention knowledge	Supervisor	13	3	10	0.23 (0.05, 1.0)	0.052	
	Worker	28	16	12	Ref		
Labor availability	Supervisor	15	7	8	1.06 (0.31, 3.66)		1
	Worker	31	14	17	Ref		
Time	Supervisor	14	6	8	0.53 (0.15, 1.93)		0.52
	Worker	29	17	12	Ref		

Across farms, the top five identified obstacles to stronger human diseases prevention included lack of belief that preventing diseases in human is worth the time/effort, lack of farm personnel compliance with infection prevention/control policies, lack of labor availability, lack of farm concern about cattle zoonoses affecting people, and lack of supervisorship communication on expectations about how to prevent diseases in people. Less than 40% of respondents ranked PPE availability as a factor (Table 5.18).

Table 5.18. Do you think the following prevent the farm from practicing stronger infection prevention/control (preventing zoonoses from cattle or diseases transmitted person-person like COVID-19?

Question	Yes (%)	No (%)
Lack of belief that preventing diseases in humans is worth the time/effort (N=44)	54.55	45.45
Not enough farm personnel compliance with infection prevention/control policies (N=45)	53.30	46.70
Not enough labor/manpower (N=45)	48.89	51.11
Lack of farm concern about cattle zoonotic diseases affecting people (N=44)	47.73	52.27
Not enough communication from leadership about expectations on how to prevent diseases in people (N=45)	46.67	53.33
Not enough leadership enforcement of infection prevention/control policies (N=45)	46.67	53.33
Not enough space to prevent people from crowding at work (N=44)	45.45	54.55
Not enough handwashing stations with soap and water (N=44)	40.91	59.09
Not enough time (N=45)	40.00	60.00
Not enough farm knowledge about cattle zoonotic diseases and how to prevent people from getting them (N=45)	40.00	60.00
Not enough PPE (N=44)	38.64	61.36
Lack of farm concern about COVID-19 affecting people (N=43)	37.21	62.79
Not enough farm knowledge about COVID-19 and how to prevent people from getting it (N=45)	35.56	64.44
Not enough carcass storage and disposal ability (N=45)	35.56	64.44
Not enough ability to ensure adequate ventilation/airflow (N=44)	34.09	65.91
Not enough money (N=45)	28.89	71.11
Shortages of cleaning and disinfecting equipment/agents (N=45)	28.89	71.11

When analyzed by farm role, supervisors compared to workers had significantly less likelihood of thinking lack of handwashing stations with soap and water, PPE availability, lack of supervisorship communicating disease prevention expectations, and lack of cleaning and disinfecting equipment agents prevented the farm from practicing stronger infection prevention/control (Table 5.19).

Table 5.19. Belief that a factor prevents the farm practicing stronger infection prevention/control (preventing zoonoses from cattle or diseases transmitted person-person like COVID-19? and association with farm role *Significant at p <0.05.

Question	Categories	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Yes	No			
Lack of space to prevent people crowding	Supervisor	14	3	11	0.21 (0.05, 0.90)	0.05	
	Worker	30	17	13	Ref		
Lack of belief human disease prevention worth time/effort	Supervisor	14	5	9	0.32 (0.09, 1.21)		0.16
	Worker	30	19	11	Ref		
Inadequate ventilation/airflow	Supervisor	14	0	14	NA	NA	
	Worker	30	15	15	Ref		
Lack of handwashing stations with soap/water	Supervisor	14	2	12	0.15 (0.03, 0.77)	0.021*	
	Worker	30	16	14	Ref		
PPE availability	Supervisor	14	1	13	0.07 (0.01, 0.58)	0.003*	
	Worker	30	16	14	Ref		
Lack of infection prevention/control compliance	Supervisor	14	4	10	0.22 (0.06, 0.87)	0.051	
	Worker	31	20	11	Ref		
Lack of supervisorship infection prevention/control policy enforcement	Supervisor	14	3	11	0.21 (0.05, 0.91)	0.052	
	Worker	32	18	14	Ref		
Lack of supervisorship communicating disease prevention expectations	Supervisor	14	2	12	0.11 (0.02, 0.55)	0.004*	
	Worker	31	19	12	Ref		
Lack of concern about cattle zoonoses affecting people	Supervisor	14	5	9	0.52 (0.14, 1.93)		0.51
	Worker	29	15	14	Ref		
Lack of cleaning and disinfecting equipment/agents	Supervisor	14	1	13	0.12 (0.01, 1.05)	0.038*	

	Worker	31	12	19	Ref		
Lack of zoonosis prevention knowledge	Supervisor	14	5	9	0.77 (0.21, 2.84)		0.95
	Worker	31	13	18	Ref		
Labor availability	Supervisor	14	6	8	0.70 (0.20, 2.51)		0.82
	Worker	31	16	15	Ref		
Time	Supervisor	14	3	11	0.29 (0.07, 1.25)	0.11	
	Worker	31	15	16	Ref		

Efficacy of Interventions to Prevent Zoonotic Diseases from Cattle to People on Dairy Farms

Respondents tended to consider preventive practices as effective in preventing zoonoses from cattle on dairy farms. All respondents considered injection safety, cleaning and disinfecting animal common areas and equipment, ventilation in animal spaces, and monitoring animals for diseases as at least moderately effective in preventing zoonoses from cattle. Hand hygiene and glove use were considered very effective by 88% and 84% of respondents, respectively. Approximately 84% of respondents also considered isolating sick animals and reporting sick animals as very effective. Ensuring cattle access to medical care was ranked as “very effective” by 87.8% of respondents. Respondents considered disinfecting footbaths, cloth face covers, N-95 respirators, surgical masks, and ensuring sunlight in animal housing, vehicles, and equipment as less effective than hand hygiene and gloves (Figure 5.28).

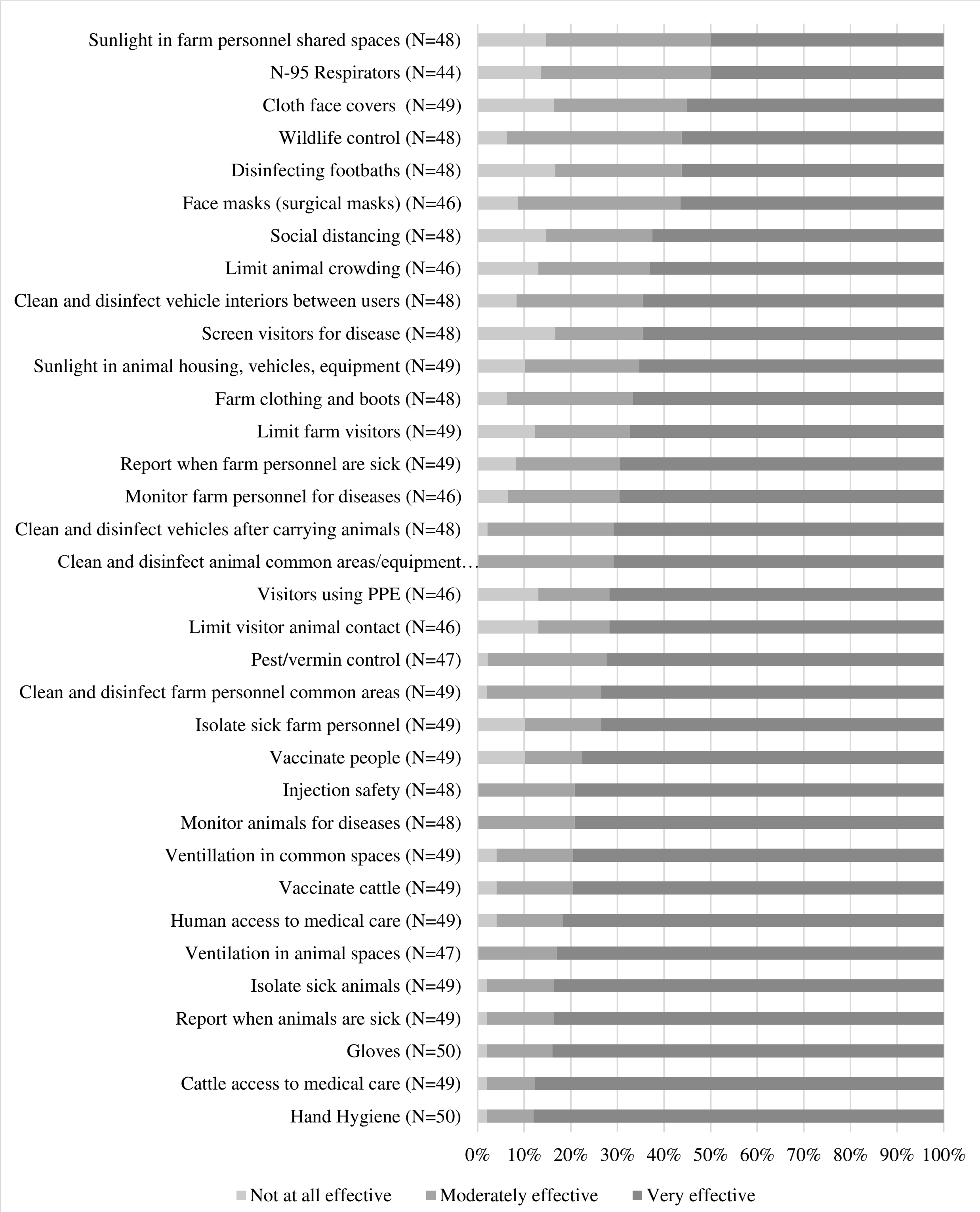

Figure 5.28. Perceived efficacy of preventive practices for zoonoses. “How effective do on think the following practices are in preventing zoonotic diseases from cattle to people on dairy farms?”

When analyzed by farm role, there were no significant differences in likelihood of supervisors compared to workers in believing preventive practices were effective or not (Table 5.20).

Table 5.20. Perceived efficacy of select factors in preventing zoonotic diseases from cattle on dairy farms and association with farm role and association with farm role *Significant at p <0.05.

How effective do you think the following practices are in preventing zoonotic diseases from cattle to people on dairy farms?							
Question	Categories	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Moderately-Very Effective	Not at all Effective			
Hand Hygiene	Supervisor	15	15	0	NA	NA	
	Worker	35	34	1	Ref		
Wearing Gloves	Supervisor	15	15	0	NA		
	Worker	35	34	1	Ref		
Wearing Cloth Face Covers	Supervisor	14	12	2	1.24 (0.22, 7.04)	1	
	Worker	35	29	6	Ref		
Wearing Face Masks (e.g., surgical masks)	Supervisor	14	12	2	0.4 (0.05, 3.17)	0.57	
	Worker	32	30	2	Ref		
Wearing N-95 Respirators	Supervisor	14	12	2	0.92 (0.15, 5.75)	1	
	Worker	30	26	4	Ref		
Wearing Farm-Designated Clothing and Boots	Supervisor	14	13	1	0.82 (0.07, 9.76)	1	
	Worker	34	32	2	Ref		
Using Disinfecting Foot Baths	Supervisor	14	14	0	NA	NA	
	Worker	34	26	8	Ref		
Limiting Number of Visitors on the Farm	Supervisor	13	11	2	0.71 (0.11, 4.43)	0.65	
	Worker	35	31	4	Ref		
Limiting Visitor Contact with Animals	Supervisor	14	13	1	2.4 (0.25, 22.77)	0.65	
	Worker	32	27	5	Ref		
Visitors using PPE	Supervisor	14	13	1	2.4 (0.25, 22.77)	0.65	
	Worker	32	27	5	Ref		
Ensuring Ventilation in Animal Spaces	Supervisor	14	14	0	NA	NA	
	Worker	33	33	0	Ref		

Ventilation in Farm Personnel Common Spaces (e.g., offices, break rooms, shared housing)	Supervisor	14	13	1	0.38 (0.02, 6.57)	0.49	
	Worker	35	34	1	Ref		
Sunlight in Animal Housing, Vehicles, Equipment	Supervisor	14	13	1	1.67 (0.17, 16.48)	1	
	Worker	35	31	4	Ref		
Sunlight in Farm Personnel Shared Spaces	Supervisor	14	11	3	0.49 (0.09, 2.54)	0.4	
	Worker	34	30	4	Ref		

Understanding Farm Rules and Expectations for Biosecurity and Zoonotic Disease Prevention

Most participants agreed they understand their farm's rules for zoonotic disease prevention and livestock biosecurity (Figure 5.29).

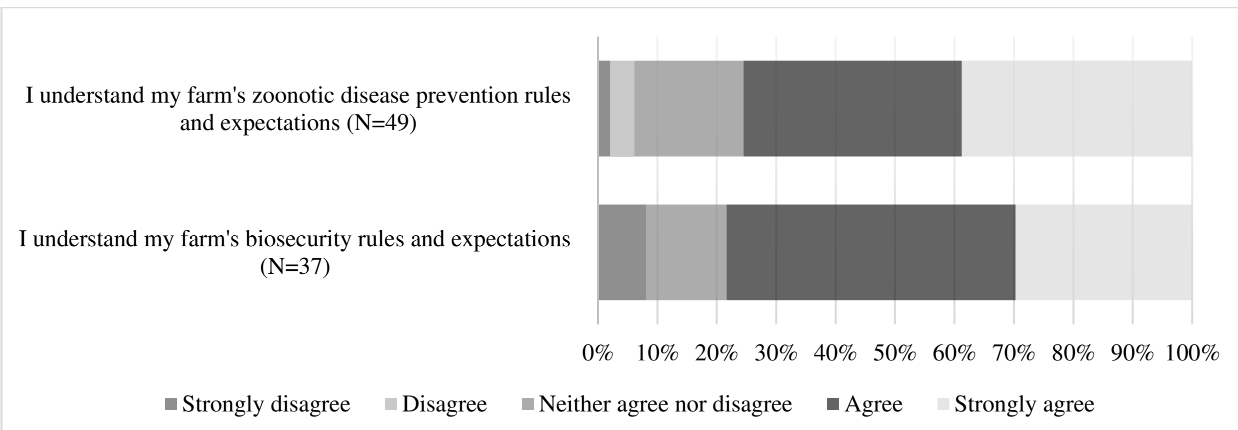

Figure 5.29. Attitudes toward understanding farm rules and expectations. How much do you agree with the following statements?

Most participants agreed they understand their farm's livestock biosecurity rules and expectations. However, 12.5% of workers versus 0% of supervisors said they strongly disagreed to this statement (Figure 5.30).

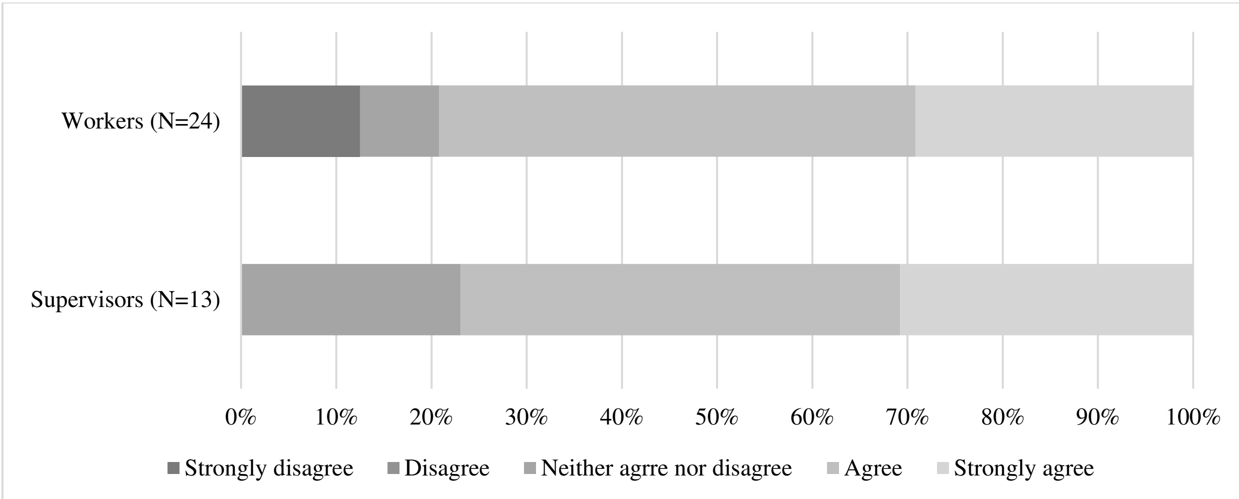

Figure 5.30. Attitudes toward livestock biosecurity. “How much do you agree with the following statement? I understand my farm’s biosecurity rules and expectations.”

When broken down by role on the farm, supervisors and workers tended to have similar understanding of their farm’s zoonotic disease prevention rules and expectations. However, 6.7% of supervisors versus 0% of workers strongly disagreed with this statement (Figure 5.31).

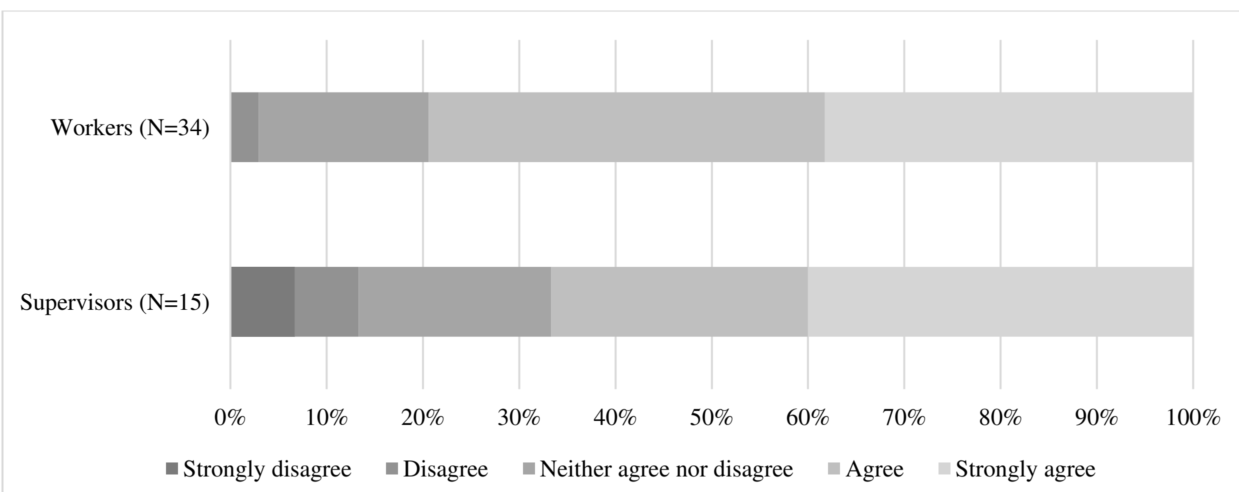

Figure 5.31. I understand my farm’s zoonotic disease prevention rules and expectations. N=49 (15 supervisors, 34 workers).

Attitudes toward Preventing Infectious Diseases in People

Most respondents (65.2%) agreed that they knew how to protect themselves from cattle zoonoses, and most (60.5%) disagreed that nothing could be done to prevent incidence of zoonoses on the farm. Only 34.8% agreed or strongly agreed that cattle zoonoses became more common since COVID-19, but 57.4% agreed that preventing zoonoses from cattle became more of a priority since the advent of COVID-19. Approximately 84% respondents agreed or strongly agreed that farm policies and practices help prevent zoonoses from cattle (Figure 5.32).

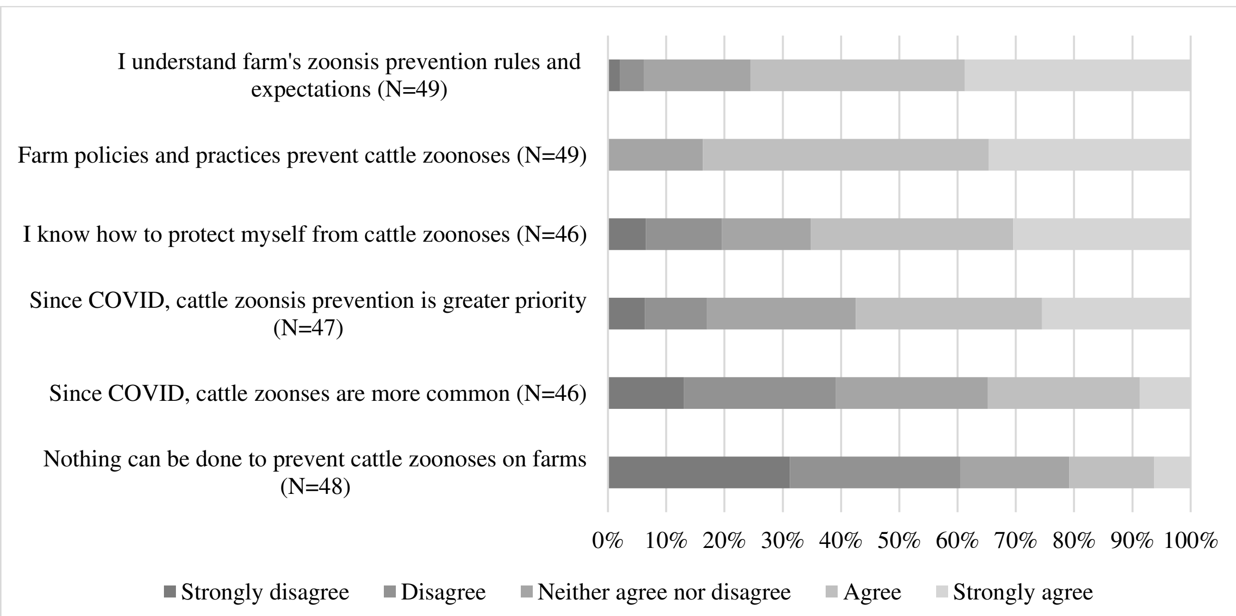

Figure 5.32. Attitudes on cattle zoonosis prevention. How much do you agree with the following statements?

Personal Protective Equipment: General

Almost all respondents agreed or strongly agreed that using PPE can help prevent zoonoses. Only 34% of respondents agreed or strongly agreed that PPE had been harder to find since the start of the COVID-19 pandemic. Most respondents agreed or strongly agreed that they had all the PPE they need (Figure 5.33).

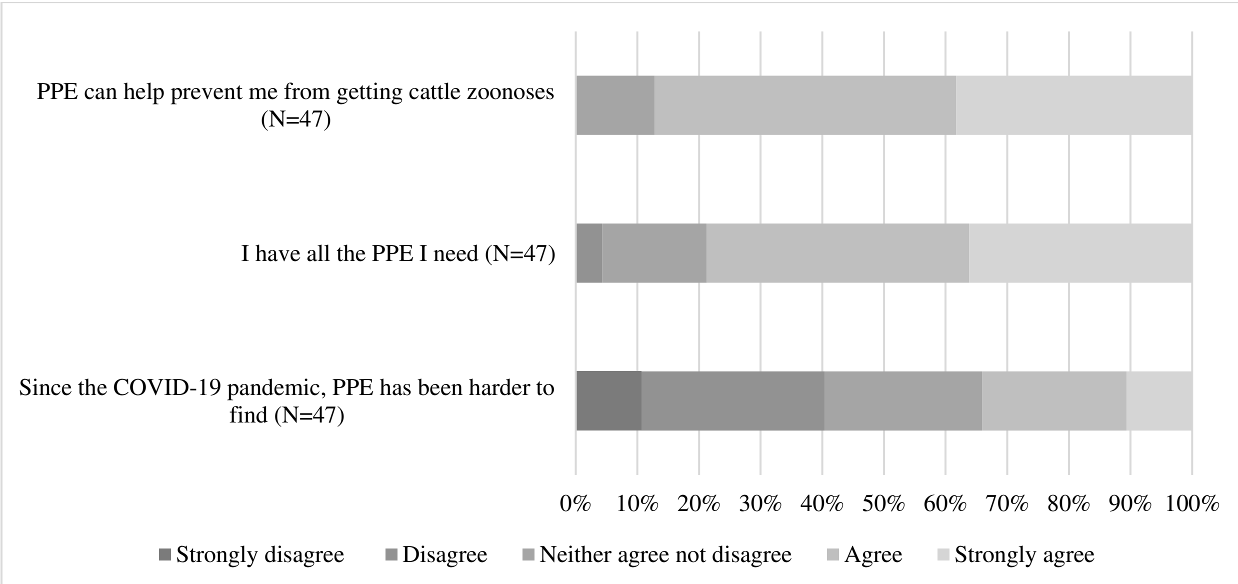

Figure 5.33. PPE and zoonotic disease prevention. "How much do you agree with the following?"

Personal Protective Equipment: Cloth Face Coverings

When asked about cloth face coverings, respondents tended to agree that they are useful in preventing infectious diseases transmitted person-person, but fewer agreed that cloth masks can reduce their chances of getting a zoonotic disease from an animal. Over half (54.4%) of respondents agreed or strongly agreed that cloth face masks interfere with their ability to do their job (Figure 5.34).

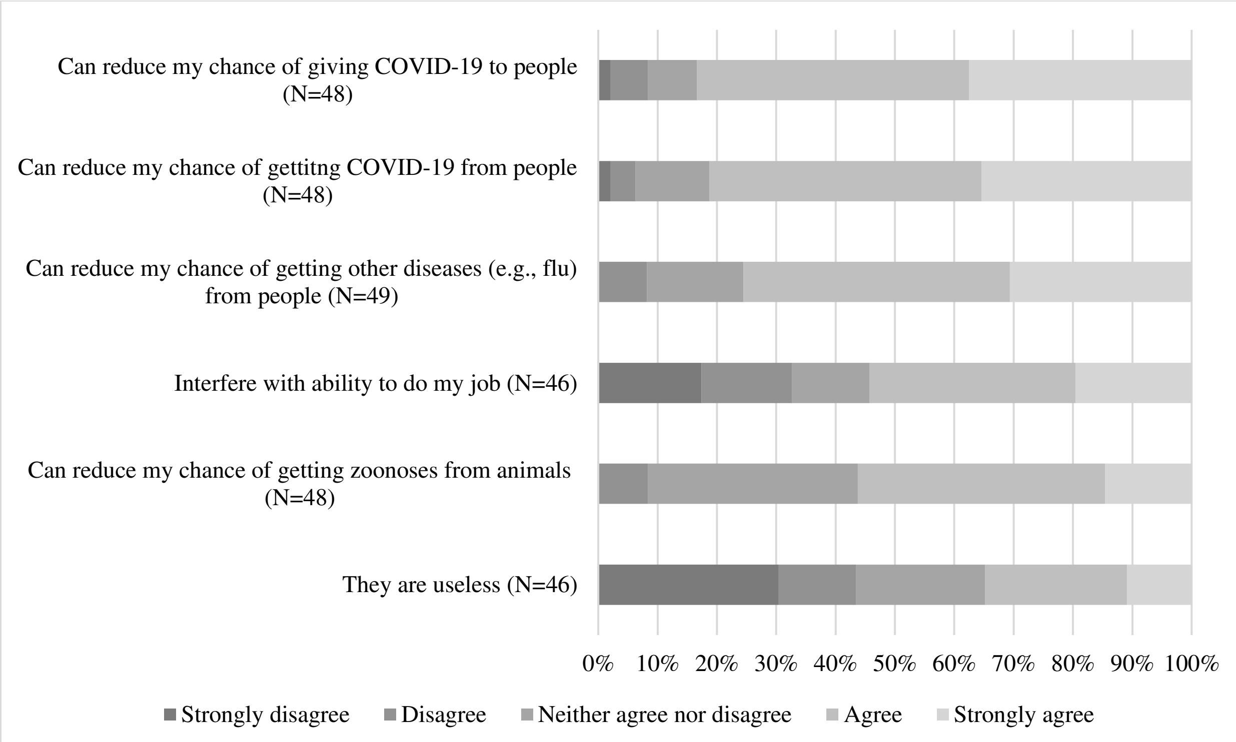

Figure 5.34. "How much do you agree or disagree with eh following statements about cloth face coverings?"

Personal Hygiene Access

Most respondents agreed or strongly agreed that they have access to hand sanitizer and handwashing facilities on the farm. However, access to hand sanitizer appears to be less than access to handwashing facilities.

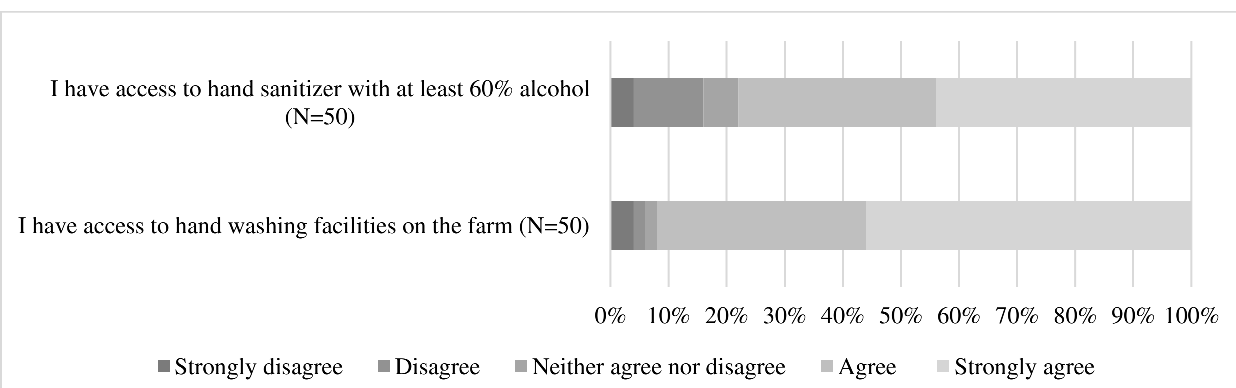

Figure 5.35. Personal hygiene. "How much do you agree or disagree with the following statements?"

Training

Almost all respondents agreed or strongly agreed that their livestock biosecurity training and zoonotic disease prevention training was provided in their preferred language, was worth the time, and that they are encouraged to provide feedback. A smaller proportion agreed or strongly agreed that their livestock biosecurity training provides accurate information (Figures 5.36 and 5.37).

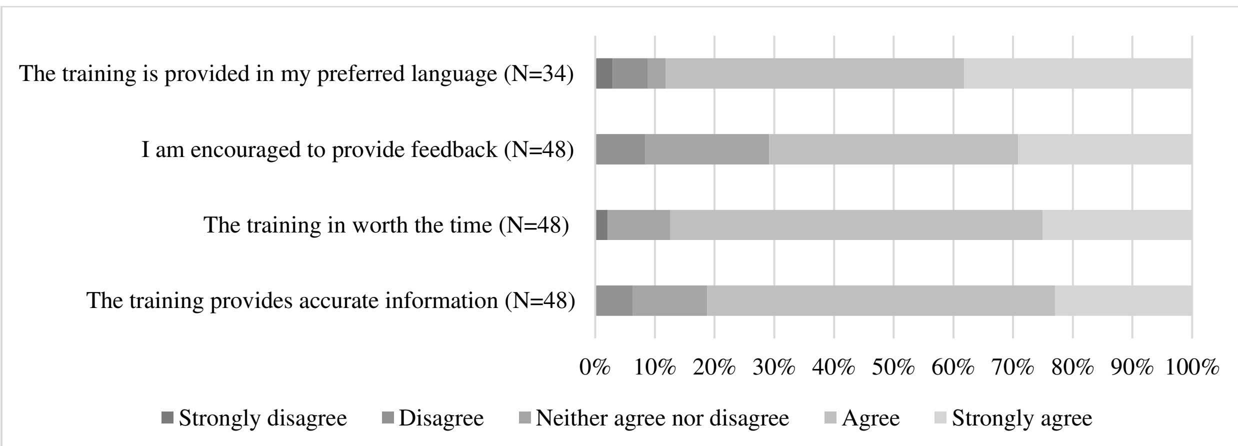

Figure 5.36. How much do you agree with the following statements about livestock biosecurity training on the farm?

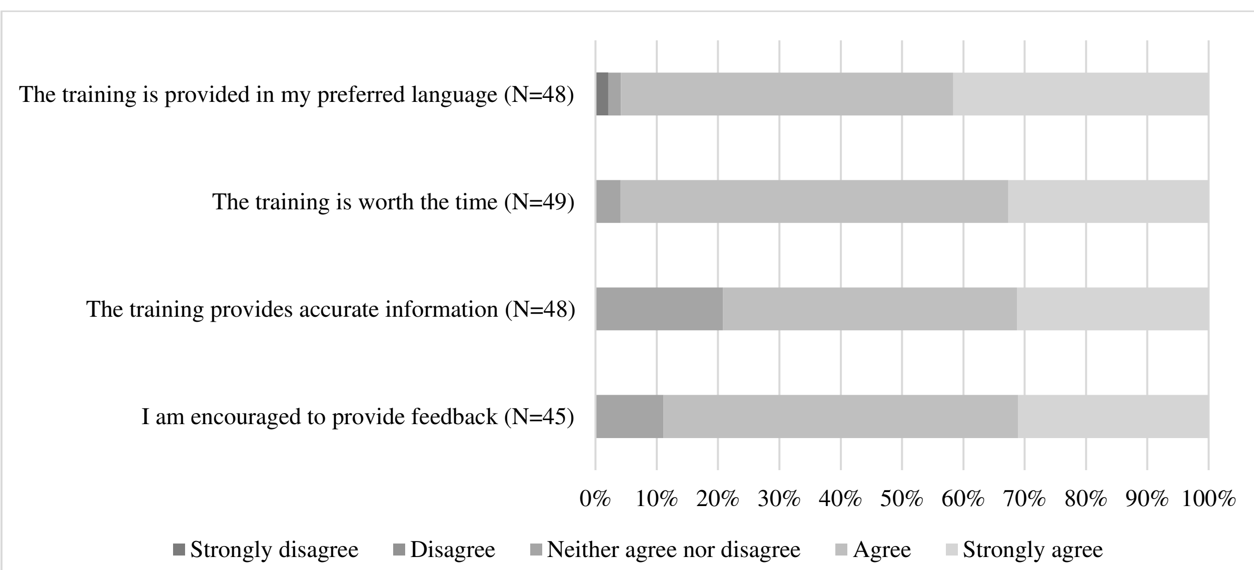

Figure 5.37. “How much do you agree with the following statements regarding your training on preventing infectious diseases (zoonotic diseases and person-to-person diseases like COVID-19?”

The most preferred methods of training were in-person training and on-the-job training by supervisors and peers. The least preferred methods of training were live webinars and cell phone apps (Figure 5.38).

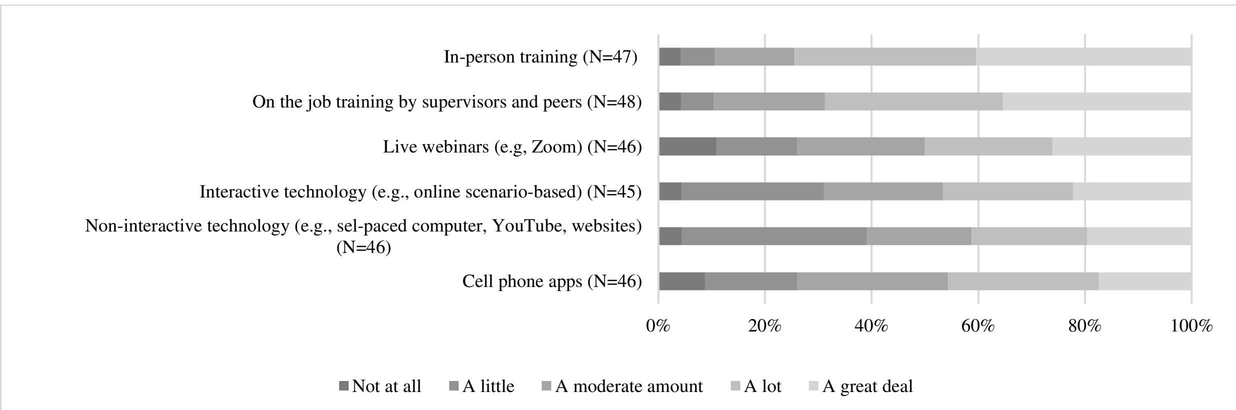

Figure 5.38. Preferred training methods. “How much would you want the following methods of training on the farm?”

Respondents indicated on-the-job training and in-person training were the most frequently used methods (Figure 5.39).

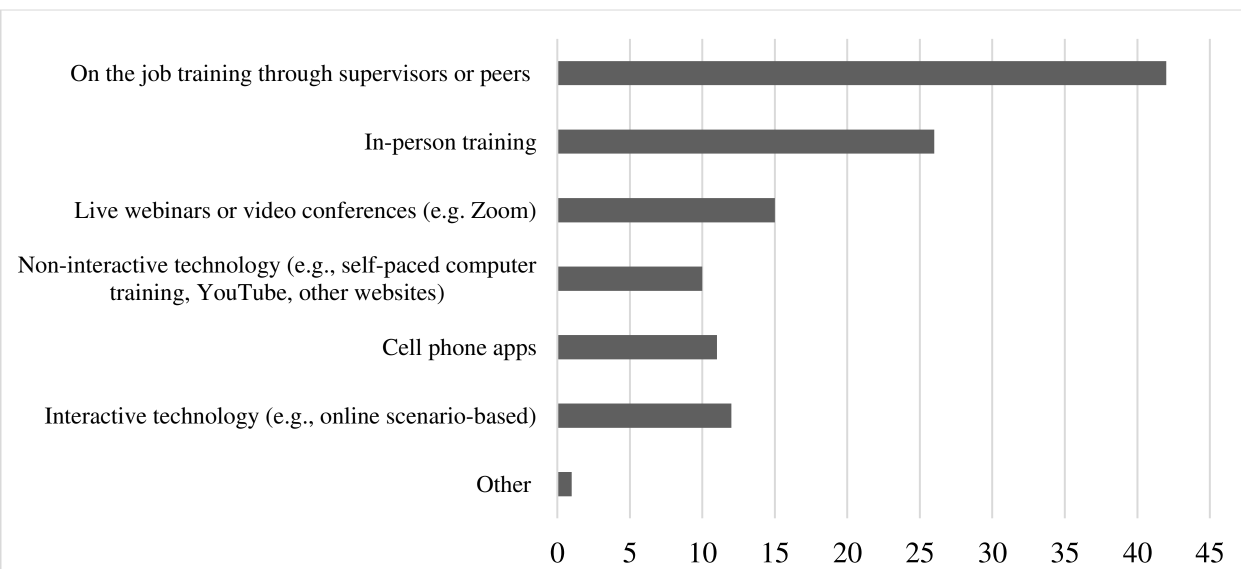

Figure 5.39. Which are used during training on preventing infectious diseases in people? Circle all that apply. N=45. Proportions represent respondents who included each option in their answer.

Sick Leave and Illness Reporting

Most respondents feel comfortable telling supervisors when they are sick, would report a zoonotic disease to their supervisors, understand their farm's sick leaves policies, and know how zoonoses from cattle could affect them, and would be encouraged to stay home if they had diarrhea from a cattle zoonosis. Almost half (46.7%) of respondents agree or strongly agree that zoonoses from cattle are under-reported on the farm (Figure 5.40). Most respondents reported knowing a person who got a zoonotic disease from animals on a farm, but few respondents believed they have ever gotten sick from animals on their current dairy farm. Few respondents believed cattle can infect people with the COVID-19 virus or that people can infect cattle with the virus. However, the proportion believing the latter was greater than that believing the former (Figure 5.41).

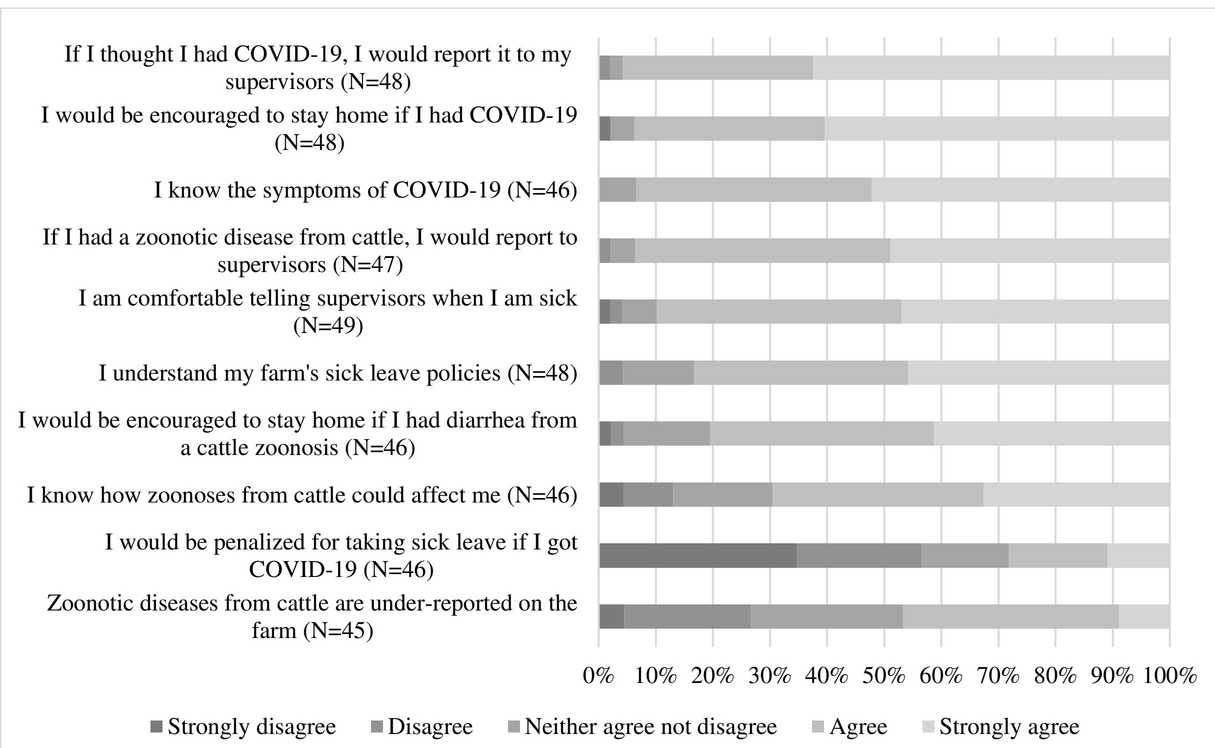

Figure 5.40. Sick leave and illness reporting. "How much do you agree with the following statements?"

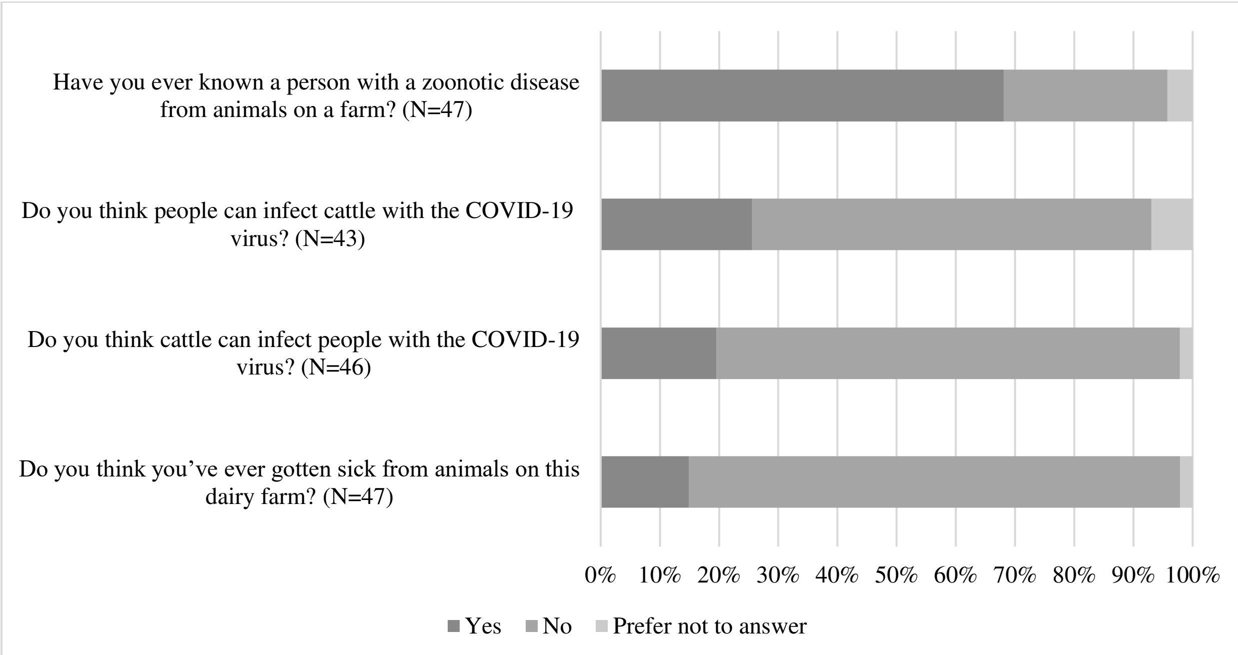

Figure 5.41. Experience with zoonoses and opinions on COVID-19.

There were no significant associations between perceived importance of preventing zoonoses from cattle to the respondent and various factor including zoonotic history, farm preventive practices, and farm role (Table 5.21)

Table 5.21. Importance of preventing cattle zoonoses and association with select factors. *Significant at p <0.05.

How important is preventing zoonoses from cattle to you?							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Slightly-Extremely Important	Not at all Important			
How important is livestock biosecurity to you?	Sightly-Extremely Important	48	45	3	NA	NA	
	Not at all important	0	0	0	Ref		
Do you think you've ever gotten sick from animals on this dairy farm?	Yes	7	6	1	0.32 (0.03, 4.16)	0.4	

	No/Prefer not to answer	39	37	2	Ref		
Have you ever known a person who got a zoonotic disease from animals on a farm?	Yes	9	8	1	0.47 (0.04, 5.85)	0.5	
	No/Prefer not to answer	36	34	2	Ref		
Does your farm have posters in English and Spanish in hazardous areas?	Yes	17	17	0	NA	NA	
	No/IDK	32	28	3	Ref		
If you got a zoonotic disease from cattle on the farm, how harmful would it be to your health?	Slightly-Extremely Harmful	48	46	2	NA	NA	
	Not at all Harmful	0	0	0	Ref		
Do you receive training on zoonotic disease spread from animals to people?	Yes	24	23	1	2.42 (0.20, 28.8)	0.59	
	No/IDK	21	19	2	Ref		
Does your farm provide training on preventing zoonoses from animals to people?	Yes	16	16	0	NA	NA	
	No/IDK	19	17	2	Ref		
Does your farm have someone in charge of preventing/controlling infectious diseases in people?	Yes	16	16	0	NA	NA	
	No/IDK	19	26	3	Ref		
Farm Personnel	Supervisor	15	14	1	0.93 (0.78, 11.18)	1	
	Worker	32	30	2	Ref		
Does your farm complete zoonotic disease checklists to identify farm vulnerabilities?	Yes	11	11	0	NA	NA	
	No/IDK	35	32	3	Ref		

Practices

When respondents were asked which pieces of evidence would motivate them to spend more time on livestock biosecurity, factors with the greatest proportion of respondents agreeing and strongly agreeing were improved animal welfare, preventing visitor introduction of diseases into the herd, and preventing cattle to humans zoonoses (Figure 5.42).

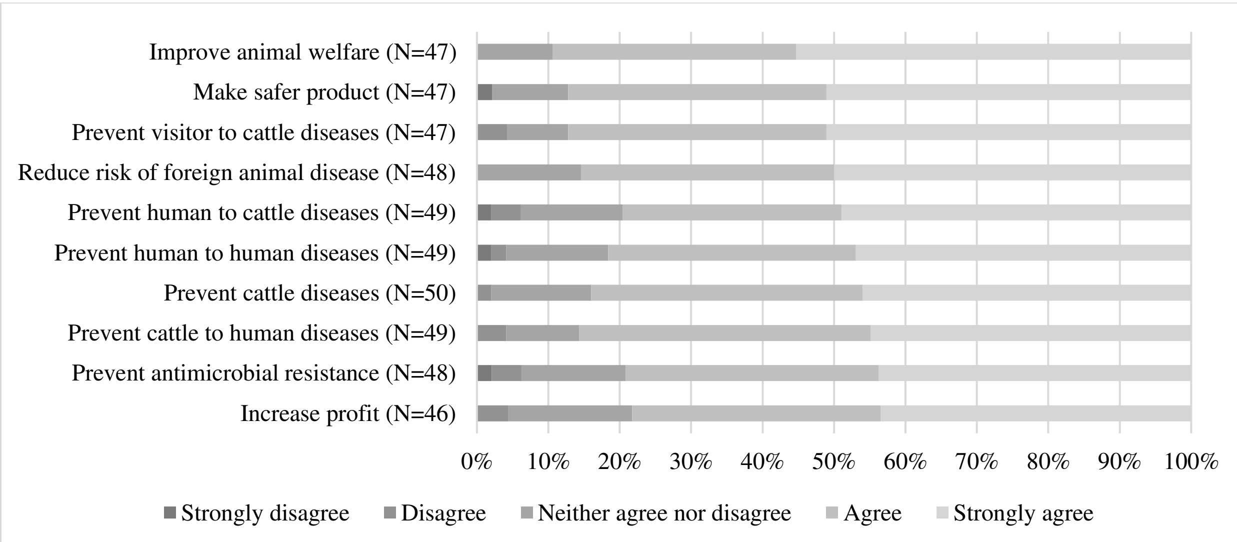

Figure 5.42. “I would increase the time I spent on livestock biosecurity if I had more evidence it could…”

Sick Leave, Illness Reporting, Hand Hygiene, Administrative Efforts

Results for supervisors are presented in Figure 5.43. Over 50% of respondents indicated their farm does not give workers a test to ensure they understand sick leave policies. Only 1/3 of respondents indicated their farms have Spanish and English posters for zoonotic disease prevention or keep written records for cleaning and disinfection of common areas. Only 20% of respondents reported that their farms complete zoonotic disease checklists to identify farm vulnerabilities, over 50% of respondents did not know if their farms completed such checklists. Less than half of respondents reported their farms have someone in charge of preventing/controlling infectious diseases in people, and 33.3% of respondents reported they did not know. Overall, at least one supervisor responded “I don’t know” to 14 of the 19 questions summarized in Figure 5.43.

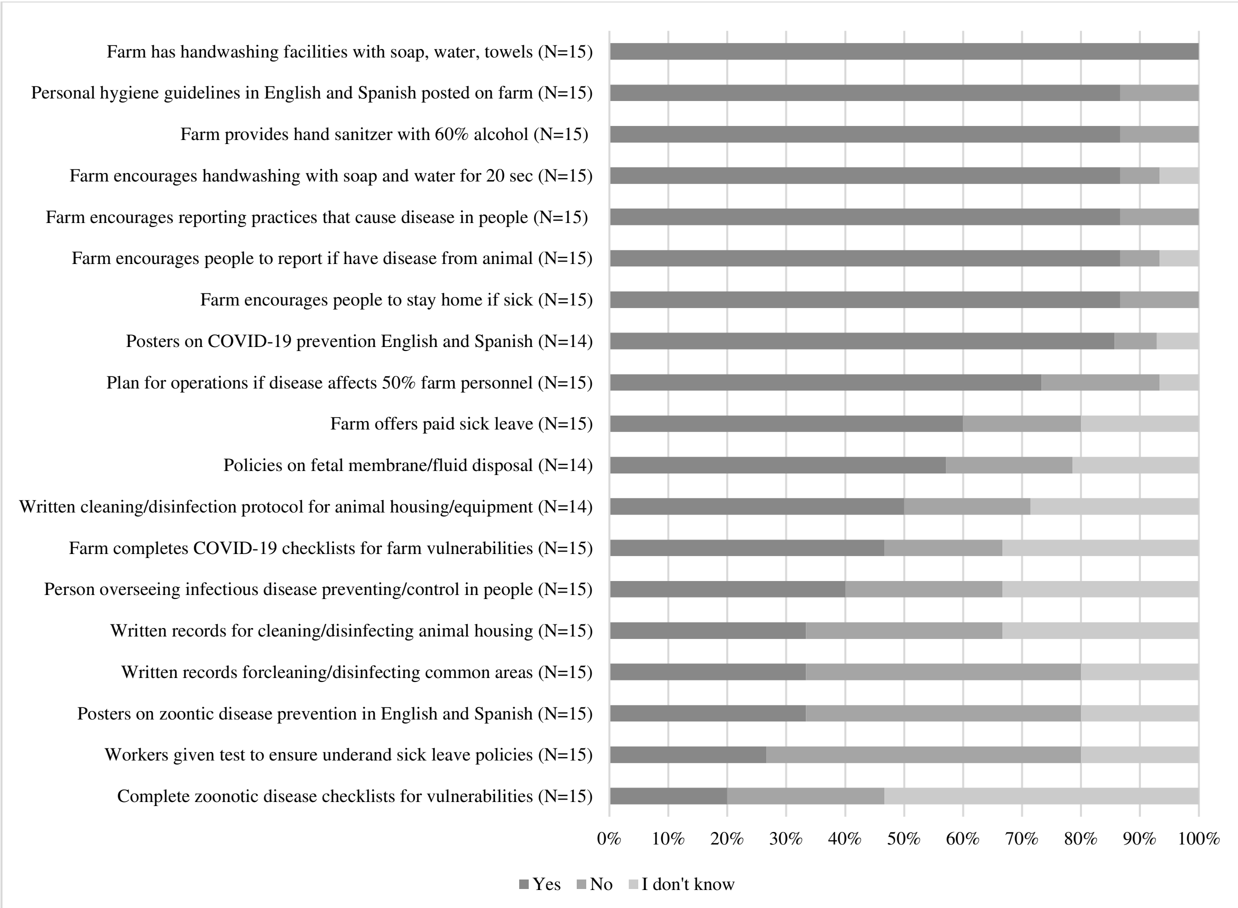

Figure 5.43. Supervisor response to farm practice questions on sick leave, illness reporting, hand hygiene, and administrative practices for zoonoses and COVID-19.

Practices: Training

Only 43.2% (16/37) respondents indicated their farms provide training on preventing zoonoses from animals to people, while 32.4% (12/37) and 24.3% (9/37) indicated “No” or “I don’t know”, respectively. Only 59.5% (22/37) respondents indicated their farms provide livestock biosecurity training, while 18.9% (7/37) and 21.62% (8/37) indicated “No” or “I don’t know”, respectively.

When asked about the frequency of livestock biosecurity and zoonotic disease training, the most commonly selected answer options were “When you start working”, “When farm supervisorship thinks it's needed", and "Once per month" (Figure 5.44). Few respondents indicated livestock biosecurity training (2/41) or zoonotic disease training (4/41) are provided when people get sick. More respondents selected "When animals get sick" rather than "When people get sick." For livestock biosecurity training, five respondents answered "Other" and provided, "Daily", "I don't know", "We haven't received it", and "4-5 times per year." For zoonotic disease training, three respondents answered "Other" and provided, "I don't know", "4-5 times per year", and "We haven't received it."

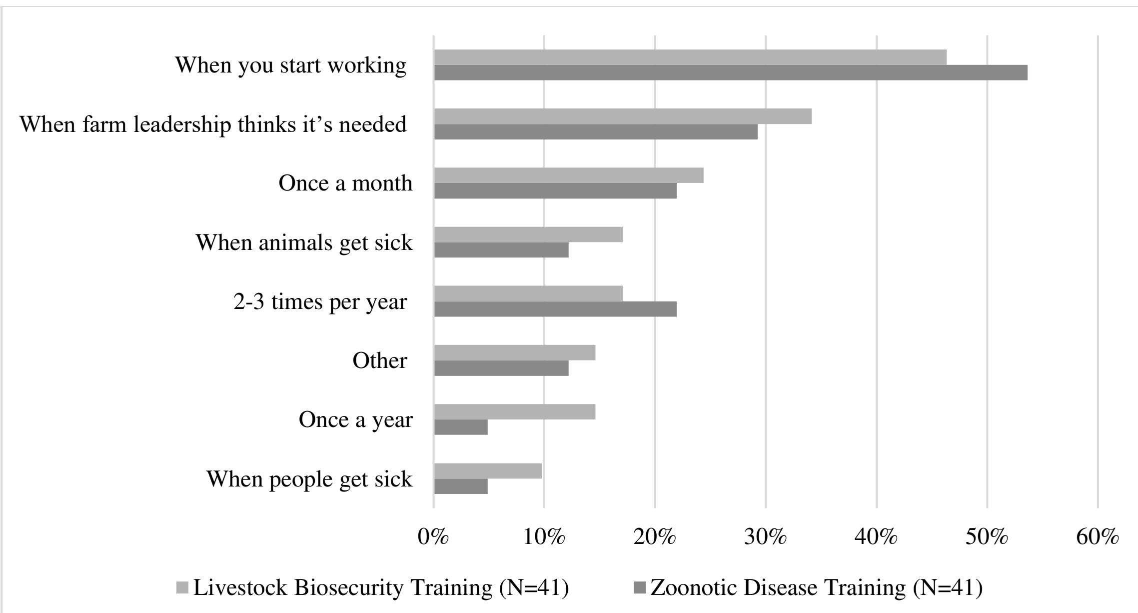

Figure 5.44. When is livestock biosecurity training provided by the farm? Circle all that apply. When is zoonotic disease training provided by the farm? Circle all that apply. Percentages represent proportion of respondents who selected each answer option.

Only 10.9% of respondents indicated that training on preventing infectious diseases in people always occurs at the same time as livestock biosecurity training, while 13% indicated this never happens (Figure 5.45). Sixty percent of respondents indicated that sine the COVID-19 pandemic, the farm has used online training more often.

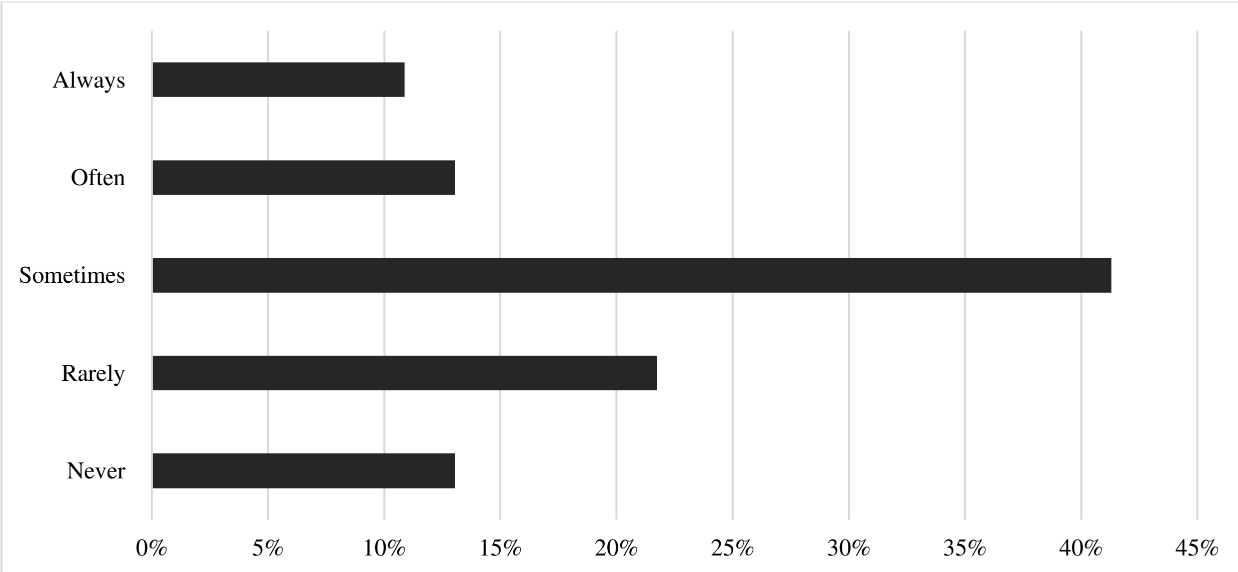

Figure 5.45. How often does training on preventing infectious diseases in people (e.g., zoonoses, COVID-19) occur at the same time as livestock biosecurity training? N=46.

Approximately 42% and 60% of respondents agreed that since the COVID-19 pandemic began their farms have increased training on zoonosis prevention and or uses more online training, respectively (Figure 5.46)

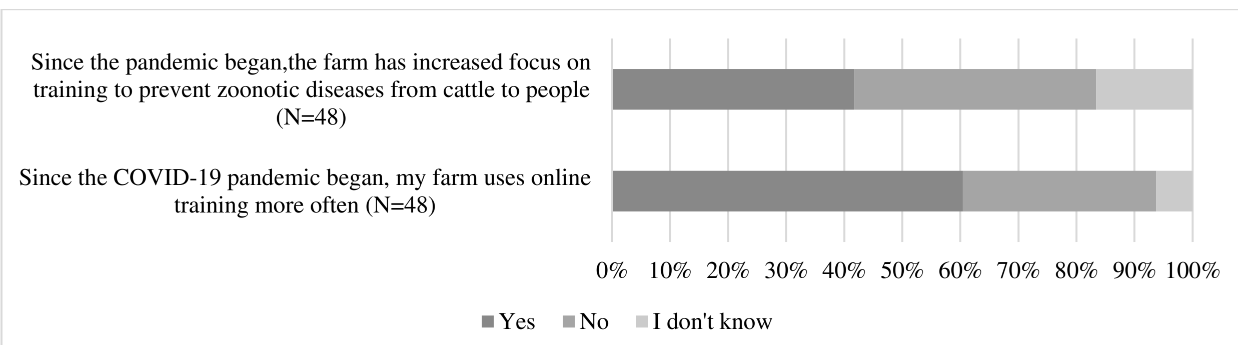

Figure 5.46. Impacts of COVID-19 pandemic on training. “Training: Which are true?”

Individual Preventive Practices

Participants were asked about preventive practices on the farm. Most respondents tended to frequently wash hands and wear farm designated clothing and footwear. Comparatively few respondents wore face coverings such as N-95s, face shields, and surgical masks. Very few respondents reporting showing on the farm after work (Figure 5.47). Only one respondent (a manager) out of 38 respondents reported drinking raw milk on the farm.

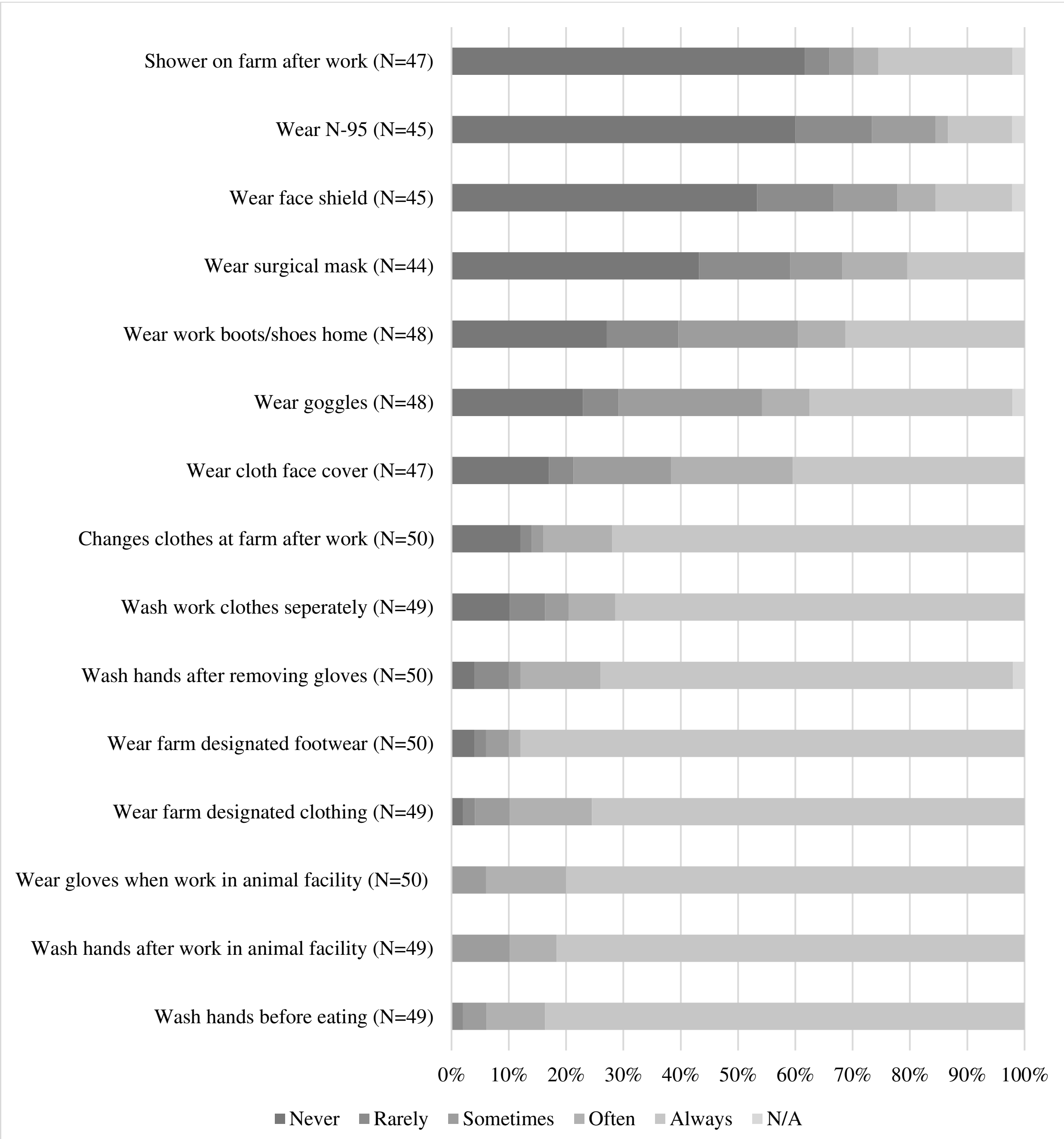

Figure 5.47. Preventive practices on the farm. The option "N/A" is given to account for farm role differences.

Associations were explored between frequency of wearing shoes/boots home at the end of the day and various factors including training, zoonotic disease history, perceived harm, perceived efficacy of preventive measures, farm role, and farm level preventive practices. No statistically significant associations were found (Table 5.22).

Table 5.22. Frequency of wearing shoes/boots home at the end of the day and association with various factors. *Significant at p <0.05.

How often do you do the following on the farm? Wear my work shoes/boots home at the end of the day							
Factor	Category	n	Outcome: Rarely-Always	Outcome: Never	Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
Do you receive training on zoonotic disease spread from animals to people?	Yes	26	17	9	0.50 (0.12, 1.98)	0.51	
	No/IDK	19	15	4	Ref		
Do you think you've ever gotten sick from animals on this dairy farm?	Yes	7	7	0	NA	NA	
	No/Prefer not to answer	38	26	12	Ref		
Have you ever known a person who got a zoonotic disease from animals on a farm?	Yes	9	9	0	NA	NA	
	No/Prefer not to answer	35	23	12	Ref		
Does your farm have posters on zoonotic disease prevention in English and Spanish in hazardous areas?	Yes	16	13	3	2.27 (0.53, 9.7)	0.33	
	No/IDK	32	21	11	Ref		
If you got a zoonotic disease from cattle on the farm, how harmful would it be to your health?	Slightly-Extremely Harmful	47	36	11	NA	NA	
	Not at all Harmful	0	0	0	Ref		
How effective do you think wearing farm designated clothing and boots is in preventing zoonotic diseases from cattle to people on dairy farms?	Moderately-Very Effective	44	32	12	2.67 (0.15, 46.11)	0.49	
	Not at all Effective	2	1	1	Ref		
	Identified all	8	8	0	NA	0.17	

How can diseases be transmitted from animals to people?	Did not identify all	40	28	12	Ref		
Can humans give some diseases to animals?	Yes	18	16	2	5.09 (0.89, 29.27)	0.12	
	No/IDK	18	11	7	Ref		
Farm Personnel	Supervisor	15	14	1	7.0 (0.81, 60.33)	0.07	
	Worker	33	22	11	Ref		
Does your farm have someone in charge of preventing/controlling infectious diseases in people?	Yes	15	12	3	1.71 (0.39, 7.58)	0.37	
	No	30	21	9	Ref		
Does your farm complete zoonotic disease checklists to identify farm vulnerabilities?	Yes	11	9	2	2.06 (0.38, 11.18)	0.47	
	No/IDK	35	24	11	Ref		
Do you receive training on preventing disease spread to family members?	Yes	31	22	9	1.22 (0.29, 5.1)	1	
	No/IDK	12	8	4	Ref		
Do you receive training on PPE putting on and taking off?	Yes	35	23	12	0.19 (0.02, 1.68)	0.14	
	No/IDK	11	10	1	Ref		

Associations were explored between frequency of changing clothes after work on the farm before returning home and various factors including efficacy of farm designed clothing, training, and farm role. No significant associations were found. However, a small proportion of respondents reported never changing clothes after work on the farm before returning home (Table 5.23).

Table 5.23. Frequency of changing clothes after work on the farm before returning home and association with various factors. *Significant at $p < 0.05$.

How often do you do the following on the farm? Change clothes after work on the farm before returning home?							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Rarely-Always	Never			

How effective do you think wearing farm designated clothing and boots is in preventing zoonotic diseases from cattle to people on dairy farms?	Moderately-Very Effective	45	39	6	NA	NA	
	Not at all Effective	3	3	0	Ref		
Do you receive training on preventing disease spread to family members?	Yes	33	30	3	2.22 (0.32, 15.43)	0.59	
	No/IDK	11	9	2	Ref		
Do you receive training on PPE putting on/taking off?	Yes	35	29	6	NA	NA	
	No	12	12	0	Ref		
Farm Personnel	Supervisor	15	11	4	0.17 (0.3, 1.04)	0.058	
	Worker	35	33	2	Ref		

Associations were explored between frequency of wearing gloves after working in animal facilities and various categories including training, zoonotic disease history, farm preventive practices, perception of harm, efficacy of gloves, and farm role. No respondents reported never wearing gloves after working in animal facilities (Table 5.24)

Table 5.24. Frequency of glove use after working in animal facilities and association with various factors. *Significant at p <0.05.

How often do you do the following on the farm? Wear gloves when working in animal facilities							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Rarely-Always	Never			
Do you receive training on purpose of PPE items?	Yes	33	33	0	NA	NA	
	No/IDK	12	12	0	Ref		
Do you think you've ever gotten sick from animals on this dairy farm?	Yes	7	7	0	NA	NA	
	No/Prefer not to answer	40	40	0	Ref		
Have you ever known a person who got a zoonotic disease from animals on a farm?	Yes	9	9	0	NA	NA	
	No/Prefer not to answer	36	36	0	Ref		

Does your farm have posters on zoonotic disease prevention in English and Spanish in hazardous areas?	Yes	32	32	0	NA	NA	
	No/IDK	17	17	0	Ref		
If you got a zoonotic disease from cattle on the farm, how harmful would it be to your health?	Slightly-Extremely Harmful	39	39	0	NA	NA	
	Not at all Harmful	0	0	0	Ref		
How effective do you think wearing gloves is in preventing zoonotic diseases from cattle to people?	Moderately to Very Effective	49	49	0	NA	NA	
	Not at all Effective	1	1	0	Ref		
Farm Personnel	Supervisor	15	15	0	NA	NA	
	Worker	35	35	0	Ref		
Does your farm have someone in charge of preventing/controlling infectious diseases in people?	Yes	16	16	0	NA	NA	
	No/IDK	31	31	0	Ref		

Associations were explored between frequency of wearing a cloth face cover on the farm, efficacy, and farm role. No significant associations were found (Table 5.25)

Table 5.25. Frequency of cloth face cover use and association with various factors. *Significant at p <0.05.

How often do you do the following on the farm? Wear a cloth face cover							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Rarely-Always	Never			
How effective do you think wearing N-95 respirators are in preventing zoonotic diseases from cattle to people?	Slightly-Very Effective	35	32	5	3.84 (0.69, 21.3)	0.14	
	Not at all Effective	10	5	3	Ref		
Farm Personnel	Supervisor	15	12	3	0.57 (0.11, 2.95)	0.67	
	Worker	32	28	4	Ref		

Associations were explored between frequency of wearing farm designated clothing, efficacy, and farm role. No significant associations were found (Table 5.26)

Table 5.6. Frequency of wearing farm designated clothing and association with various factors. *Significant at p <0.05.

How often do you do the following on the farm? Wear farm-designated clothing (e.g., coveralls)							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Rarely-Always	Never			
How effective do you think wearing farm-designated clothing and boots are in preventing zoonotic diseases from cattle to people?	Slightly-Very Effective	44	43	1	NA	NA	
	Not at all Effective	3	3	0	Ref		
Farm Personnel	Supervisor	15	14	1	NA	NA	
	Worker	34	34	0	Ref		

Associations were explored between frequency of wearing farm designated clothing, efficacy, and farm role. No significant associations were found. However, several respondents reported eating while conducting work duties (Table 5.27)

Table 5.27. Frequency of eating while conducting work duties with various factors. *Significant at p <0.05.

How often do you do the following while conducting work duties: Eat							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Rarely-Always	Never			
Do you receive training on food safety?	Yes	30	18	12	1.0 (0.28, 3.54)		1
	No/IDK	15	9	6	Ref		
Do you receive training on hand hygiene?	Yes	36	20	16	0.36 (0.07, 1.96)	0.28	
	No/IDK	9	7	2	Ref		
Farm Personnel	Supervisor	15	10	4	1.94 (0.50, 7.53)	0.51	
	Worker	32	18	14	Ref		

Worker Requirements for PPE and Hygiene when Working with Sick Animals

All respondents indicated workers are required to wear gloves while working with sick animals. Almost all respondents indicated farm workers must change gloves and wash hands after handing sick animals. Fewer respondents indicated workers must wash work clothes separately, change/disinfect clothes, or wear face masks or goggles (Figure 5.48)

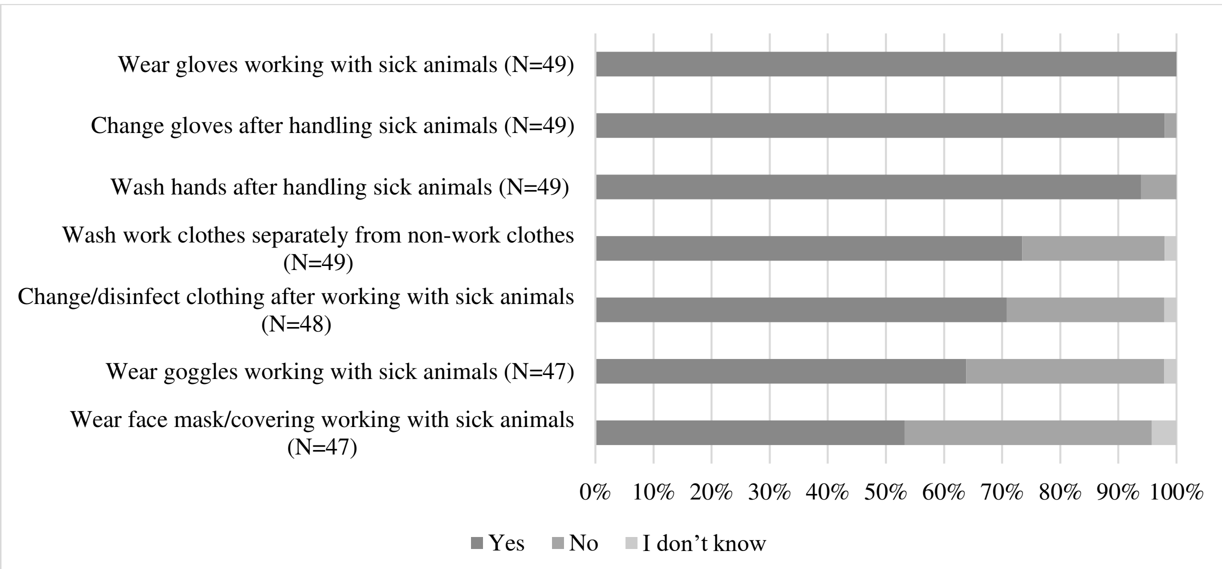

Figure 5.48. Worker requirements for PPE and hygiene while working with sick animals. "Are farm workers required to…?"

Motivation to Try New Tools for Infectious Disease Threat Evaluation

Almost all (93.7%) of respondents agreed or strongly agreed they would try a new tool on farm if it prevents their family from getting sick. A focus on animal and human health and prevention of infectious diseases in cattle were also highly supported. Approximately 85% of respondents agreed or strongly agreed they would try a new tool if it prevents zoonoses in farm personnel. Some respondents strongly disagreed and disagreed they would try the tool if it prevents infectious diseases from humans to cattle (Figure 5.49)

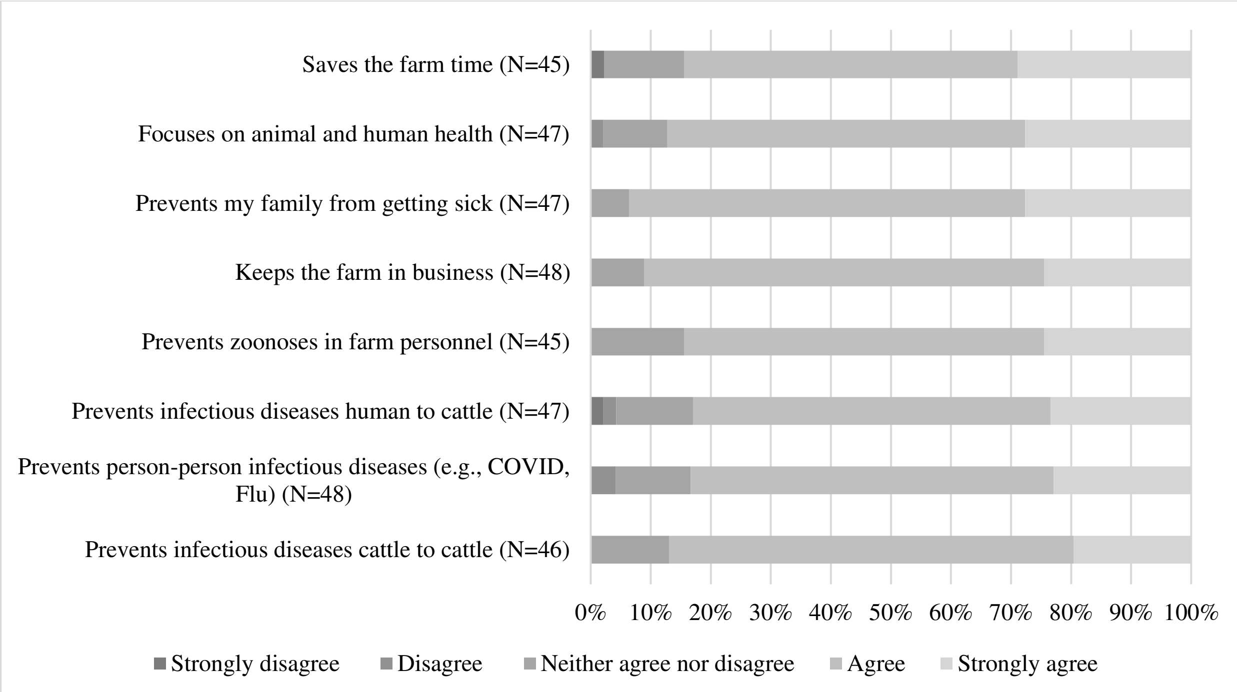

Figure 5.49. "I would try a new tool to evaluate infectious disease threats on the farm if it…"

Training

With regard to livestock biosecurity training, most respondents stated they received training on topics including recognizing and reporting cattle diseases, PPE, and hand hygiene. However, only around 25% of respondents indicated they received training on COVID-19 in animals or spread of COVID-19 from people to animals (Figure 5.50).

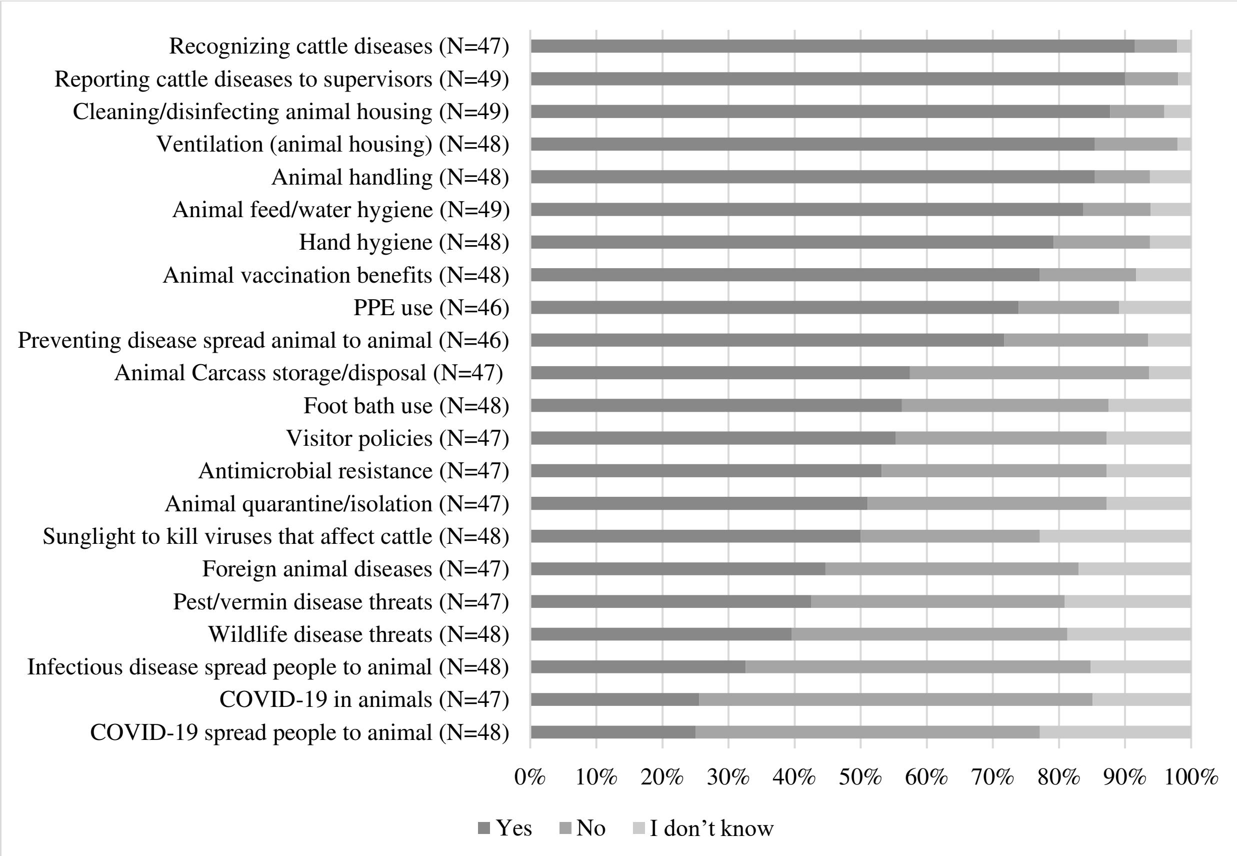

Figure 5.50. Do you receive training on the following topics (Livestock biosecurity)?

The vast majority of respondents reported receiving training on reporting illnesses to supervisors and needle safety. Only 31.3% of respondents reported receiving training on COVID-19 spread from animals to people. Only 46.7% and 54.3% of respondents reported receiving training on symptoms of cattle zoonoses in people and zoonotic disease spread from animals to people. At least one respondent in every training category indicated they did not know if they received the respective training (Figure 5.51).

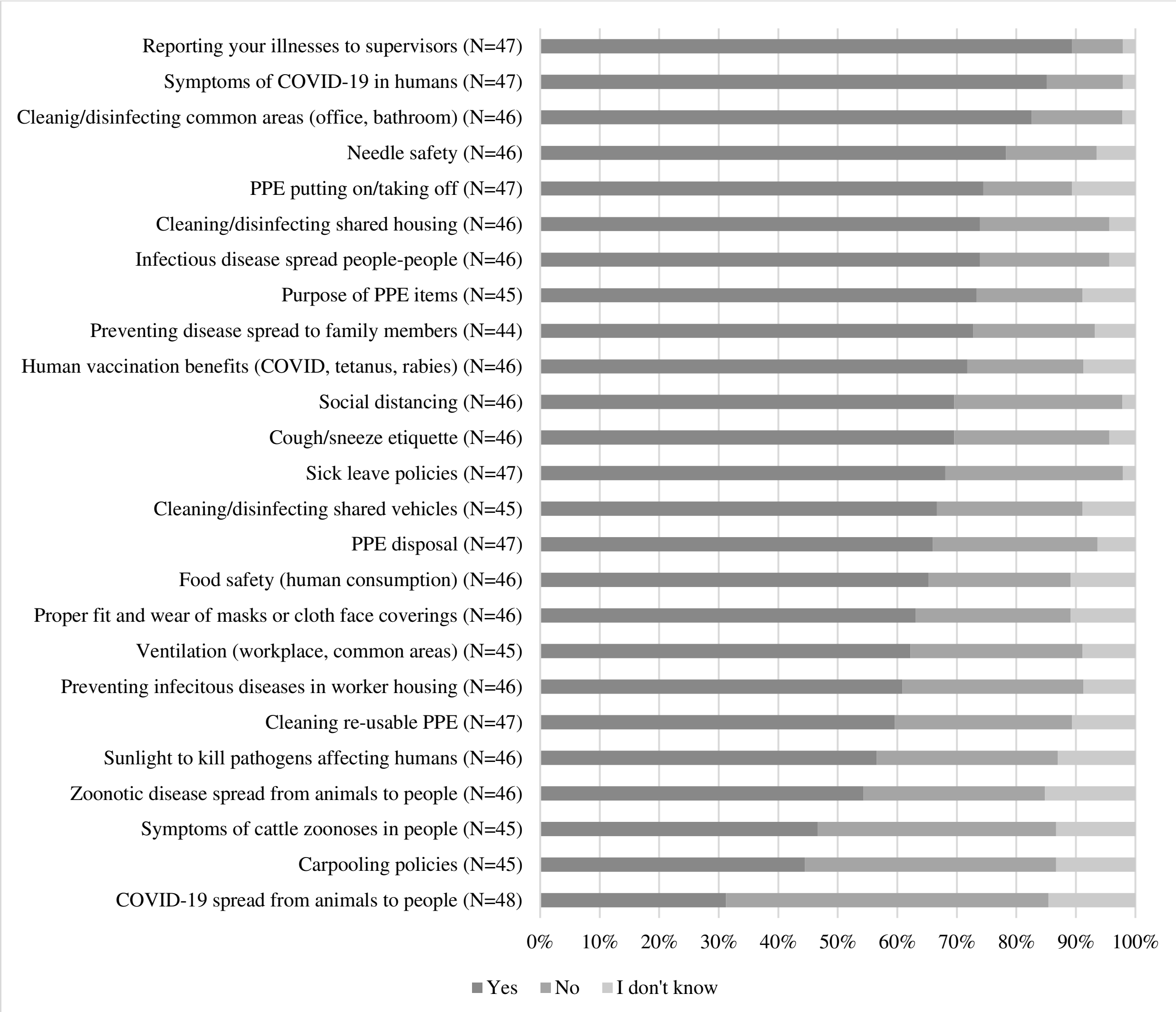

Figure 5.51. “Do you receive training on the following topics?” (Biosafety)

Associations between Biosecurity and Biosafety Practices

There were several significant associations between biosecurity and biosafety practices whereby farms or individuals completing a specific practice or receiving a specific training aimed at preventing diseases in animals had a greater likelihood of completing the corresponding practice or receiving the corresponding training (Table 5.28).

Table 5.28. Associations between livestock biosecurity and biosafety practices.

Does your farm encourage human illness reporting?

Factor	Category	n	Outcome: Yes	Outcome: No/IDK	Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
Does your farm encourage animal illness reporting?	Yes	35	32	3	58.67 (8.63, 398.52)	0.0000011*	
	No/IDK	13	2	11	Ref		

Does your farm encourage people to report if they have a disease from an animal?

Factor	Category	n	Outcome: Yes	Outcome: No/IDK	Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
Does your farm encourage animal illness reporting?	Yes	33	29	4	10.88 (2.5, 47.28)	0.0012*	
	No/IDK	15	6	9	Ref		

Does your farm encourage people to stay home if they are sick?

Factor	Category	n	Outcome: Yes	Outcome: No/IDK	Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
Does your farm isolate and test sick animals?	Yes	38	33	5	3.3 (0.62, 17.62)	0.17	
	No/IDK	9	6	3	Ref		

Ventilation systems or open windows are used to provide even airflow in common areas

Factor	Category	n	Outcome: Yes	Outcome: No/IDK	Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
Does your farm use ventilation systems in animal housing to produce even airflow?	Yes	36	34	2	13.6 (1.95, 94.61)	0.012*	
	No/IDK	9	5	4	Ref		

The farm uses sunlight to kill pathogens in shared spaces (e.g., offices, breakrooms) or shared equipment (e.g., vehicles)

Factor	Category	n	Outcome: Yes	Outcome: No/IDK	Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
Does your farm use direct sunlight to kill pathogens in animal housing/equipment?	Yes	28	17	11	1.93 (0.58, 6.41)		0.44
	No/IDK	18	8	10	Ref		

Does your farm complete zoonotic disease checklists to identify farm vulnerabilities?

Factor	Category	n	Outcome: Yes	Outcome: No/IDK	Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
Complete livestock biosecurity assessments or checklists?	Yes	21	10	11	21.82 (2.48, 192.24)	0.0010*	
	No/IDK	25	1	24	Ref		

Does your farm have someone in charge of preventing/controlling infectious diseases in people?

Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Yes	No/IDK			
Have someone in charge of livestock biosecurity	Yes	28	13	15	4.33 (1.02 18.38)	0.058	
	No/IDK	18	3	15	Ref		
Does your farm keep written records for cleaning/disinfecting commonly used areas (breakrooms, offices, vehicles)?							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Yes	No/IDK			
Does your farm keep a written record for cleaning/disinfecting animal common areas/equipment?	Yes	29	18	11	5.73 (1.50, 21.89)	0.015*	
	No/IDK	18	4	14	Ref		
Do you receive training on reporting your illnesses to supervisors?							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Yes	No/IDK			
Do you receive training on reporting cattle diseases to supervisors?	Yes	43	39	4	3.25 (0.27, 39.05)	0.37	
	No/IDK	4	3	1	Ref		
Do you receive training on zoonotic disease spread from animals to people?							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Yes	No/IDK			
Do you receive training on infectious disease spread from people to animals?	Yes	14	11	3	4.19 (0.97, 18.12)	0.058	
	No/IDK	30	14	16	Ref		
Do you receive training on ventilation (workplace, common areas)?							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Yes	No/IDK			
Do you receive training on ventilation (animal housing?)	Yes	34	25	9	2.22 (0.49, 10.16)	0.42	
	No/IDK	9	5	4	Ref		
Do you receive training on human vaccination benefits (e.g., COVID-19, tetanus, rabies)?							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Yes	No/IDK			
Do you receive training on animal vaccination benefits?	Yes	35	29	6	7.25 (1.55, 22.84)	0.013*	
	No/IDK	10	4	6	Ref		
Do you receive training on purpose of PPE items?							
Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
			Yes	No/IDK			
Do you receive training on PPE use?	Yes	32	28	4	16.33 (2.95, 90.38)	0.0011*	

Factor	Category	n	Outcome		Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
	No/IDK	10	3	7	Ref		
Do you receive training on use of sunlight to kill pathogens that can affect humans?							
Factor	Category	n	Yes	No/IDK	Odds Ratio (95% CL)	Fisher's exact p-value	Chi square p-value
Do you receive training on use of sunlight to kill viruses that can affect cattle?	Yes	25	19	6	5.43 (1.47, 20.08)		0.021*
	No/IDK	19	7	12	Ref		

Discussion

This chapter focusses on results obtained from use of an integrated biosafety-biosecurity knowledge, attitudes, and practices (KAP) questionnaire on a small samples size of Front Range Colorado dairy farm supervisors and workers. While the questionnaire addresses cattle diseases, COVID-19, and zoonoses, analysis focusses on zoonoses. The chapter also describes questionnaire development, and farm recruitment during the peak of the COVID-19 pandemic. Results help guide recommendations for improved farm measures aimed to prevent infectious diseases in farm personnel and can guide future efforts on construction of integrated infectious disease risk assessment tools for the dairy farm environment.

Background

All farms reported presence of wildlife, and 5/6 farms reported that at least one animal species has access to animal housing. While wildlife on a dairy farm is not unusual, efforts should be made to control animal populations and their access to animal housing and food sources. Bacterial pathogens such as salmonella species can be introduced into animal feed by vermin and potentially lead to illness in cattle (Holschbach & Peek, 2018). This can increase risk of zoonotic salmonella transmission to humans working on farms. Only 39.6% of respondents indicated they receive training on wildlife disease threats. Together, these findings support need for increased training focus on wildlife disease threats and their potential role in impacting cattle and human health.

Knowledge

Overall, supervisors compared to workers appeared to have a more comprehensive understanding of the word "biosecurity", which included elements of animal and human health. There was a lack of significant association between having a more comprehensive understanding of biosecurity and receiving integrated biosecurity-biosafety training. One might expect that farm personnel receiving concurrent training would be more likely to identify animal and human elements of biosecurity. Similarly, supervisors compared to workers had a more comprehensive understanding of the word "zoonosis" regarding transmission of pathogens *between* animals and humans. Supervisors' greater likelihood of identifying all means of disease transmission from animals to humans also suggests a potential knowledge discrepancy between supervisors and workers. Some argue the tendency to apply a holistic or integrated mindset can vary across social systems (Schwabe, 2004) or culture (Nisbett & Miyamoto, 2005). Future studies should further explore this possibility within the dairy farm community, particularly with respect to potential variations across cultural groups in terms of the extent to which they perceive infectious disease dynamics through a holistic versus analytic (i.e., focusing on relevant objects independent of context) lens. The lack of significant association between receiving concurrent biosecurity-biosafety training and ability to identify the bidirectionally of zoonoses is unexpected. However, the finding of greater likelihood of identifying the bidirectionality of zoonoses and identifying all means of disease spread from animals to people in respondents who receive training on infectious disease spread from people to animals compared to those who do not is unsurprising and may indicate effective training programs. Similarly, the finding of greater likelihood of demonstrating full knowledge of salmonellosis in respondents on farms providing training on zoonotic disease prevention from animals to humans may suggest favorable training outcomes. The finding that few respondents were able to provide names of zoonoses (either animal to people or people to animal) is potentially alarming and may suggest need for additional training. Cryptosporidiosis was the least commonly identified zoonotic disease but can pose a serious health treat, particularly to immunocompromised personnel. Therefore, additional training on this disease may be warranted for the population studied. Together, these findings suggest potential knowledge gaps within this population and highlight knowledge discrepancies between supervisors and workers. Shared knowledge across groups within a work setting is important to building a shared understanding and working in an efficient manner. A shared understanding is particularly important when occupational health and food security are at stake.

Attitudes

The KAP questionnaire used in this research was created as the COVID-19 pandemic unfolded. The potential for humans to be infected with SARS-CoV-2 from cattle and vice versa was poorly understood at the start of the COVID-19 pandemic. The finding of some concern in this population that cattle could infect them or that they could be infected by cattle would likely different if this study were repeated today. As the COVID-19 pandemic progressed, more research shed light on the involvement of animals in SARS-CoV-2 transmission. These included studies showing SARS-CoV-2 transmission from humans to farm minks and back to humans on farm (Oude Munnink et al., 2021), from humans to captive zoo animals at the Bronx Zoo

(McAloose et al., 2020), from humans to companion animals (Leroy et al., 2020), and propagation within white tailed deer populations (Palmer et al., 2021). Cattle do not appear to be susceptible to SARS-CoV-2 and are not thought to play role in transmission to humans (Ulrich et al., 2020). Regardless, the respondents' concern about cattle involvement in SARS-CoV-2 transmission may represent a justified caution in the absence of evidence at the time of data collection.

The study provides a snapshot COVID-19's impact on biosecurity and biosafety and health outcomes. At the time, the overall impact on farm biosecurity and PPE was uncertain. Regarding this population of dairy farms, findings suggest the pandemic did not have a major impact on farms' ability to conduct biosecurity or on PPE availability. However, the fact that workers tended to agree more than supervisors that the pandemic made it more difficult to practice livestock biosecurity warrants additional exploration as to why this was the case. Perhaps supervisors did not observe or understand the difficulties workers faced. This is further justification for ensuring a shared understanding exists in the occupational setting. The finding that less than 40% of respondents ranked PPE availability as an obstacle to either biosecurity or biosafety further supports that notion that PPE availability was not a main concern among this population in the peak of COVID-19 pandemic. This is further supported by the finding that only 34% of respondents agreed that PPE has been harder to find since the start of the pandemic. There was most agreement among respondents that livestock biosecurity became more of a priority and that maintaining workers became more difficult. The finding that 57.4% of respondents agreed that preventing zoonoses from cattle became more of a priority since the advent of COVID-19 could be due to increased focused on infectious disease prevention as whole or linked to the finding that 34.8% of these agreed or strongly agreed that cattle zoonoses became more common since COVID-19. Smaller proportions of respondents agreed that since the pandemic began, there were more cattle diseases, decreased access to animal care, or increased presence of vermin or wildlife. Together, these findings may suggest farms were able to maintain livestock biosecurity efforts despite COVID-19's impact. Maintenance of biosecurity efforts is important for safeguarding both animal and human health on farms (Renault et al., 2018; Youssef et al., 2020). However, the impact of the COVID-19 on worker availability is concerning, as a workforce is required to maintain biosecurity operations. Respondents' answers to these questions and other might have been influenced by the time at which data were collected, as there was rapid change of knowledge and stressors as the COVID-19 pandemic unfolded.

The finding that most respondents found preventing zoonoses and preventing infectious diseases in cattle (i.e., livestock biosecurity) very to extremely important and that most respondents agreed that livestock biosecurity could prevent infectious diseases in both cattle and people on the farm suggests that this population tends to appreciate the impact of biosecurity measures on animal and human health. Within the studied population, this finding can be used to build on efforts to create integrated, or holistic biosecurity tools that include animal and human health. Support for such efforts within this population may be evidenced in the finding that while respondents ranked zoonotic diseases as unlikely to occur relative to other health events, they did recognize potential harm to health stemming from zoonoses. However, the finding that most respondents agreed or strongly agreed that farm policies and practices help prevent zoonoses from cattle, that they knew how to protect themselves from cattle zoonoses and believe PPE can prevent zoonoses, and that 60.5% disagreed that nothing could be done to prevent incidence of zoonoses on the farm suggests that most of the studied population believes in its ability to protect itself from zoonoses on the farm. The finding that over half (54.4%) of respondents agreed or strongly agreed that cloth face masks interfere with their ability to do their job should be further explored. Within the framework of the Health Belief Model, perceived barriers may impact tendency to engage in health maintenance behaviors (Janz & Becker, 1984). Dairy farm workers often engage in physical and repetitive activity, often in uncomfortable temperatures. Regarding cloth face masks and other PPE items, future studies should explore design, fit, and/or function factors that explain how PPE interferes with workers' ability to carry out their job duties.

The finding that veterinarians are both highly used and trusted as information sources for prevention of cattle diseases and zoonoses highlights the importance of veterinarians in bridging gaps between animal and human health. Previous studies have shown veterinarians are the main sources of biosecurity information for livestock farmers (Cardwell et al., 2016) and are trusted sources of biosecurity information (Chomyn et al., 2023). Calvin Schwabe advocates for veterinarians as members of the public health team and identifies veterinarians as uniquely poised and qualified to contribute to the protection of human health on the farm, as they have a relationship with farmers and familiarity with rural life and associated health threats. However, inadequate efforts at instilling within the veterinary profession a commitment to rural health responsibilities and lack of public knowledge on the capabilities of veterinarians in public health may hinder these efforts (Schwabe, 1969). While much of the studied population trusted veterinarians for prevention information on diseases transmitted person-person (e.g., COVID-19), veterinarians were not highly used for such information. Considering their training and applied work in comparative medicine, veterinarians may be reliable sources of information on infectious diseases threatening human health on dairy farms. However, veterinarians are not qualified or licensed to treat humans and should not be used as substitutes for human healthcare providers or farm settings. These findings may also indicate expanded training opportunities for veterinarians within the farming population studied. Veterinarians' training and communication skills have been linked to dairy farmers' decisions to implement biosecurity measures (Moya et al., 2020). The finding that the most preferred and used methods of training are in person training and on the job training can be leveraged for future training efforts and integrated tool development focusing on this population. If desired and feasible, veterinarian incorporation into dairy farm training programs could lead to greater implementation of biosecurity measures. Cellular phone apps were among the least desired methods of training, so this should be taken into consideration when developing training programs and integrated tools.

Exploring potential differences in opinions between workers and supervisors regarding obstacles to livestock biosecurity and biosafety helps reveal potential differences in opinion that might underlie lack of shared understanding. When analyzed by farm role, supervisors compared to workers had significantly less likelihood of thinking PPE availability, lack of personnel biosecurity compliance, and lack of farm concern about cattle infectious diseases prevented the farm from practicing stronger livestock biosecurity. Similarly, supervisors compared to workers had significantly less likelihood of thinking lack of handwashing stations with soap and water, PPE availability, lack of supervisorship communicating disease prevention expectations, and lack of cleaning and disinfecting equipment agents prevented the farm from practicing stronger infection prevention/control in humans. These findings the potential existence of misunderstandings and disparate everyday experiences between supervisors and workers. Future efforts in this population should attempt to explore factors underlying differences in lived experiences and perceptions on the dairy farm.

A shared understanding between supervisors and workers is also important regarding perceived efficacy of preventive practices, as practices deemed less effective might be less employed. The finding of no significant differences in likelihood of perceived efficacy between supervisors and workers for a series of core preventive measures may imply existence of a shared understanding between farm personnel. However, the finding that many respondents found disinfecting footbaths, preventing animal crowding, visitors using PPE, and sunlight in farm personnel shared spaces as “not effective” highlights the need to better understand these perceptions. Each of the preventive measures can directly and indirectly prevent zoonoses from cattle. For example, animal crowding can lead to increased incidence of disease among cattle and potential for increased disease transmission to humans. Personal protective equipment use among visitors can help prevent introduction of diseases into cattle population and therefore potentially reduce threat of zoonotic disease threat to humans.

The finding that most participants agreed they understand their farm’s rules for zoonotic disease prevention and livestock biosecurity is encouraging. However, future studies should further explore potential differences in these perceptions between supervisors and workers with respect to livestock biosecurity and zoonotic disease prevention. No significant associations were found while analyzing associations between perceived importance of preventing cattle zoonoses and factors such as zoonotic disease history, training on farm preventive practices, and farm role.

This is likely attributable to the small sample size of this study. However, the finding that the vast majority (83%) of respondents do not believe they have ever gotten sick from an animal on their farm is encouraging. Conversely, the finding that 68% of respondents know someone who has gotten a zoonotic disease from an animal on a farm may suggest general awareness of zoonotic disease presence in this farming community.

Practices

Practices are shaped, but not always defined, by attitudes and knowledge. Understanding practices of this dairy farming population can help guide future interventions and research approaches, including training, integrated risk assessment tools, and improved KAP questionnaires. The vast majority of respondents agreed they would spend more time on livestock biosecurity if it would, among other outcomes, prevent cattle disease and prevent cattle to human diseases. This finding could indicate receptivity to future participation in studies but also highlights the importance of continued research quantifying benefits of implementing preventive measures on dairy farms, as profitability may be important in influencing dairy farmers' decisions to implement biosecurity measures (Moya et al., 2020). The findings on factors that would motivate respondents to try a new tool to evaluate infectious disease threats on the farm suggest an interest focusing on animal and human health, in preserving cattle health (i.e., preventing cattle-cattle disease transmission), one's own health (i.e., zoonotic disease prevention), and health of one's family members. Fewer respondents agreed preventing human to cattle diseases is a motiving factor. Almost all (93.7%) of respondents agreed or strongly agreed they would try a new tool on farm if it prevents their family from getting sick. Approximately 85% of respondents agreed or strongly agreed they would try a new tool if it prevents zoonoses in farm personnel. However, these results should be considered in the context of likelihood that respondents would actually use a given tool considering factors such as perceived barriers and benefits to implementation along with perceived susceptibility and severity, which are components of the Health Belief Model (Janz & Becker, 1984). Therefore, application of these results should consider preferred design (e.g., cell phone application versus more preferred platforms) and current cattle and human health threats on the farm. If this study were repeated in 2023, it is conceivable responses might vary, as more information is known about the threat of COVID-19 to animal and human health.

Considering previously discussed knowledge gaps in “reverse zoonoses” and the comparatively lower interest in human to cattle disease transmission, the studied population might benefit from additional training in human to cattle zoonoses However, based on potential health impact to individuals and to farm operations, one could argue that prevention of injuries and zoonoses from cattle to farm workers should be a greater priority than prevention of zoonoses transmitted from human to animals. Regardless, the interest in protecting cattle, oneself, and one’s family can be leveraged when creating integrated risk assessment tools focusing on human and animal health.

Results for supervisors on sick leave, illness reporting, hand hygiene, and administrative efforts are concerning in that they indicate only a fraction of farms complete checklists of zoonotic disease vulnerabilities, have someone in charge of preventing and controlling infectious diseases in humans, and have posters focusing on zoonotic disease prevention in hazardous areas. It is also concerning that many supervisors did not know whether their farms had these mechanisms and others in place. To build a shared understanding in the farm setting, it is important for supervisors to be aware of administrative practices in place.

One means by which farms can potentially strengthen the shared understanding between supervisors and workers is to focus on training. The finding that many respondents indicated livestock biosecurity training occurs concurrently with training on preventing infectious diseases in people provides an opportunity for more robust efforts at integrated biosecurity-biosafety training. Depending on the topic, integration of such training may increase efficiency and help trainees learn about overlapping factors and preventive practices relevant to human and animal infectious disease prevention. However, this study showed that integrated training was not associated with more comprehensive, or holistic understanding of biosecurity or zoonotic disease. Integration of training efforts should be further explored to determine extent of integration and training focus areas.

Few respondents indicated that livestock biosecurity training or training on preventing infectious diseases in people occur when a person gets sick or when an animal gets sick. Failure to train in response to these occurrences may represent a missed opportunity to highlight the overlap of preventive practices and disease transmission from animals to humans and humans to animals. However, increased frequency of training on preventing cattle zoonoses since the advent of COVID-19 is a positive development and represent increased focus on overall disease prevention in dairy farm settings. The finding online training occurs more often since the advent of COVID-19 is not surprising considering the rapid uptake of remote meeting technologies since

2019. Online modalities provide an opportunity for greater breadth and depth of training, but these efforts must be balanced with desired training approaches (i.e., in-person and on the job).

Training can shape individual preventive practices, but other factors including zoonotic disease history, knowledge, perceived efficacy of preventive measures, farm role, and farm level preventive policies and approaches might shape individual preventive practices. Most respondents always wore gloves in animal facilities and washed hands after working in animal facilities. Most also always wore farm designed footwear and washed hands before eating wore farm designated clothing and footwear and changed clothes at the farm before going home Comparatively few respondents frequently wore face coverings such as N-95s, face shields, and cloth face masks. Very few respondents reporting showering on the farm after work. Future KAP questionnaires should consider if showers are available on farms, as the current questionnaire did not address this question. Future studies should also explore the potential factor of discomfort or interference with job with respect to particular PPE items such as cloth face masks.

Although analysis did not reveal significant association between the practice of wearing work shoes/boots home at the end of the day and various factors including training, perceived harm, knowledge, farm role, exploring footwear is important because pathogens can be spread throughout a farm and home to family members. Similar justification can be made for exploring individual practices of changing clothes on the farm before going to work, frequency of glove use while working in animal facilities, and frequency of cloth face mask usage. In addition to preventing infection while on the farm, many of these practices can also prevent pathogen spread to family members or the public. Notably, 0% of respondents reporting "never" wearing gloves while working in animal facilities, and 100% of respondents reporting that workers are required to wear gloves while working with sick animals. With the exception of only 53.2% of respondents reporting that workers are required to wear face masks/coverings while working with sick animals, results suggest stringent PPE and hand hygiene requirements for workers interacting with sick animals. Although no significant associations were found between eating while conducting job duties and farm role, training on food safety, or training on hand hygiene, exploring food consumption on the job is important, particularly if food is consumed in animal housing areas. While only one respondent in this study reported drinking raw milk, this issue was not explored. Future studies should explore in greater detail the practice of raw milk consumption and factors associated with its occurrence, including training.

Most respondents indicated that they receive training on a wide array of subjects related to livestock biosecurity and infectious disease prevention in humans. At the time of KAP questionnaire creation, the threat of SARS-CoV-2 transmission from human to animal or from animal to animal was poorly understood. Few respondents indicated they receive training on these two topics. Considering the lack of information, the topic at the time, this gap in training is understandable. Within the context of livestock biosecurity, the low presence of training on wildlife disease threats and pest/vermin disease threats should be addressed, as 5/6 of the included farms are characterized by animals with access to cattle housing. Wildlife interactions with cattle can lead to cattle infections, which can ultimately lead to human infections. The finding that few respondents indicated they receive training on infectious disease spread from people to animals should be addressed, as understanding this mechanism is important to appreciating infectious disease prevention through a holistic lens. Finally, the finding that several respondents did not know if they receive training on various topics is concerning. Within the context of training on preventing infectious diseases in people, some respondents also indicated they did not know if they receive training on topics. Not knowing might indicate "No." The finding that few respondents reported receiving training on COVID-19 spread from animals to people is understanding considering the time frame during which farm visits were made, as COVID-19 transmission from animals to people was poorly understood. The finding that only 46.7% and 54.3% of respondents reported receiving training on symptoms of cattle zoonoses in people and zoonotic disease spread from animals to people, respectively, is concerning and indicates need for additional training. The finding that over 50% of respondents reporting receiving training on sunlight to kill pathogens affecting humans and ventilation in workspace/common areas is encouraging. Sunlight and ventilation are both important for reducing infectious disease threats.

Finally, there were several significant associations between biosecurity and biosafety practices whereby farms or individuals completing a specific practice or receiving a specific training aimed at preventing diseases in animals had a greater likelihood of competing the corresponding practice or receiving the corresponding training. This finding is not surprising, as farms completing one preventive practice (e.g., livestock biosecurity checklists) might be expected to also complete checklists with that include zoonoses. These pairing of animal and human health preventive practices can potentially increase efficiency, depth and breadth of training, and help farm workers and supervisors develop a more holistic view on infectious disease prevention and shared understanding within the dairy farm environment.

Study Limitations and Recommendations for Improvement

The small sample size and missing data were among the most relevant limitations. In particular, few supervisors completed the KAP questionnaire. Access to owners was generally low and limited owner participation in this study. Therefore, these findings may not be generalizable to Front Range Colorado dairies. Farm recruitment was especially challenging. Overall effects of the COVID-19 pandemic potentially influenced farms' willingness and ability to participate in this research. The use of the word "biosecurity" during recruitment and studying COVID-19 and other infectious diseases during a period of financial uncertainty and political tension might have also diminished recruitment success. Researchers should be aware of any relevant policy proposals that might influence farmers' willingness to participate in research efforts. For example, the Colorado Ballot Initiative 16 "Protect Animals from Unnecessary Suffering and Exploitation", or "PAUSE" was proposed to be included on the 2022 state ballot (CSU, 2021). One farm that declined to participate in this research cited the university's perceived lack of opposition to this initiative as a factor influencing this decision.

Farming population culture can be distinct from culture of the general and academic population in many ways. Researchers might not always be familiar with these cultures, and this can potentially influence study recruitment success. Raper (1960) proposes several guidelines for researchers working in rural areas. These guidelines are based on his experience as a consultant for agrarian reform in the southern United States in 1946 and Japan from 1947-1950. Basic principles of these guidelines relevant to the dairy farming community and potentially helpful with future recruitment efforts include: ensuring researcher presence is understood; developing a common interest; understanding why things are done the way they are done; finding out what people really want; working within the cultural framework; respecting the pace of people; understanding how the researcher is really perceived; recognizing supervisors and organizations; and making sure people understand potential benefits to participation (Raper, 1960).

Future recruitment efforts with dairy farmers should focus on obtaining buy-in from farm owners and managers. Successful global health promotion programs typically include understanding and incorporating cultural values, beliefs, and behaviors, a community-based approach that includes community participation, recognition of gender issues, peer group education including application of community-based outreach workers, and multilevel approaches (Merson et al., 2012). Principles of global health promotion can also be applied toward recruitment and study design. Studies should be designed around the desires and interests of researchers and farmers. Future efforts should include participation of Spanish speaking behavioral scientists such as cultural anthropologists in recruitment, study design, instrument (e.g., KAP questionnaire) design, data collection, and recruitment. In coordination with other study collaborators, researchers should conduct focus groups with participation from industry supervisors, state organizations (e.g., Colorado Livestock Association), and farm owners, managers, and workers. Findings from these focus groups could help researchers determine reasonable time availability of study participants, desired participation incentives, and topics areas of most interest and concern to producers. As shown in the results, university researchers might be among the most frequently used sources of information on animal and human infectious disease prevention, but respondents in this research did not rank researchers among the most trusted resources. Future studies should explore this potential gap and improve this trust.

At 515 questions, the KAP questionnaire was undoubtedly too long and addressed too many topics. The question structure was often variable, which forced respondents to dedicate mental energy to adjusting to changing question formats. The multiple-choice questions included instructions to select “all that apply”, which led to a variety of answer combinations and required additional mental energy and expenditure from the respondent. Dairy farm supervisors and owners are very busy, as dairies are “24/7” operations. Future KAP questionnaires for the dairy farm population should be designed to be completed in no more than 20-30 minutes. Overall structure should be user-friendly, and question formats should be simple and consistent. Topics included should be focused. Questionnaire length in this study may have reduced internal validity, as it is conceivable that respondents’ time availability and mental energy declined as they worked to finish the questionnaire. Internal validity could have also been reduced by varying levels of literacy among respondents. Future research exploring KAP in the dairy farming population should collect data via interviews led by research assistants proficient in both English and Spanish. Research assistants should be trained on the questionnaire tool and interview approach. Although farm supervisors were asked to provide all workers with the opportunity to participate in this study, it is unclear if these attempts were made. Future studies should ensure farm supervisors randomly select worker participants from a list of potential participants.

Finally, this study was conducted during the peak of the COVID-19 pandemic. It is conceivable that knowledge, attitudes, and practices regarding infectious diseases during this time were shaped by some of the stressors, uncertainties, and evolving infectious disease information and understanding of COVID-19 itself. This should be considered when applying results of these findings to the population studied.

Recommendations for Future Studies

This study did not characterize KAP potential differences between organic and conventional farms. Future efforts can include analysis of data collected in the current study and new studies exploring these potential differences in greater depth with respect to biosecurity and biosafety knowledge and training. Future efforts should also explore potential KAP associations with demographic and background information, as farmer preventive behavior can be associated with farm size (Sayers et al., 2013) and dairy farmer age (Frössling & Nöremark, 2016). While this study did ask respondents to indicate where they spend most of their time on the farm, analysis did not include specifics of work location (e.g., parlor versus hospital pen). Future studies with greater samples sizes should explore association of specific job function with KAP outcomes. A worker pending most of their time in the hospital pen likely has different experiences and exposures than a worker spending most time in the parlor or working with machinery. Future studies may also consider factors related to mental health and exhaustion, which can be framed within the Total Worker Health concept (Dissertation Chapter 2).

Conclusions

The undertaking represents a novel attempt at developing and using an integrated biosecurity-biosafety KAP questionnaire in a dairy farm setting. Results helped identify some knowledge strengths and potential deficiencies. Differences between supervisors and workers were also identified with respect to the degree to respective groups considered definitions of biosecurity and zoonoses in a manner including animal and human health. Although respondents generally agreed that PPE was available and useful for preventing zoonoses, supervisors were less likely compared to workers to consider PPE availability a farm obstacle for zoonotic disease prevention. Better understanding potential differences in perceived farm obstacles preventing stronger infectious disease prevention efforts may help streamline efforts and communication between supervisors and workers. A shared understanding between researcher and dairy farmers and between members of a farm team may ultimately lead to more favorable biosecurity and biosafety results. Training was association with some positive knowledge outcomes, including understanding the more comprehensive definition of zoonotic disease, which includes disease transmission *between* animals and humans. Identifying veterinarians as trusted and used sources of infectious disease prevention in both cattle and farm personnel can justify increasing their involvement as biosecurity advisors on dairy farms. Identifying potential preventive practice deficiencies and understanding desired training methods and motivations can guide training and development of cattle-human integrated tools that focus on farm needs and desires. Understanding knowledge, attitudes, and practices is a first step in developing a common language, trust, and building recommendations based on study population desires/motivations and within the context and limitations of their current practices. This study captures a unique time in history (i.e., the COVID-19 pandemic) when animal and human health threats were rapidly changing and poorly characterized. Insights from this research can be applied toward recruitment and developing improved integrated KAP tools and research designs, training programs, and risk assessment tools within a more holistic framework that includes elements of animal and human health.

CHAPTER 6: CONCLUSIONS

This research is unique in that it represents an initial attempt at developing an integrated livestock-human infectious disease management framework for the dairy farm environment. As evidenced by the COVID-19 pandemic, infectious diseases are dynamic. Infectious diseases will undoubtedly continue to emerge, and these may pose zoonotic threats (Jones et al., 2008) relevant to animal and human health.

This research laid the groundwork for a basic approach to dairy farm biosecurity that more fully integrates cattle and human health within the dairy farm environment and provided recommendations for more fully incorporating a human and animal health focus into biosecurity. Many interventions aimed at safeguarding animal health may also be relevant to protecting human health on dairy farms, and vice versa. It also highlighted the need for greater understanding of farmer knowledge, attitudes, and practices regarding PPE in the context of zoonotic disease prevention. This research also helped shape basic recommendations toward developing integrated biosecurity-biosafety tools that focus on cattle and worker infectious disease prevention. Insight gained from these efforts guided construction and use of a KAP questionnaire novel in its focus on cattle and human health. Results gained from the KAP questionnaire helped identify dairy farmer strengths and weaknesses regarding zoonotic disease preventive practices on dairies. Results also highlighted focus areas (e.g., knowledge of zoonoses and understanding of the word “biosecurity”) where workers and supervisors might have different understandings. Differences between workers and supervisors with respect to perceived obstacles to infectious disease prevention were also identified. A shared understanding between personnel working on a farm is important to maximize efficiency and prevent infectious diseases in both humans and cattle. This research identified some focus areas where potential KAP differences between workers and supervisors can be addressed through training. Results also highlighted the impact of COVID-19 on biosecurity within the studied farms provided insight into preferred training methods and desired characteristics in tools to evaluate infectious disease threats on farms. Using information on preferred training methods can be applied toward not only future training, but also development of integrated biosecurity-biosafety tools that consider human and cattle health. Results also identified veterinarians as trusted and used information sources for both animal health and human health. Lessons learned through difficulty with farm recruitment during the COVID-19 pandemic are valuable and can be applied to future research efforts with this population. Ultimately, this research was an attempt to help bridge the divide between livestock infectious disease and human infectious disease prevention on dairy farms, which may help improve efficiency, safety time and resources, and ultimately improve health and food security, potential at national and global levels (Figure 6.1).

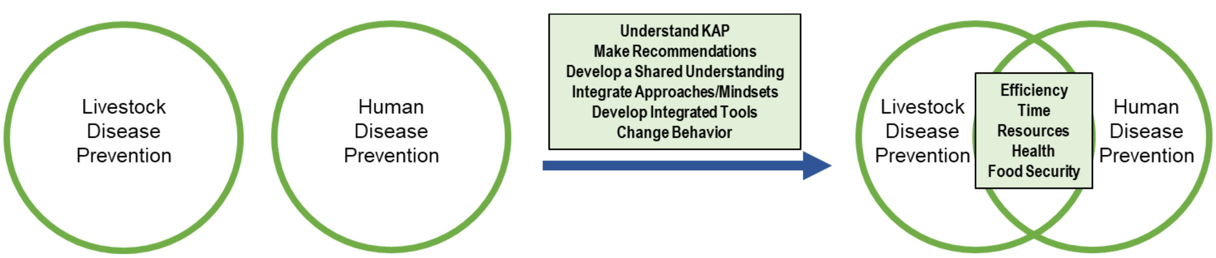

Figure 6.1. Bridging the gap between livestock and human infectious prevention on dairy farms and potential benefits.

Future studies continue to explore infectious disease prevention KAP among dairy farmers by more thoroughly examining some of the focus areas highlighted in this research. What factors might underlie KAP differences between supervisors and workers? Language and other demographic factors such as age should be explored in this regard and others. Future work should also attempt to understand potential influences of indigenous languages or dialects associated with KAP findings. Raw milk consumption was not thoroughly explored in this research, as only one question was asked on this topic. But this question is worth additional attention. Future efforts should also more thoroughly explore PPE factors underlying inference with job duties. While PPE availability did not appear to be a major concern among the respondents, the widely held belief that cloth masks interfere with job functions should be explored.

The concept of integrating mindsets and actions toward cattle and human infectious disease prevention should also be further explored. This research did not find significant associations between knowledge outcomes and frequency of training that involved concomitant livestock biosecurity and human infectious disease prevention efforts. One might assume that integrated training leads to more favorable outcomes, but perhaps such training approaches are overwhelming or fail to adequately address basic concepts. Some knowledge outcomes were associated with training on the respective topic, however. Future efforts should continue to explore favorable knowledge, attitude, and practice outcomes and their associations with training on specific topics or through specific modalities.

As additional insight into farmer KAP is gained, future work should attempt to develop animal-human integrated risk assessment tools that truly capture elements relevant to health of cattle and farm workers and supervisors. These risk assessment tools should identify shortcomings and provide actionable plans for implementation and link preventive measures to quantifiable outcomes, including reduced incidence of disease in cattle and humans, increased production, and saved time. But researchers should also attempt to better understand the degree to which integrated tools are desired by supervisors and workers.

As we strive to continue breaking down professional and disciplinary silos that prevent application of more integrated approaches to infectious disease prevention on farms and in other settings, it is important to determine if the “holistic approach” is always optimal or desired based on observed health outcomes and perceived health threats. For example, this research highlighted a greater perceived likelihood and severity of farm accidents compared to zoonotic diseases. While the COVID-19 pandemic era ushered in a renewed interest in infectious disease prevention, this interest must be considered with respect to actual priorities in the farm setting. Future work should strive to clarify farm priorities and quantify the actual benefit of integrated infectious disease prevention approaches in terms of health outcomes, profit, and time investment. It may not always be the case the integrated efforts lead to more favorable outcomes.

This research had several limitations. The small number of farms and producers included in this study is the most apparent limitation and highlights the need for modified recruitment efforts that better engage stakeholders at farm and industry levels. Almost all farms included in this study were at the time or have in the past collaborated with our university. Future recruitment efforts should strive to increase farm numbers and diversity by exploring farm ownership characteristics and worker preferences associated with successful recruitment outcomes. Future studies involving questionnaire design and use should also strive to improve questionnaire structure and reduce length. As this research occurred during the peak of the COVID-19 pandemic logistical constraints and the general uncertainty of the times undoubtedly impacted recruitment efforts and sample size.

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APPENDICES

APPENDIX 1: BIOCHECK.UGENT DAIRY CHECKLIST AND ASSESSMENT (ENGLISH)

This file is used for research purposes and is modified from the original version at https://biocheck.ugent.be/en

BioCheck.UGent Utility Assessment Instructions

My name is Dr. Robert Fathke. I am a veterinarian and PhD student at the Colorado State University in Fort Collins, Colorado. Part of my PhD project focuses on application of livestock biosecurity on dairy farms in Colorado. To better understand biosecurity and its application on these farms we are using a quantitative tool called BioCheck.UGent. Since this tool was developed in Europe and has not been used often on dairy farms in the United States, we would like you to complete the assessment for your farm and provide feedback for each question. This information will be useful as researchers in the United States develop similar quantitative biosecurity tools.

Please evaluate each of the questions for its importance and clarity. Please also provide comments and recommendations for question improvement. We have transcribed all cattle BioCheck.UGent questions into a Word file and have included 3 assessment questions for each question of the BioCheck.UGent tool. Please evaluate each question even if your previous BioCheck.UGent answers direct you to skip it. After you complete the BioCheck.UGent assessment and provide your feedback, please email this Word file to me at Robert.Fathke@colostate.edu.

Once I receive the completed file, I will enter your answers into the BioCheck.UGent website and email you the resultant biosecurity score breakdown. I will also email you a short survey (5 questions) to get your overall impression of the BioCheck.UGent tool. As a reminder, we do not give any identifying information into the BioCheck.UGent website. The only required information is the country in which the assessment takes place.

The BioCheck.UGent online assessment for cattle can be accessed here: https://biocheck.ugent.be/en/questionnaires/dairy-cattle-11. A PDF copy of the questions on the BioCheck.UGent cattle assessment is here: https://biocheck.ugent.be/sites/default/files/2020-02/Dairy_EN.pdf.

For each question or section (as indicated), please respond to the following:

Importance of Question

How important is this question to livestock biosecurity?

1=Not at all important

2=Slightly important

3=Moderately important

4=Very important

5=Extremely important

Clarity of Question

I believe this question is written in a way that makes sense:

Yes

No

Comments/Recommendations for Question Improvement

NOTE: Research participants were given a Word file version of the English language BioCheck.UGent dairy cattle survey (available here:

https://biocheck.ugent.be/sites/default/files/2020-02/Dairy_EN.pdf. The three research questions (i.e., importance, clarity, recommendations) were added under each question.

APPENDIX 2: BIOCHECK.UGENT DAIRY CHECKLIST AND ASSESSMENT (SPANISH)

This file is used for research purposes and is modified from the original version at https://biocheck.ugent.be/en

Instrucciones para la evaluación de la utilidad de BioCheck.UGent

Mi nombre es Dr. Robert Fathke. Yo soy veterinario y estudiante de doctorado en la Universidad Estatal de Colorado en Fort Collins, Colorado. Una parte de mi proyecto de doctorado se enfoca en aplicación de la bioseguridad ganadera en las granjas lecheras de Colorado. Para comprender mejor la bioseguridad y su aplicación en las granjas, estamos usando una herramienta cuantitativa que se llama BioCheck.UGent. Porque esta herramienta fue desarrollada en Europa y no se ha utilizado con frecuencia en las granjas lecheras en los Estados Unidos, nos gustaría que completara la evaluación de su granja y proporcione comentarios para cada pregunta. Esta información será útil a medida que los investigadores de los Estados Unidos desarrollen herramientas cuantitativas similares de bioseguridad.

Por favor evalué cada una de las preguntas por su importancia y claridad. Por favor también proporcione comentarios y recomendaciones para la mejora de las preguntas. Hemos transcrito todas las preguntas de BioCheck.UGent del ganado en un archivo de Word y hemos incluido 3 preguntas de evaluación para cada pregunta de la herramienta BioCheck.UGent. Por favor evalué cada pregunta, incluso si sus respuestas anteriores de BioCheck.UGent le dirigen a saltarla. Después de completar la evaluación de BioCheck.Ugent y proporcionar su realimentación, por favor envíeme este archivo de Word en un email a Robert.Fathke@colostate.edu.

Una vez que reciba el archivo completado, ingresaré sus respuestas en el sitio web de BioCheck.UGent y le enviaré un correo electrónico con el resultado de la puntuación de bioseguridad. También te enviaré un email con un breve cuestionario (5 preguntas) para obtener tu impresión general de la herramienta BioCheck.Ugent. Como recordatorio, nosotros no damos ninguna información de identificación al sitio web de BioCheck.UGent. La única información requerida es el país en el que se lleva a cabo la evaluación.

Se puede acceder la evaluación en línea de BioCheck.UGent para el ganado aquí: https://biocheck.ugent.be/en/questionnaires/dairy-cattle-11. Una copia PDF de las preguntas de la evaluación de BioCheck.UGent para ganado está aquí: https://biocheck.ugent.be/sites/default/files/2020-02/Dairy_ES.pdf.

Para cada pregunta o sección (como se indica), por favor responda a lo siguiente:

Importancia de la Pregunta

¿Qué tan importante es esta pregunta para la bioseguridad ganadera?

1=No importante en lo absoluto

2=Un poco importante

3=Moderadamente importante

4=Muy importante

5=Extremadamente Importante

Claridad de la Pregunta

Creo que esta pregunta está escrita en una manera que hace sentido.

Sí

No

Comentarios / Recomendaciones para mejorar la pregunta:

NOTE: Research participants were given a Word file version of the Spanish language BioCheck.UGent dairy cattle survey (available here: https://biocheck.ugent.be/sites/default/files/2020-02/Dairy_ES.pdf. The three research questions (i.e., importance, clarity, recommendations) were added under each question.

APPENDIX 3: OVERALL ASSESSMENT OF BIOCHECK.UGENT TOOL (ENGLISH)

	Not at all useful	Slightly useful	Moderately useful	Very useful	Extremely useful
How useful is the BioCheck.UGent tool to you?					

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
I would use this tool to assess livestock biosecurity on my farm					
I believe the BioCheck.UGent checklist covered all livestock biosecurity topics that are relevant to my farm					

Recommendations for topics that should be added to or removed from the checklist:
Add:
Remove:

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
I believe the BioCheck.UGent checklist summary presented results in a way that is useful to me					

Recommendations for improvement on results summary:

Please provide any additional feedback on the BioCheck.UGent tool as whole:

APPENDIX 4: OVERALL ASSESSMENT OF BIOCHECK.UGENT TOOL (SPANISH)

	No es útil para nada	Un poco útil	Moderadamente útil	Muy útil	Extremadamente útil
¿Qué tan útil es la herramienta BioCheck.UGent para usted?					

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo
Yo usaría esta herramienta para evaluar la bioseguridad del ganado en mi granja.					
Creo que la lista de comprobación de BioCheck.UGent cubrió todas las temas de bioseguridad que son relevante para mi granja.					

Recomendaciones para temas que deben agregarse o quitarse de la lista de comprobación:
Anadir
Eliminar:

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo

Creo que el resumen de la lista de verificación BioCheck.UGent presenta los resultados en una manera que me resulta útil.					

Recomendaciones para mejorar el resumen de los resultados:

Por favor proporcione cualquier comentario adicional sobre la herramienta BioCheck.UGent en su conjunto:

APPENDIX 5: RECRUITMENT EMAIL TO FARM OWNERS AND MANAGERS

Subject: CSU Dairy Biosecurity and Infectious Disease Prevention Research: Recruiting Farms

Dear (Name),

I am a PhD student at Colorado State University (College of Veterinary Medicine and Biomedical Sciences). My research focusses on livestock biosecurity and prevention of farm personnel infectious diseases on dairy farms. I am writing to share a summary of the research project goals and to invite you and the workers in your farm to participate. The project description is attached.

This is a volunteer solicitation for your participation in helping the US dairy industry. Pease do not hesitate to contact me either through email at Robert.Fathke@colostate.edu or phone at XXX-XXX-XXXX.

The overall aim of my project is to assess the level of biosecurity and biosafety in front range dairy farms as a pilot study to support a future large-scale study with the same aim across US dairy farms. An existing biosecurity tool called BioCheck.UGent will be applied in this assessment. The BioCheck.UGent tool consists of 135 questions and provides a numerical score for overall biosecurity and scores for each biosecurity category. The tool was developed by veterinary epidemiologists in Belgium but has not been used often in the United States. The main BioCheck.UGent website is here https://biocheck.ugent.be/en. The link to the checklist is here https://biocheck.ugent.be/sites/default/files/2020-02/Dairy_EN.pdf. Note: The BioCheck.UGent livestock biosecurity assessment tool is free to anybody who chooses to use it. For example, any farm owner can access the website, do their own livestock biosecurity assessment, and obtain results. There is no special technical expertise required to conduct the assessment or to interpret the results. The BioCheck.UGent livestock biosecurity assessment costs nothing to users, and the assessment is available free of charge to those who choose to use it.

Additional assessments to determine knowledge, attitudes, and practices on the farm will be conducted. A survey will be administrated in-person to farm owner(s), manager(s) and worker(s) with the aim to identify their knowledge, attitude and practices (KAP) regarding livestock biosecurity and prevention of infectious diseases in people on the farm. Infectious diseases include diseases spread from animals to people and human-to-human transmissible diseases with a focus on COVID-19. The KAP survey will take approximately 60 to 75 minutes to complete. The survey will be translated into Spanish and a Spanish translator will be available during survey administration.

If you agree to participate, I am as the researcher will meet with you as the designated farm owner or manager to complete the BioCheck.UGent checklist. This will take approximately 30 to 60 minutes. I will then enter the answers into the BioCheck.UGent website, which will generate numerical scores. The tool does not ask for farm name or identifiers. The researcher will email the score summary report generated by the BioCheck.UGent website to the farm owner or manager.

As the owner or the manager of the farm, please convey the information about the study to all managers and workers on the farm. Workers interested in participating in the KAP questionnaires will be provided a $40 gift card for a store like King Soopers or Wal-Mart. As you convey the information about this study to workers and managers on the farm, it is essential that you explain to all potential research participants that their participation in this research is 100% voluntary, that their participation is NOT required, and that they can stop their participation in the project at any time without penalty. I recommend that you use the following script to explain these important statements to workers and managers who express interest in participating in this research:

Your participation in the research project "A quantitative assessment tool to enhance agricultural biosecurity and worker safety in conventional and organic Colorado dairy farms" is 100% voluntary and is not required. You are not obligated to participate in this research project. Your decision to participate or not participate in this study is entirely your own and will not impact your job performance evaluation or promotions. You will not be rewarded or penalized by the farm for participating or not participating in this research project. If you choose to participate in the research project, you can decide to stop your participation at any time without penalty.

Ensure workers and managers who prefer Spanish as their language are read (by a proficient Spanish speaker) and shown the following Spanish-translated script of the above statement:

Su participación en este proyecto de investigación "Una herramienta de evaluación cuantitativa para mejorar la bioseguridad agrícola y la seguridad de los trabajadores en las granjas lecheras convencionales y orgánicas de Colorado" es 100% voluntario y no es requerido. Usted no está obligado a participar en este proyecto de investigación. Su decisión de participar o no participar en este estudio es completamente suya y no impactará su evaluación de su trabajo o ascensos. Usted no será beneficiado o penalizado por la finca por su participación o no participación en este proyecto de investigación. Si usted decide participar en este proyecto de investigación, usted puede dejar de participar en cualquier momento sin ninguna penalidad.

Your attention to this request and willingness to participate are much appreciated. We hope this project can benefit your farm and the US dairy industry.

Sincerely,

Robert Fathke DVM, MS, MPH

APPENDIX 6: RECRUITMENT EMAIL ATTACHMENT

Livestock Biosecurity and Infectious Disease Prevention Study

Colorado State University

Summary

The purpose of this letter is to describe the research project and to invite your selected dairy farms to participate in the study. Dr. Robert Fathke is a PhD student at Colorado State University (College of Veterinary Medicine and Biomedical Sciences). His PhD research explores livestock biosecurity and worker safety with regard to infectious disease prevention on organic and conventional dairy farms in Colorado.

Research Personal and Contact Information

Researcher: Dr. Robert Fathke, DVM, MS, MPH

Email: Robert.Fathke@colostate.edu

Phone: XXX-XXX-XXXX

Principle Investigator: Dr. Sangeeta Rao, BVSc, MVSc, PhD

Email: sangeeta.rao@colostate.edu

Other Thesis Committee Members:

Dr. Mo Salman (CSU Department of Clinical Sciences, Academic Advisor)

mo.salman@colostate.edu

Dr. Pablo Pinedo (CSU Department of Animal Sciences)

Dr. Stephen Reynolds (CSU Department of Environmental &Radiological Health Sciences)

Research Goals:

Goal 1: Complete a biosecurity assessment of your farm using an online biosecurity assessment tool called BioCheck.UGent. The tool consists of 135 questions and provides a score for overall biosecurity and scores for each biosecurity category. The tool was developed by veterinary epidemiologists in Belgium but has not been used often in the United States. The main BioCheck.UGent website is here https://biocheck.ugent.be/en. The link to the checklist is here https://biocheck.ugent.be/sites/default/files/2020-02/Dairy_EN.pdf. Dr. Robert Fathke (the researcher) will meet with the farm owner or manager to complete the checklist. This will take approximately 30 to 60 minutes. He will then enter the answers into the BioCheck.UGent website, which will generate numerical scores. The tool does not ask for farm name or identifiers. The researcher will email the score summary report generated by the BioCheck.UGent website to the farm owner or manager.

Goal 2: Obtain farm owner or manager feedback on the BioCheck.UGent tool. The researcher will email the farm owner or manager a questionnaire giving them an opportunity to provide feedback on each question of the BioCheck.UGent tool and provide general feedback on the tool.

Goal 3: Conduct a Knowledge, Attitudes, and Practices (KAP) survey on livestock biosecurity and prevention of infectious diseases in farm personnel. A questionnaire will be administrated in-person to farm owner(s), manager(s) and worker(s) with the aim to identify Knowledge, Attitude and Practices regarding livestock biosecurity and prevention of infectious diseases in people on the farm. Infectious diseases include diseases spread from animals to people and human-to-human transmissible diseases with a focus on COVID-19. Administrating this questionnaire will take approximately 60 to 75 minutes to complete. The questionnaire will be translated into Spanish and a Spanish translator will be available during its administration.

Goal 4: Share findings and make recommendations with farm owners. Based on findings from your farm, the researcher will provide the farm responder a written report with a summary of findings and recommendations. The summary will include BioCheck.UGent output and a farm-level summary of findings from the KAP survey. Recommendations on how to improve livestock biosecurity and prevention of infectious diseases in farm personnel will be provided.

<u>Benefits to Participants:</u>

- The potential benefits to participants are indirect in nature. There is no direct personal benefit to participate in this research.
- Assessment with the BioCheck.UGent tool can potentially highlight deficiencies in farm biosecurity practices. Identifying deficiencies could lead to indirect benefits in the form of changes to biosecurity practices that could prevent animal disease on the farm.
- Researcher recommendations could help the farm improve its biosecurity practices. However, a direct monetary benefit cannot be attributed to changes that could potentially stem from these recommendations. Note: The BioCheck.UGent livestock biosecurity assessment tool is free to anybody who chooses to use it. For example, any farm owner can access the website, do their own livestock biosecurity assessment, and obtain results. There is no special technical expertise required to conduct the assessment or to interpret

the results. The BioCheck.UGent livestock biosecurity assessment costs nothing to users, and the assessment is available free of charge to those who choose to use it.

- By providing feedback on the BioCheck.UGent tool, farms are helping CSU evaluate and improve quantitative biosecurity checklists that can be developed in the future for large scale application.
- Completing the KAP survey will provide CSU researchers with information and tools to provide recommendations useful as farms improve their biosecurity and prevention of infectious diseases among farm personnel. Specifically, recommendations generated from this research might help farms prevent cases of COVID-19 and diseases spread from animals to humans on the farm.
- Information gained from this study may ultimately help Colorado dairy farmers improve their livestock biosecurity. Participating is an opportunity to help researchers optimally serve Colorado dairy farms.

APPENDIX 7: VERBAL CONSENT FORM OWNERS AND MANAGERS (ENGLISH)

Dear Participant,

Introduction: My name is Dr. Robert Fathke. I am a veterinarian and PhD student at the Colorado State University in Fort Collins, Colorado. I am conducting a research project entitled, "A quantitative assessment tool to enhance agricultural biosecurity and worker safety in conventional and organic Colorado dairy farms." This project is funded by the College Research Council of the Colorado State University College of Veterinary Medicine and Biomedical Sciences and High Plains Intermountain Center for Agricultural Health and Safety. I (Dr. Robert Fathke) will conduct the research. The primary investigator is Dr. Sangeeta Rao, also of Colorado State University.

Explanation of Research and Procedures: This study involves research designed to help scientists understand farm owner and manager knowledge, attitude, and practices (KAP) related to two topics. These topics are 1). farm livestock biosecurity and 2). prevention of farm employee infectious diseases from animals and from farm co-workers. To collect information on your knowledge, attitude, and practices on these two topics, you will be asked to complete two KAP questionnaires. One KAP questionnaire will focus on livestock biosecurity. The other KAP questionnaire will focus on prevention of farm worker infectious diseases from animals and from co-workers, including COVID-19. Questions on both questionnaires are a combination of multiple-choice questions, ranking questions, and short fill in the blank questions. We will send you both of the questionnaires to read. This will help save time for you. Questionnaires will be written in Spanish and English. After you have read through the questionnaires, I will meet you in person. During our in-person meeting, I will ask you each question on both of the questionnaires, and I will write down results. A Spanish translator will also be present on the farm with me during the in-person interviews. It will take approximately 60-75 minutes to finish all questions. None of the activities you will complete in this research are dangerous or invasive.

This study also involves research designed to help scientists understand biosecurity strengths and weaknesses on farms. The researcher will email you a copy of questions from BioCheck.UGent and a link to an optional Google Forms version. The researcher will ask you to answer the 124 BioCheck.UGent biosecurity questions and evaluate each question. A copy of the assessment questions is available here: https://biocheck.ugent.be/sites/default/files/2020-02/Dairy_EN.pdf. A Spanish version is available here: https://biocheck.ugent.be/sites/default/files/2020-02/Dairy_ES.pdf. The BioCheck.UGent website homepage is available here: https://biocheck.ugent.be/en. After completing the biosecurity assessment, the researcher will email you the results and email you a short survey so you can provide feedback on how useful the tool was to you overall.

Risks and Discomforts: There are no known risks or discomforts involved in this study that are greater than those encountered in day-to-day living.

Benefits: There are no direct personal benefits from participating in this research. While there are no direct benefits to you, we hope to expand upon livestock biosecurity KAP and infectious disease prevention KAP. Data gathered from this study will be used to develop recommendations to participating farms on how to improve their biosecurity and infectious disease prevention practices. Summary of all findings will be shared with you with the ability to point out the average response from your farm.

Confidentiality: The information collected during this study will be kept confidential. This study protects confidentiality and privacy because it does not ask participants to provide their names or other identifiers that can be linked to their names. Results gathered from the study may be published for scientific purposes, but publications will not include your name or the farm name.

Do you have any questions about privacy or confidentiality?

Withdrawal from Study: Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participation at any time without penalty.

Questions: Any questions about the research or risks of participating in the research should be directed to Dr. Robert Fathke. He can be reached by telephone at (XXX) XXX-XXXX or by email at Robert.Fathke@colostate.edu. If you have any questions about your rights as a voluntary participant in this research, contact the Colorado State University Institutional Review Board (IRB) at: RICRO_IRB@mail.colostate.edu; 970-491-1553.

Legal Rights: You are not waiving any of your legal rights by verbally consenting to participate in this study.

Do you have any questions for me?

Verbal Consent: To maintain privacy, we will not be collecting signatures on this verbal consent form. Do you agree to participate in this study? Please answer "Yes" or "No."

APPENDIX 8: VERBAL CONSENT FORM OWNERS AND MANAGERS (SPANISH)

Estimado Participante,

Introducción: Mi nombre es Dr. Robert Fathke. Yo soy veterinario y estudiante de doctorado en la Universidad Estatal de Colorado en Fort Collins, Colorado. Estoy realizando un proyecto de investigación titulado "Una herramienta de evaluación cuantitativa para mejorar la bioseguridad agrícola y la seguridad de los trabajadores en las granjas lecheras convencionales y orgánicas de Colorado". Este proyecto está financiado por el Consejo de Investigación Universitaria de la Facultad de Medicina Veterinaria y Ciencias Biomédicas de la Universidad Estatal de Colorado y el Centro Intermountain de High Plains para la Salud y Seguridad Agrícola. Yo (el Dr. Robert Fathke) realizaré la investigación. El investigador principal es la Dra. Sangeeta Rao, también de la Universidad Estatal de Colorado.

Explicación de la Investigación y los Procedimientos: Esta investigación incluye un estudio diseñado para ayudar a los científicos a comprender el conocimiento, la actitud y las prácticas (CAP) del propietario y gerente de la finca relacionados con dos temas. Estos temas son 1). La bioseguridad del ganado y 2). La prevención de enfermedades infecciosas en los empleados de la granja de los animales y sus compañeros de trabajo de la granja. Para recopilar información sobre su conocimiento, actitud y prácticas sobre estos dos temas, se le solicitará que complete dos cuestionarios CAP. Un cuestionario CAP se centrará en la bioseguridad del ganado. El otro cuestionario CAP se centrará en la prevención de las enfermedades infecciosas en los trabajadores agrícolas de los animales y sus compañeros de trabajo, incluyendo el COVID-19. Las preguntas de ambos cuestionarios son una combinación de preguntas de selección múltiple, preguntas de clasificación y preguntas breves para completar los espacios en blanco. Le enviaremos las dos encuestas para que las lea. Esto le ayudará a ahorrar tiempo para usted. Las encuestas se redactarán en español e inglés. Una vez que haya leído los cuestionarios, me reuniré con usted en persona. Durante nuestra reunión en persona, le haré cada pregunta en ambos cuestionarios y escribiré los resultados. Un intérprete de español también estará presente en la finca conmigo durante las entrevistas en persona. Tardará aproximadamente 60-75 minutos para contestar las preguntas. Ninguna de las actividades que completará en esta investigación es peligrosa o invasiva.

Esta investigación también incluye estudios diseñadas para ayudar a los científicos a comprender las fortalezas y debilidades sobre la bioseguridad en las granjas. El investigador realizará una evaluación de bioseguridad en su granja. El investigador realizará la evaluación reuniéndose con usted en persona en la granja y haciéndole una serie de 136 preguntas de bioseguridad desde una herramienta en línea de BioCheck.UGent. Habrá un interprete del español disponible.

Una copia de las preguntas de la evaluación está disponible aquí: https://biocheck.ugent.be/sites/default/files/2020-02/Dairy_EN.pdf.

La versión en español esta disponible aquí: https://biocheck.ugent.be/sites/default/files/2020-02/Dairy_ES.pdf.

La página de inicio del sitio web BioCheck.UGent está disponible aquí: https://biocheck.ugent.be/en.

Después de completar la evaluación de bioseguridad, el investigador le enviará un correo electrónico con los resultados y una breve encuesta para que pueda proporcionar comentarios sobre la utilidad de la herramienta para usted.

Riesgos y malestar: No se conocen riesgos o malestares involucrados en esta investigación que sean mayores que los encontrados en la vida diaria.

Beneficios: No existen beneficios personales directos por participar en esta investigación. Aunque no hay beneficios directos para usted, esperamos ampliar el CAP de bioseguridad del ganado y el CAP de prevención de enfermedades infecciosas. Los datos recopilados en esta investigación se utilizarán para desarrollar recomendaciones para las granjas participantes sobre cómo mejorar sus prácticas de bioseguridad y prevención de enfermedades infecciosas. El resumen de todos los hallazgos se compartirá con usted para comunicarle la respuesta promedio de su granja.

Confidencialidad: La información recopilada durante esta investigación se mantendrá confidencial. Esta investigación protege la confidencialidad y la privacidad porque no pide a los participantes que proporcionen sus nombres u otros identificadores que puedan vincularse a sus nombres. Los resultados obtenidos de la investigación pueden publicarse con fines científicos, pero las publicaciones no incluirán su nombre ni el nombre de la granja.

¿Tiene usted alguna pregunta sobre su privacidad o confidencialidad?

Retiro de la investigación: su participación en esta investigación es voluntaria. Si decide participar en la investigación, puede retirar su consentimiento y dejar de participar en cualquier momento sin penalidad alguna.

Preguntas: Cualquier pregunta sobre la investigación o los riesgos de participar en esta investigación debe dirigirse al Dr. Robert Fathke. Puede comunicarse con él por teléfono al (XXX) XXX-XXXX o por correo electrónico a Robert.Fathke@colostate.edu. Si tiene alguna pregunta sobre sus derechos como participante voluntario en esta investigación, comuníquese con la Junta de Revisión Institucional (IRB) de la Universidad Estatal de Colorado en: RICRO_IRB@mail.colostate.edu; 970-491-1553.

Derechos legales: Usted no renuncia a ninguno de sus derechos legales al consentir verbalmente su participación de este estudio.

¿Tiene alguna pregunta para mi?

Consentimiento verbal: Para mantener la privacidad, no recopilaremos su firma ni ninguna firma en este formulario de consentimiento verbal.

¿Desea participar en este estudio? Por favor responda “Sí” o “No.”

APPENDIX 9: KAP QUESTIONNAIRE ORIGINAL (ENGLISH)

KAP Survey: Colorado Dairy Biosecurity

Objectives:

- Evaluate dairy farmer and owner knowledge, attitudes, and practices (KAP) of dairy livestock biosecurity using a structured questionnaire
- Compare KAP findings between dairy production systems (organic versus conventional) and between farm personnel (worker versus owner and managers)
- Gather KAP data on the effects of COVID-19 on livestock biosecurity
- Gather KAP data on antimicrobial usage
- Gather KAP data on foreign animal diseases
- Gather KAP on incentives to practice livestock biosecurity
- Gather general livestock biosecurity KAP data
- Gather KAP data on training

<u>Demographics and Background</u>

1. Date of interview with researchers____________________

2. What is your preferred language?
Circle one
a. English
b. Spanish
c. Other (Specify)

3. What is your gender?
Circle one
a. Man
b. Woman
c. Other
d. Prefer not to answer

4. How old are you?
Circle one
a. 18-20 years old
b. 21-30 years old
c. 31-40 years old
d. 41-50 years old
e. 51-60 years old
f. 61-70 years old
g. 71 years old and above

5. What is the highest level of education you have finished?
Circle one
a. None
b. Primary/elementary school
c. Middle school
d. High school
e. Technical education
f. Associates degree
g. Bachelor’s degree
h. Master’s degree
i. Doctoral degree

6. For how long have you worked on this dairy farm?
Circle one
a. Less than one year
b. More than one year
c. More than five years

7. Have you ever worked in other dairies?
Circle one
a. Yes
b. No

8. How long have you worked in a dairy job/environment?
Circle one
a. Less than one year
b. More than one year
c. More than five years

9. Do you live on the dairy farm that currently employs you?
Circle one
a. Yes
b. No

10. Do you live with other farm workers?
Circle one
a. Yes
b. No

11. Please select all the correct answers
Circle all that apply
a. I live with my spouse or significant other
b. I live with my kid(s)
c. I live with other farm employees
d. I live alone
e. I live with other family members (e.g., parents, grandparents, siblings, cousins, etc.)

12. What is your current role/job at the dairy?
Circle one
a. Worker
b. Owner
c. Manager/Supervisor
d. Other (Specify)

13. Where do you spend most of your time working on the farm?
Circle one
a. Dairy parlor
b. Calf pens
c. Maternity
d. Hospital
e. Office
f. Other (Specify)

14. What is the type of dairy on which you currently work?
Circle one
a. Conventional
b. Organic

15. Please indicate the total number of cattle on your farm (includes lactating animals, replacement heifers, dry cows, and bulls)____

<u>Knowledge</u>

I will ask you some questions on your knowledge of biosecurity. Is it okay to proceed? (Check One):
Yes
No: (Please indicate the reason for decline) ___________________________________

16. Have you heard of "livestock biosecurity"?
Circle one
a. Yes
b. No
17. What does "biosecurity" mean to you?
Select all that apply
a. Preventing animal pathogens and diseases from entering and leaving the farm
b. Preventing spread of animal pathogens and disease within the farm
c. Preventing all pathogens and diseases (human and animal) from entering the farm and spreading within the farm
d. I do not know
e. Other (Specify)

18. Which cattle diseases can cause major production loss on Colorado dairies?
Select all that apply
a. Johne’s Disease
b. Mastitis
c. Bovine viral diarrhea
d. All of the above
e. None of the above

19. Foreign animal diseases are diseases present in other countries but do not typically appear within the United States. With regard to the United States, which of are considered foreign animal diseases that can affect **cattle**?
Select all that apply
a. African Swine Fever
b. Peste des Petits Ruminant (PPR)
c. Foot and Mouth Disease (FMD)
d. All of the above
e. None of the above

20. Can animals give some diseases to humans?
Circle one
a. Yes
b. No
c. I don’t know

21. Which are personal protective equipment (PPE)?
Circle all that apply
a. Face masks (N95 Respirators and Surgical Masks)
b. Gloves
c. Boots
d. Aprons
e. Obstetric sleeves
f. Coveralls
g. Goggles
h. None of the above

22. When should antibiotics be used on the farm?
Circle all that apply
a. When an animal has a bacterial infection
b. When an animal has a viral infection
c. Whenever an animal is lame
d. All of the above
e. None of the above
f. Other (Specify)

23. Have you ever worked on a farm that had an animal disease outbreak that required culling of animals?
Circle One
a. Yes
b. No
c. I don’t know
d. Prefer not to answer

Attitudes

I will ask you your opinion on questions related to livestock biosecurity. Is it okay to proceed? (Check One):
Yes
No: (Please indicate the reason for decline) ________________________________

24. Livestock biosecurity can be defined as measures taken to prevent pathogens from entering or leaving a livestock population and from spreading within a livestock population. Some components of livestock biosecurity measures include isolation of newly introduced and sick animals, pest control, visitor policies, personal hygiene and use of farm-specific clothing, feed safety, calf and adult health management, animal purchase, animal transport and carcass removal, cleaning and disinfection of pens and stables, and animal vaccination. How important is livestock biosecurity to you?
Circle one
a. Extremely important
b. Very important
c. Moderately important
d. Slightly important
e. Not at all important

25. Which is most important to you?
Circle one
a. Preventing pathogens and diseases from entering the herd
b. Preventing pathogens and diseases from spreading within the herd
c. Both are equally important

26. Has livestock biosecurity become more important to you since the start of COVID-19?
Circle one
a. Yes
b. No

27. If you answered “Yes” to the above question, please explain____
____

28. Who do you most trust to give you accurate information on livestock biosecurity? Rank the options with a rank of "1" through "8." "1" = Most trusted. "8" = Least trusted
Please rank
a. Veterinarians____
b. Dairy industry leaders____
c. Co-workers____
d. Dairy Managers____
e. University Professors____
f. Human Healthcare Professionals____
g. Friends and Relatives____
h. Dairy Owners____

29. What motivates you to practice livestock biosecurity?
Rank the options with a rank of "1" through "7.". "1" = Strongest motivator. "6" = Weakest motivator. with "1" being the strongest motivator and "7" being the weakest motivator.
Please rank
a. Belief that livestock biosecurity leads to increased profit for the farm____
b. Belief that livestock biosecurity reduces animal diseases____
c. Belief that livestock biosecurity can help prevent animals spreading diseases to humans on the farm____
d. Peer pressure from co-workers____
e. Desire to follow rules and regulations____
f. Belief that livestock biosecurity can help prevent antimicrobial resistance____
g. Belief that livestock biosecurity can prevent humans spreading diseases to animals on the farm

30. How has your farm changed livestock biosecurity efforts since the COVID-19 pandemic started in the United States?
Circle one
a. The farm has increased livestock biosecurity efforts
b. The farm has decreased livestock biosecurity efforts
c. The farm's livestock biosecurity efforts have not changed
d. I don't know
e. Other (Specify)____

31. Please explain your answer to the previous question____
____
____

32. Has he COVID-19 pandemic made it more difficult for your farm to practice effective livestock biosecurity?
Circle one
a. Yes
b. No
c. I don't know

33. Please explain your answer to the previous question____

____

34. Antimicrobial resistance occurs when bacteria, viruses, fungi, or parasites change in ways that make them less susceptible to effects of medications/drugs used to kill them or slow their growth. What farm practices do you believe can lead to antimicrobial resistance in cattle? *Circle one*

a. Treating sick animals with antibiotics when they are not needed
b. Failing to separate sick animals from healthy animals
c. Both
d. Neither
e. I don't know
f. Other (Specify)

35. To what extent do you agree or disagree with the following statements?

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	I don't know	I prefer not to answer
Livestock biosecurity can help prevent antimicrobial resistance on the farm							
Livestock biosecurity can help prevent animal diseases on the farm							
Livestock biosecurity can help prevent spread of animal diseases to humans on the farm							
Livestock biosecurity can help prevent humans spreading diseases to farm animals							
Livestock biosecurity is worth the time and effort to do it							
Livestock biosecurity can help the farm make more money							
I receive effective livestock biosecurity training on my farm							
The level of livestock biosecurity practiced on							

my farm is adequate to prevent and control cattle diseases							
My farm has enough carcass storage and disposal space							
There is nothing my farm can do prevent diseases in cattle							

36. What would most motivate you to practice stronger livestock biosecurity on your farm? Rank the following options with a rank of “1” through “4.: “1” = Strongest motivator. “4” = Weakest motivator
Please rank
a. Increasing farm profits____
b. Preventing antimicrobial resistance in cattle____
c. Preventing disease spread from animals to humans on the farm____
d. Preventing a foreign animal disease from entering the farm or spreading throughout the farm____

37. What do you believe is your farm’s biggest obstacle to practicing stronger livestock biosecurity? Rank the following options with a rank of “1” through “10.” “1” = Biggest obstacle. “10” = Smallest obstacle
Please rank
a. Lack of time____
b. Lack of money____
c. Lack of knowledge about livestock biosecurity____
d. Lack of space on the farm____
e. Lack of equipment____
f. Lack of sanitizing agents____
g. Lack of feasibility____
h. The overall impacts of COVID-19____
i. Lack of interest in biosecurity____
j. Lack of ability to communicate farm biosecurity rules and regulations to all employees____

38. Personal protective equipment (PPE) is wearable equipment designed to protect the wearer. It includes face masks (N95 Respirators and Surgical Masks), gloves, boots, aprons, obstetric sleeves, coveralls, goggles and other items. Do you have enough PPE on the farm?
Circle one
a. Yes
b. No

39. If you answered “No” in the above question, which types of PPE does your farm need more of?
Circle all that apply

a. Face masks (N95 Respirators and Surgical Masks)
b. Gloves
c. Boots
d. Aprons
e. Obstetric sleeves
f. Coveralls
g. Goggles
h. Other (Specify)____

40. Has the COVID-19 pandemic decreased availability of PPE on the farm?
Circle one
a. Yes
b. No
c. I don't know

41. If you answered "Yes" to the above question, please explain____

42. To what extent do you agree or disagree with the following statements? Since the COVID-19 pandemic began…

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	I don't know	I prefer not to answer
there have been more diseases in cattle on the farm							
the farm is using more antimicrobials to treat animals							
it has been harder to provide medical care for animals							
it has been harder to provide cattle preventive measures (e.g., vaccines, dewormers)							
there have been more vermin or pests on the farm							

there has been more wildlife interacting with cattle on the farm							
there have been more abortions in cattle							
diseases spreading from cattle to people have become more common							
it has been more difficult to practice livestock biosecurity on the farm							
the farm has focused more on livestock biosecurity training							
it has been more difficult for the farm to maintain the needed number of workers							

43. How would you like to receive livestock biosecurity training? Circle your top 3 choices.
a. On the job training through supervisors or peers
b. In-person conferences
c. Webinars
d. Internet videos (e.g. YouTube videos)
e. Classroom based lectures
f. Classroom discussions
g. Mobile phone technology
h. Other (Specify)

Practices

I will ask information on livestock biosecurity practices on your farm. Is it okay to proceed? (Check One):
Yes
No: (Please indicate the reason for decline) ________________________________

44. Does your farm have a written livestock biosecurity policy/plan?

Circle one
a. No
b. Yes
c. I don't know

45. If you answered "Yes" to the above question, how often is the biosecurity policy/plan revised on average?
Circle one
a. Never
b. Once per year
c. More than once per year
d. I don't know
e. Other (Specify)

46. Which are parts of livestock biosecurity on your farm?
Circle all that apply
a. Visitor policies
b. Personal protective equipment (PPE)
c. Isolation of sick animals
d. Pest and vermin control programs
e. Cleaning and disinfection of stables and pens
f. Wearing farm-specific clothing and boots
g. None of the above
h. I don't know

47. Does your farm have a foreign animal disease outbreak plan (e.g., Foot and Mouth Disease)?
Circle one
a. Yes
b. No
c. I don't know

48. Does your farm have someone in charge of livestock biosecurity?
Circle one
a. Yes
b. No
c. I don't know

49. Does your farm complete livestock biosecurity assessments or checklists?
Circle one
a. Yes
b. No
c. I don't know

50. If you answered "Yes" to the above question, which year did your farm last complete the livestock biosecurity assessment or checklist?

(Indicate year and month)

____

I don’t know

51. For which activities does your farm maintain records?
Select all that apply
a. Changing foot bath solutions
b. Cleaning stalls
c. Visitor logs
d. Pest and vermin control
e. Antimicrobial usage
f. None of the above
g. I don’t know

52. Between handling calves, workers are required to
Circle one
a. Wash their hands
b. Change their gloves
c. Both of the above
d. Neither
e. I don’t know

53. Are feed storage areas protected from pests and vermin, including wildlife?
Circle one
a. Yes
b. No
c. I don’t know

54. Pest and vermin control programs on the farm are designed to control which?
Circle all that apply
a. Dogs
b. Cats
c. Birds
d. Rodents
e. Insects
f. Raccoons
g. None of the above
h. I don’t know

55. Before entering the farm, visitors must first:
Circle all that apply
a. Sign a visitors’ log
b. Wash hands with soap and water
c. Put on gloves
d. Put on farm-designated clothing
e. Put on farm-designated boots

f. Stand in a disinfecting footbath
g. Wear a face mask or cloth face covering
h. None of the above
56. Farm workers are required to:
Circle all that apply
a. Wash hands with soap and water
b. Wear gloves
c. Wear farm-designated clothes
d. Wear farm-designated boots
e. Change clothes after work before leaving the farm
f. Wear a face mask or cloth face covering
g. None of the above

57. How often does your farm conduct livestock biosecurity training?
Circle one
a. More than once per month
b. More than once every six months
c. More than once per year
d. At least once per year
e. Less than once per year
f. Never

58. What topics are covered in your livestock biosecurity training?
Circle all that apply
a. Carcass storage
b. Carcass disposal
c. Visitor policies
d. Pest and vermin control
e. Personal protective equipment (PPE)
f. Foreign animal diseases
g. Hand sanitation
h. Antimicrobial resistance
i. Disease transmission from animals to humans
j. Disease transmission from humans to animals
k. Other (Specify)____
l. My farm does not conduct livestock biosecurity training

59. Is livestock biosecurity training provided in your preferred language?
Circle one
a. Yes
b. No
c. My farm does not offer livestock biosecurity training

60. Which of the apply to your livestock biosecurity training experiences on the farm
Circle all that apply
a. My training involves a test or examination

b. I can provide feedback on the trainings
c. None of the above
d. My farm does not offer livestock biosecurity training

61. What are used during your livestock biosecurity training?
Please circle all that apply
a. On the job training through supervisors or peers
b. In-person conferences
c. Webinars
d. Internet videos (e.g. YouTube videos)
e. Classroom based lectures
f. Classroom discussions
g. Other (Specify)
h. Mobile phone technology
i. My farm does not conduct livestock biosecurity training

KAP Survey: Colorado Dairy Biosafety

Objectives:

- Evaluate dairy farmer and owner knowledge, attitudes, and practices (KAP) of dairy biosafety using a structured questionnaire
- Compare findings between production dairy production systems (organic versus conventional) and between occupations (worker versus owner)
- Focus on infectious diseases, including zoonoses and COVID-19

<u>Demographics and Background</u>

1. Date of interview with researchers____________________

2. What is your preferred language?
Circle one
a. English
b. Spanish
c. Other (Specify)

3. What is your gender?
Circle one
a. Man
b. Woman
c. Other
d. Prefer not to answer

4. How old are you?
Circle one
a. 18-20 years old

b. 21-30 years old
c. 31-40 years old
d. 41-50 years old
e. 51-60 years old
f. 61-70 years old
g. 71 years old and above

5. What is the highest level of education you have finished?
Circle one
a. None
b. Primary/elementary school
c. Middle school
d. High school
e. Technical education
f. Associates degree
g. Bachelor's degree
h. Master's degree
i. Doctoral degree
6. How long have you worked on a dairy farm?
Circle one
a. Less than one year
b. More than one year but less than five years
c. More than five years

7. Have you ever worked in other dairies?
Circle one
a. Yes
b. No

8. How long have you worked in a dairy job/environment?
Circle one
a. Less than one year
b. More than one year but less than five years
c. More than five years

9. Do you live on the dairy farm where you work?
Circle one
a. Yes
b. No

10. Do you live with anyone else? Please select all the correct answers
Circle all that apply
a. I live with my spouse or significant other
b. I live with my kid(s)
c. I live with other farm workers
d. I live alone

e. I live with other family members (e.g., parents, grandparents, siblings, cousins, etc.)

11. What is your current role/job at the dairy
Circle one
a. Worker
b. Owner
c. Manager/Supervisor
d. Other (Specify)

12. Where do you spend most of your time working on the farm?
Circle one
a. Dairy parlor
b. Calf pens
c. Maternity
d. Hospital
e. Office
f. Other (Specify)

13. What is the type of dairy on which you currently work?
Circle one
a. Conventional
b. Organic

14. Please indicate the total number of cattle on your farm (includes lactating animals, replacement heifers, dry cows, and bulls)____
I don't know

<u>Knowledge</u>

I will ask you some questions on your knowledge. Is it okay to proceed?
(Check One):
Yes
No: (Please indicate the reason for decline) __________________________________

15. Have you heard of the term "zoonotic disease"?
Circle one
a. Yes
b. No
c. I don't know

16. What is a "zoonotic disease"?
Circle one
a. A disease that can be spread from animals to people
b. A disease that only affects animals
c. A disease that cannot be prevented
d. Other (Specify)

e. I don't know

17. Zoonotic diseases are diseases that can be spread from animals to people. Which zoonotic diseases can people get from cattle?
Circle all that apply
a. Rabies
b. Ringworm
c. Leptospirosis
d. Q fever
e. Cryptosporidiosis
f. Methicillin Resistant *Staphylococcus aureus* (MRSA)
g. Foot and mouth disease (FMD)
h. Tuberculosis
i. *E. coli*
j. Salmonellosis
k. Diabetes
l. None of the above
18. How can diseases be transmitted from animals to people?
Circle all that apply
a. By touching or handling animals
b. Through air
c. Exposure to blood
d. Exposure to body fluids from birth and/or abortion
e. Exposure to saliva
f. By eating food
g. By being bitten
h. None of the above

19. Which are true about cryptosporidiosis?
Circle all that apply
a. It is a protozoal parasite
b. It can cause diarrhea in people
c. Washing your hands can help prevent it
d. You can be infected through food or water
e. Calves can spread it in their feces
f. None of the above are true

20. Is it possible for humans to give diseases to animals?
Circle one
a. Yes
b. No
c. I don't know

21. Which diseases could people spread to one another on dairy farms?
Circle all that apply
a. COVID-19

b. The common cold
c. Seasonal influenza
d. Tuberculosis
e. Diabetes
f. None of the above

22. What causes COVID-19?
Circle one
a. Virus
b. Bacteria
c. Fungi
d. Chemicals
e. Other (Specify)
f. None of the above

23. What is the main way people get sick with COVID-19?
Circle one
a. Air, by breathing it in
b. Eating contaminated food
c. Mosquito bites
d. Drinking contaminated water
e. I don't know
f. Other (Specify)

24. True or false? Tuberculosis and COVID-19 can both be transmitted from person-to-person through the air.
Circle One
a. True
b. False
c. I don't know

25. Which are true?
Circle all correct options
a. People who are not showing symptoms of COVID-19 can make others sick
b. COVID-19 symptoms may appear 2-14 days after someone gets exposed to the virus
c. Symptoms of COVID-19 can be like symptoms of influenza
d. All people with COVID-19 have symptoms

26. Which are personal protective equipment (PPE)?
Circle all that apply
a. Face masks (N95 Respirators and Surgical Masks)
b. Gloves
c. Boots
d. Aprons
e. Obstetric sleeves
f. Coveralls

g. Goggles
h. None of the above

27. Which can prevent spread of COVID-19?
Circle all that apply
a. Using face masks or cloth face coverings
b. Maintaining six feet distance between people
c. Washing hands often with soap and water for at least 20 seconds
d. Cover coughs and sneezes with inside of elbow
e. Clean and disinfect surfaces often
f. Monitor your health daily
g. None of the above

28. Face masks or cloth face coverings should be worn to cover what?
Circle all that apply
a. Mouth
b. Nose

<u>Attitudes</u>

I will ask you some questions on your attitudes and beliefs. Is it okay to proceed?
(Check One):
Yes
No: (Please indicate the reason for decline) ________________________________

29. Please us the table below the answer the following questions

	Extremely Concerned	Very Concerned	Moderately Concerned	Slightly Concerned	Not at all Concerned	I Prefer not to Answer
Zoonotic diseases are infectious diseases transmitted from animals to people. How concerned are you about getting a zoonotic disease while being on the farm?						
How concerned are you about getting COVID-19 from another person while working on the farm?						

30. Livestock biosecurity can be defined as measures taken to prevent diseases from entering or leaving a livestock population and from spreading within a livestock population. Some components of livestock biosecurity measures include isolation of new or sick animals, pest

control, visitor policies, personal hygiene and use of farm-specific clothing. It can also include feed safety, health management of all animals, animal purchase, animal transport and carcass removal, cleaning and disinfection of pens and stables, and animal vaccination. To what extent do you agree or disagree with the following statement: I believe practicing livestock biosecurity on the farm can decrease the chance that farm employees will get a disease from animals on the farm.
Circle one
a. Strongly agree
b. Agree
c. Neither agree nor disagree
d. Disagree
e. Strongly disagree

31. Do you think you've ever gotten sick from working with animals at this dairy farm?
Circle one
a. Yes
b. No
c. I don't know
d. I prefer not to answer

32. Do you think you've ever gotten sick from one of the other workers on the dairy farm?
Circle one
a. Yes
b. No
c. I don't know
d. I prefer not to answer

33. Which do you believe is more likely to happen to you on the farm? Rank "1" through "3."
"1" = most likely. "3" = least likely.
Please rank
a. I will get a disease from an animal____
b. I will get COVID-19 from someone working on the farm____
c. I will be injured in an accident while working on the farm____

34. Which do you believe would harm your health the most if it happened to you? Rank "1" through "3."
"1" = most likely. "3" = least likely.
Please rank
a. Getting a disease from an animal on the farm____
b. Catching COVID-19 from someone working on the farm____
c. Being injured in an accident while working on the farm____

35. Have ever known a person who has contracted any of these?
Circle all that apply
a. A disease from a farm animal
b. COVID-19

c. Neither

36. Do you believe animals on the farm could transmit the COVID-19 virus to people on the farm?
Circle one
a. Yes
b. No

38. Do you believe it is possible for people to transmit COVID-19 to animals?
Circle one
a. Yes
b. No

39. Personal protective equipment (PPE) is equipment that keeps you safe when you wear it. There are many different types of PPE. PPE on the farm includes face masks (N95 Respirators and Surgical Masks), gloves, boots, aprons, obstetric sleeves, coveralls, goggles and other items. To what extent do you agree or disagree with the following statement: Using PPE will reduce my chances of getting a disease from an animal on the farm.
Circle One
a. Strongly agree
b. Agree
c. Neither agree nor disagree
d. Disagree
e. Strongly disagree

40. To what extent do you agree or disagree with the following statements:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	I don't know	I prefer not to answer
The precautions taken on my farm will protect me from getting COVID-19							
There is nothing I can do to prevent myself from getting a disease from animals while on the farm							
There is nothing I can do to prevent myself from getting COVID-19 while on the farm							

The farm provides me with everything I need to protect myself from getting diseases from animals on the farm							
The farm provides me everything I need to protect myself from getting diseases like COVID-19 from people on the farm							
The farm has enough personal protective equipment (PPE) for me							
Wearing cloth face coverings on the farm will help prevent the spread of COVID-19							
Personal protective equipment (PPE) has been harder to find on the farm since the COVID-19 pandemic began							
I know how to protect myself from animal diseases while working on the farm							
I know how to protect myself from COVID-19 while working on the farm							
I know how to properly put on and take off personal protective equipment (PPE)							

Since COVID-19 started, I think there have been more cases of diseases from animals to people on the farm							
I understand my farm's COVID-19 policies							

41. What do you think is the most important reason to try to keep diseases off the farm? Please rank the following options with a rank of "1" through "11."
"1" = biggest motivator
"11" = smallest motivator.
Please Rank
a. I could get diseases from farm animals____
b. Animals could spread diseases to other animals____
c. Humans could give diseases to farm animals____
d. I could get diseases like COVID-19 from other people working on the farm____
e. People could spread diseases to other people working on the farm____
f. I could spread a disease to my family members____
g. The farm could lose money____
h. Peer pressure____
i. The farm could earn more money____
j. Recommendations from a veterinarian____
k. I want to follow laws____

42. Which personal protective equipment (PPE) do you wish you had more of on the farm?
Circle all that apply
a. Face masks (N95 Respirators and Surgical Masks)
b. Gloves
c. Boots
d. Aprons
e. Obstetric sleeves
f. Coveralls
g. Goggles
h. None of the above
i. Other (Specify)

43. What do you believe are your farm's biggest obstacles to improving programs that aim to prevent the spread of diseases from animals to people on the farm? Please rank the following options with a rank of "1" through "8", with "1" being the biggest obstacle and "8" being the smallest obstacle.
Please rank
a. Lack of time____
b. Lack of money____

c. Lack of knowledge about infectious diseases and how to prevent them____
d. Lack of concern about infectious diseases____
e. Lack of personal protective equipment (PPE)____
f. Lack of disinfecting or sanitizing agents____
g. Lack of feasibility____
h. Lack of ability to communicate farm safety rules and regulations to all employees____

44. What do you believe are your farm's biggest obstacles to improving programs that aim to prevent diseases spread from people to people like COVID-19? Please rank the following options with a rank of "1" through "8.".
"1" = biggest obstacle
"8" = smallest obstacle
Please rank
a. Lack of time____
b. Lack of money____
c. Lack of knowledge about infectious diseases and how to prevent them____
d. Lack of concern about infectious diseases____
e. Lack of personal protective equipment (PPE)____
f. Lack of disinfecting or sanitizing agents____
g. Lack of feasibility____
h. Lack of ability to communicate farm safety rules and regulations to all employees____

45. When is it most important to wear a face mask (N95 Respirator or Surgical Mask)? Please rank the following options with a rank of "1" through "5"
"1" = most important
"5" = least important.
Please rank
a. While riding in vehicle with co-workers____
b. While working with chemicals____
c. While working in dusty areas____
d. While working with animals____
e. While standing less than 6 feet away from another person on the farm____

46. What would motivate you to wear a face mask (N95 Respirator or Surgical Mask) more often on the farm? Please rank the following options with a rank of "1" through "6."
"1" = biggest motivator
"6" = smallest motivator.
Please rank
a. Having more proof that a face mask is useful____
b. Having a face mask that is more comfortable____
c. Having more access to face masks____
d. Having a face mask that interferes less with my work____
e. Stricter farm rules and regulations____

47. Which do you believe about cloth face coverings on the farm?
Circle all that apply

a. They can prevent me from catching COVID-19 from people
b. They can reduce my chances of giving COVID-19 to people
c. They can prevent me from catching zoonotic diseases from animals
d. They can prevent me from breathing in dust
e. They are useless
f. None of the above

48. Does wearing a cloth face covering interfere with your ability to do your job on the farm?
Circle One
a. Yes
b. No
c. I prefer not to answer

49. If you answered "Yes" to the above question, explain your answer____
____

50. Which statements do you agree with?
Circle all that apply
a. Social distancing can help prevent COVID-19 on my farm
b. Social distancing will not help prevent COVID-19 on my farm
c. My farm leadership encourages social distancing
d. I believe social distancing is unnecessary
e. Social distancing on the farm can prevent me from getting diseases from other people
f. Farm employees do their best to follow social distancing guidelines from farm leadership
g. None of the above

51. Does social distancing on your farm interfere with your ability to do your work?
Circle one
a. Yes
b. No
c. I prefer not to answer
d. My farm does not practice social distancing

52. Where would it be most difficult to practice social distancing at your farm?
Circle one
a. Break room
b. My workstation
c. Other (Specify)

53. Which statements do you agree with?
Circle all that apply
a. I feel comfortable telling my supervisors when I am sick
b. I feel comfortable telling my supervisors when I have an accident
c. I believe I will be penalized for taking sick leave
d. I understand my farm's sick leave policies

e. I believe I will be penalized for taking sick leave if I get a disease from a farm animal
f. I believe I will be penalized for taking sick leave if I get COVID-19
g. The farm encourages people to report when they are sick
h. The farm encourages people to report unsafe practices that could lead to disease in people

54. Does your farm provide health/safety training?
Circle one
a. Yes
b. No
c. I don’t know

55. If you answered “No”, skip to question 57
How often is health/safety training provided?
Circle all that apply
a. When you start to work there
b. Once a year
c. Once a month
d. 2-3 times per year
e. After someone gets hurt or sick
f. After animals get sick
g. I don’t know

56. Is health/safety training provided in your preferred language?
Circle one
a. Yes
b. No
c. I don’t know

57. To what extent do you agree or disagree with the statement: The training I receive on the farm teaches me how to protect myself from diseases from animals.
Circle One
a. Strongly agree
b. Agree
c. Neither agree nor disagree
d. Disagree
e. Strongly disagree
f. My farm does not provide farm safety training

58. To what extent do you agree or disagree with the statement: The training I receive on the farm teaches me how to protect myself from COVID-19.
Circle One
a. Strongly agree
b. Agree
c. Neither agree nor disagree
d. Disagree
e. Strongly disagree

f. My farm does not provide farm safety training

59. Who do you most trust to give you accurate information about COVID-19 and other diseases transmitted person-to-person?
Rank the following options with a rank of “1” through “7”
“1” = most trusted
“7” = least trusted
Please rank
a. Supervisors/Managers____
b. Co-workers____
c. Veterinarians____
d. Farm owners____
e. Local public health officials____
f. Your doctor____
g. Other (Specify)____

60. Who do you most trust to give you accurate information about zoonotic diseases from cattle?
Rank the following options with a rank of “1” through “7.”
“1” = most trusted
“7” least trusted
Please rank
a. Supervisors/Managers____
b. Co-workers____
c. Veterinarians____
d. Farm owners____
e. Local public health officials____
f. Your doctor____
g. Other (Specify)____

61. How has your access to PPE changed since the start of the COVID-19 pandemic?
a. PPE is easier to find since the pandemic started
b. PPE is harder to find since the pandemic started
c. Access has not changed since the pandemic started

62. How would you like to receive infectious disease prevention training? Circle your top 3 choices.
a. On the job training through supervisors or peers
b. In-person conferences
c. Webinars
d. Internet videos (e.g. YouTube videos)
e. Classroom based lectures
f. Classroom discussions
g. Mobile phone technology
h. Other (Specify)

Practices

I will ask you some questions on your practices of farm safety. Is it okay to proceed?
Circle One
Yes
No (Please indicate the reason for decline)________________________________

62. Social distancing means keeping 6 feet between yourself and others. Does your farm have any requirements about social distancing?
Circle one
a. Yes
b. No
c. I don't know

63. How often does your farm conduct health/safety training that includes instruction on diseases from animals and/or diseases spread person-to-person like COVID-19?
Circle one
a. More than once per month
b. More than once every six months
c. More than once per year
d. At least once per year
e. Less than once per year
f. Never
g. Other (Specify)

64. Which are used during your health/safety training on the farm?
Circle all that apply
a. On the job training through supervisors or peers
b. In-person conferences
c. Webinars
d. Internet videos (e.g. YouTube videos)
e. Classroom-based lectures
f. Classroom discussions
g. Other (Specify)
h. My farm does not offer health/safety training

65. If you wanted to find farm safety information on infectious diseases (including zoonotic diseases and communicable diseases like COVID-19) which sources would you most likely use? Please rank the following options with a rank of "1" through "10."
"1" = most likely
"10" = least likely
Please rank
a. Radio____
b. Internet searches (Google, other search engines) ____
c. Co-workers____
d. Relatives____
e. Training events____

f. Social media (Face Book, Twitter, Instagram, etc.) ____
g. Veterinarians____
h. Supervisors/Managers____
i. Farm owners____
j. Other (Specify)____

66. Which apply to your health/safety training experiences on the farm?
Circle all that apply
a. My training involves an assessment or examination to measure learning
b. I can give feedback on the trainings
c. None of the above
d. My farm does not offer farm health/safety training

67. What topics are included in your farm health/safety training programs?
Circle all that apply
a. COVID-19 awareness and prevention
b. Personal protective equipment (PPE) use
c. Proper fit and wear of face masks and cloth face coverings
d. Animal handling procedures
e. Needle stick prevention
f. Accident and illness reporting procedures
g. Sick leave policies
h. Handwashing practices
i. Equipment and premises sanitation
j. Recognizing signs and symptoms of zoonotic diseases in animals
k. Recognizing signs and symptoms of infectious diseases in humans
l. Farm-specific social distancing policies and practices
m. Cough and sneeze etiquette
n. Posters in English on COVID-19 prevention are posted in areas where they are likely to be seen
o. Posters in Spanish on COVID-19 prevention are posted in areas where they are likely to be seen
p. None of the above
q. Other (Specify)

68. PPE training includes which?
Circle all that apply
a. Explanation of when to use PPE and what PPE is necessary
b. How to properly put on and take off PPE
c. How to properly dispose of PPE
d. How to clean reusable PPE
e. Recommendation to wash hands with soap and water for 20 seconds (or use alcohol-based hand sanitizer) after removing PPE
f. Fit-testing for respirators
g. None of the above
h. My farm does not offer PPE training

69. Regarding personal hygiene, which are true on your farm?
Circle all that apply
a. Employees have access to handwashing facilities with soap, potable water, and clean, single use towels
b. Employees are encouraged to wash their hands often with soap and water for at least 20 seconds
c. Employees have access to hand sanitizer containing at least 60% alcohol
d. There are enough hand washing stations
e. Personal hygiene guidelines written in English are posted on the farm
f. Personal hygiene guidelines written in Spanish are posted on the farm
g. None of the above

70. Regarding premises and equipment disinfection and sanitation, which of are true on your farm?
Circle all that apply
a. Farm policies include instructions on disposal of fetal membranes and fluids associated with cattle birth and abortion
b. The farm has a written disinfection and sanitation policy
c. Equipment shared among workers is cleaned and disinfected between each employee use
d. Break rooms are cleaned and disinfected between each group using the area

71. Regarding sick leave, which are true on your farm?
Circle all that apply
a. Employees who get sick can lose their job if they miss too many days
b. Employees can take sick leave, but they don’t get paid
c. My farm has a policy where you can take sick leave and still get paid
d. Workers are penalized for taking sick leave if they have COVID-19
e. Workers are given a test to ensure they understand farm sick leave policies

72. If farm worker housing exists on the farm, which sanitation and social distancing policies are in place and enforced?
Circle all that apply
a. Farm housing provides designated living quarters to isolate people with confirmed or suspected COVID-19
b. Shared sleeping quarters are arranged to allow six feet between beds.
c. Tables and seating in common use spaces are arranged to allow for social distancing of 6 feet apart
d. Common use spaces are stocked with hand washing supplies
e. Inhabitants use cloth face covers in common use areas
f. Posters in English and Spanish on COVID-19 prevention are present in common use areas
g. I don’t know
h. Worker housing does not exist on the farm

73. Regarding carpooling, which are true?
Circle all that apply

a. Employees wear masks or cloth face coverings while in the car
b. Cars are disinfected between trips
c. Riders wash hands before entering vehicles
d. Riders undergo health screening before entering shared vehicles
e. Riders usually ride with members of their work crews and/or housemates
f. Carpooling is organized and facilitated by farm management, leadership, or contractors
f. Carpooling is organized and facilitated by farm workers without farm management or leadership control
h. Carpooling does not occur
i. I don't know
j. None of the above

74. Regarding prevention and control of COVID-19 on the farm, which are true?
Circle all that apply
a. My farm encourages social distancing (i.e., maintaining 6 feet separation between people) during work
b. My farm has a medical screening system in place
c. My farm has a system in place to separate workers who show COVID-19 symptoms while at work
d. My farm requires use of a face covering (either face mask or cloth face covering) at all times
e. My farm only requires use of a face covering when people less than 6 feet apart
f. Employees are provided contact information for health centers where they can get medical care
g. I don't know
h. None of the above

75. Which are true about cloth face coverings you use on the farm?
Circle all that apply
a. It is provided by the farm
b. I buy it myself
c. It includes multiple layers of fabric
d. It covers my nose and mouth
e. It connects to my ears
f. I do not use a cloth face covering
76. What kinds of PPE have you worn on this farm?
Circle all that apply
a. N-95
b. Surgical mask or other medical masks
c. Cloth mask
d. Gloves
e. Boots
f. Aprons
g. Obstetric sleeves
h. Coveralls
i. Goggles
j. Other (Specify)
k. None of the above

77. Do you do any of these while conducting work duties?
Circle all that apply
a. Eat
b. Drink
c. Smoke
d. Chew tobacco or dip
e. Drink raw milk
f. None of the above

78. Farm employees are required to:
Circle all that apply
a. Wash hands with soap and water
b. Wear gloves
c. Wear farm-designated clothes
d. Wear farm-designated boots
e. Change clothes after work before leaving the farm
f. None of the above
g. I don't know

79. Circle all of the true statements about your daily work routine
Circle all that apply
a. I change clothes on the farm before returning home after work
b. I shower on the farm after work
c. I wash my work clothes separately from my non-work clothes
d. I wear my work boots home at the end of the day
e. I wash my hands after changing gloves

80. Which apply to the farm's visitor policies?
Circle all that apply
a. Visitors are required to sign a log
b. Visitors are required to wear visible identification provided by the farm
c. Visitors must wear farm-issued PPE
d. Visitors must cover their faces with either a face mask or cloth face covering
e. Visitors are provided information on zoonotic disease prevention
f. Visitors must wash their hands before entering the main farm
g. Visitors must walk through a disinfecting foot bath before entering the main farm

81. Does your farm have a plan in place to ensure farm operations continue in the event that a disease outbreak like COVID-19 occurs among workers?
Circle one
a. Yes
b. No
c. I don't know

82. Does your farm have a COVID-19 health and safety program?
Circle one

a. Yes
b. No
c. I don’t know

83. If you answered “No” to the above question, skip this question.
If you answered “Yes” to the above, which are components of the COVID-19 health and safety program?
Circle all that apply
a. Education about how COVID-19 spreads
b. Education about how to prevent COVID-19 from spreading at work
c. Education about how to prevent spreading COVID-19 to family members
d. A plan if someone is unable to work
e. Posters in commonly used areas
f. Training in English and Spanish
g. Whistleblower protection policies so people can report unsafe practices without fear of retaliation?
g. I don’t know

APPENDIX 10: KAP QUESTIONNAIRE ORIGINAL (SPANISH)

Encuesta CAP: Bioseguridad de los productos lácteos de Colorado

Objetivos:

- Evaluar los trabajadores y propietarios de granjas lecheras sobre los conocimientos, las actitudes, y las prácticas (CAP) de bioseguridad del ganado lechero utilizando un cuestionario estructurado
- Comparar los hallazgos CAP entre de los sistemas de producción de lácteos (orgánico versus convencional) y entre el personal (trabajador versus propietario y gerentes)
- Recopilar los datos CAP sobre efectos del COVID-19 en la bioseguridad del ganado
- Recopilar los datos CAP en el uso de los agentes antimicrobianos
- Recopilar los datos CAP en las enfermedades foráneas en los animales
- Recopilar los datos CAP en los incentivos de practicar la bioseguridad del ganado
- Recopilar los datos CAP generales de la bioseguridad ganadera
- Recopilar los datos CAP en la capacitación

<u>**Demografía y antecedentes**</u>

1. Fecha de la entrevista con los investigadores_______________

2. ¿Qué idioma prefiere?

Circule uno
a. Inglés
b. Español
c. Otro (especifique)

3. ¿Cuál es su género?

Circule uno
a. Hombre
b. Mujer
c. Otro
d. Prefiero no contestar

4. ¿Cuántos años tiene usted?

Circule uno
a. 18-20 años
b. 21-30 años
c. 31-40 años
d. 41-50 años

e. 51-60 años
f. 61-70 años
g. 71 años o más

5. ¿Cuál fue el nivel más alto de educación que terminó?
Circule uno
a. Ninguno
b. Escuela primaria/elemental
c. Escuela intermedia
d. Escuela secundaria
e. Educación técnica/vocacional
f. Grado asociado
g. Licenciatura
h. Maestría
i. Doctorado

6. ¿Cuánto tiempo lleva trabajando en esta granja lechera?
Circule uno
a. Menos de un año
b. Más de un año
c. Más de cinco años

7. ¿Ha trabajado usted en otras granjas lecheras*?*
Circule uno
a. Sí
b. No

8. ¿Cuánto tiempo ha trabajado en un trabajo relacionado con granjas lecheras?
Circule uno
a. Menos de un año
b. Más de un año
c. Más de cinco años

9. ¿Vive en la granja lechera donde trabaja?
Circule uno
a. Sí
b. No

10. ¿Vive usted con otros trabajadores de la granja?
Circule uno
a. Sí
b. No

11. Por favor seleccione todas las respuestas correctas.
Circule todas las que apliquen
a. Vivo con mi esposa o pareja
b. Vivo con mis hijos
c. Vivo con otros trabajadores de la granja
d. Vivo solo
e. Vivo con familiares (padres, abuelos, hermanos, primos, etc.)

12. ¿Cuál es su función/trabajo en la lechería?
Circule uno
a. Obrero
b. Propietario
c. Gerente/Supervisor
d. Otro (especifique)

13. ¿Dónde pasa la mayor parte del tiempo trabajando en la granja?
Circule uno
a. Sala de productos lácteos
b. Corrales para terneros
c. Maternidad
d. Hospital
e. Oficina
f. Otra (especificar)

14. ¿En qué tipo de granja lechera trabaja usted actualmente?
Circule uno
a. Convencional
b. Orgánica

15. Por favor indique el número total de cabezas de ganado en su granja (incluya animales lactantes, novillas de reemplazos, vacas secas,y toros) ________________________

Conocimiento
Le haré algunas preguntas sobre su conocimiento sobre la bioseguridad. ¿Está bien continuar?
Circulo uno
Sí
No (Por favor indique el motivo del rechazo) ________________________________

16. ¿Ha escuchado el término "bioseguridad del ganado"?
Circule uno
a. Sí
b. No

17. ¿Qué significa la "bioseguridad del ganado" para usted?

Circule todas las que apliquen

a. Prevenir los agentes patógenos y las enfermedades de entrar y salir de la granja
b. Prevenir la propagación de los agentes patógenos y la enfermedad dentro de la granja
c. Prevenir todos los agentes patógenos y las enfermedades (de los humanos y los animales) de entrar a la granja y de propagarse dentro de la granja
d. No sé
e. Otra (especifique)

18. ¿Cuáles enfermedades ganaderas pueden causar perdidas grandes en la producción de granjas lecheras de Colorado?

Circule todas las que apliquen

a. Enfermedad de Johne (Paratuberculosis)
b. Mastitis
c. Diarrea viral bovina
d. Todas las anteriores
e. Ninguna de las anteriores

19. Las enfermedades foráneas de los animales están presentes en otros países, pero usualmente no se ven en los Estados Unidos. En cuanto a los Estados Unidos, ¿que se consideran enfermedades foráneas en los animales que pueden afectar al ganado?

Circule todas las que apliquen

a. Fiebre Africana Porcina
b. Peste Des Petits Ruminant (PPR)
c. Fiebre aftosa
d. Todas las anteriores
e. Ninguna de las anteriores

20. ¿Pueden los animales contagiar a los humanos con enfermedades?

Circule uno

a. Sí
b. No
c. No sé

21. ¿Cuáles son los equipos de protección personal (EPP)?

Circule todos las que apliquen

a. Las mascarillas (los respiradores de N95 y las mascarillas quirúrgicas)
b. Guantes
c. Botas
d. Delantales
e. Mangas obstétricas
f. Overoles
g. Gafas de seguridad

h. Ninguna de las anteriores

22. ¿Cuándo deben utilizarse los antibióticos en la granja?

Circule uno

a. Cuando un animal tiene una infección bacterial
b. Cuando un animal tiene una infección viral
c. Cuando un animal está cojo
d. Todas las anterior
e. Ninguna de las anteriores
f. Otro (especifique)

23. ¿Ha trabajado usted en una granja que tuvo sacrificar animales por brote de alguna enfermedad?

Circule uno

a. Sí
b. No
c. No sé
d. Prefiero no contestar

<u>Actitudes</u>

Le haré unas preguntas sobre su opinión sobre la bioseguridad del ganado. ¿Está bien continuar? (Marque uno)

Sí

No (Por favor indique el motivo de rechazo*)* ____

24. La bioseguridad del ganado puede definirse como las medidas adoptadas para evitar que los agentes patógenos entren o salgan de la población ganadera y para prevenir la propagación entre el ganado. Algunos componentes de las medidas de la bioseguridad incluyen el aislamiento de los animales nuevos enfermos, control de plagas, políticas para visitantes, higiene personal y el uso de ropa especifica para la granja, la seguridad de los alimentos, el manejo de la salud de los becerros y adultos, la compra de los animales, la transportación de los animales y la remoción (eliminación) de los animales muertos, la limpieza y desinfección de los corrales y establos, y la vacunación de animales. ¿Qué tan importante es la bioseguridad ganadera para usted?

Circule uno

a. Extremadamente importante
b. Muy importante
c. Moderadamente importante
d. Poco importante
e. No es importante
f.

25. ¿Cuáles son más importante para usted?

Circule uno

a. Prevenir los agentes patogénicos y las enfermedades de entrar a la manada
b. Prevenir los agentes patogénicos y las enfermedades de propagarse dentro de la manada
c. Los dos son igualmente importantes

26. ¿Se ha vuelto más importante para usted la bioseguridad ganadera desde comenzó el COVID-19?

Circule uno

a. Sí
b. No

27. Si contestó "Sí" a la pregunta anterior, por favor explique____
____

28. ¿En quién confía más para darle información correcta sobre la bioseguridad del ganado? Marque del *"1"* al "8". "1" – Más confiable. "8" – Menos confiable

a. Veterinarios____
b. Lideres de la industria láctea___
c. Compañeros de trabajo____
d. Los gerentes de las granjas lecheras___
e. Los profesores universitarios___
f. Los profesionales de la salud médica___
g. Los amigos y parientes___
h. Los propietarios de las granjas lecheras___

29. ¿Qué le motiva a practicar la bioseguridad del ganado?

Marque del "1" a "7". "1" – El motivador más fuerte. "7" – El motivador más débil.

a. La creencia que la bioseguridad ganadera lleva a mayor ganancia para la granja___
b. La creencia que la bioseguridad ganadera reduce las enfermedades de los animales ___
c. La creencia que la bioseguridad puede ayudar a prevenir la propagación de las enfermedades de los animales a humanos que están en la granja ___
d. La presión de grupo de sus compañeros de trabajo ___
e. El deseo de seguir las reglas y reglamentos ___
f. La creencia que la bioseguridad ganadera puede ayudar a prevenir la resistencia de los agentes antimicrobianos ___
g. La creencia que la bioseguridad puede prevenir la propagación de las enfermedades por los humanos a los animales de la granja ___

30. ¿Como han cambiado los esfuerzos para la bioseguridad en la granja desde el comienzo de la pandemia del COVID-19 en los Estados Unidos?

Circule uno

a. La granja lechera ha aumentado los esfuerzos de la bioseguridad ganadera
b. La granja lechera ha disminuido los esfuerzos de la bioseguridad ganadera

c. Los esfuerzos de la bioseguridad ganadera no han cambiado en la granja lechera
d. No sé
e. Otro (especifique)___

31. Por favor explique su respuesta a la pregunta anterior

____

____

32. ¿En la granja, la pandemia del COVID-19 ha hecho más difícil practicar la bioseguridad del ganado de manera efectiva?

Circule uno
a. Sí
b. No
c. No sé

33. Por favor explica su respuesta a la pregunta anterior

____

____

34. La resistencia a los agentes antimicrobianos se produce cuando las bacterias, los viruses, los hongos, o los parásitos cambian en maneras que los hacen menos susceptibles a los efectos de las medicinas/ las drogas que usamos para matarlos o detener su crecimiento. ¿Cuáles prácticas agrícolas piensa usted que pueden llevar a la resistencia a los agentes antimicrobianos en el ganado?

Circule uno
a. Tratar los animales enfermos con antibióticos cuando no los necesitan
b. No separar los animales enfermos de los animales saludables
c. Ambas
d. Ninguno de lo anterior
e. No sé
f. Otro (especifique)

35. ¿En qué medida está de acuerdo o desacuerdo de las siguientes declaraciones?

	Totalmente de acuerdo	De acuerdo	Ni de acuerdo ni en desacuerdo	En desacuerdo	Totalmente en desacuerdo	No sé	Prefiero no contestar
La bioseguridad ganadera puede ayudar a prevenir la resistencia antimicrobiana en la granja							

La bioseguridad ganadera puede ayudar a prevenir las enfermedades de los animales en la granja							
La bioseguridad ganadera puede ayudar a prevenir la propagación de las enfermedades de los animales a las personas en la granja							
La bioseguridad ganadera puede ayudar a prevenir la propagación de las enfermedades de los humanos a los animales en la granja							
La bioseguridad ganadera vale la pena en cuestión de tiempo y esfuerzo							
La bioseguridad ganadera puede ayudar a la granja a ganar más dinero							
Recibo capacitación efectiva en la bioseguridad ganadera en la granja							
El nivel de bioseguridad ganadera practicado en esta finca es							

adecuado para prevenir y controlar las enfermedades ganaderas							
Esta finca tiene espacio suficiente para almacenar y disponer los animales muertos							
No hay nada que mi finca pueda hacer para prevenir las enfermedades en el ganado							

36. ¿Qué sería lo que lo motivaría a practicar más la bioseguridad del ganado?
Clasifique del "1" al "4". "1" – El motivador más fuerte. "4" – El motivador más débil.
a. Aumentar de los ingresos de la granja ____
b. Prevenir la resistencia antimicrobiana en el ganado ____
c. Prevenir la propagación de la enfermedad animales a los humanos en la granja ___
d. Prevenir que las enfermedades foráneas de animales entren en la granja o se propaguen dentro de la granja___

37. ¿Qué piensa que es el obstáculo más grande en la granja para practicar medidas más estrictas sobre la bioseguridad del ganado?
Clasifique del "1" a "10". "1" – El obstáculo más grande. "10" – El obstáculo más pequeño.
a. Falta de tiempo ___
b. Falta de dinero ___
c. Falta de conocimiento sobre la bioseguridad del ganado ___
d. Falta de espacio en la granja ___
e. Falta de equipo ___
f. Falta de agentes de limpieza ___
g. Falta de viabilidad ___
h. Los impactos de COVID-19 ___
i. Falta de interés en la bioseguridad ___
j. Falta de comunicar las reglas y reglamentos sobre la bioseguridad del ganado a todos los empleados ___

38. El equipo de protección individual (EPP) es un equipo que al poner protege al que lo tenga puesto. Incluye las mascarillas (respiradoras N95 y mascarillas quirúrgicas), los guantes, las

botas, los delantales, las mangas obstétricas, los overoles, las gafas de seguridad, y otros artículos. ¿Ustedes tienen suficiente equipo de protección personal (EPP) en la granja?
Circule uno
a. Sí
b. No

39. Si contestó "No" en la pregunta anterior, ¿qué tipo de EPP le hace falta a la granja?
Circule todos los que apliquen
a. Mascarillas (respiradoras N95 y mascarillas quirúrgicas)
b. Guantes
c. Botas
d. Delantales
e. Mangas obstétricas
f. Overoles
g. Gafas de seguridad
h. Otros artículos (especifique) ___

40. ¿Ha disminuido la pandemia del COVID-19 la disponibilidad del EPP en la granja?
Circule uno
a. Sí
b. No
c. No sé

41. Si contestó "Sí" a la pregunta anterior, por favor explique
____
____

42. ¿En qué medida está de acuerdo o desacuerdo con las siguientes declaraciones? Desde el principio de la pandemia COVID-19…

	Totalmente de acuerdo	De acuerdo	Ni en acuerdo ni en desacuerdo	En desacuerdo	Totalmente en desacuerdo	No sé	Prefiero no contestar
Han habido más enfermedades granaderas en la granja							
La granja está utilizando más antibióticos para tratar los animales							

Ha sido más difícil proveer atención medica a los animales							
Ha sido más difícil proveer medidas preventivas al ganado (por ejemplo, las vacunas y los antiparasitarios)							
Ha habido más sabandijas o plagas en la granja.							
Ha habido más vida silvestre interactuando con el ganado en la granja.							
Ha habido más abortos entre el ganado							
Ha habido más propagación de las enfermedades de los animales a las personas							
Ha sido más difícil practicar la bioseguridad del ganado en la granja							

La granja se ha concentrado más en la capacitación sobre la bioseguridad del ganado							
Ha sido más difícil para la granja mantener el numero necesario de trabajadores							

43. ¿Como le gustaría recibir la capacitación sobre la bioseguridad granadera?
Marque sus tres opciones preferidas
a. Capacitación laboral por supervisores o compañeros de trabajo
b. Conferencias en persona
c. Seminarios por computadora
d. Videos del internet (por ejemplo, videos de YouTube)
e. Charlas en el aula
f. Discusiones en el aula
g. Tecnología de telefonía móvil
h. Otro (por favor, especifique)

<u>Practicas</u>
Le haré unas preguntas sobre las practicas de la bioseguridad del ganado en su granja. ¿Está bien continuar?
Circule uno
Sí
No (por favor indique porque) ____

44. Tiene la granja una política/plan por escrito sobre la bioseguridad del ganado?
Circule uno
a. Sí
b. No
c. No sé

45. Si contestó "Si" a la pregunta anterior, con que frecuencia se revisa la política/plan de bioseguridad?
Circule uno
a. Nunca
b. Una vez al año
c. Mas de una vez al año
d. No sé
e. Otra (especifique)

46. ¿Cuáles son partes de la bioseguridad ganadera en la granja?
Circule todos que aplican
a. Políticas para los visitantes
b. Equipo de protección personal (EPP)
c. Aislamiento de los animales enfermos
d. Programas de control a las sabandijas y las plagas
e. Limpiar y desinfectar los establos y los corrales
f. Utilizar ropa y botas específicas para la granja
g. Ninguno de los anteriores
h. No sé

47. ¿La granja tiene un plan para brotes de enfermedades foráneas en los animales (por ejemplo, fiebre aftosa)?
Circule uno
a. Sí
b. No
c. No sé

48. ¿La granja tiene alguien que está a cargo de la bioseguridad del ganado?
Circule uno
a. Sí
b. No
c. No sé

49. ¿La granja completa evaluaciones o hojas de cotejo sobre bioseguridad del ganado?
Circule uno
a. Sí
b. No
c. No sé

50. Si contestó "Sí" a la pregunta anterior, ¿en que año se realizó la última evaluación o cotejo sobre la bioseguridad del ganado?
a. (indique año y mes) ____
b. No sé

51. ¿Para qué actividades mantiene la granja registros?
Circule todos los que apliquen
a. Cambiar las soluciones bañeras de los pies
b. Limpiar los establos
c. Registros de los visitantes
d. Control de las sabandijas y las plagas
e. El uso de los antibióticos
f. Ninguno de los anteriores
g. No sé

52. Entre la manipulación de terneros, los trabajadores están obligados a….
Circule uno
a. Lavarse las manos
b. Cambiar los guantes
c. Ambas de los anteriores
d. Ninguna de los anteriores
e. No sé

53. ¿Están protegidas las áreas de almacenamiento de alimentos de sabandijas y vectores?
Circule uno
a. Sí
b. No
c. No sé

54. ¿Los programas de control de sabandijas y plagas están designados para controlar qué?
Circule todos que apliquen
a. Perros
b. Gatos
c. Aves
d. Roedores
e. Insectos
f. Mapaches
g. Ninguno de lo anterior
h. No sé

55. Antes de entrar en la granja, los visitantes tienen que primero…
Circule todos que aplican
a. Firmar un registro de visitante
b. Lavarse las manos con jabón y agua
c. Utilizar guantes
d. Ponerse ropa especifica para la granja
e. Ponerse botas especificas para la granja
f. Pasar las botas por baños desinfectantes
g. Usar una mascarilla o una cubierta facial de tela
h. Ninguno de lo anterior

56. Los trabajadores agrícolas están obligados a:
Circule todos que aplican
a. Lavarse las manos con jabón y agua
b. Utilizar guantes
c. Ponerse en ropa especifica para la granja
d. Ponerse en botas especifica para la granja
e. Cambiarse de ropa después del trabajo y antes de salir de la granja
f. Utilizar una mascarilla o una cubierta facial de tela
g. Ninguno de los anteriores

57. ¿Con qué frecuencia se realizan capacitaciones sobre bioseguridad del ganado en la granja?
Circule uno
a. Más de una vez al mes
b. Más de una vez cada seis meses
c. Más de una vez al año
d. Por lo menos una vez al año
e. Menos de una vez al año
f. Nunca

58. ¿Qué temas se discuten en la capacitación sobre la bioseguridad del ganado?
Marque todos que aplican
a. Almacenamiento de animales muertos
b. Eliminación de animales muertos
c. Políticas para visitantes
d. Control de plagas y sabandijas
e. Equipo de protección personal (EPP)
f. Enfermedades foráneas en los animales
g. Limpieza de las manos
h. La resistencia antimicrobiana
i. La transmisión de las enfermedades de los animales a los humanos
j. La transmisión de las enfermedades de los humanos a los animales
k. Otro (especifique)
l. Mi granja no realiza capacitación en bioseguridad del ganado

59. ¿La capacitación en bioseguridad del ganado se provee en su idioma preferido?
Circule uno
a. Sí
b. No
c. Mi granja no ofrece capacitación en bioseguridad granadera

60. ¿Cuáles de estos se aplica a sus experiencias de capacitación en la bioseguridad del ganado en la granja?
Marque todos que aplican
a. Mi adiestramiento incluye un examen o prueba
b. Puedo proporcionar comentarios sobre los adiestramientos
c. Ninguno de los anteriores
d. Mi granja no ofrece capacitación sobre la bioseguridad del ganado

61. ¿Que se utilizan durante la capacitación de la bioseguridad del ganado?
Circule todos que apliquen
a. Capacitación laboral por supervisores o compañeros
b. Conferencias en persona
c. Los seminarios por computadora
d. Los videos del internet (por ejemplo, videos de YouTube)
e. Charlas en el aula
f. Discusiones en el aula

Encuesta CAP: Bioseguridad de los productos lácteos de Colorado

Objetivos:

- Evaluar los conocimientos, las actitudes y las prácticas (CAP) de los trabajadores y propietarios de fincas de productos lácteos sobre la bioseguridad de los productos mediante un cuestionario estructurado
- Comparar los hallazgos entre los sistemas de producción de lácteos (orgánicos versus convencionales) y entre ocupaciones (trabajador versus propietario)
- Dar énfasis a las enfermedades infecciosas, que incluye las zoonosis y COVID-19

Demografía y antecedentes

1. Fecha de la entrevista con los investigadores____________________

2. ¿Cuál es su idioma preferido?
Circule uno
a. inglés
b. español
C. Otro (especifique)

3. ¿Cuál es su género?
Circule uno
a. Hombre
b. Mujer
c. Otro
d. Prefiero no responder

4. ¿Qué edad tiene usted?
Circule uno
a. 18-20 años
b. 21-30 años
c. 31-40 años
d. 41-50 años
e. 51-60 años
f. 61-70 años
g. 71 años o más

5. ¿Cuál es el nivel más alto de educación que terminó?
Circule uno
a. Ninguno
b. Escuela primaria/elemental
c. Escuela intermedia
d. Escuela secundaria
e. Educación técnica/vocacional
f. Grado asociado

g. Licenciatura
h. Maestría
i. Doctorado

6. ¿Cuánto tiempo lleva trabajando en una granja lechera?
Circule uno
a. Menos de un año
b. Más de un año, pero menos de cinco años
C. Más de cinco años

7. ¿Ha trabajado en otras granjas lecheras?
Circule uno
a. Sí
b. No

8. ¿Cuánto tiempo ha trabajado en granjas o la industria lechera?
Circule uno
a. Menos de un año
b. Más de un año, pero menos de cinco años
c. Más de cinco años

9. ¿Vive en la granja lechera donde trabaja?
Circule uno
a. Sí
b. No

10. ¿Vive con alguien más? Por favor seleccione todas las respuestas que sean correctas
Encierre en un círculo todas las que apliquen
a. Vivo con mi cónyuge o pareja
b. Vivo con mi (s) hijo (s)
c. Vivo con otros trabajadores agrícolas
d. Vivo solo
e. Vivo con familiares (por ejemplo, padres, abuelos, hermanos, primos, etc.)
11. ¿Cuál es su función / trabajo actual en la granja lechera?
Circule uno
a. Obrero
b. Propietario
c. Gerente / Supervisor
d. Otra (especifique)

12. ¿Dónde pasa la mayor parte del tiempo trabajando en la granja?
Circule uno
a. Sala de productos lácteos
b. Corrales para terneros
c. Maternidad
d. Hospital

e. Oficina
f. Otra (especifique)

13. ¿En que tipo de granja lechera trabaja usted actualmente?
Circule uno
a. Convencional
b. Orgánico

14. Por favor indique la cantidad total de cabezas de ganado en su granja (incluya animales lactantes, vaquillas de reemplazo, vacas secas y toros) ____________________________________
Desconozco

Conocimiento

Le haré algunas preguntas sobre su conocimiento. ¿Está bien continuar?
(Marque uno):
Si
No: (indique el motivo del rechazo) __________________________________

15. ¿Ha escuchado el término "enfermedad zoonótica"?
Circule uno
a. Sí
b. No
c. No sé

16. ¿Qué es una "enfermedad zoonótica"?
Circule uno
a. Una enfermedad que puede transmitirse de animales a personas.
b. Una enfermedad que solo afecta a los animales
c. Una enfermedad que no se puede prevenir
d. Otra (especifique)
e. No sé

17. Las enfermedades zoonóticas son enfermedades que pueden transmitirse de los animales a las personas. ¿Qué enfermedades zoonóticas pueden contraer las personas del ganado?
Encierre en un círculo todas las que apliquen
a. Rabia
b. Dermatofitosis
c. Leptospirosis
d. Fiebre Q
e. Criptosporidiosis
f. *Staphylococcus aureus* resistente a la meticilina (MRSA)
g. Fiebre aftosa (FA)
h. Tuberculosis
i. *E. coli*

j. Salmonella
k. Diabetes
l. Ninguna de las anteriores

18. ¿Cómo se pueden transmitir las enfermedades de los animales a las personas?
Circule todas las que apliquen
a. Al tocar o manipular animales
b. A través del aire
c. Exposición a sangre
d. Exposición a fluidos corporales por el nacimiento y / o aborto
e. Exposición a la saliva
f. Al comer comida
g. Al ser mordido
h. Ninguna de las anteriores

19. ¿Cuáles de estas son verdaderas sobre la criptosporidiosis?
Circule todas las que apliquen
a. Es un parásito protozoos.
b. Puede causar diarrea a las personas.
c. Lavarse las manos puede ayudar a prevenirlo
d. Puede infectarse a través de la comida o el agua.
e. Los terneros pueden transmitirlo en sus heces.
f. Ninguna de las anteriores son cierta

20. ¿Es posible que los humanos transmitan enfermedades a los animales?
Circule una
a. Si
b. No
c. No sé

21. ¿Qué enfermedades pueden transmitir las personas de una a otra en las granjas lecheras?
Circule todas las que apliquen
a. COVID-19
b. Resfriado
c. Influenza estacional
d. Tuberculosis
e. Diabetes
F. Ninguna de las anteriores

22. ¿Qué causa el COVID-19?
Circule uno
a. Virus
b. Bacterias
c. Hongos
d. Químicos
e. Otra (especifique)

f. Ninguna de las anteriores

23. ¿Cuál es la forma principal en que las personas se enferman con el COVID-19?
Circule uno
a. Aire, al inhalarlo
b. Comer alimentos contaminados
c. Picadura de mosquito
d. Beber agua contaminada
e. No lo sé
f. Otra (especifique)

24. ¿Cierto o falso?, la tuberculosis y el COVID-19 pueden ambas ser transmitidas de persona a persona a través del aire.
Circule uno
a. Cierto
b. Falso
c. No sé

25. ¿Cuáles son ciertas?
Circule todas las opciones correctas
a. Las personas que no muestran síntomas de COVID-19 pueden enfermar a otras
b. Los síntomas de COVID-19 pueden aparecer de 2 a 14 días después de que alguien se expone al virus
c. Los síntomas del COVID-19 pueden parecerse a los síntomas de la influenza
d. Todas las personas con COVID-19 tienen síntomas

26. ¿Cuáles son los equipos de protección personal (EPP)?
Circule todas las que apliquen
a. Mascarillas faciales (respiradores N95 y mascarillas quirúrgicas)
b. Guantes
c. Botas
d. Delantales
e. Mangas obstétricas
f. Overoles
g. Gafas de seguridad
h. Ninguna de las anteriores

27. ¿Qué puede prevenir la propagación de COVID-19?
Circule todas las que apliquen
a. Usar mascarillas o cubiertas faciales de tela
b. Mantener una distancia de seis pies entre las personas
c. Lavarse las manos frecuentemente con agua y jabón por al menos 20 segundos
d. Cubrir la boca al estornudar o toser con la parte interior del codo
e. Limpiar y desinfectar las superficies con frecuencia
f. Monitoree su salud diariamente
g. Ninguna de las anteriores

28. ¿Las mascarillas o las cubiertas faciales de tela deben cubrir?
Circule todas las que apliquen
a. Boca
b. Nariz

Actitudes

Le haré algunas preguntas sobre sus actitudes y creencias. ¿Está bien continuar?
(Marque uno):
Sí
No: (indique el motivo del rechazo) ________________________________

Pregunta en la siguiente página
29. Por favor, utilice la tabla abajo para las siguientes preguntas

	Extremadamente Preocupado	Muy Preocupado	Moderadamente Preocupado	Un poco preocupado	No me preocupa en absoluto	Prefiero no responder
Las enfermedades zoonóticas son enfermedades infecciosas que se transmiten de los animales a las personas. ¿Cuán preocupado está por contraer una enfermedad zoonótica mientras está en la granja?						
¿Cuán preocupado está por contraer COVID-19 de otra persona mientras trabaja en la granja?						

30. La bioseguridad del ganado puede definirse como las medidas adoptadas para evitar que las enfermedades entren o salgan de una población ganadera y se propaguen dentro de una población

ganadera. Algunos componentes de las medidas de bioseguridad del ganado incluyen el aislamiento de animales nuevos o enfermos, control de plagas, políticas para visitantes, higiene personal y el uso de ropa específica de granja. También puede incluir la seguridad de los alimentos, el mantenimiento de la salud de todos los animales, la compra de animales, la transportación de animales y la remoción de animales muertos, la limpieza y desinfección de corrales y establos, y la vacunación de animales. En qué medida está de acuerdo o en desacuerdo con la siguiente afirmación: Creo que practicar la bioseguridad del ganado en la granja puede disminuir la posibilidad de que los empleados de la granja contraigan una enfermedad de los animales en la granja.
Circule uno
a. Totalmente de acuerdo
b. De acuerdo
c. Ni de acuerdo ni en desacuerdo
d. No de acuerdo
e. En desacuerdo total

31. ¿Cree qué alguna vez se ha enfermado por trabajar con animales en esta granja lechera?
Circule uno
a. Sí
b. No
c. No lo sé
d. Prefiero no contestar

32. ¿Cree qué alguna vez se ha enfermado por causa de otro trabajador de la granja lechera?
Circule uno
a. Sí
b. No
c. No lo sé
d. Prefiero no contestar

33. ¿Qué cree que sea más probable que le suceda en la granja? Marque del "1" al "3"
"1" = más probable. "3" = menos probable.
Por favor clasifique
a. Voy a contraer una enfermedad de un animal____
b. Me contagiaré con COVID-19 de alguien que trabaja en la granja____
c. Me lesionaré por un accidente mientras trabajo en la granja____

34. ¿Qué cree que perjudicaría más su salud si le sucediera? Marque del "1" al "3"
"1" = más probable. "3" = menos probable.
Por favor clasifique
a. Contraeré una enfermedad de un animal en la granja____
b. Me contagiaré con COVID-19 de alguien que trabaja en la granja____
c. Me lesionaré por un accidente mientras trabajo en la granja____
35. ¿Ha conocido a una persona que haya contraído alguna de estas?
Circule todas las que apliquen
a. Una enfermedad de un animal de granja.

b. COVID-19
c. Ninguno

36. ¿Cree que los animales de la granja podrían transmitir el virus COVID-19 a las personas en la granja?
Circule uno
a. Sí
b. No

38. ¿Cree que es posible que las personas transmitan COVID-19 a los animales?
Circule uno
a. Sí
b. No

39. El equipo de protección personal (EPP) es un equipo que lo mantiene seguro cuando se usa. Hay muchos tipos de diferentes EPP. El EPP en la granja incluye mascarillas faciales (respiradores N95 y mascarillas quirúrgicas), guantes, botas, delantales, mangas obstétricas, overoles, gafas y otros artículos. ¿En qué medida está de acuerdo o en desacuerdo con la siguiente afirmación? El uso de EPP reducirá mis posibilidades de contraer una enfermedad de un animal en la granja.
Circule uno
a. Totalmente de acuerdo
b. De acuerdo
c. Ni de acuerdo ni en desacuerdo
d. En desacuerdo
e. Muy en desacuerdo

40. En que medida esta en acuerdo o desacuerdo con lo siguiente:

	Totalmente de acuerdo	De acuerdo	Ni en acuerdo o desacuerdo	En desacuerdo	Totalmente en desacuerdo	No lo sé	Prefiero no contestar
Las precauciones tomadas en mi granja me protegerán de contraer COVID-19							
No hay nada que yo pueda hacer para evitar contraer una enfermedad de los animales mientras estoy en la granja							
No hay nada que yo pueda hacer para evitar							

contraer COVID-19 mientras estoy en la granja							
La granja me proporciona todo lo que necesito para protegerme y no contagiarme con las enfermedades de los animales en la granja							
La granja me proporciona todo lo que necesito para protegerme de enfermedades como COVID-19 de las personas en la granja							
La finca tiene suficiente equipo de protección personal (EPP) para mí							
El uso de cubiertas faciales de tela en la granja ayudará a prevenir la propagación de COVID-19							
El equipo de protección personal (EPP) ha sido más difícil de conseguir en la granja desde que comenzó la pandemia de COVID-19							
Sé cómo protegerme de las enfermedades de los animales mientras trabajo en la granja							
Sé cómo protegerme del COVID-19 mientras trabajo en la granja							

Sé cómo ponerme y quitarme correctamente el equipo de protección personal (EPP)							
Desde que comenzó el COVID-19, creo que ha habido más casos de enfermedades de animales a personas en la granja							
Entiendo las políticas del COVID-19 de mi granja							

41. ¿Cuál cree que es la razón más importante para tratar de mantener las enfermedades fuera de la granja? Clasifique las siguientes opciones del "1" al "11".
"1" = motivador mayor
“11” = motivador menor.
Por favor clasifique
a. Podría contraer enfermedades de los animales de granja____
b. Los animales pueden transmitir enfermedades a otros animales____
c. Los seres humanos pueden transmitir enfermedades a los animales de granja____
d. Podría contraer enfermedades como el COVID-19 de otras personas que trabajan en la granja____
e. Las personas pueden transmitir enfermedades a otras personas que trabajan en la granja____
f. Podría contagiar a los miembros de mi familia con una enfermedad____
g. La finca podría perder dinero____
h. Presión de grupo____
g. La finca podría ganar más dinero____
j. Recomendaciones de un veterinario____
k. Quiero cumplir las leyes____

42. ¿Qué equipo de protección personal (EPP) le gustaría que hubiera más en la granja?
Circule todas las que apliquen
a. Mascarillas faciales (respiradores N95 y mascarillas quirúrgicas)
b. Guantes
c. Botas
d. Delantales
e. Mangas obstétricas
f. Overoles
g. Gafas de seguridad
h. Ninguna de las anteriores
i. Otra (especifique)

43. ¿Cuáles cree que son los mayores obstáculos de su granja para mejorar los programas que tienen como objetivo prevenir la propagación de enfermedades de los animales a las personas en la granja? Clasifique las siguientes opciones del "1" al "8", siendo "1" el obstáculo más grande y "8" el obstáculo más pequeño.
Por favor clasifique
a. Falta de tiempo____
b. Falta de dinero____
c. Falta de conocimiento sobre las enfermedades infecciosas y cómo prevenirlas____
d. Falta de preocupación por las enfermedades infecciosas____
e. Falta de equipo de protección personal (EPP) ____
f. Falta de agentes desinfectantes o higienizantes____
g. Falta de viabilidad____
h. Falta de capacidad para comunicar las reglas y reglamentos de seguridad agrícola a todos los empleados____

44. ¿Cuáles cree que son los mayores obstáculos de su granja para mejorar los programas que tienen como objetivo prevenir la propagación de enfermedades de persona a persona como el COVID-19? Clasifique las siguientes opciones del "1" al "8".
"1" = mayor obstáculo
"8" = obstáculo más pequeño
Por favor clasifique
a. Falta de tiempo____
b. Falta de dinero____
c. Falta de conocimiento sobre las enfermedades infecciosas y cómo prevenirlas____
d. Falta de preocupación por las enfermedades infecciosas____
e. Falta de equipo de protección personal (EPP) ____
f. Falta de agentes desinfectantes o higienizantes____
g. Falta de viabilidad____
h. Falta de capacidad para comunicar las reglas y reglamentos de seguridad agrícola a todos los empleados____

45. ¿Cuándo es más importante usar una mascarilla (respirador N95 o mascarilla quirúrgica)? Clasifique las siguientes opciones con una clasificación de "1" a "5"
"1" = más importante
"5" = menos importante.
Por favor clasifique
a. Mientras viaja en un vehículo con compañeros de trabajo ____
b. Mientras trabaja con productos químicos____
c. Mientras trabaja en áreas polvorientas____
d. Mientras trabaja con animales____
e. Mientras está parado a menos de 6 pies de distancia de otra persona en la granja____

46. ¿Qué lo motivaría a usar una mascarilla (respirador N95 o mascarilla quirúrgica) con más frecuencia en la granja? Clasifique las siguientes opciones del "1" al "6".
"1" = mayor motivador

“6” = motivador más pequeño.
Por favor clasifique
a. Tener más evidencia de que la mascarilla es útil____
b. Tener una mascarilla que sea más cómoda____
c. Tener más acceso a mascarillas faciales____
d. Tener una mascarilla que interfiera menos con mi trabajo____
e. Reglas y reglamentos agrícolas más estrictos____

47. ¿Qué cree sobre las cubiertas faciales de tela en la granja?
Encierre en un círculo todas las que apliquen
a. Pueden evitar que contraiga COVID-19 de las personas.
b. Pueden reducir mis posibilidades de transmitir COVID-19 a las personas
c. Pueden evitar que contraiga enfermedades zoonóticas de los animales.
d. Pueden evitar que respire polvo
e. Son inútiles
f. Ninguna de las anteriores

48. ¿El uso de una cubierta facial de tela interfiere con su capacidad para hacer su trabajo en la granja?
Circule uno
a. Si
b. No
c. Prefiero no contestar

49. Si respondió “Sí” a la pregunta anterior, explique su respuesta____
____

50. ¿Con cuáles de estas afirmaciones está de acuerdo?
Circule todas las que apliquen
a. El distanciamiento social puede ayudar a prevenir el COVID-19 en mi granja
b. El distanciamiento social no ayudará a prevenir el COVID-19 en mi granja
c. Los directivos de mi granja fomentan el distanciamiento social
d. Creo que el distanciamiento social es innecesario
e. El distanciamiento social en la granja puede evitar que contraiga enfermedades de otras personas.
f. Los empleados agrícolas hacen todo lo posible para seguir las pautas de distanciamiento social de los directivos.
g. Ninguna de las anteriores

51. ¿El distanciamiento social en su granja interfiere con la capacidad que tiene para realizar su trabajo?
Circule uno
a. Sí
b. No

c. Prefiero no contestar
d. Mi finca no practica el distanciamiento social

52. ¿Dónde sería más difícil practicar el distanciamiento social en su granja?
Circule uno
a. Sala de descanso
b. Mi puesto de trabajo
c. Otra (especifique)

53. ¿Con cuáles de estas afirmaciones está de acuerdo?
Circule todas las que apliquen
a. Me siento cómodo diciéndole a mis supervisores cuando estoy enfermo
b. Me siento cómodo diciéndole a mis supervisores cuando tengo un accidente
c. Creo que me sancionarán por ausentarme por enfermedad
d. Entiendo las políticas de licencia por enfermedad de mi granja
e. Creo que me sancionarán por tomar una licencia por enfermedad si contraigo una enfermedad de un animal de granja.
f. Creo que me penalizarán por tomar una licencia por enfermedad si contraigo COVID-19
g. La granja motiva a las personas a informar cuando están enfermas.
h. La granja motivas a las personas a informar sobre prácticas inseguras que podrían provocar enfermedades en las personas

54. ¿Su finca ofrece capacitación de salud / seguridad?
Circule uno
a. Sí
b. No
c. No sé

55. Si respondió "No", pase a la pregunta 57
¿Con qué frecuencia se brinda capacitación en salud / seguridad?
Circule todas las que apliquen
a. Cuando empieza a trabajar
b. Una vez al año
c. Una vez al mes
d. 2-3 veces al año
e. Después que alguien se lastime o se enferma
f. Después que los animales se enferman
g. No sé

56. ¿Se ofrece capacitación en salud / seguridad en el idioma que usted prefiere?
Circule uno
a. Sí
b. No
c. No sé

57. ¿En qué medida está de acuerdo o en desacuerdo con la afirmación: ¿La capacitación que recibo en la granja me enseña cómo protegerme de las enfermedades de los animales?
Circule uno
a. Totalmente de acuerdo
b. De acuerdo
c. Ni de acuerdo ni en desacuerdo
d. En desacuerdo
e. Muy en desacuerdo
f. Mi granja no brinda capacitación en seguridad agrícola

58. ¿En qué medida está de acuerdo o en desacuerdo con la afirmación: ¿La capacitación que recibo en la finca me enseña cómo protegerme del COVID-19?
Circule uno
a. Totalmente de acuerdo
b. De acuerdo
c. Ni de acuerdo ni en desacuerdo
d. En desacuerdo
e. Muy en desacuerdo
f. Mi granja no brinda capacitación en seguridad agrícola

59. ¿En quién confía más para brindarle información precisa sobre COVID-19 y otras enfermedades que se transmiten de persona a persona?
Clasifique las siguientes opciones del "1" al "7"
"1" = más confiable
"7" = menos confiable
Por favor clasifique
a. Supervisores / Gerentes ____
b. Compañeros de trabajo ____
c. Veterinarios____
d. Propietarios de granjas____
e. Funcionarios locales de salud pública____
f. Su doctor____
g. Otra (especifique)_________________

60. ¿En quién confía más para brindarle información precisa sobre las enfermedades zoonóticas del ganado?
Clasifique las siguientes opciones del "1" al "7".
"1" = más confiable
"7" menos confiable
Por favor clasifique
a. Supervisores / Gerentes ____
b. Compañeros de trabajo ____
c. Veterinarios____
d. Propietarios de granjas____
e. Funcionarios locales de salud pública____
f. Su doctor____

g. Otra (especifique)___________

61. ¿Cómo ha cambiado su acceso al EPP desde el inicio de la pandemia COVID-19?
a. El EPP es más fácil de conseguir desde que comenzó la pandemia
b. El EPP es más difícil de conseguir desde que comenzó la pandemia
c. El acceso no ha cambiado desde que comenzó la pandemia

62. ¿Cómo le gustaría recibir capacitación en prevención de enfermedades infecciosas? Circule sus 3 opciones principales.
a. Capacitación en el trabajo a través de supervisores o compañeros
b. Conferencias presenciales
c. Seminarios por computadora
d. Videos de Internet (por ejemplo, videos de YouTube)
e. Conferencias en el aula
f. Debates en el aula
g. Tecnología de telefonía móvil
h. Otra (especifique)

Prácticas

Le haré algunas preguntas sobre sus prácticas de seguridad agrícola. ¿Está bien continuar?
Circule uno
Sí
No (indique el motivo del rechazo)

62. Distanciamiento social significa mantener 6 pies entre usted y los demás. ¿Su granja tiene algún requisito sobre el distanciamiento social?
Circule uno
a. Sí
b. No
c. No sé

63. ¿Con qué frecuencia su granja lleva a cabo capacitación en salud / seguridad que incluye instrucción sobre enfermedades de animales y / o enfermedades que se transmiten de persona a persona como COVID-19?
Circule uno
a. Más de una vez al mes
b. Más de una vez cada seis meses
c. Más de una vez al año
d. Al menos una vez al año
e. Menos de una vez al año
f. Nunca
g. Otra (especifique)

64. ¿Cuáles se utilizan durante su capacitación en salud / seguridad en la granja?
Circule todas las que apliquen
a. Capacitación en el trabajo a través de supervisores o compañeros
b. Conferencias presenciales
c. Seminarios por computadora
d. Videos de Internet (por ejemplo, videos de YouTube)
e. Conferencias en el aula
f. Discusiones en el aula
g. Otra (especifique)
h. Mi granja no ofrece capacitación en salud / seguridad.

65. Si quisiera encontrar información de seguridad agrícola sobre enfermedades infecciosas (incluidas enfermedades zoonóticas y enfermedades transmisibles como COVID-19), ¿qué fuentes probablemente utilizaría? Clasifique las siguientes opciones con una clasificación del "1" al "10".
"1" = más probable
"10" = menos probable
Por favor clasifique
a. Radio____
b. Búsquedas en Internet (Google, otros motores de búsqueda) ____
c. Compañeros de trabajo ____
d. Familiares____
e. Eventos de capacitación____
f. Redes sociales (Facebook, Twitter, Instagram, etc.) ____
g. Veterinarios____
h. Supervisores / Gerentes ____
i. Propietarios de granjas____
j. Otra (especifique)________________

66. ¿Cuáles se aplican a sus experiencias de capacitación en salud / seguridad en la granja?
Circule todas las que apliquen
a. Mi capacitación implica una evaluación o examen para medir el aprendizaje.
b. Puedo comentar sobre las capacitaciones
c. Ninguna de las anteriores
d. Mi granja no ofrece capacitación en salud / seguridad agrícola

67. ¿Qué temas se incluyen en los programas de capacitación en salud / seguridad de su granja?
Circule todas las que apliquen
a. Concienciación y prevención del COVID-19
b. Uso de equipo de protección personal (EPP)
c. Ajuste y uso adecuados de mascarillas y cubiertas faciales de tela
d. Procedimientos de manejo de animales
d. Prevención de pinchazos con agujas
f. Procedimientos de notificación de accidentes y enfermedades
g. Políticas de licencia por enfermedad

h. Prácticas de lavado de manos
i. Limpieza de equipos e instalaciones
j. Reconocimiento de signos y síntomas de enfermedades zoonóticas en animales.
k. Reconocer signos y síntomas de enfermedades infecciosas en humanos.
l. Políticas y prácticas de distanciamiento social especificas para trabajo de la granja
m. Formas aceptadas de toser y estornudar
n. Carteles en inglés sobre la prevención de COVID-19 en áreas donde es probable que se vean
o. Carteles en español sobre la prevención del COVID-19 en áreas donde es probable que se vean
p. Ninguna de las anteriores
q. Otra (especifique)

68. ¿Cuál se incluye en la capacitación en EPP?
Circule todas las que correspondan
a. Explicación de cuándo usar EPP y qué EPP es necesario
b. Cómo ponerse y quitarse correctamente el EPP
c. Cómo desechar correctamente el EPP
d. Cómo limpiar el EPP reusable
e. Recomendación de lavarse las manos con agua y jabón durante 20 segundos (o usar desinfectante de manos a base de alcohol) después de quitarse el EPP
f. Prueba de ajuste para respiradores
g. Ninguna de las anteriores
h. Mi granja no ofrece capacitación en EPP

69. En cuanto a la higiene personal, ¿cuáles son las ciertas en su granja?
Circule todas las que apliquen
a. Los empleados tienen acceso a instalaciones para lavarse las manos con jabón, agua potable y toallas limpias de un solo uso.
b. Se anima a los empleados a lavarse las manos con frecuencia con agua y jabón durante al menos 20 segundos.
c. Los empleados tienen acceso a un desinfectante para manos que contenga al menos un 60% de alcohol
d. Hay suficientes estaciones para el lavado de manos.
e. Las pautas de higiene personal escritas en inglés están visibles en la granja.
f. Las pautas de higiene personal escritas en español están visibles en la granja.
g. Ninguna de las anteriores

70. Con respecto a la desinfección y limpiezas en las instalaciones y los equipos, ¿cuáles son ciertas en su finca?
Circule todas las que apliquen
a. Las políticas agrícolas incluyen instrucciones sobre la eliminación de las membranas fetales y los líquidos asociados con los partos y los abortos del ganado.
b. La finca tiene una política de desinfección y limpieza por escrito.
c. El equipo compartido entre los trabajadores se limpia y desinfecta después de ser utilizado por cada empleado.
d. Las salas de descanso se limpian y desinfectan después de ser utilizadas por cada grupo

71. Con respecto a las ausencias por enfermedad, ¿cuáles son ciertas en su finca?
Circule todas las que apliquen
a. Los empleados que se enferman pueden perder su trabajo si faltan demasiados días
b. Los empleados pueden tomar una licencia por enfermedad, pero no se les paga
c. Mi granja tiene una política en la que puede tomar una licencia por enfermedad y todavía le pagan
d. Los trabajadores son sancionados por tomar licencia por enfermedad si tienen COVID-19
e. Los trabajadores reciben una prueba para asegurarse de que comprenden las políticas de licencia por enfermedad

72. Si existen viviendas para trabajadores agrícolas en la finca, ¿qué políticas de limpieza y distanciamiento social existen y se aplican?
Circule todas las que apliquen
a. La vivienda agrícola proporciona viviendas designadas para aislar a las personas confirmado o sospechado de tener COVID-19
b. Los dormitorios compartidos están diseñados y permiten seis pies entre las camas.
c. Las mesas y los asientos en los espacios de uso común están diseñados para permitir una distancia social de 6 pies de distancia.
d. Los espacios de uso común están equipados con lo necesario para lavarse las manos
e. Los habitantes usan cubiertas faciales de tela en áreas de uso común
f. Carteles en inglés y español sobre la prevención de COVID-19 están presentes en áreas de uso común
g. No sé
h. La vivienda para trabajadores no existe en la finca

73. Respecto al uso compartido de automóvil, ¿cuáles son ciertas?
Circule todas las que apliquen
a. Los empleados usan mascarillas o cubiertas faciales de tela mientras están en el automóvil
b. Los automóviles se desinfectan entre viajes
c. Los pasajeros se lavan las manos antes de montarse en los vehículos
d. Los pasajeros se someten a pruebas de salud antes de montarse a los vehículos que comparten
e. Los pasajeros generalmente viajan con miembros de sus equipos de trabajo y / o compañeros de casa.
f. El uso compartido del automóvil está organizado y facilitado por la administración de la granja, los directivos o los contratistas
g. Los trabajadores agrícolas organizan y facilitan el uso compartido del automóvil sin la administración de la granja o el control de los directivos
h. El uso compartido de automóviles no ocurre
i. No sé
j. Ninguna de las anteriores

74. Respecto a la prevención y control de COVID-19 en la finca, ¿cuáles son ciertas?
Circule todas las que apliquen
a. Mi granja fomenta el distanciamiento social (es decir, mantener una separación de 6 pies entre las personas) durante el trabajo

b. Mi granja cuenta con un sistema de pruebas de salud
c. Mi granja tiene un sistema para separar a los trabajadores que muestran síntomas de COVID-19 mientras están en el trabajo
d. Mi granja requiere el uso de una cubierta facial (ya sea mascarilla o cubierta de tela) en todo momento
e. Mi granja solo requiere el uso de una cubierta facial cuando hay personas a menos de 6 pies de distancia
f. Los empleados reciben información de contacto de los centros de salud donde pueden recibir atención médica.
g. No lo sé
h. Ninguna de las anteriores

75. ¿Cuáles son ciertas sobre las cubiertas faciales de tela que usa en la granja?
Circule todas las que apliquen
a. Es proporcionado por la finca
b. Lo compro yo mismo
c. Incluye varias capas de tela
d. Me cubre la nariz y la boca
e. Se conecta a mis oídos
f. No utilizo una cubierta facial de tela para la cara

76. ¿Qué tipo de PPE ha utilizado en esta granja?
Circule todas las que apliquen
a. N-95
b. Mascarilla quirúrgica u otras mascarillas médicas
c. Máscara de tela
d. Guantes
e. Botas
f. Delantales
g. Mangas obstétricas
h. Overoles
i. Gafas de seguridad
j. Otra (especifique)
k. Ninguna de las anteriores

77. ¿Realiza alguno de estos mientras realiza tareas laborales?
Circule todas las que apliquen
a. Comer
b. Beber
c. Fumar
d. Masticar tabaco o arenilla de tabaco
e. Beber leche sin procesar
f. Ninguna de las anteriores

78. Los empleados agrícolas deben:
Circule todas las que apliquen

a. Lávese las manos con agua y jabón.
b. Usar guantes
c. Use ropa designada para la granja
d. Use botas designadas para la granja
e. Cambiarse de ropa después del trabajo antes de salir de la granja.
f. Ninguna de las anteriores
g. No sé

79. Circule todas las afirmaciones verdaderas sobre su rutina diaria de trabajo.
Circule todas las que apliquen
a. Me cambio de ropa en la granja antes de regresar a casa después del trabajo.
b. Me ducho en la granja después del trabajo
c. Lavo la ropa de trabajo separada de mi ropa que no es de trabajo
d. Uso mis botas de trabajo para ir a casa al final del día.
e. Me lavo las manos después de cambiarme los guantes

80. ¿Cuáles se aplican a las políticas de visitantes de la granja?
Circule todas las que apliquen
a. Los visitantes deben firmar un registro
b. Los visitantes deben llevar una identificación visible proporcionada por la granja.
c. Los visitantes deben usar EPP que les provee la granja
d. Los visitantes deben cubrirse la cara con una mascarilla o una cubierta de facial tela
e. Los visitantes reciben información sobre la prevención de enfermedades zoonóticas
f. Los visitantes deben lavarse las manos antes de ingresar a la granja principal.
g. Los visitantes deben pasar por un baño desinfectante de pies antes de ingresar a la granja principal

81. ¿Tiene su finca un plan para asegurar que las operaciones de la finca continúen en caso de que ocurra un brote de enfermedad como COVID-19 entre los trabajadores?
Circule uno
a. Sí
b. No
c. No sé

82. ¿Tiene su finca un programa de salud y seguridad COVID-19?
Circule uno
a. Sí
b. No
c. No sé

83. Si respondió “No” a la pregunta anterior, omita esta pregunta.
Si respondió “Sí” a lo anterior, ¿cuáles son los componentes del programa de salud y seguridad COVID-19?
Circule todas las que apliquen
a. Educación sobre cómo se propaga COVID-19
b. Educación sobre cómo prevenir la propagación de COVID-19 en el trabajo

c. Educación sobre cómo prevenir la transmisión de COVID-19 a los miembros de la familia
d. Un plan si alguien no puede trabajar
e. Carteles en áreas de uso común
f. Capacitación en inglés y español
g. ¿Políticas de protección para los denunciantes de practicas inseguras sin que estos tengan temor a represalias?
h. No sé

APPENDIX 11: KAP QUESTIONNAIRE FINAL (ENGLISH)

*****You may stop participating in this questionnaire at any time without penalty*****

KAP Questionnaire: Colorado Dairy Livestock Biosecurity
Date of interview with researchers____________________

Knowledge
What does "biosecurity" mean to you? *Select **all** that apply*
a. Preventing animal pathogens and diseases from entering the herd
b. Preventing animal pathogens and diseases from spreading within the herd
c. Preventing animal pathogens and diseases from leaving the farm
d. Preventing human pathogens and diseases from entering the herd
e. Preventing humans from getting diseases from animals on the farm
f. Preventing humans from spreading diseases to one another on the farm
g. Other (Specify)__________________________________
h. I am not sure I understand the meaning

Which can increase disease spread between dairy cattle? *Circle **all** that apply*
a. Poor ventilation in housing
b. Animal crowding
c. Animal nose-to-nose contact
d. I don't know

When should antibiotics be used on cattle? Note: The goal of this question is to assess your knowledge about when antibiotics should be used in cattle, regardless of whether your farm uses them or not. *Circle **all** that apply*
a. To treat a bacterial infection
b. To treat a viral infection
c. Whenever an animal seems sick
d. Other (Specify)_____________________________
e. I don't know

Foreign animal diseases are diseases present in other countries but not typically in the United States. With regard to the United States, which are foreign animal diseases that can infect **cattle**? *Select **all** that apply*
a. African Swine Fever (ASF)
b. Vesicular stomatitis
c. Foot and Mouth Disease (FMD)
d. I don't know

Can humans give some diseases to animals? *Circle one:* Yes / No / I don't know

If you answered "Yes", can you provide an example of a disease humans can give to animals?
____

Can humans infect some animals with the virus that causes COVID-19? *Circle one:* Yes / No / I don't know

Is a licensed COVID-19 vaccine available for cattle? *Circle one*: Yes / No / I don't know

Attitudes

"Livestock biosecurity" can be defined as management and physical measures to prevent pathogens and diseases from entering or leaving a livestock population and from spreading within a livestock population. Some components of livestock biosecurity measures include isolation of new and sick animals, monitoring animals for diseases, pest/vermin and wildlife control, visitor policies, hand hygiene, foot baths, farm-specific clothing and personal protective equipment (PPE), feed/water safety, herd health management, animal purchase, animal transport and carcass removal, animal vaccination, ventilation, cleaning and disinfection of equipment and animal housing. Cleaning focusses on removing organic material (dirt, manure, dust, feed, etc.). Disinfecting focusses on killing remaining microbes using a chemical compound (disinfectant), heat, or UV light. Personal protective equipment (PPE) includes face coverings, face masks (N95 Respirators and Surgical Masks), gloves, boots, aprons, obstetric sleeves, coveralls, goggles and other items to protect the user and prevent spread of pathogens between animals and locations.

Overall importance of livestock biosecurity

	Not at all important	Slightly important	Moderately Important	Very Important	Extremely important
How important is livestock biosecurity to you?					
How important is livestock biosecurity to your supervisors?					
How important is livestock biosecurity to your co-workers?					
How important is it to prevent pathogens/diseases from entering the herd?					
How important is it to prevent pathogens/diseases from spreading within the herd?					
How important is it to prevent pathogens/diseases from leaving the herd (leaving the farm)?					

Attitudes toward livestock biosecurity. How much do you agree with the following statements?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Livestock biosecurity can help prevent cattle diseases					
Livestock biosecurity practiced on my farm helps prevent cattle diseases					
Livestock biosecurity can reduce chances of people getting diseases from cattle on dairy farms					
I understand my farm's biosecurity rules and expectations					
Nothing can be done on dairy farms to reduce the chances of cattle getting diseases					
The COVID-19 pandemic has made it more difficult for my farm to practice livestock biosecurity					

Concern about foreign animal diseases

	Not at all concerned	Slightly concerned	Moderately concerned	Very concerned	Extremely concerned
How concerned are you about a foreign animal disease (e.g., FMD) getting onto the farm?					

"Antimicrobial resistance" occurs when bacteria, viruses, fungi, or parasites change in ways that make them less susceptible to effects of medications/drugs used to kill them or slow their growth.

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
How important is it to prevent antimicrobial resistance in cattle?					

COVID-19 and animals

	Yes	No	I don't know
Do you believe humans can infect cattle with the COVID-19 virus?			

	Not at all concerned	Slightly concerned	Moderately concerned	Very concerned	Extremely concerned
How concerned are you that humans on the farm will infect cattle with the COVID-19 virus?					

Sources of livestock biosecurity information

	Check the 3 you would most trust for accurate information on livestock biosecurity	Check the 3 you use most frequently for livestock biosecurity information
Private Veterinarians		
Government Veterinarians		
Dairy Owners		
Co-Workers		
Dairy Managers		
University Researchers		
Human Healthcare Professionals (Doctors/Nurses)		
Public Health Officials (Local/State Health Department)		
Social Media (e.g., Facebook, Twitter, Instagram, etc.)		
Training Provided by Farm		
State Department of Agriculture		
US Department of Agriculture (USDA)		
Centers for Disease Control and Prevention (CDC)		
Friends and Relatives		
Internet		
National Institute of Occupational Safety and Health (NIOSH)		

COVID-19 impact on farm: How much do you agree with the following statements? Since the COVID-19 pandemic began…

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Livestock biosecurity on the farm has become more of a priority					
There have been more diseases in cattle (e.g., mastitis)					
The farm is using more antimicrobials					
It has been harder to provide cattle vaccines					
Animal access to medical care has decreased					
There have been more vermin/pests on the farm					
There has been more wildlife on the farm					
There have been more abortions in cattle					
It has been harder for the farm to maintain the needed number of workers					
It has been harder to find PPE					

How much do you agree with the following statements about livestock biosecurity training on the farm?

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The training provides accurate information					
The training is worth the time					
I am encouraged to provide feedback on the training					
The training is provided in my preferred language					

Do you think the following prevent the farm from practicing stronger livestock biosecurity?

	Yes	No
Not enough time		
Not enough labor/manpower		
Not enough money		
Not enough knowledge about livestock diseases and how to prevent them		
Not enough space for animal housing		
Not enough space for animal isolation or quarantine		
Shortages of cleaning and disinfecting equipment/agents		
Lack of farm concern about cattle infectious diseases		
Not enough communication from leadership about livestock biosecurity expectations		
Not enough enforcement of biosecurity policies		
Not enough farm personnel compliance with biosecurity policies		
Not enough PPE		
Not enough carcass storage and disposal ability		
Not enough handwashing stations with soap and water		
Inability to control pests/vermin or wildlife		
Poor ventilation		
Lack of farm belief that livestock biosecurity is worth the time/effort		
Not enough space to prevent animals from crowding		

How effective do you think the following are in preventing infectious diseases in cattle on dairy farms?

	Not at all effective	Moderately Effective	Very effective
Hand hygiene (washing/sanitizing hands)			
Wearing gloves			
Wearing cloth face covers			
Wearing face masks (e.g., surgical masks)			
Wearing N-95 respirators			
Wearing farm designated clothing and boots			
Using disinfecting footbaths			
Limiting animal crowding			
Social distancing (maintaining 6 feet from other people)			
Monitoring animals for diseases			

Reporting when animals are sick			
Isolating sick animals			
Monitoring farm personnel for diseases			
Reporting when farm personnel are sick			
Isolating (e.g., sick leave) sick farm personnel			
Vaccinating cattle			
Vaccinating people			
Ensuring cattle have access to veterinary care			
Ensuring farm personnel have access to medical care			
Limiting number of visitors on the farm			
Limiting visitor contact with animals			
Screening visitors for diseases (e.g., ask if have symptoms of COVID-19 or exposed)			
Visitors using PPE			
Pest/vermin control			
Wildlife control			
Ensuring ventilation in animal spaces			
Ventilation in farm personnel common spaces (e.g., offices, break rooms, shared housing)			
Sunlight in animal housing, vehicles, equipment			
Sunlight in farm personnel shared spaces (offices, vehicles)			
Cleaning and disinfecting animal common areas/equipment (e.g., housing, parlor, feed/water troughs)			
Cleaning and disinfecting farm personnel common areas and equipment (e.g., break rooms, bathrooms, surfaces, shared housing)			
Cleaning and disinfecting vehicles (e.g., trailers) after carrying animals			
Cleaning and disinfecting vehicle interiors (e.g., cabins) between users			
Injection safety			

Practices

I would increase the time I spent on livestock biosecurity if I had more evidence it could…

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Prevent cattle diseases					
Prevent spread of human diseases to cattle on the farm (Human to cattle)					
Prevent spread of cattle diseases to humans on the farm (Cattle to human)					
Prevent humans spreading diseases to one another on the farm (Human to human)					

Prevent visitors from introducing diseases/pathogens into the herd					
Prevent antimicrobial resistance					
Increase farm profit/Save money					
Improve animal welfare					
Make a safer product for consumers					
Reduce risk of a foreign animal disease (e.g., FMD) entering the farm					

Which are true regarding your farm's visitor policies?

	Yes	No	I don't know
Visitors must sign a log			
Visitors are limited on the farm			
Visitors must wear a face covering or face mask in animal facilities			
Visitors must wash or sanitize their hands as they enter the farm			
Visitors must wash or sanitize their hands as they leave the farm			
Visitors must put on farm-provided coveralls and boots if entering animal facilities			
Visitors must walk through a disinfecting foot bath before entering the main farm			
Visitor contact with animals is minimized			
Visitor vehicle exterior must be cleaned/disinfected			

Are farm workers required to…

	Yes	No	I don't know
Wear disposable gloves when handling animals			
Wash hands with soap and water before handling animals			
Wear face covers or masks in animal facilities			
Wear farm-designated clothing			
Wear farm-designated boots			
Use disinfecting footbaths between production units			
Change clothes after work before leaving the farm			
Shower at work before leaving the farm			

Does your farm…

	Yes	No	I don't know
Monitor and test healthy animals			
Encourage animal illness reporting			
Encourage human illness reporting			
Isolate and test sick animals			
Quarantine and test newly purchased animals			
Vaccinate cattle			
Limit animal crowding			
Maintain pest/vermin control program			
Prevent wildlife from accessing animal housing, feed/water			
Clean and disinfect animal common areas/equipment (e.g., housing, parlor, feed/water troughs)			

Clean and disinfect vehicles after transporting cattle			
Use ventilation systems in animal housing to produce even air flow (minimize stagnation or drafts)			
Use direct sunlight to kill pathogens in animal housing/equipment			
Ensure feed hygiene (monitoring for spoilage, animal droppings)			
Ensure water hygiene (lab testing)			
Maintain regular vet visits			
Encourage safe injection practices			

Does your farm…

	Yes	No	I don't know
Have someone in charge of livestock biosecurity?			
Have a written livestock biosecurity management plan?			
Have a written cleaning/disinfection standard operating procedure?			
Keep a written record for cleaning/disinfecting of animal common areas/equipment			
Keep a written record for cleaning cleaning/disinfecting vehicles			
Have a foreign animal disease preparedness and response plan?			
Complete livestock biosecurity assessments or checklists?			
Have a person designated to talk to the media if the farm is affected by a foreign animal disease outbreak?			

Does your farm provide livestock biosecurity training?
Circle ***one****:* Yes / No / I don't know (IF NO, SKIP THE NEXT QUESTION)

When is livestock biosecurity training provided by the farm? *Circle* ***all*** *that apply*
a. When you start working
b. Once a month
c. 2-3 times per year
d. Once a year
e. When people get sick
f. When animals get sick
g. When farm leadership thinks it's needed
h. Other (Specify)____

Do you receive training on the following topics?

	Yes	No	I don't know
Animal carcass storage and disposal			
Animal quarantine and isolation			
Visitor policies			
Animal handling			
Pest/vermin disease threats			
Wildlife disease threats			
Recognizing cattle diseases			
Reporting cattle diseases to supervisors			

Foreign animal diseases (e.g., FMD)			
Infectious disease spread from people to animals			
COVID-19 spread from people to animals			
Symptoms of COVID-19 in animals			
Hand hygiene			
Cleaning and disinfection techniques for animal housing			
Ventilation (e.g., animal housing)			
Antimicrobial resistance			
Preventing disease spread from animal to animal			
Animal vaccination benefits			
Animal feed and water hygiene			
PPE use			
Use of sunlight to kill viruses (that can affect cattle)			
Disinfectant foot bath use			

PREVENTING INFECTIOUS DISEASES IN HUMANS ON THE FARM

Knowledge

What does "biological safety" mean to you?
*Circle **all** that apply*
a. Same as biosecurity
b. Preventing people from getting diseases in labs
c. Preventing people from getting diseases from animals on farms
d. Preventing people from getting diseases from one another on farms
e. Preventing animals from getting diseases on farms
f. Other (Specify)____
g. I don't know

What is a "zoonotic disease"?
*Circle **all** that apply*
a. Disease that can spread between animals and people
b. Disease that can spread from animals to people but NOT people to animals
c. Other (Specify)____
d. I don't know

Name a zoonotic disease that people can get from cattle____________________________________

How can diseases be transmitted from animals to people?
*Circle **all** that apply*
a. By touching animals
b. Through air
c. Exposure to blood
d. Exposure to body fluids from birth and/or abortion
e. Drinking raw milk
f. Being bitten

g. Fecal-oral
h. I don't know

Zoonotic diseases are diseases that can be spread between animals and people. Which are diseases people can get from cattle?
*Circle **all** that apply*
a. Rabies
b. Q fever
c. Cryptosporidiosis
d. Foot and mouth disease (FMD)
e. *E. coli* infection
f. Salmonellosis
g. Brucellosis
h. Tuberculosis
i. Methicillin-resistant Staphylococcus aureus (MRSA)
j. I don't know

What is true about salmonellosis?
*Circle **all** that apply*
a. In people, it can cause diarrhea, abdominal cramping, and/or fever
b. Washing your hands can help prevent you from getting it
c. *Salmonella* bacteria can be in cattle feces
d. Infected cattle may not show signs of salmonellosis
e. Cattle can be infected by ingesting contaminated feed, water, and/or grass
f. I don't know

What is the most common way people get infected with COVID-19?
*Circle **one***
a. Exposure to respiratory droplets from people
b. Contact with contaminated surfaces
c. Exposure to animals
d. Mosquito bites
e. Eating animal products (e.g., meat, milk)
f. Other (Specify)____
g. I don't know

COVID-19: Which are true?
*Circle **all** correct options*
a. People with COVID-19 who are not showing symptoms can still make others sick
b. Symptoms may appear 2-14 days after someone gets exposed to the virus
c. Symptoms can include loss of taste or smell
d. Symptoms can include shortness of breath and difficulty breathing
e. People with COVID-19 infection always show symptoms
f. I don't know

Which can help prevent spread of COVID-19?

*Circle **all** that apply*
a. Using face masks or cloth face coverings
b. Maintaining 6 feet distance between people
c. Washing hands often with soap and water for at least 20 seconds
d. Avoid touching eyes, nose, and mouth
e. Clean and disinfect touched surfaces often
f. Vaccinating people for COVID-19
g. I don't know

COVID-19

	Yes	No	I don't know
In a closed room with poor ventilation, is it possible to be infected with COVID-19 from a person standing more than 6 feet away from you?			
Can some animals transmit the COVID-19 virus to humans?			
Is there a vaccine for COVID-19 for people in the United States?			

Attitudes

Perceived Risk: Zoonoses are infectious diseases transmitted between animals and people. How likely are you to….

	Extremely unlikely	Unlikely	Neutral	Likely	Extremely likely
Get a zoonotic disease from cattle on the farm?					
Get COVID-19 from someone on the farm?					
Get seasonal influenza from someone on the farm?					
Get injured in an accident while working on the farm?					

Perceived Health Impact

	Not at all Harmful	Slightly Harmful	Moderately Harmful	Very Harmful	Extremely Harmful
If you got a zoonotic disease from cattle on the farm, how harmful would it be to your health?					
If you got COVID-19 on the farm, how harmful would it be to your health?					
If you got seasonal influenza on the farm, how harmful would it be to your health?					
If you were injured in an accident on the farm, how harmful would it be to your health?					

Concern about COVID-19 from animals

	Not at all Concerned	Slightly Concerned	Moderately Concerned	Very Concerned	Extremely Concerned

How concerned are you about getting COVID-19 from cattle?					

How effective do you think the following practices are in preventing zoonotic diseases from cattle to people on dairy farms?

	Not at all effective	Moderately Effective	Very effective
Hand hygiene (washing/sanitizing hands)			
Wearing gloves			
Wearing cloth face covers			
Wearing face masks (e.g., surgical masks)			
Wearing N-95 respirators			
Wearing farm designated clothing and boots			
Using disinfecting footbaths			
Limiting animal crowding			
Social distancing (maintaining 6 feet from other people)			
Monitoring animals for diseases			
Reporting when animals are sick			
Isolating sick animals			
Monitoring farm personnel for diseases			
Reporting when farm personnel are sick			
Isolating (e.g., sick leave) sick farm personnel			
Vaccinating cattle			
Vaccinating people			
Ensuring cattle have access to veterinary care			
Ensuring farm personnel have access to medical care			
Limiting number of visitors on the farm			
Limiting visitor contact with animals			
Screening visitors for diseases (e.g., ask if have symptoms of COVID-19 or exposed)			
Visitors using PPE			
Pest/vermin control			
Wildlife control			
Ensuring ventilation in animal spaces			
Ventilation in farm personnel common spaces (e.g., offices, break rooms, shared housing)			
Sunlight in animal housing, vehicles, equipment			
	Not at all effective	Moderately Effective	Very effective
Sunlight in farm personnel shared spaces (offices, vehicles)			
Cleaning and disinfecting animal common areas/equipment (e.g., housing, parlor, feed/water troughs)			
Cleaning and disinfecting farm personnel common areas and equipment (e.g., break rooms, bathrooms, surfaces, shared housing)			

Cleaning and disinfecting vehicles (e.g., trailers) after carrying animals			
Cleaning and disinfecting vehicle interiors (e.g., cabins) between users			
Injection safety			

How effective do you think the following practices are in preventing person-to-person diseases like COVID-19 or seasonal influenza on dairy farms?

	Not at all effective	Moderately Effective	Very effective
Hand hygiene (washing/sanitizing hands)			
Wearing gloves			
Wearing cloth face covers			
Wearing face masks (e.g., surgical masks)			
Wearing N-95 respirators			
Wearing farm designated clothing and boots			
Using disinfecting footbaths			
Limiting animal crowding			
Social distancing (maintaining 6 feet from other people)			
Monitoring animals for diseases			
Reporting when animals are sick			
Isolating sick animals			
Monitoring farm personnel for diseases			
Reporting when farm personnel are sick			
Isolating (e.g., sick leave) sick farm personnel			
Vaccinating cattle			
Vaccinating people			
Ensuring cattle have access to veterinary care			
Ensuring farm personnel have access to medical care			
Limiting number of visitors on the farm			
Limiting visitor contact with animals			
Screening visitors for diseases (e.g., ask if have symptoms of COVID-19 or exposed)			
Visitors using PPE			
Pest/vermin control			
Wildlife control			
Ensuring ventilation in animal spaces			
Ventilation in farm personnel common spaces (e.g., offices, break rooms, shared housing)			
Sunlight in animal housing, vehicles, equipment			
Sunlight in farm personnel shared spaces (offices, vehicles)			
Cleaning and disinfecting animal common areas/equipment (e.g., housing, parlor, feed/water troughs)			
	Not at all effective	Moderately Effective	Very effective

Cleaning and disinfecting farm personnel common areas and equipment (e.g., break rooms, bathrooms, surfaces, shared housing)			
Cleaning and disinfecting vehicles (e.g., trailers) after carrying animals			
Cleaning and disinfecting vehicle interiors (e.g., cabins) between users			
Injection safety			

Do you think the following prevent the farm from practicing stronger infection prevention/control (preventing <u>zoonoses from cattle or diseases transmitted person-person like COVID-19</u>)?

	Yes	No
Not enough time		
Not enough labor/manpower		
Not enough money		
Not enough farm knowledge about cattle zoonotic diseases and how to prevent people from getting them		
Not enough farm knowledge about COVID-19 and how to prevent people from getting it		
Shortages of cleaning and disinfecting equipment/agents		
Lack of farm concern about cattle zoonotic diseases affecting people		
Lack of farm concern about COVID-19 affecting people		
Not enough communication from leadership about expectations on how to prevent diseases in people		
Not enough leadership enforcement of infection prevention/control policies		
Not enough farm personnel compliance with infection prevention/control policies		
Not enough PPE		
Not enough carcass storage and disposal ability		
Not enough handwashing stations with soap and water		
Not enough ability to ensure adequate ventilation/airflow		
Lack of belief that preventing diseases in humans is worth the time/effort		
Not enough space to prevent people from crowding at work		

Importance of preventing infectious diseases in people on the farm

	Not at all Important	Slightly Important	Moderately Important	Very Important	Extremely Important
How important is preventing zoonoses from cattle to you?					
How important is preventing zoonoses from cattle to your supervisors?					
How important is preventing zoonoses from cattle to your co-workers?					
How important is preventing COVID-19 to you?					
How important is preventing COVID-19 to your supervisors?					

How important is preventing COVID-19 to your co-workers?					

Attitudes toward preventing infectious diseases in people. How much do you agree with the following statements?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Policies and practices on my farm help prevent cattle zoonotic diseases in farm personnel					
Policies and practices on my farm help prevent COVID-19 in farm personnel					
I understand my farm's zoonotic disease prevention rules and expectations					
I understand my farm's COVID-19 prevention rules and expectations					
Since COVID-19 started, preventing zoonoses from cattle to people have become more of a priority					
Since the COVID-19 pandemic began, zoonotic diseases from cattle to people have become more common					
Nothing can be done on dairy farms to reduce chances of people getting COVID-19 from one another					
Nothing can be done on dairy farms to reduce chances of people getting zoonoses from cattle					
People on dairy farms are at higher risk for getting COVID-19					
I know how to protect myself from cattle zoonoses while working on the farm					
I know how to protect myself from COVID-19 while working on the farm					
I can see a healthcare provider if I need to					

Trusted and used sources of information. **Animal-to-Human Diseases**

	Which 3 would you most trust for accurate information on preventing farm zoonotic diseases in people? (Check 3)	Which 3 do you use most frequently for information on preventing farm zoonotic diseases in people? (Check 3)
Private Veterinarians		
Government Veterinarians		
Dairy Owners		
Co-Workers		
Dairy Managers		

University Researchers		
Human Healthcare Professionals (Doctors/Nurses)		
Public Health Officials (Local/State Health Department)		
Social Media (e.g., Facebook, Twitter, Instagram)		
Training Provided by Farm		
State Department of Agriculture		
US Department of Agriculture (USDA)		
Centers for Disease Control and Prevention (CDC)		
Friends and Relatives		
Internet		
National Institute for Occupational Safety and Health (NIOSH)		

Trusted and used sources of information: **Person-Person Diseases (COVID-19, Seasonal Influenza, etc.)**

	Which 3 would you most trust for accurate information on preventing COVID-19 and other diseases transmitted person-to-person? (Check 3)	Which 3 do you use most frequently for information on preventing COVID-19 and other diseases transmitted person-to-person? (Check 3)
Private Veterinarians		
Government Veterinarians		
Dairy Owners		
Co-Workers		
Dairy Managers		
University Researchers		
Human Healthcare Professionals (Doctors/Nurses)		
Public Health Officials (Local/State Health Department)		
Social Media (e.g., Facebook, Twitter, Instagram)		
Training Provided by Farm		
State Department of Agriculture		
US Department of Agriculture (USDA)		
Centers for Disease Control and Prevention (CDC)		
Friends and Relatives		
Internet		

National Institute for Occupational Safety and Health (NIOSH)		

PPE: How much do you agree with the following?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I have all the PPE I need					
Since the start of the COVID-19 pandemic, PPE has been harder to find on the farm					
Using PPE can help prevent me from getting zoonoses from cattle					
Using PPE can help prevent me from getting COVID-19 from people					

How much do you agree or disagree with the following statements about **cloth face coverings** on the farm?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
They can reduce my chances of getting COVID-19 from people					
They can reduce my chances of giving COVID-19 to people					
They can reduce my chances of getting zoonotic diseases from animals					
They can reduce my chances of getting other infectious diseases (e.g., influenza) from people					
They interfere with my ability to do my job					
They are useless					

Personal Hygiene: How much do you agree or disagree with the following statements?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I have access to hand washing facilities on the farm					
I have access to hand sanitizer containing at least 60% alcohol					

Social Distancing (keeping 6 feet distance from others): How much do you agree with the following statements?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Social distancing can reduce my chances of getting COVID-19 on the farm					
Social distancing can reduce my chances of getting other diseases from people (e.g., influenza)					
It is difficult to practice social distancing at my workstation					
It is difficult to practice social distancing in the breakroom					
People try their best to practice social distancing on the farm					
Encouraging social distancing is not needed because people are usually more than 6 feet apart anyway					

Vaccinations and Testing

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I can get the COVID-19 vaccine if I want to get it					
A person who is vaccinated for COVID-19 should still wear a face mask or face covering					
A person vaccinated for COVID-19 should still practice social distancing					
COVID-19 vaccines are safe					
Getting the COVID-19 vaccine can help prevent me from getting COVID-19					
Getting the COVID-19 vaccine can prevent me from becoming seriously sick or dying if I get infected					
I can get a COVID-19 test if I want to get it					
Seasonal influenza vaccines are safe					
Seasonal influenza vaccines can help prevent me from getting the flu					

Visitors

	Not at all Concerned	Slightly Concerned	Moderately Concerned	Very Concerned	Extremely Concerned
How concerned are you about visitors bringing diseases onto the farm?					

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The training provides accurate information					
The training is worth the time					
I am encouraged to provide feedback on the training					
The training is provided in my preferred language					

Farm Training: How much do you agree with the following statements regarding your training on preventing infectious diseases **(zoonotic diseases and person-to-person diseases like COVID-19)?**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The training provides accurate information					
The training is worth the time					
I am encouraged to provide feedback on the training					
The training is provided in my preferred language					

How much would you want the following methods of training on the farm?

	Not at all	A little	A moderate amount	A lot	A great deal
On the job training through supervisors and peers					
In-person training					
Live webinars or video conferences (e.g., Zoom)					
Non-interactive technology (e.g., self-paced computer training, YouTube, other websites)					
Cell phone apps					
Interactive technology (e.g., online scenario-based)					

Sick Leave and Illness Reporting: How much do you agree or disagree with the following statements?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I am comfortable telling my supervisors when I am sick					
I understand my farm's sick leave policies					
I would be penalized for taking sick leave if I got COVID-19					
I would be encouraged to stay home if I had COVID-19					
I would be encouraged to stay home if I had diarrhea from a cattle zoonosis					
I know how zoonotic diseases from cattle could affect me					
I know the symptoms of COVID-19					
Zoonotic diseases from cattle are under-reported on the farm					
If I thought I had a zoonotic disease from cattle, I would report it to my supervisors					
If I thought I had COVID-19, I would report it to my supervisors					

Please answer the questions below

	Yes	No	Prefer not to answer
Do you think you've ever gotten sick from a person working on this dairy farm?			
Do you think you've ever gotten sick from animals on this dairy farm?			
Do you think cattle can infect people with the COVID-19 virus?			
Do you think people can infect cattle with the COVID-19 virus?			
Have you ever known a person who got COVID-19?			
Have you ever known a person who got a zoonotic disease from animals on a farm?			

Practices

Ventilation and sunlight

	Yes	No	I don't know
Ventilation systems (e.g., fans) or open windows are used to provide even airflow (minimize stagnation or drafts) in common areas (e.g., offices, breakrooms)			
The farm uses sunlight to kill pathogens in shared spaces (e.g., offices, breakrooms) or shared equipment (e.g., vehicles)			

Visitors Policies: Which are true regarding your farm's visitor policies?

	Yes	No	I don't know
Visitors are screened for COVID-19 (asked if they have symptoms or have been around anyone with COVID-19)			

Visitor temperature is checked			
Visitors are provided information on zoonotic disease prevention			

Sick Leave, Reporting, Vaccinations

	Yes	No	I don't know
The farm offers paid sick leave			
Workers are given a test to ensure they understand farm sick leave policies			
The farm encourages people to stay home if they are sick			
The farm encourages people to report if they believe they have a disease from an animal			
The farm encourages people to report if they believe they have COVID-19			
The farm encourages people to report unsafe practices that could lead to disease in people			
The farm encourages people to get vaccinated for seasonal influenza			
The farm encourages people to get vaccinated for COVID-19			
There are posters on the farm about the COVID-19 vaccine			

Hand Hygiene

	Yes	No	I don't know
Farm has handwashing facilities with soap, water, and single use towels			
Farm encourages people to wash their hands often with soap and water for at least 20 seconds			
Farm provides hand sanitizer containing at least 60% alcohol			
Personal hygiene guidelines written in English and Spanish are posted on the farm			

Does your farm…

	Yes	No	I don't know	N/A
Have someone in charge of preventing/controlling infectious diseases in people?				
Encourage a health screening evaluation after being offered a job on the farm?				
Have a COVID-19 assessment and control plan?				
Complete COVID-19 checklists to identify farm vulnerabilities?				
Complete zoonotic disease checklists to identify farm vulnerabilities?				
Have a plan in place to ensure farm operations continue if a disease outbreak like COVID-19 affects 50% of farm personnel?				
Have posters on COVID-19 prevention in English and Spanish in commonly used areas?				
Have posters on zoonotic disease prevention in English and Spanish in hazardous areas?				
Have a person designated to talk to the media if a large COVID-19 outbreak occurs on the farm?				

Encourage following Centers for Disease Control and Prevention (CDC) COVID-19 guidelines?				
Keep written records for cleaning/disinfecting commonly used areas (e.g., breakrooms, offices, vehicles)?				
Keep written records for cleaning/disinfecting animal housing?				
Verbally screen farm personnel for symptoms and exposure to COVID-19?				
Check worker temperature at beginning of each shift?				
Provide contact information for health centers providing medical care and COVID testing?				

If a large COVID-19 outbreak occurred on the farm, who would be in charge?
a. The same person in charge if a foreign animal disease (e.g., FMD) occurred on the farm
b. I don't know
c. Other (Specify)____

Does your farm provide training on preventing zoonoses from animals to people? *Circle* ***one***
Yes / No / I don't know (IF NO, SKIP NEXT QUESTION)

When is **zoonotic disease training** provided by the farm? *Circle* ***all*** *that apply*
a. When you start working
b. Once a month
c. 2-3 times per year
d. Once a year
e. When people get sick
f. When animals get sick
g. When farm leadership thinks it's needed
h. Other (Specify)___

Does your farm provide training on preventing COVID-19 in people?
Circle one: Yes / No / I don't know (IF NO, SKIP NEXT QUESTION)

When is ***COVID-19*** **training** provided by the farm?
Circle ***all*** *that apply*
a. When you start working
b. Once a month
c. 2-3 times per year
d. Once a year
e. When people get sick
f. When animals get sick
g. When farm leadership thinks it's needed
h. Other (Specify)___

	Never	Rarely	Sometimes	Often	Always
How often does training on preventing infectious disease in people (e.g., zoonoses, COVID-19) occur at the same time as livestock biosecurity training?					

How often do you do the following on the farm?

	Never	Rarely	Sometimes	Often	Always	N/A
Change clothes after work on the farm before returning home						
Shower on the farm after work						
Wash my work clothes separately from my non-work clothes						
Wear my work shoes/boots home at the end of the day						
Wash my hands after removing gloves						
Wash my hands before eating						
Wear a cloth face covering						
Wear a surgical mask						
Wear an N-95 respirator						
Wear a face shield						
Wear goggles						
Wash hands after working in animal facilities						
Wear gloves when working in animal facilities						
Wear farm designated clothing (e.g., coveralls)						
Wear farm designated footwear (e.g., boots)						

Which are true about **cloth face coverings** you use on the farm?
*Circle **all** that apply*
a. It is provided by the farm
b. I buy it myself
c. It includes multiple layers of fabric
d. It covers my nose and mouth
e. It connects to my ears
f. The only cloth face covering I use is a bandana
g. I do not use a cloth face covering

Training: Which are true?

	Yes	No	I don't know
Since the COVID-19 pandemic began, my farm uses online training more often			
Since the pandemic began, the farm has increased focus on training to prevent zoonotic diseases from cattle to people			
Since the pandemic began, the farm has increased focus on training to prevent person-person infectious diseases (e.g., COVID-19 and seasonal influenza)			

Cleaning and Disinfection: Which are true?

	Yes	No	I don't know
Vehicle interiors are cleaned/disinfected between users			
Farm has a written cleaning and disinfection protocol for common spaces (offices, breakrooms, bathrooms)			
Farm has a written cleaning and disinfection protocol for animal housing and equipment?			
Farm policies include instructions on disposal of fetal membranes and fluids from cattle birth and abortion			

Cleaning/Disinfection Schedules

	Never	Once per week	More than once per week	Once per day	More than once per day	I don't know
How often are breakrooms cleaned/disinfected?						
How often are bathrooms cleaned/disinfected?						

Social Distancing: Social distancing means keeping 6 feet between yourself and others. Does your farm…

	Yes	No	I don't know	N/A
Encourage social distancing in workplaces?				
Limit numbers of in-person meetings?				
Encourage social distancing in shared housing?				
Encourage social distancing in break rooms?				
Put up physical barriers (e.g., plexiglass) in common areas?				

Face covering and face masks: Does your farm…

	Yes	No	I don't know
Require wearing face covering or face mask at all times?			
Require wearing face covering or face mask when outdoors?			
Require wearing face covering or face mask when less than 6 feet away from others?			
Require wearing face covering or face mask when indoors (e.g., office, breakroom)?			
Require vehicle occupants to wear face coverings or face masks when traveling together?			

How often are you less than 6 feet away from other people while in the following locations?

	Never	Rarely	Sometimes	Often	Always
Breakroom					
Workstation					

How often do you wear a **<u>cloth face covering or face mask</u>** in the following areas?

	Never	Rarely	Sometimes	Often	Always
While indoors					
While outdoors					
While at my main workstation					
In the breakroom					
While sharing a vehicle					

How often do you wear the following on the farm?

	Never	Rarely	Sometimes	Often	Always
Bandana over face					
Cloth face covering with straps connecting to ears					
Surgical Mask					
N-95 Respirator					

How often do you do the following while conducting work duties?

	Never	Rarely	Sometimes	Often	Always
Eat					
Drink					
Smoke					
Chew tobacco or dip					

Do you drink raw milk from cattle on the farm?
*Circle **one**:* Yes/No

How often do you…

	Never	Seldom	Sometimes	Often
Spend time in a breakroom				
Carpool to work				

Are farm workers required to…

	Yes	No	I don't know
Wear gloves when working with sick animals?			
Wear a face mask or face covering while working with sick animals?			
Wear goggles while working with sick animals?			
Wash work clothes separately from non-work clothes?			
Wash hands with soap and water after handling sick animals?			
Change gloves after handling a sick animal?			
Change or disinfect clothing after working with a sick animal?			

Does farmworker housing exist on the farm?
*Circle **one**:* Yes / No / I don't know (IF NO, SKIP NEXT QUESTION)

Farm Worker Housing. Which are true?

	Yes	No	I don't know
Housing provides living quarters to isolate people with confirmed or suspected COVID-19			
Shared sleeping quarters are arranged to allow six feet between beds			
Tables and seating in common spaces are arranged to allow for social distancing of 6 feet apart			
Common spaces are stocked with hand washing supplies			
Residents are encouraged to use face covers in common areas			
Posters in English and Spanish on COVID-19 prevention are present in common areas			
The farm encourages residents to regularly clean and sanitize living quarters			
The farm provides cleaning supplies			
Airflow is maintained in shared/common areas			

Is shared transportation (i.e., carpooling) used by farm personnel?
*Circle **one**:* Yes / No / I don't know (IF NO, SKIP NEXT QUESTION)

Carpooling

	Yes	No	I don't know
Vehicles are cleaned/disinfected between trips			

Riders must wash/sanitize hands before entering vehicles			
Riders undergo health screen before entering shared vehicles			
Riders ride with members of their work crews and/or housemates			
Riders are encouraged to wear cloth face coverings			

I would try a new tool to evaluate infectious disease threats on the farm if it…

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Prevents infectious diseases from cattle to cattle					
Prevents infectious diseases from humans to cattle					
Prevents zoonoses in farm personnel					
Prevents person-person infectious diseases in farm personnel (e.g., COVID-19, seasonal influenza)					
Prevents my family from getting sick					
Focusses on animal and human health					
Keeps the farm in business					
Saves the farm time					

Do you receive training on the following topics?

	Yes	No	I don't know
Sick leave policies			
Reporting your illnesses to supervisors			
Symptoms of cattle zoonoses in people			
COVID-19 spread from animals to people			
Infectious disease spread from people to people			
Zoonotic disease spread from animals to people			
Symptoms of COVID-19 in humans			
Cleaning and disinfecting common areas (e.g., breakrooms, offices, bathrooms)			
Cleaning and disinfecting shared housing			
Cleaning and disinfecting shared vehicles			
Ventilation (e.g., workplace, common areas)			
Preventing disease spread to family members			
Human vaccination benefits (e.g., COVID-19, tetanus, Rabies)			
Food safety (human consumption)			
PPE putting on/taking of			
Purpose of PPE items			
PPE disposal			
Cleaning re-usable PPE			
Proper fit and wear of face masks or cloth face coverings			
Cough and sneeze etiquette			
Social distancing			
Preventing infectious diseases in worker housing			
Carpooling policies			
Use of sunlight to kill pathogens that can affect humans			
Needle Safety			

Which are used during training on preventing infectious diseases in people?
*Circle **all** that apply*
a. On the job training through supervisors or peers
b. In-person training
c. Live webinars or video conferences (e.g. Zoom)
d. Non-interactive technology (e.g., self-paced computer training, YouTube, other websites)
e. Cell phone apps
f. Interactive technology (e.g., online scenario-based)
g. Other (Specify)___

Background

What is the highest level of education you have finished? *Circle **one***
a. Less than middle school
b. Middle school
c. High school
d. Technical education
e. Associate degree
f. Bachelor's degree
g. Master's degree
h. Doctoral degree

For how long have you worked on this dairy farm? ___________________years

Have you ever worked in other dairies? *Circle **one**:* Yes / No

How long have you worked in a dairy job/environment? ___________________years

Have you ever worked on a farm when it had to cull animals due to an animal disease outbreak?
*Circle **one***
a. Yes
b. No
c. I don't know
d. Prefer not to answer

How many milking cows are on the farm? ___________________

Is shared worker housing used on the farm? *Circle **one**:* Yes / No / I don't know

Presence of domestic animals and wildlife (Check if YES)

	Present on Farm?	Access to Animal Housing?
Dogs		
Cats		
Minks/Weasels		

Mice/Rats		
Raccoons		
Prairie Dogs		
Deer		
Small birds (Pigeons, sparrows, etc.)		
Large birds (Geese, turkeys, etc.)		

Demographics

What is your preferred language?
Circle ***one***
a. English
b. Spanish
c. An indigenous language
d. Other (Specify)____________________

What is your gender? Male / Female / Other / Prefer not to answer

How old are you?_____________years

Do you live on the dairy farm where you work? *Circle* ***one:*** Yes / No

Do you live with anyone else?
Circle ***all*** *that apply*
a. I live with my spouse or significant other
b. I live with my kid(s)
c. I live with other farm workers
d. I live alone
e. I live with other family members (e.g., parents, grandparents, siblings, cousins, etc.)

What is your current role/job at the dairy? *Circle* ***one***
a. Worker
b. Owner
c. Manager/Supervisor
d. Other (Specify)__________________________________

Where do you spend most of your time working on the farm? *Circle* ***one***
a. Dairy parlor
b. Calf yard
c. Cow pens
d. Maternity
e. Hospital
f. Office
g. Machinery room
h. Other (Specify)____

APPENDIX 12: KAP QUESTIONNAIRE FINAL (SPANISH)

*****Puede dejar de participar en este cuestionario en cualquier momento sin penalidad*****

Encuesta CAP: Bioseguridad de los productos lácteos de Colorado
Fecha de la entrevista con los investigadores______________

<u>Conocimiento</u>
¿Qué significa la "bioseguridad" para usted? *Circule* ***<u>todas</u>*** *las que apliquen*
a. Prevención de la entrada de patógenos y enfermedades animales al ganado
b. Prevención de la propagación de patógenos y enfermedades animales en el ganado
c. Prevención de la salida de la finca de patógenos y enfermedades animales
d. Prevención de la entrada de patógenos y enfermedades humanas a el ganado
e. Prevenir que los seres humanos contraen enfermedades de animales en la finca
f. Evitar que los seres humanos se propaguen enfermedades entre sí en la finca
g. Otros (especifique) ___________________________________
h. No estoy seguro de que entiendo el significado

¿Qué puede aumentar la propagación de enfermedades entre el ganado lechero? *Circule* ***<u>todas</u>*** *las que apliquen*
a. Mala ventilación en la vivienda
b. El hacinamiento animal
c. Contacto de nariz a nariz animal
d. No sé

¿Cuándo se deben usar los antibióticos en el ganado? Nota: El objetivo de esta pregunta es evaluar sus conocimientos sobre cuándo deben utilizarse los antibióticos en el ganado, independientemente de si su granja los usa o no. *Circule* ***<u>todas</u>*** *las que apliquen*
a. Para tratar una infección bacteriana
b. Para tratar una infección viral
c. Cuando un animal parece enfermo
d. Otros (especificar) _______________________________
e. No sé

Las enfermedades animales extranjeras son enfermedades presentes en otros países, pero no típicamente en los Estados Unidos. Con respecto a los Estados Unidos, ¿cuáles son las enfermedades animales extranjeras que pueden infectar al **<u>ganado</u>**? *Seleccione* ***<u>todas</u>*** *las opciones que correspondan*
a. Peste porcina africana (PPA)
b. Estomatitis vesicular
c. Fiebre aftosa
d. No sé

¿Pueden los seres humanos dar algunas enfermedades a los animales? *Circule uno*: Sí / No / No sé

Si respondió "Sí", ¿puede dar un ejemplo de una enfermedad que los seres humanos pueden pasar a los animales? ______________________________________

¿Pueden los seres humanos infectar a algunos animales con el virus que causa el COVID-19? *Circule uno*: Sí / No / No sé

¿Existe una vacuna autorizada COVID-19 disponible para el ganado? *Círculo uno*: Sí / No / No sé

Actitudes

La "bioseguridad ganadera" puede definirse como medidas de gestión y físicas para evitar que los patógenos y las enfermedades entren o salgan de una población ganadera y se propaguen dentro de una población ganadera. Algunos componentes de las medidas de bioseguridad del ganado incluyen el aislamiento de animales nuevos y enfermos, el control de enfermedades de los animales, la peste/alimañas y el control de la vida silvestre, políticas de visitantes, higiene de manos, baños de pies, ropa específica para la granja y equipo de protección personal (PPE), seguridad de los piensos/agua, gestión de la salud de los rebaños, compra de animales, transporte de animales y eliminación de cadáveres, vacunación de animales, ventilación, limpieza y desinfección de equipos y alojamiento de animales. La limpieza se centra en la eliminación de material orgánico (suciedad, estiércol, polvo, alimento, etc.). La desinfección se centra en matar los microbios restantes usando un compuesto químico (desinfectante), calor o luz UV. El equipo de protección personal (PPE) incluye revestimientos para la cara, mascarillas para la cara (N95 respiradores y máscaras quirúrgicas), guantes, botas, delantales, mangas obstétricas, overoles de trabajo, gafas y otros artículos para proteger al usuario y evitar la propagación de patógenos entre animales y lugares.

Importancia general de la bioseguridad del ganado

	No es importante	Un poco importante	Moderadamente importante	Muy importante	Extremadamente importante
¿Cuán importante es para usted la bioseguridad del ganado?					
¿Cuán importante es para sus supervisores la bioseguridad del ganado?					
¿Cuán importante es para sus compañeros de trabajo la bioseguridad del ganado?					
¿Cuán importante es evitar que los patógenos/enfermedades entren en el rebaño?					

¿Cuán importante es prevenir que los patógenos/enfermedades se propaguen dentro del rebaño?					
¿Cuán importante es evitar que los patógenos/enfermedades salgan del rebaño (abandonando la granja)?					

Actitudes hacia la bioseguridad ganadera. ¿Cuánto está de acuerdo con las siguientes declaraciones?

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo
La bioseguridad del ganado puede ayudar a prevenir las enfermedades del ganado					
La bioseguridad del ganado practicada en mi granja ayuda a prevenir enfermedades del ganado					
La bioseguridad del ganado puede reducir las posibilidades de que las personas contraigan enfermedades del ganado en las granjas lecheras					
Entiendo las reglas de bioseguridad de mi granja y expectativas					
No se puede hacer nada en las granjas lecheras para reducir las posibilidades de contraer enfermedades por parte del ganado					
La pandemia de COVID-19 ha hecho que sea más difícil para mi granja practicar la bioseguridad del ganado					

Preocupación por las enfermedades animales extranjeras

	No estoy preocupado en lo absoluto	Un poco preocupado	Moderadamente preocupado	Muy preocupado	Extremadamente preocupado

¿Cuánto le preocupa que una enfermedad animal extranjera (por ejemplo, la fiebre aftosa) entre en la granja?					

La "resistencia a los antimicrobianos" ocurre cuando las bacterias, virus, hongos o parásitos cambian de maneras que los hacen menos susceptibles a los efectos de los medicamentos/medicamentos utilizados para matarlos o ralentizar su crecimiento.

	No es importante	Un poco importante	Moderadamente importante	Muy importante	Extremadamente importante
¿Cuán importante es prevenir la resistencia a los antimicrobianos en el ganado?					

COVID-19 y los animales.

	Si	No	No sé
¿Crees que los humanos pueden infectar el ganado con el virus del COVID-19?			

	No estoy preocupado en lo absoluto	Un poco preocupado	Moderadamente preocupado	Muy preocupado	Extremadamente preocupado
¿Cuán preocupado está de que los seres humanos en la granja infecten al ganado con el virus del COVID-19?					

Fuentes de información sobre la bioseguridad del ganado

	Marque los 3 que más confiaría como fuente de información precisa sobre la bioseguridad ganadera	Marque los 3 que utiliza con más frecuencia para obtener información sobre la bioseguridad del ganado
Veterinarios privados		
Veterinarios gubernamentales		
Propietarios de granjas lecheras		
Compañeros de trabajo		
Supervisores de granjas lecheras		
Investigadores universitarios		

Profesionales de la Salud Humana (médicos/enfermeros)		
Funcionarios locales de Salud Pública (Departamento de Salud Local/ Estatal)		
Redes sociales (p. ej., Facebook, Twitter, Instagram, etc.)		
Adiestramientos proporcionada por la finca		
Departamento de Agricultura del Estado		
Departamento de Agricultura de EE. UU. (USDA)		
Centros para el Control y la Prevención de Enfermedades (CDC)		
Amigos y familiares		
Internet		
Instituto Nacional para la Seguridad y Salud Ocupacional (NIOSH)		

Impacto del COVID-19 en la granja: ¿Cuánto está de acuerdo con las siguientes declaraciones? Desde que comenzó la pandemia del COVID-19...

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo
La bioseguridad del ganado en la granja se ha convertido en una prioridad					
Ha habido más enfermedades en el ganado (por ejemplo, mastitis)					
La granja está usando más antimicrobianos					
Ha sido más difícil proporcionar vacunas para el ganado					
El acceso de los animales a la atención médica ha disminuido					
Ha habido más alimañas/plagas en la granja					
Ha habido más fauna en la granja					
Ha habido más abortos en el ganado					
Ha sido más difícil para la granja mantener el número necesario de trabajadores					
Ha sido más difícil encontrar EPP					

¿Cuánto está de acuerdo con las siguientes declaraciones sobre su capacitación en bioseguridad ganadera a través de la granja?

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo
El adiestramiento provee información precisa					
El adiestramiento vale la pena en la relación al tiempo					
Me animamos a proporcionar retroalimentación sobre el adiestramiento					
El adiestramiento se proporciona en mi idioma preferido					

¿Cree que los siguientes impiden que la granja practique una bioseguridad del ganado más fuerte?

	Sí	No
Tiempo insuficiente		
Mano de obra insuficiente		
No hay suficiente dinero		
No hay suficientes conocimientos agrícolas sobre las enfermedades zoonóticas del ganado y cómo evitar que la gente las agarre		
No hay suficiente espacio para la vivienda de los animales		
No hay suficiente espacio para el aislamiento o cuarentena de los animales		
Escasez de equipos/agentes de limpieza y desinfección		
Falta de preocupación agrícola por las enfermedades zoonóticas del ganado		
No hay suficiente comunicación de los líderes sobre las expectativas de bioseguridad del ganado		
No hay suficiente aplicación de las políticas de bioseguridad		
En la finca el personal agrícola no cumple con las políticas de prevención y control de infecciones		
No hay suficiente EPP		
No hay suficiente capacidad de almacenamiento y eliminación de carcasas		
No hay suficientes estaciones de lavado de manos con agua y jabón		
La incapacidad para controlar pestes/alimañas o vida silvestre		
Mala ventilación		
Falta de creencia que la prevención de las enfermedades en los seres humanos vale el tiempo/esfuerzo		
No hay suficiente espacio para evitar que los animales se amontonen		

¿Qué tan eficaz cree que son los siguientes en la <u>prevención de enfermedades infecciosas en el ganado</u>?

	Para nada	Moderadamente efectivo	Muy efectivo

Higiene de las manos (lavado/desinfección de las manos)			
Uso de guantes			
Uso de cubiertas de tela			
Uso de máscaras faciales (por ejemplo, máscaras quirúrgicas)			
Uso de respiradores N-95			
Uso de ropa y botas designadas para la granja			
Uso de baños de pies desinfectantes			
Limitación de la aglomeración de animales			
Distanciamiento social (manteniendo 6 pies de distancia entre personas)			
Monitoreo de animales para enfermedades			
Reportando cuando los animales están enfermos			
Aislando animales enfermos			
Monitoreo del personal agrícola para enfermedades			
Reportando cuando el personal agrícola está enfermo			
Aislamiento (por ejemplo, ausencia por enfermedad) del personal agrícola enfermo			
Vacunando al ganado			
Vacunando a las personas			
Asegurándose que el ganado tenga acceso a atención veterinaria			
Asegurándose de que el personal de la granja tenga acceso a atención médica			
Limitando el número de visitantes en la granja			
	Para nada	Moderadamente efectivo	Muy efectivo
Limitando el contacto de los visitantes con los animales			
Detectando a los visitantes con enfermedades (por ejemplo, preguntar si tienen síntomas de COVID-19 o han sido expuestos)			
Visitantes usando EPP			
Control de plagas y roedores			
Control de la vida silvestre			
Asegurándose que hay ventilación en espacios de animales			
Asegurándose que hay ventilación en espacios comunes del personal de la granja (por ejemplo, oficinas, salas de descanso, viviendas compartidas)			
Luz solar en viviendas para animales, vehículos, equipos			
Luz solar en espacios compartidos del personal de la granja (oficinas, vehículos)			
Limpieza y desinfección de áreas/equipos comunes de animales (por ejemplo, viviendas, salones, canales de alimentación/agua)			
Limpieza y desinfección de las áreas comunes y equipos del personal de la granja (por ejemplo, salas de descanso, baños, superficies, viviendas compartidas)			

Limpieza y desinfección de vehículos (por ejemplo, remolques) después de transportar animales			
Limpieza y desinfección de interiores de vehículos (por ejemplo, cabinas) entre usuarios			
Seguridad de inyección			

Prácticas

Aumentaría el tiempo que paso en la bioseguridad ganadera si tuviera más evidencia de que podría...

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo
Prevenir las enfermedades del ganado					
Prevenir la propagación de enfermedades humanas al ganado en la granja (humano a ganado)					
Prevenir la propagación de enfermedades del ganado a los seres humanos en la granja (ganado a humano)					
Prevenir que los seres humanos se contagien enfermedades entre sí en la granja (humano a humano)					
Evitar que los visitantes introduzcan enfermedades/patógenos en el rebaño					
Prevenir la resistencia a los antimicrobianos					
Aumentar el beneficio de la granja/ahorre dinero					
Mejorar el bienestar animal					
Hacer un producto más seguro para los consumidores					
Reducir el riesgo de una enfermedad animal extranjera (por ejemplo, fiebre aftosa) de entrar a la finca					

¿Cuáles son ciertas con respecto a las políticas de visitantes de su granja?

	Si	No	No sé
Los visitantes deben firmar un registro			
Se limitan los visitantes en la finca			
Los visitantes deben usar una cubierta o máscara faciales en instalaciones de animales			
Los visitantes deben lavarse o desinfectar sus manos al entrar en la granja			
Los visitantes deben lavarse o desinfectar sus manos cuando se van de la granja			

Los visitantes de la granja deben ponerse los overoles y botas si van a entrar a las instalaciones de animales			
Los visitantes deben caminar a través un baño de pies desinfectante antes de entrar en la granja principal			
El contacto de los visitantes con los animales se minimiza			
El exterior del vehículo de los visitantes se debe limpiarse/desinfectarse			

Se le requiere a los empleados…

	Sí	No	No sé
Usar guantes desechables cuando maneja animales			
Lavarse las manos con agua y jabón antes de manejar animales			
Usar cubiertas o máscaras en instalaciones para animales			
Usar ropa designada para la granja			
Usar botas designadas para la granja			
Utilizar baños de pies desinfectantes entre unidades de producción			
Cambiar la ropa después del trabajo antes de salir de la granja			
Duchar en el trabajo antes de salir de la granja			

Su finca…

	Sí	No	No sé
Monitorea y examina animales sanos			
Fomenta la notificación de enfermedades animales			
Fomenta la notificación de enfermedades humanas			
Aísla y hace pruebas a los animales			
Pone en cuarentena y hacerle pruebas de enfermedad a los animales recién comprados			
Vacuna al ganado			
Limita el hacinamiento de animales			
Mantiene el programa de control de plagas y alimañas			
Evita que la fauna silvestre accese a la vivienda de los animales, alimentación/agua			
Limpia y desinfecta las áreas/equipos comunes de los animales (por ejemplo, vivienda, salón, canales de alimentación/agua)			
Limpia y desinfecta los vehículos después de transportar ganado			
Usa sistemas de ventilación en la vivienda animal para producir un flujo de aire uniforme (minimiza el estancamiento o las corrientes de aire)			
Usar la luz solar directa para matar patógenos en la vivienda o el equipo de los animales			
Asegurar la higiene de los alimentos (control de la descomposición, excremento animales)			
Asegurar la higiene del agua (pruebas de laboratorio)			
Mantiene visitas regulares a los veterinarios			
Fomenta prácticas seguras de inyección			

Su finca tiene/hace…

	Si	No	No sé
¿Tiene alguien a cargo de la bioseguridad del ganado?			

¿Tiene un plan de manejo para la bioseguridad del ganado por escrito?			
¿Tiene un procedimiento de operación estándar de limpieza/desinfección por escrito?			
Mantiene un registro escrito para la limpieza/desinfección de áreas/equipos comunes de animales			
Mantiene un registro escrito para la limpieza/desinfección de vehículos			
¿Tiene un Plan de Preparación y Respuesta para enfermedades animales extranjeras?			
¿Tiene evaluaciones o listas de comprobación para la bioseguridad del ganado?			
¿Ha designado a una persona para que hable con los medios de comunicación si la granja está afectada por un brote de enfermedad animal extranjera?			

¿Su granja proporciona adiestramientos sobre la bioseguridad ganadera? *Círculo* ***uno:*** Sí / No / No sé
(SI NO, SALTE LA PRÓXIMA PREGUNTA)

¿Cada cuánto se imparte adiestramientos sobre la bioseguridad a los animales en la granja? Circula **todas** las opciones que apliquen
a. Cuando comienza a trabajar
b. Una vez al mes
c. 2-3 veces al año
d. Una vez al año
e. Cuando la gente se enferma
f. Cuando los animales se enferman
g. Cuando los gerentes piensan que es necesario
h. Otros (especificar) ____

¿Usted recibe adiestramientos en los siguientes temas?

	Sí	No	No sé
Almacenamiento y eliminación de cadáveres de animales			
La cuarentena y el aislamiento de animal			
Políticas para los visitantes			
Manejo de los animales			
Pestes /amenazas de enfermedad de alimaña/sabandijas			
Amenazas de enfermedad a la vida silvestre			
Reconociendo las enfermedades del ganado			
Reportar enfermedades del ganado a los supervisores			
Enfermedades animales extranjeras (por ejemplo, fiebre aftosa)			
Enfermedades infecciosas transmitidas de las personas a los animales			
COVID-19 propagación de las personas a los animales			
Síntomas de COVID-19 en los animales			
Higiene de las manos			
Técnicas de limpieza y desinfección para la vivienda animal			
Ventilación (p. ej., vivienda de los animales)			
Resistencia a los antimicrobianos			
Prevención de la propagación de enfermedades de animales a animales			
Beneficios de la vacunación de los animales			

Higiene de los alimentos y el agua			
Uso de EPP			
Uso de la luz solar para matar viruses (que pueden afectar al ganado)			
Uso de baños de pies desinfectantes			

PREVENCIÓN DE ENFERMEDADES INFECCIOSAS EN SERES HUMANOS EN LA GRANJA

Conocimientos

¿Qué significa para usted la "seguridad biológica"? *Circule* ***todas*** *las opciones que correspondan*

a. Es lo mismo que la bioseguridad
b. Prevenir que las personas contraigan enfermedades en los laboratorios
c. Prevenir que las personas contraigan enfermedades de los animales en las granjas
d. Prevenir que las personas contraigan enfermedades entre ellos en las granjas
e. Prevenir que los animales contraigan enfermedades en las granjas
f. Otros (especifique) ____
g. No lo sé

¿Qué es una "enfermedad zoonótica"? *Circule* ***todas*** *las opciones que correspondan*

a. Enfermedad que puede propagarse entre animales y personas
b. Enfermedad que puede propagarse de los animales a las personas, pero NO de personas a los animales
c. Otro (especifique)____
d. No lo sé

Nombre una enfermedad zoonótica que la gente puede contraer del ganado
____

¿Cómo pueden transmitirse enfermedades de los animales a las personas? *Circule* ***todas*** *las opciones que correspondan*

a. Al tocar animales
b. A través del aire
c. Al ser expuestos a sangre
d. Al ser expuestos a líquidos corporales al nacimiento o en abortos
e. Al beber leche cruda
f. Al ser mordido
g. Heces a la boca
h. No lo sé

Las enfermedades zoonóticas son enfermedades que pueden propagarse entre animales y personas. ¿Cuáles son enfermedades que la gente pueden contraer del ganado? *Circule* ***todas*** *las opciones que correspondan*

a. Rabia
b. Q fiebre

c. Criptosporidiosis
d. Fiebre aftosa
e. Infección por E. coli
f. Salmonelosis
g. Brucelosis
h. Tuberculosis
i. Staphylococcus aureus resistente a la meticilina (MRSA)
j. No lo sé

¿Qué es verdad sobre la salmonelosis? *Circule* ***todas*** *las opciones que correspondan*
a. En las personas, puede causar diarrea, calambres abdominales y/o fiebre
b. Lavarse las manos puede ayudar a evitar que se le pegue
c. Las bacterias de Salmonella pueden estar en las heces del ganado
d. El ganado infectado puede ser que no muestre síntomas de salmonelosis
e. El ganado puede infectarse al ingerir alimento contaminado, agua y/o hierba
f. No lo sé

¿Cuál es la forma más común que las personas se infectan con COVID-19? *Circule* ***una***
a. Exposición a gotitas respiratorias de las personas
b. Contacto con superficies contaminadas
c. Exposición a animales
d. Picaduras de mosquitos
e. Comer productos animales (por ejemplo, carne, leche)
f. Otros (especifique) ____
g. No lo sé

COVID-19: ¿Cuál es cierto? *Circule* ***todas*** *las opciones correctas*
a. Las personas con COVID-19 que no presentan síntomas pueden enfermar a otros
b. Los síntomas pueden aparecer 2-14 días después de que alguien es expuesto al virus
c. Los síntomas pueden incluir pérdida del gusto u olfato
d. Los síntomas pueden incluir falta de aire y dificultad al respirar
e. Las personas infectadas por COVID-19 siempre muestran síntomas
f. No lo sé

¿Qué puede ayudar a prevenir la propagación del COVID-19? *Circule* ***todas*** *las opciones que correspondan*
a. Uso de máscaras faciales o máscaras de tela
b. Mantener una distancia de 6 pies entre las personas
c. Lavarse las manos frecuentemente con agua y jabón por lo menos por 20 segundos
d. Evite tocarse los ojos, la nariz y la boca
e. Limpie y desinfecte las superficies que toca menudo
f. Vacunando a las personas contra COVID-19
g. No lo sé

COVID-19

	Sí	No	No sé
En una habitación cerrada con mala ventilación, ¿es posible que se infecte con COVID-19 de una persona que está a más lejos de 6 pies de distancia de usted?			
¿Pueden algunos animales transmitir el virus COVID-19 a los seres humanos?			
¿Existe una vacuna contra el COVID-19 para personas en los Estados Unidos?			

Actitudes

Riesgo percibido: Las zoonosis son enfermedades infecciosas transmitidas entre animales y personas. ¿Qué tan probable es...?

	Extremadamente improbable	Improbable	Neutral	Probable	Extremadamente probable
¿Contraen una enfermedad zoonótica del ganado en la granja?					
¿Agarrar COVID-19 de alguien en la granja?					
¿Agarrar la gripe estacional de alguien en la granja?					
¿Lesionarse en un accidente mientras trabajaba en la granja?					

Impacto percibido de la salud

	No es perjudicial en lo absoluto	Un poco perjudicial	Moderadamente perjudicial	Bastante perjudicial	Extremadamente perjudicial
Si se le pega una enfermedad zoonótica del ganado en la granja, ¿qué tan perjudicial sería para su salud?					
Si se le pega el COVID-19 en la granja, ¿qué tan perjudicial sería para su salud?					
Si se le pega la influenza estacional en la granja, ¿qué tan perjudicial sería para su salud?					
Si fuese herido en un accidente en la granja, ¿qué tan perjudicial sería para su salud?					

Preocupaciones sobre el COVID-19 proveniente de los animales

	No estoy preocupado en lo absoluto	Un poco preocupado	Moderadamente preocupado	Muy preocupado	Extremadamente preocupado

¿Cuán preocupado está usted de agarrar el COVID-19 del ganado?					

¿Qué tan eficaces creen que son las siguientes prácticas en la prevención de enfermedades zoonóticas del ganado a las personas en las granjas lecheras?

	Para nada	Moderadamente efectivo	Muy efectivo
Higiene de las manos (lavado/desinfección de las manos)			
Uso de guantes			
Uso de cubiertas de tela			
Uso de máscaras faciales (por ejemplo, máscaras quirúrgicas)			
Uso de respiradores N-95			
Uso de ropa y botas designadas para la granja			
Uso de baños de pies desinfectantes			
Limitación de la aglomeración de animales			
Distanciamiento social (manteniendo 6 pies de distancia entre personas)			
Monitoreo de animales para enfermedades			
Reportando cuando los animales están enfermos			
Aislando animales enfermos			
Monitoreo del personal agrícola para enfermedades			
Reportando cuando el personal agrícola está enfermo			
Aislamiento (por ejemplo, ausencia por enfermedad) del personal agrícola enfermo			
Vacunando al ganado			
Vacunando a las personas			
Asegurándose que el ganado tenga acceso a atención veterinaria			
Asegurándose de que el personal de la granja tenga acceso a atención médica			
Limitando el número de visitantes en la granja			
Limitando el contacto de los visitantes con los animales			
Detectando a los visitantes con enfermedades (por ejemplo, preguntar si tienen síntomas de COVID-19 o han sido expuestos)			
Visitantes usando EPP			
Control de plagas y roedores			
Control de la vida silvestre			
Asegurándose que hay ventilación en espacios de animales			
Asegurándose que hay ventilación en espacios comunes del personal de la granja (por ejemplo, oficinas, salas de descanso, viviendas compartidas)			
Luz solar en viviendas para animales, vehículos, equipos			
	Para nada	Moderadamente efectivo	Muy efectivo

Luz solar en espacios compartidos por el personal de la granja (oficinas, vehículos)			
Limpieza y desinfección de áreas/equipos comunes de animales (por ejemplo, viviendas, salones, canales de alimentación/agua)			
Limpieza y desinfección de las áreas comunes y equipos del personal de la granja (por ejemplo, salas de descanso, baños, superficies, viviendas compartidas)			
Limpieza y desinfección de vehículos (por ejemplo, remolques) después de transportar animales			
Limpieza y desinfección de los interiores de los vehículos (por ejemplo, cabinas) entre usuarios			
Seguridad de inyección			

¿Qué tan eficaces creen que son las siguientes prácticas para prevenir enfermedades de persona a persona como el COVID-19 o la gripe estacional en las granjas lecheras?

	Para nada	Moderadamente efectivo	Muy efectivo
Higiene de las manos (lavado/desinfección de las manos)			
Uso de guantes			
Uso de cubiertas de tela			
Uso de máscaras faciales (por ejemplo, máscaras quirúrgicas)			
Uso de respiradores N-95			
Uso de ropa y botas designadas para la granja			
Uso de baños de pies desinfectantes			
Limitación de la aglomeración de animales			
Distanciamiento social (manteniendo 6 pies de distancia entre personas)			
Monitoreo de animales para enfermedades			
Reportando cuando los animales están enfermos			
Aislando animales enfermos			
Monitoreo del personal agrícola para enfermedades			
Reportando cuando el personal agrícola está enfermo			
Aislamiento (por ejemplo, ausencia por enfermedad) del personal agrícola enfermo			
Vacunando al ganado			
Vacunando a las personas			
Asegurándose que el ganado tenga acceso a atención veterinaria			
Asegurándose de que el personal de la granja tenga acceso a atención médica			
Limitando el número de visitantes en la granja			
Limitando el contacto de los visitantes con los animales			
Detectando a los visitantes con enfermedades (por ejemplo, preguntar si tienen síntomas de COVID-19 o han sido expuestos)			
Visitantes usando EPP			

Control de plagas y roedores			
Control de la vida silvestre			
Asegurándose que hay ventilación en espacios de animales			
Asegurándose que hay ventilación en espacios comunes del personal de la granja (por ejemplo, oficinas, salas de descanso, viviendas compartidas)			
Luz solar en viviendas para animales, vehículos, equipos			
	Para nada	Moderadamente efectivo	Muy efectivo
Luz solar en espacios compartidos del personal de la granja (oficinas, vehículos)			
Limpieza y desinfección de áreas/equipos comunes de animales (por ejemplo, viviendas, salones, canales de alimentación/agua)			
Limpieza y desinfección de las áreas comunes y equipos del personal de la granja (por ejemplo, salas de descanso, baños, superficies, viviendas compartidas)			
Limpieza y desinfección de vehículos (por ejemplo, remolques) después de transportar animales			
Limpieza y desinfección de interiores de vehículos (por ejemplo, cabinas) entre usuarios			
Seguridad de inyección			

¿Cree que los siguientes impiden que la granja practique una mayor prevención/control de infecciones (prevención de zoonosis del ganado o enfermedades transmitidas persona-persona como COVID-19)?

	Sí	No
Tiempo insuficiente		
Mano de obra insuficiente		
No hay suficiente dinero		
No hay suficientes conocimientos agrícolas sobre las enfermedades zoonóticas del ganado y cómo evitar que la gente las agarre		
No hay suficientes conocimientos agrícolas sobre COVID-19 y cómo prevenir que las personas lo agarren		
Hay escasez de equipos/agentes de limpieza y desinfección		
Falta de preocupación agrícola por las enfermedades zoonóticas del ganado que afectan a las personas		
Falta de preocupación de las explotaciones agrícolas por el COVID-19 que afecta a las personas		
No hay suficiente comunicación por parte de los gerentes de las expectativas sobre cómo prevenir las enfermedades en las personas		
No hay suficiente control de liderazgo sobre las políticas de prevención/control de infecciones		
En la finca el personal agrícola no cumple con las políticas de prevención y control de infecciones		
No hay suficiente EPP		
No hay suficiente capacidad de almacenamiento y eliminación de carcasas		
No hay suficientes estaciones de lavado de manos con agua y jabón		
No tienen suficiente capacidad para garantizar ventilación/flujo de aire adecuado		

Falta de creencia que la prevención de las enfermedades en los seres humanos vale el tiempo/esfuerzo		
No hay suficiente espacio para evitar que las personas se amontonen en el trabajo		

Importancia de prevenir enfermedades infecciosas en las personas de la granja

	No es importante	Un poco importante	Moderadamente importante	Muy importante	Extremadamente importante
¿Cuán importante es para usted la prevención de las zoonosis del ganado?					
¿Cuán importante es para sus supervisores prevenir las zoonosis del ganado?					
¿Cuán importante es para sus compañeros de trabajo prevenir las zoonosis del ganado?					
¿Cuán importante es para usted evitar el COVID-19?					
¿Cuán importante es para sus supervisores evitar el COVID-19?					
¿Cuán importante es para sus compañeros de trabajo prevenir el COVID-19?					

Actitudes hacia la prevención de enfermedades infecciosas en las personas. ¿Cuánto está de acuerdo con las siguientes declaraciones?

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo
Las políticas y prácticas en mi granja ayudan a prevenir las enfermedades zoonóticas del ganado en el personal de la granja					
Las políticas y prácticas en mi granja ayudan a prevenir el COVID-19 en el personal de la granja					
Entiendo las reglas y expectativas de prevención de las enfermedades zoonóticas de mi granja					
Entiendo las reglas y expectativas de					

prevención del COVID-19 de mi granja					
Desde que el COVID-19 comenzó, la prevención de las zoonosis del ganado a la gente se ha convertido en una prioridad					
Desde que comenzó la pandemia del COVID-19, las enfermedades zoonóticas del ganado a la gente se han vuelto más comunes					
No se puede hacer nada en las granjas lecheras para reducir las posibilidades de las personas agarren COVID-19 entre ellos					
No se puede hacer nada en las granjas lecheras para reducir las posibilidades de las personas agarren zoonosis del ganado					
Las personas en las granjas lecheras corren un riesgo mayor de contraer COVID-19					
Sé como protegerme de las zoonosis del ganado mientras trabajo en la granja					
Sé como protegerme del COVID-19 mientras trabajo en la granja					
Puedo ver un proveedor de atención médica si lo necesito					

Fuentes de información de confianza y utilizadas. Enfermedades de origen **Animal-a-Humano**

	¿En qué 3 confiaría más para obtener información precisa sobre la prevención de enfermedades zoonóticas agrícolas en las personas? (Marque 3)	¿Qué 3 utiliza con más frecuencia para obtener información sobre la prevención de enfermedades zoonóticas agrícolas en las personas? (Marque 3)

Veterinarios privados		
Veterinarios gubernamentales		
Propietarios de granjas lecheras		
Compañeros de trabajo		
Supervisores de granjas lecheras		
Investigadores universitarios		
Profesionales de la Salud Humana (Médicos/enfermeros)		
Funcionarios de Salud Pública (Departamento de Salud Local/Estatal)		
Redes sociales (por ejemplo, Facebook, Twitter, Instagram)		
Adiestramientos proporcionados por la finca		
Departamento de Agricultura del Estado		
Departamento de Agricultura de EE. UU. (USDA)		
Centros para el Control y la Prevención de Enfermedades (CDC)		
Amigos y familiares		
Internet		
Instituto Nacional para la Seguridad y Salud Ocupational (NIOSH)		

Fuentes de información de confianza y utilizadas. Enfermedades **<u>Persona a Persona (COVID-19, Influenza estacional, etc.)</u>**

	¿En qué 3 confiaría más para obtener información precisa sobre la prevención del COVID-19 y otras enfermedades transmitidas de persona a persona? (Marque 3)	¿Qué 3 utiliza con más frecuencia para obtener información sobre la prevención del COVID-19 y otras enfermedades transmitidas de persona a persona? (Marque 3)
Veterinarios privados		
Veterinarios gubernamentales		
Propietarios de granjas lecheras		
Compañeros de trabajo		
Supervisores de granjas lecheras		
Investigadores universitarios		
Profesionales de la Salud Humana (Médicos/enfermeros)		
Funcionarios de Salud Pública (Departamento de Salud Local/Estatal)		
Redes sociales (por ejemplo, Facebook, Twitter, Instagram)		
Adiestramientos proporcionados por la finca		
Departamento de Agricultura del Estado		
Departamento de Agricultura de EE. UU. (USDA)		
Centros para el Control y la Prevención de Enfermedades (CDC)		
Amigos y familiares		
Internet		
Instituto Nacional para la Seguridad y Salud Ocupacional (NIOSH)		

EPP: ¿Cuánto está de acuerdo con lo siguiente?

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo
Tengo todo el EPP que necesito					
Desde el inicio de la pandemia de COVID-19, el EPP ha sido más difícil de conseguir en la granja					
El uso del EPP puede ayudar a evitar que me contagie con zoonosis de ganado					
El uso del EPP puede ayudar a prevenir que agarre COVID-19 de personas					

¿Cuánto está de acuerdo o en desacuerdo con las siguientes declaraciones sobre las **cubiertas faciales de tela** en la granja?

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo
Pueden reducir mis posibilidades de contraer el COVID-19 de personas					
Pueden reducir mis posibilidades de contagiar COVID-19 a las personas					
Pueden reducir mis probabilidades de contraer enfermedades zoonóticas de los animales					
Pueden reducir mis probabilidades de contraer otras enfermedades infecciosas (por ejemplo, gripe) por parte de las personas					
Interfieren con mi capacidad para hacer mi trabajo					
Son inútiles					

Higiene Personal: ¿Cuánto está de acuerdo o en desacuerdo con las siguientes declaraciones?

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo
Tengo acceso a las estaciones para el lavado de manos en la granja					
Tengo acceso a desinfectante de manos que contiene al menos un 60% de alcohol					

Distanciamiento social (mantener 6 pies de distancia de los demás): ¿Cuánto está de acuerdo con las siguientes declaraciones?

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo
El distanciamiento social puede reducir mis probabilidades de contraer COVID-19 en la granja					
El distanciamiento social puede reducir mis probabilidades de contraer otras enfermedades de las personas (por ejemplo, la gripe)					
Es difícil practicar el distanciamiento social en mi estación de trabajo					
Es difícil practicar el distanciamiento social en la sala de descanso					
Las personas hacen todo lo posible para practicar el distanciamiento social en la granja					
No es necesario fomentar el distanciamiento social porque las personas suelen estar a más de 6 pies de distancia de todos modos					

Vacunas y pruebas

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo
Puedo recibir la vacuna del COVID-19 si la quiero					
Una persona vacunada contra el COVID-19 todavía debe utilizar una máscara o una cubierta de cara					
Una persona vacunada para COVID-19 debe seguir practicando el distanciamiento social					
Las vacunas del COVID-19 son seguras					
La vacuna del COVID-19 me puede ayudar a evitar que me contagie con el COVID-19					
Recibir la vacuna COVID-19 puede evitar que me vuelva severamente enfermo o morir si me llego a infectar					

Puedo conseguir una prueba para detectar el COVID-19 si la deseo					
Las vacunas contra la influenza estacional son seguras					
Las vacunas contra la influenza estacional pueden ayudar a prevenir que me contagie con la gripe					

Visitantes

	No estoy preocupado en lo absoluto	Un poco preocupado	Moderadament e preocupado	Muy preocupado	Extremadamente preocupado
¿Cuánto le preocupa que los visitantes traigan enfermedades a la granja?					

Adiestramientos en la finca: ¿Cuánto está de acuerdo con las siguientes declaraciones sobre sus adiestramientos en la prevención de enfermedades infecciosas (**<u>enfermedades zoonóticas y enfermedades de persona a persona como el COVID-19</u>**)?

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo
El adiestramiento provee información precisa					
El adiestramiento vale la pena y mi tiempo					
Me animo a proporcionar retroalimentación sobre el adiestramiento					
El adiestramiento se proporciona en mi idioma preferido					

¿Cuáles de estos métodos de capacitaciones le gustaría en la granja?

	Para nada	Un poco	Una cantidad moderada	Bastante	Mucho
Capacitaciones en el trabajo a través de supervisores y compañeros					
Capacitaciones en persona					
Seminarios virtuales o videoconferencias (por ejemplo, Zoom)					
Tecnología no interactiva (por ejemplo, formación en informática auto guiada, YouTube, otros sitios web)					
Aplicaciones de teléfonos inteligentes					

Tecnología interactiva (por ejemplo, en línea basada en escenarios)					

Informes de licencia por enfermedad y reportes de enfermedad: ¿Cuánto está de acuerdo o en desacuerdo con las siguientes declaraciones?

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo
Me siento cómodo informándole a mis supervisores cuando estoy enfermo					
Entiendo las políticas de ausencia por enfermedad de mi granja					
Yo sería penalizado por tomar licencia por enfermedad si me contagió con el COVID-19					
Se me recomendaría que me quedara en casa si me contagiara con el COVID-19					
Se me recomendaría que me quedara en casa si tuviese diarrea por una zoonosis bovina					
Sé cómo las enfermedades zoonóticas del ganado podrían afectarme					
Sé los síntomas del COVID-19					
Las enfermedades zoonóticas del ganado casi no se reportan en la granja					
Si creo que tengo una enfermedad zoonótica del ganado, lo reportaría a mis supervisores					
Si creo que tengo COVID-19, lo reportaría a mis supervisores					

Por favor, responda las siguientes preguntas

	Sí	No	Prefiero no contestar
¿Cree que alguna vez se ha enfermado por una persona que trabaja en esta granja lechera?			
¿Cree que alguna vez se ha enfermado por animales en esta granja lechera?			
¿Cree que el ganado puede infectar a las personas con el virus COVID-19?			
¿Cree que las personas pueden infectar al ganado con el virus COVID-19?			
¿Sabe de alguna persona que fue diagnosticada con el COVID-19?			

¿Sabe de alguna persona que ha padecido de una enfermedad zoonótica de animales en una granja?			

Prácticas

Ventilación y luz solar

	Sí	No	No sé
Los sistemas de ventilación (por ejemplo, ventiladores) o las ventanas abiertas se utilizan para proporcionar un flujo de aire uniforme (minimizar el estancamiento o las corrientes de aire) en áreas comunes (por ejemplo, oficinas, salas de descanso)			
La granja utiliza la luz solar para matar patógenos en espacios compartidos (por ejemplo, oficinas, salas de descanso) o equipos compartidos (por ejemplo, vehículos)			

Políticas de visitantes: ¿Cuáles son ciertas con respecto a las políticas de visitantes en su granja?

	Sí	No	No sé
Los visitantes son examinados para COVID-19 (pregunta si tienen síntomas o han estado alrededor de alguien con COVID-19)			
Se toma la temperatura de los visitantes			
Se proporciona información a los visitantes sobre la prevención de las enfermedades zoonóticas			

Licencia por enfermedad, informes, vacunas

	Sí	No	No sé
La granja ofrece licencia paga por enfermedad			
Se le da una prueba a los trabajadores para asegurarse de que entienden las políticas de licencia por enfermedad en la granja			
La granja anima a las personas a quedarse en casa si están enfermos			
La granja anima a la gente a informar si creen que tienen una enfermedad de un animal			
La granja anima a la gente a informar si creen que ellos tienen el COVID-19			
La granja anima a las personas a informar las practicas no seguras que podrían llevar a enfermedades en las personas			
La granja anima a las personas a vacunarse contra la gripe estacional			
La granja anima a las personas a vacunarse contra el COVID-19			
Hay carteles en la granja sobre la vacuna COVID-19			

Higiene de mano

	Sí	No	No sé
La granja tiene estaciones de lavado de manos con jabón, agua, y toallas de un solo uso			
La granja anima a las personas a lavarse las manos a menudo con agua y jabón por lo menos 20 segundos			
La granja proporciona desinfectante para manos que contiene al menos 60% de alcohol			
Hay carteles sobre las directrices de higiene personal escritas en inglés y español se publican en la granja			

Su finca…

	Sí	No	No sé	N/A
¿Tiene alguien a cargo de prevenir/controlar las enfermedades infecciosas en las personas?				
¿Fomenta una evaluación de salud después de que se le ofrezca un trabajo en la granja?				
¿Tiene un plan de evaluación y control COVID-19?				
¿Completa las listas de comprobación de COVID-19 para identificar las vulnerabilidades agrícolas?				
¿Completa las listas de comprobación de control de enfermedades zoonóticas para identificar vulnerabilidades agrícolas?				
¿Existe un plan para asegurar que las operaciones agrícolas continúen si un brote de enfermedad como el COVID-19 afecta al 50% del personal agrícola?				
¿Tiene carteles sobre la prevención del COVID-19 en inglés y español en las áreas de uso común?				
¿Tiene carteles sobre la prevención de las enfermedades zoonóticas en inglés y español en zonas peligrosas?				
¿Ha designado a una persona para que hable con los medios de comunicación si se produce un brote grande de COVID-19 en la granja?				
¿Fomenta el seguimiento de las recomendaciones del Centros para el Control y la Prevención de Enfermedades (CDC) sobre el COVID-19?				
¿Mantiene registros escritos para la limpieza/desinfección de las áreas de uso común (por ejemplo, salas de descanso, oficinas, vehículos)?				
¿Mantiene registros escritos para la limpieza/desinfección de las viviendas de los animales?				
¿Hace preguntas al personal de la granja en busca de síntomas y exposición al COVID-19?				
¿Revisa la temperatura del trabajador al comienzo de cada turno?				
¿Provee información de contacto para los centros de salud que ofrecen atención médica y pruebas de COVID?				

Si se produjera un gran brote de COVID-19 en la granja, ¿quién estaría a cargo?

a. La misma persona a cargo si una enfermedad animal extranjera (por ejemplo, fiebre aftosa) ocurriera en la granja
b. No sé
c. Otros (especifique)____

¿Su granja ofrece capacitación sobre la prevención de las zoonosis de los animales a las personas?
Circule **uno:** Sí / No / No lo sé (SI NO, SALTE LA PRÓXIMA PREGUNTA)

¿Cuándo se ofrece **capacitaciones** sobre las **enfermedades zoonóticas** en la granja? *Circule **todas** las opciones que apliquen*

a. Cuando empieza a trabajar
b. Una vez al mes
c. 2-3 veces al año
d. Una vez al año
e. Cuando la gente se enferma
f. Cuando los animales se enferman
g. Cuando la gerencia piensa que es necesario
h. Otros (especificar)

¿Su granja ofrece capacitaciones sobre la prevención del COVID-19 en las personas? *Circule **uno**:* Sí / No / No sé
(SI NO, SALTE LA PRÓXIMA PREGUNTA)

¿Cuándo se ofrece la **capacitación de COVID-19** por parte de la granja? *Circule **todas** las opciones que correspondan.*
a. Cuando empieza a trabajar
b. Una vez al mes
c. 2-3 veces al año
d. Una vez al año
e. Cuando la gente se enferma
f. Cuando los animales se enferman
g. Cuando la gerencia piensa que es necesario
h. Otros (especificar)

	Nunca	Rara vez	A veces	A menudo	Siempre
¿Con qué frecuencia se lleva a cabo la capacitación sobre la prevención de enfermedades infecciosas en las personas (por ejemplo, zoonosis, COVID-19) al mismo tiempo que la capacitación sobre la bioseguridad ganadera?					

¿Con qué frecuencia hace lo siguiente en la granja?

	Nunca	Rara vez	A veces	A menudo	Siempre	N/A
Se cambia la ropa después de trabajar en la granja antes de regresar a casa						
Se ducha en la granja después del trabajo						
Lava su ropa de trabajo separada de la otra ropa						
Se lleva a su casa los zapatos y botas del trabajo						
Se lava las manos después de quitarse los guantes						
Se lava las manos antes de comer						
Usa una mascarilla de tela en la cara						
Usa una máscara quirúrgica						
Usa respirador N-95						
Usa un escudo facial						
Usa gafas de seguridad						

Se lava las manos después de trabajar en instalaciones de animales						
Se pone guantes cuando trabaja en las instalaciones de animales						
Se pone ropa designada para la finca (por ejemplo, coverales)						
Se pone calzado designado para la finca (por ejemplo, botas)						

¿Cuáles son ciertas sobre las **cubiertas de tela para la cara** que usted utiliza en la granja?
*Circule **todas** las opciones que correspondan*

a. Son proporcionadas por la granja
b. Las compro yo mismo
c. Incluye varias capas de tela
d. Cubre mi nariz y boca
e. Se conecta a mis orejas
f. La única cubierta de tela que uso es una bandana
g. No uso una cubierta de tela

Adiestramientos: ¿Cuáles son ciertos?

	Sí	No	No sé
Desde que comenzó la pandemia COVID-19, mi granja utiliza la capacitación en línea con más frecuencia			
Desde que comenzó la pandemia, la granja ha aumentado su atención en la capacitación para prevenir las enfermedades zoonóticas del ganado a las personas			
Desde que comenzó la pandemia, la granja ha aumentado su atención en la capacitación para prevenir las enfermedades infecciosas persona-persona (Por ejemplo, COVID-19 e influenza estacional)			

Limpieza y desinfección: ¿Cuáles son ciertos?

	Sí	No	No sé
Los interiores de los vehículos se limpian/desinfectan entre los usuarios			
La granja tiene un protocolo escrito sobre la limpieza y desinfección para espacios comunes (oficinas, salas de descanso, baños)			
¿La granja tiene un protocolo escrito de limpieza y desinfección para la vivienda y el equipo de animales?			
Las políticas agrícolas incluyen instrucciones sobre la eliminación de las membranas fetales y los líquidos cuando nacen o abortan			

Horarios de limpieza/desinfección

	Nunca	Una vez a la semana	Más de una vez por semana	Diario	Más de una vez por día	No sé
¿Con qué frecuencia se limpian/desinfectan las salas de descanso?						
¿Con qué frecuencia se limpian/desinfectan los baños?						

Distanciamiento social: Distanciamiento social significa mantener 6 pies entre usted y los demás. ¿Su granja...

	Sí	No	No sé	N/A
¿Fomenta el distanciamiento social en los lugares de trabajo?				
¿Limita el número de reuniones en persona?				
¿Fomenta el distanciamiento social en la vivienda compartida?				
¿Fomenta el distanciamiento social en salas de descanso?				
¿Coloca barreras físicas (por ejemplo, plexiglás) en áreas comunes?				

Cubiertas faciales y máscaras faciales: ¿Su granja...

	Si	No	No sé
¿Le requiere usar una máscara o máscara facial en todo momento?			
¿Le requiere usar una máscara facial o una máscara facial al aire libre?			
¿Le requiere usar una máscara o una máscara facial cuando esté a menos de 6 pies de distancia de otros?			
¿Le requiere usar una máscara o una máscara facial mientras en el interior (por ejemplo, en la oficina o en la sala de descanso)?			
¿Le requiere que los ocupantes del vehículo usen cubiertas para la cara o máscaras cuando viajan juntos?			

¿Con qué frecuencia estás a menos de 6 pies de distancia de otras personas mientras estás en los siguientes lugares?

	Nunca	Rara vez	A veces	A menudo	Siempre
Sala de descanso					
Estación de trabajo					

¿Con qué frecuencia usas **una cubierta facial de tela o una máscara facial** en las siguientes áreas?

	Nunca	Rara vez	A veces	A menudo	Siempre
Dentro de un edificio					
Afuera al aire libre					
En mi estación de trabajo principal					
En el salón de descanso					

Mientras comparte un vehículo					

¿Con qué frecuencia usas lo siguiente en la granja?

	Nunca	Rara vez	A veces	A menudo	Siempre
Bandana sobre la cara					
Máscara de tela con cordón de oreja a oreja					
Máscara quirúrgica					
N-95 Respirador					

¿Con qué frecuencia hace lo siguiente mientras realiza tareas de trabajo?

	Nunca	Rara vez	A veces	A menudo	Siempre
Come					
Bebe					
Fuma					
Masca tabaco o tabaco en el labio					

¿Bebes leche cruda de ganado en la granja? *Circule **uno**:* Sí / No

Con qué frecuencia…

	Nunca	Rara vez	A veces	A menudo
Pasa tiempo la sala de descanso				
Carpool para el trabajo				

Se le requiere a los empleados de la finca…

	Sí	No	No sé
¿Usar guantes al trabajar con animales enfermos?			
¿Usar una máscara o una cubierta facial mientras trabaja con animales enfermos?			
¿Usar gafas de protección mientras trabajas con animales enfermos?			
¿Lavar la ropa de trabajo separada de la ropa que no es de trabajo?			
¿Lavarse las manos con agua y jabón después de trabajar con animales enfermos?			
¿Cambiar los guantes después de trabajar con un animal enfermo?			
¿Cambiar o desinfectar la ropa después de trabajar con un animal enfermo?			

¿Existe vivienda de trabajadores agrícolas en la granja? *Circule **uno**:* Sí / No / No lo sé (SI NO, SALTE LA PRÓXIMA PREGUNTA)

Vivienda para trabajadores agrícolas. ¿Cuáles son ciertos?

	Sí	No	No sé

Se proporciona viviendas para aislar a las personas confirmados o sospechados del COVID-19			
Los dormitorios compartidos permiten seis pies entre las camas			
Las mesas y los asientos en los espacios comunes permiten el distanciamiento social de 6 pies de separación			
Los espacios comunes tienen suministros para el lavado de manos			
Se anima a los residentes a usar las cubiertas para la cara en las áreas comunes			
Hay carteles en inglés y español sobre la prevención COVID-19 en áreas comunes			
La granja anima a los residentes que limpien y desinfecten las viviendas			
La finca ofrece productos de limpieza			
El flujo de aire se mantiene en áreas comunes/compartidas			

¿El transporte compartido (es decir, el carpooling) es utilizado por el personal de la granja?
Circule ***uno***: Sí / No / No lo sé (SI NO, SALTE LA PRÓXIMA PREGUNTA)

Vehículo compartido

	Sí	No	No sé
Los vehículos se limpian/desinfectan entre viajes			
Los pasajeros deben lavarse/desinfectar las manos antes de entrar en los vehículos			
Los pasajeros se someten a un examen de salud antes de entrar vehículos compartidos			
Los pasajeros viajan con los miembros de su área y/o sus viviendas			
Se anima a los pasajeros a usar cubiertas de tela para la cara			

Intentaría una nueva herramienta para evaluar las amenazas de enfermedades infecciosas en la granja si...

	Totalmente en desacuerdo	En desacuerdo	Ni de acuerdo ni en desacuerdo	De acuerdo	Totalmente de acuerdo
Previene las enfermedades infecciosas del ganado vacuno a ganado					
Previene las enfermedades infecciosas de personas al ganado					
Previene las zoonosis en el personal de la granja					
Previene las enfermedades infecciosas persona-persona en el personal de la granja (por ejemplo, COVID-19, gripe estacional)					
Impide que mi familia se enferme					
Se enfoca en la salud animal y humana					
Mantiene a la finca operando					
Le ahorra tiempo a la finca					

¿Recibe capacitación sobre los siguientes temas?

	Sí	No	No sé
Políticas de ausencias por enfermedad			
Informar a los supervisores sobre sus enfermedades			
Los síntomas de las zoonosis bovinas en las personas			
COVID-19 se propaga entre los animales a las personas			
Las enfermedades infecciosas se propagan entre persona a persona			
Las enfermedades zoonóticas se propagan de los animales a las personas			
Síntomas del COVID-19 en seres humanos			
Limpieza y desinfección de áreas comunes (p. ej., salas de descanso, oficinas, baños)			
Limpieza y desinfección de viviendas compartidas			
Limpieza y desinfección de vehículos compartidos			
Ventilación (p. ej., lugares de trabajo, áreas comunes)			
Prevención de la propagación de la enfermedad a los miembros de la familia			
Beneficios de la vacunación humana (por ejemplo, COVID-19, tétanos, rabia)			
Seguridad alimentaria (consumo humano)			
Como ponerse y quitarse el EPP			
Propósito de los elementos del EPP			
Disposición del EPP			
Limpieza del EPP reutilizable			
Ajuste y uso adecuado de las máscaras o la cara de tela coberturas			
Procedimiento de tos y estornudos			
Distanciamiento social			
Prevención de las enfermedades infecciosas en la vivienda de los trabajadores			
Políticas de la transportación compartida			
Uso de la luz solar para matar patógenos que pueden afectar a los seres humanos			
Seguridad de las agujas			

¿Qué se utilizan durante los adiestramientos sobre la prevención de enfermedades infecciosas en las personas? Circule **todas** las opciones que apliquen

a. Capacitación en el trabajo a través de supervisores o compañeros
b. Capacitaciones en persona
c. Seminarios virtuales o videoconferencias (por ejemplo, Zoom)
d. Tecnología no interactiva (por ejemplo, formación informática autodidacta, YouTube, otros sitios web)
e. Aplicaciones de teléfonos inteligentes
f. Tecnología interactiva (por ejemplo, basada en escenarios en línea)
g. Otros (especificar)___

Historial

¿Cuál fue el nivel más alto de educación que terminó? *Circule* ***uno***

a. Menos de escuela intermedia
b. Escuela intermedia
c. Escuela secundaria

d. Educación técnica/vocacional
e. Grado asociado
f. Licenciatura
g. Maestría
h. Doctorado

¿Cuánto tiempo lleva trabajando en <u>esta</u> granja lechera? ___________ años

¿Ha trabajado usted en otras granjas lecheras? *Circule* ***<u>uno</u>***: Sí / No

¿Cuánto tiempo ha trabajado en un trabajo relacionado con granjas lecheras? __________ años

¿Alguna vez has trabajado en una finca donde tuvo que sacrificar animales debido a un brote de enfermedad animal? *Circule* ***<u>uno</u>***

a. Sí
b. No
c. No sé
d. Prefiero no contestar

¿Cuántas vacas lecheras hay en la finca? __________

¿Se utiliza la vivienda compartida para los trabajadores en la granja? *Circule* ***<u>uno</u>:*** Si / No / No sé

Presencia de animales domésticos y vida silvestre (Marque si hay)

	¿Presente en la finca?	¿Acceso a la vivienda animal?
Perros		
Gatos		
Visones/Comadrejas		
Ratones o Ratas		
Mapaches		
Perritos de pradera		
Venados		
Aves pequeñas (Palomas, gorriones, etc.)		
Aves grandes (gansos, pavos, etc.)		

<u>Demografía</u>

¿Qué idioma prefiere?
Circule ***<u>uno</u>***

a. Inglés
b. Español
c. Una lengua indígena
d. Otro (especifique) ________________________________

¿Cuál es su género? Hombre / Mujer / Otro / Prefiero no contestar

¿Cuántos años tiene usted? _________________ años

¿Vive en la granja lechera donde trabaja? *Circule* ***uno***: Sí / No

¿Vive usted con alguien más? *Circule* ***todas*** las que apliquen

a. Vivo con mi esposo/a o pareja
b. Vivo con mi hijo(s)
c. Vivo con otros trabajadores de la granja
d. Vivo solo
e. Vivo con familiares (padres, abuelos, hermanos, primos, etc.)

¿Cuál es su función/trabajo en la lechería? *Circule* ***uno***

a. Obrero
b. Propietario
c. Gerente/Supervisor
d. Otro (especifique)________________________

¿Dónde pasa la mayor parte del tiempo trabajando en la granja? *Circule* ***uno***

a. Sala de productos lácteos
b. Corrales para terneros
c. Corrales para vacas
d. Maternidad
e. Hospital
f. Oficina
g. Sala de maquinaría
h. Otra (especificar) ________________________

APPENDIX 13: SPANISH LANGUAGE FIELD GUIDE

Spanish Terms for Colorado Dairy fieldwork

Phrases

1. Hi! My name is *** and I'm a veterinarian and PhD student from Colorado State University.

   *Hola. Me llamo *** y soy veterinario y estudiante de doctorado en la universidad estatal de Colorado en Fort Collins.*

2. Where would you like to conduct this survey?

   ¿Dónde quieres conducir esta encuesta?

3. Where can I wash my hands?

   ¿Dónde puedo lavar las manos?

Farm and Animals

1. Dairy Farm

   La granja lechera

2. Dairy production systems

   Los sistemas de producción de lácteos

3. Herd

   La manada

4. Head of cattle

   Cabezas de ganado

5. Heifer

    Novilla

6. Cow

    vaca

7. Lactating animals

    Animales lactantes

8. Replacement heifers

    Novillas de reemplazos

9. Dry cows

    Vacas secas

10. Bulls

    Toros

11. Calves

    Terneros

12. Pens and stables

    Corrales y establos

13. Dairy parlor

    Sala de productos lácteos

14. Calf pens

    Corrales para terneros

15. Maternity

    Maternidad

Farm and Workers

1. Farm workers

    Los trabajadores de granjas lecheras

    Los obreros

2. Veterinarian

    Veterinario

3. Manager

    Gerente

4. Owner

    Propietario

5. Coworker

    Compañero de trabajo

6. Break Room

    Sala de descanso

Biosecurity

1. Livestock biosecurity

    Bioseguridad del ganado lechero

2. Disease

    Enfermedad

3. Spread of disease

    Propagación de la enfermedad

Infectious disease, COVID-19

1. COVID-19 pandemic

    La pandemia COVID-19

2. Organic versus conventional

   Orgánico versus convencional

3. Zoonotic disease

   Enfermedad zoonótica

4. Infectious disease

   Enfermedad infecciosa

5. Isolation

   Aislamiento

6. Prevent

   Evitar; Prevenir

7. Signs and symptoms

   Signos y síntomas

8. Vaccination

   La vacunación

9. To infect

   Contagiar

10. To transmit

    Transmitir

11. Through air

    A través del aire

12. Exposure to blood

    Exposición a sangre

13. Exposure to bodily fluids from birth and/or abortion

Exposición a fluidos corporales por el nacimiento y/o aborto

14. Exposure to saliva

Exposición a la saliva

15. To be bitten

Al ser mordido

16. Parasite

parásito

17. Foreign animal diseases

Las enfermedades foráneas en los animales

18. Healthy Animals

Animales saludables

19. Sick animals

Animales enfermos

20. Antimicrobials

Los agentes antimicrobianos

Antibióticos

21. Bacterial infection

Infección bacterial

22. Viral infection

Infección viral

23. Disease outbreak

Brote de una enfermedad

24. To cull

Sacrificar

25. Pest control

    Control de plagas

26. Vermin

    Sabandijas

Administrative

1. Training

   Capacitación

2. Policies

   Políticas

Specific Diseases

1. Johne's Disease

   La enfermedad de Johne (Paratuberculosis)

2. Mastitis

   Mastitis

3. Bovine Viral Diarrhea

   Diarrea viral bovina

4. African Swine Fever

   Fiebre Africana Porcina

5. Peste Des Petits Ruminant

   Peste des Petits Ruminant

6. Foot and Mouth Disease

Fiebre Aftosa

7. Rabies

    Rabia

8. Ringworm

    Dermatofitosis

9. Leptospirosis

    Leptospirosis

10. Coxiellosis (Q Fever)

    Fiebre Q

11. Cryposporidiosis

    Criptosporidiosis

12. MRSA

    Staphylococcus aureus resistente a la meticilina

13. Tuberculosis

    Tuberculosis

14. E. coli

    E. coli

15. Salmonella

    Salmonella

16. Diabetes

    Diabetes

PPE

1. Personal protective equipment (PPE)

Equipo de protección personal (EPP)

2. Masks

    Las mascarillas (los respiradores de N95 y las mascarillas quirúrgicas)

3. Gloves

    Guantes

4. Boots

    Botas

5. Aprons

    Delantales

6. Obstetrical Sleeves

    Mangas Obstétricas

7. Coveralls

    Overoles

8. Goggles

    Gafas de seguridad

9. Foot Baths

    Bañeras de los pies

10. To wash one’s hands

    Lavarse las manos

APPENDIX 14: KAP QUESTIONNAIRE PILOT TEST RESPONSES

Summary of KAP questionnaire pilot test responses from one owner and two workers on Farm 1. Numbers indicate frequency of response. General recommendations are not included in section or overall response summaries.

	Comments by Category		
	Content	**Structure**	**Terminology**
Demographics & Background	*Q12 Work location* Add option: Machinery Room (1) Pregnant cows (1)	*Q6 Dairy experience* Add option: Options past 5 years (1) *Q15 Farm size* Add option: "I don't know" (1)	
Section responses	2	1	0
Biosafety			
Knowledge	*Q16 Zoonoses definition* Add option: Human to animal transmission (1) *Q17 Identify zoonoses* Add option: Brucellosis (1) Remove option: MRSA (relevance) (1)		*Q19 Cryptosporidiosis* Lack of familiarity with term (1)
Attitudes	*Q29 Concern with zoonoses and COVID* Add more questions on topic (1) Lack of infectious disease concerns (relevance) (1) *Q41 Importance of keeping diseases off the farm* Peer pressure and veterinarians suggestions do not matter (relevance) (1) *Q42 PPE availability* PPE available not an issue (relevance) (1) *Q52 Social distancing difficulty* Add option: dairy parlor (1) *Q62 Infectious disease training preferences* Add option: online training due to COVID-19 (1)	*Q30 Biosecurity to prevent zoonoses* Shorten descriptive text introducing question (2) *Q34 Perceived harm to health* Change from numerical ranking to high, medium, low (1) *Q39 PPE efficacy* Shorten descriptive text introducing question (1) *Q41 Importance of keeping diseases off the farm* Reduce answer options (2) Ranking is difficult (2) Poor wording for answer option (1) *Q44 Obstacles to preventing person-person diseases* Reduce answer options (1) Ranking is difficult (1)	*Q43 Obstacles to preventing zoonoses* "Feasibility" not understood (1)

		Q45 Face use mask motivation Mismatch between rank and answer options (1) *Q59 Trusted sources of communicable disease information* Mismatch between rank and answer options (1)	
Practices		*Q63 Frequency of training on zoonoses and COVID-19* Reduce answer options (1) *Q65 Used information sources for infectious diseases* Reduce answer options (1) Ranking is difficult (1)	*Q74 COVID-19 prevention and control* "Medical screening" unclear (1)
General recommendations	*Add questions to questionnaire: Perceived importance of reporting zoonoses (1); comfort taking COVID-19 vaccine and factors influencing decision (1)*		
Section responses	10	16	3
Biosecurity			
Knowledge	*Q22 Antibiotic use* Antibiotics not used on organic farms (relevance) (2)		
Attitudes	*Q29 Motivation for livestock biosecurity* Remove answer options for peer pressure and following rules (relevance) (1) *Q42 Preferred livestock biosecurity training* Add option: Online training due to COVID-19 (1)	*Q32: Effect of pandemic on livestock biosecurity* Misspelled "the" (1) *Q36 Motivations for livestock biosecurity* Ranking is difficult (1)	
Practices	*Q54 Pest and vermin control program* Add option: Turkeys and prairie dogs (1)		
Section responses	5	2	0
Total responses and overall percentage by category	17 (43.59%)	19 (48.72%)	3 (7.69)