

Zoonotic Disease Risk for Livestock Production Workers

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Abstract

Farm workers and their families rarely recognize the human risks of infectious diseases commonly found in livestock operations in Canada. Almost two thirds of infectious human diseases are recognized as zoonoses, or diseases shared with animals. Awareness of common risks and knowledge of procedures that can be implemented to reduce the chances of infection are keys to preventing zoonotic disease. The consideration of zoonotic diseases is an important part of a farm safety audit, and since many zoonotic diseases also have important animal health and food safety implications, veterinary input into the assessment process is imperative.

Introduction

The emergence of diseases has shaped our world through history, through events such as colonization and wars and through factors such as economic conditions, international trade in animals and animal products, human travel, and cultural traditions. Many historically important diseases have been ones that are shared with animals or that humans could contract directly from animals.

A zoonosis (plural: zoonoses) is traditionally defined as a disease of animals that affects humans. But if it is considered that there have been well-documented cases of these diseases being transmitted the other direction – from people to animals – a zoonosis might be more broadly thought of as a disease shared between species which can infect humans.

Zoonoses tend to be dynamic in both time and space. A disease of this type may be a constant threat to a population for many years, and then retreat and not be important for decades before re-emerging. This ebb and flow may be due to climate changes, habitat alterations that affect the distribution of host species, increases or declines in vector populations (flies, mosquitoes), mutation or alterations of the disease organism itself, and many other factors.

Notably, it has been calculated that 61% of 1415 infectious human pathogens are zoonoses and that 75% of 175 notable recently “emerged” human infections are zoonotic (Taylor et al, 2001).

Unfortunately, much of the emphasis of both veterinarians and rural physicians has turned away from the control and eradication of zoonoses over the past 50 years, since major ones such as tuberculosis and brucellosis were eradicated in developed countries such as Canada.

Despite our modern health care system, there remains in Canada a long list of potentially zoonotic pathogens for agricultural workers, including bacteria, viruses, rickettsiae, parasites and fungi. They may be as mild as superficial fungal infections such as ringworm that are easily treated, or they may be life-threatening problems such as rabies or anthrax (Table 1).

Getting People Thinking About Zoonoses

The many possible zoonoses mean that living and working with animals can impact human health at the individual level. Veterinarians who treat animals that become ill with confirmed infections should assess the risk for zoonotic potential and inform the animals' owners accordingly. But workers who deal with animals on a daily basis need to be knowledgeable about possible infectious diseases that they might contract or potentially carry on their clothing to expose other people. As farms grow and livestock operations change from being small family farms to become large, corporate organizations that may employ dozens or even hundreds of workers, sometimes on multiple sites and raising several species of livestock, the risk of infection of large numbers of people through the outbreak of zoonotic disease increases. When it is considered that in such situations, not only the worker, but family members and acquaintances could become exposed by contact with a worker's contaminated clothing or other items, the potential consequences grow exponentially.

Occupational health and safety information does not consistently address zoonotic disease risks to farm workers and their families. The Alberta Farm Safety Program website of the Alberta Government has no information on zoonoses. Many other farm safety websites and information sheets do an excellent job with other aspects of farm safety, but neglect issues of infectious diseases people can contract from animals. An exception that may be noted is the Infectious Disease Hazards module from "Healthy and Safe Practices in Pork Production: Technical Modules" published by the Occupational Health and Safety Division of Saskatchewan Labour. This is quite a complete and thorough outline of routes of infection, risky activities, control measures, and planning. Many occupational health and safety organizations publish individual information sheets on diseases such as Hantavirus. But few have produced exhaustive guides to assist livestock producers identify and mitigate zoonotic risks.

It is not only the occupational health and safety profession that has neglected zoonoses. At a lecture on emerging infectious diseases during a recent national veterinary conference, an informal poll was taken of veterinarians regarding their own practices with respect to zoonotic disease protection (Stephen, 2005). Less than 1/3 of veterinarians present answered "yes" to all three of the following questions:

- Do you wear personal protective devices when handling animals with infections of unknown origin?
- Do you wear more than gloves when doing post-mortems or cleaning pens or cages of animals with infectious diseases?
- Has every one of your staff (and volunteers) had training on zoonoses and personal protection?

One study that looked at the relationship between veterinarians and physicians in assisting veterinary clients/human patients to deal with zoonotic risks indicated that the expertise of veterinarians tends to be underutilized (Grant and Olsen, 1999). Patients themselves do not appear to view veterinarians as a source of zoonotic disease information. Communication between vets and physicians regarding zoonosis is rare. Vets and physicians even have very different views about risks from zoonoses, which organisms present the biggest risks. The study indicated that two thirds of vets have never discussed human health risks pertaining to immunocompromise with clients despite having diagnosed zoonoses in their animals. Physicians participating in the study indicated that veterinarians should be involved not only in controlling zoonotic disease pathogens in animals, but also in providing information for patients and physicians.

To some degree, part of the issue is that the reporting of animal and human disease is usually split between agencies in most jurisdictions. Even the reporting of different classes of animal diseases may be split, depending on whether they are of economic (trade) importance, human health significance, or other factors.

Zoonoses Do Occur in Farm Workers

Despite the casual attitude many in the industry might display towards potential zoonotic hazards, there are numerous instances in which experienced, skilled agricultural workers become infected with zoonotic diseases. Some examples of outbreaks of zoonotic diseases in agricultural settings illustrate the importance that this occupational hazard should have in farm safety audits and planning.

In the summer of 1994, the Guelph area health unit was notified that a member of a work crew had suffered a diarrheal illness following one day of employment on a catching crew at a turkey farm about 1 week earlier (Health Canada, 1995). Two other members of the work crew had also called in sick since then. Investigation of a possible outbreak began, and each individual of the nine-member crew was contacted. It turned out that seven of the nine workers reported having had symptoms including diarrhea, vomiting, cramps, and fever. The most severely affected individual had a history of chronic colitis. Four permanent workers at the farm also reported diarrheal illness a day to two after handling the same birds.

The job had consisted of catching and transporting 13,000 6-week-old turkey poults from a brooding barn to a growing barn on a nearby farm. The turkeys showed no sign of any illness. No designated lunch time or breaks were scheduled, and six of the nine workers reported eating as they worked. One of the workers smoked as he worked. The remaining

two did not consume anything except water from a container brought from home. These two individuals were the only ones who did not get sick. Hand washing facilities were not available. A bucket of cold water without soap was provided to wash up at the end of the day. Workers were not advised of any risks of pathogenic bacteria being shed, or the need for thorough hand washing before eating or smoking. Masks were offered but not encouraged, and gloves were not provided.

Stool samples from the two most severely affected individuals were positive for *Campylobacter*. Several environmental samples from the farm were collected a month after the incident, but a different flock of turkeys were present, and although *Campylobacter* was isolated, it was of a different serotype. Significantly, basic biosecurity measures such as rodent control, proper cleaning and disinfection of barns between flocks, restricted entry onto premises, and hand washing were not strictly followed at the farm.

A similar outbreak of *Campylobacter* enteritis affected 8 of 15 workers at a Wyoming pheasant farm (Heryford and Seys, 2004). Many other occupational animal exposures have been shown to be involved in outbreaks of *Campylobacter*, including workers with cattle, pigs and other species.

Campylobacter is the most common cause of bacterial gastroenteritis in the United States. Outbreaks are typically due to contaminated water exposure, or consumption of raw milk, but many sporadic cases involve consumption of undercooked poultry, contact with puppies and kittens, and contact with diarrheic animals. Living on or visiting a farm increases the odds of infection. A study of risk factors in Michigan indicated that a significant proportion of cases were attributable to poultry husbandry (Potter et al, 2003). The care and raising of poultry raised the odds for disease almost 7 times over the odds from raising other species such as cattle and swine that are also known to be reservoirs of *Campylobacter*.

Animals infected with pathogens such as *E. coli*, *Salmonella* or *Campylobacter* frequently have only mild symptoms or even show no signs of illness, and shedding of bacteria may be intermittent. These organisms may live for long periods in the environment. As is now well-known following incidents such as the Walkerton water contamination, infections with *E. coli* 0157-H7 can be extremely serious or even fatal in humans. Removing animals with diarrhea is necessary to protect animal and human health but is not sufficient to prevent infectious animals that appear healthy from persistently shedding organisms and contaminating the environment. It can be difficult to identify subclinical cases of infections of this type due to the intermittent shedding, and the limitations of laboratory testing. Antimicrobial treatment may not be effective and ultimately some problem cases cannot be eliminated without depopulation and thorough decontamination and disinfection of the housing environment.

Even in situations where people would be expected to be vigilant to zoonotic transmission of animal diseases, and aware of symptoms and methods of prevention, outbreaks of common zoonotic diseases occur. In the late 1980s an outbreak of a

gastrointestinal protozoan parasite called *Cryptosporidium* occurred at a beef farm in northern Colorado and infected almost all of 90 or so calves at the operation (Reif et al, 1989). Several newborn calves were admitted to the Veterinary Teaching Hospital at Colorado State University with profuse diarrhea and were housed in the isolation unit. Subsequently, 85% of calves on the farm tested positive for the organism. Among the veterinary students involved in nursing care, sample collection, and treatment of the calves, several developed gastrointestinal symptoms within a week of first contact, and some were ill for up to two weeks. One student's spouse had no contact with the calves, but became infected after washing fecally-contaminated clothing. Ultimately, it was found that 26 of 112 potentially exposed students and staff developed watery diarrhea, cramping, flatulence and headache. Significantly, all of the people infected were immunologically normal in this case, though Cryptosporidiosis is often reported to be more frequent and more severe in immune compromised individuals. In such cases the disease can be life-threatening.

Other life-threatening diseases also remain occasional threats to agricultural workers and their families. Very recently rabies was diagnosed in a kitten near Innisfail, Alberta (AVMA, 2006). The kitten, from an unvaccinated litter of barn cats, was approximately 14 weeks old and was brought to a veterinary clinic because it had been sick for about a week. Its symptoms were not immediately indicative of rabies. It was affectionate, but it had neurologic symptoms. The kitten's condition deteriorated and it was euthanized the next day and sent for rabies testing. Following the positive test for rabies, five vet clinic employees and three farm family members were given prophylactic rabies treatment. Although several rabid bats are found in Alberta each year, this was the first case in a cat since 2001. There was a rabies case in a dog in 1998. Although rare in Alberta, rabies is much more common in other parts of Canada, particularly in Manitoba and Ontario, where a handful of cattle and other species, particularly skunks, are diagnosed each year. Cattle with rabies may appear to be choking or having difficulty swallowing, and occasionally farm workers and veterinarians are exposed to rabies while examining the mouth and throat. It is very important that any animal that shows neurologic symptoms be properly assessed and sent for testing so that appropriate contact history and treatment can be initiated for humans if necessary. Farm pets' vaccines should always be kept up to date.

Many of the routine husbandry and health promotion practices for farm animals, such as all-in / all-out management in poultry or hogs, routine cleaning and disinfection, and vaccination of livestock for common infections and of pets for diseases such as rabies, are aimed at not only promoting the health of the animals but also reducing the risk of these infections that might be dangerous to humans (Von Essen and McCurdy, 1998). In the *Cryptosporidium* case described above, after the outbreak was diagnosed in the human population, no further cases arose, probably due to instituting hygienic measures and the awareness of the outbreak.

The Risks Must Be Assessed

Because there is a wide range of potentially zoonotic diseases that can affect agricultural workers (Table 1), awareness of these hazards, identification of risk factors, and institution of routine procedures and practices to help reduce the risk are all necessary to protect the livestock worker. Human cases of diseases such as West Nile Virus encephalitis, Hantavirus respiratory syndrome, and *E. coli* 0157:H7 make the news because they are often life-threatening or fatal, but they tend to be relatively rare. Other more common but potentially serious infections such as Salmonellosis, Q-fever and *Streptococcus suis* are frequently not reported in the media.

The organisms that cause zoonoses may be present in saliva, blood, feces, urine, vomitus, or other body fluids of diseased animals. Because of the close contact that livestock handlers have, they may come in contact with these substances numerous times daily. Accidental ingestion of feces, blood or other body fluid from splashes, or on contaminated hands during facial touching, smoking or eating are the most common means of infection. Splashes or sprays of material into eyes, or into wounds in the skin, or accidental injection from needle sticks contaminated with animal blood are also risks. Dust contaminated with infectious material can be inhaled. Direct contact with skin may occur during handling of live animals or their carcasses.

Particular routine and commonly performed activities put individuals at greater risk and so all activities should be reviewed to identify hazards. These activities include assisting with birth of calves, lambs or piglets, handling afterbirths (placental tissues), handling stillborns, handling or treating diseased animals or their wounds, giving animals injections, performing routine surgery such as castrations, disposing of dead animals or birds, and handling unhatched eggs (hatch residue). During any of these activities, workers should ensure increased vigilance to contamination of clothing, ensure proper decontamination including changing of clothes or showering if necessary, and wearing of personal protective equipment such as gloves, masks and goggles.

Although healthy individuals are at risk of infection with many of the common zoonotic agents, young children, the elderly, and any individuals who are immunocompromised are at a higher risk of contracting and displaying more severe symptoms of many zoonoses. In the modern North American population, there exist many people who have reduced immunity, due to chemotherapy, immune suppressive treatment for organ transplant, systemic diseases such as diabetes mellitus, or infectious diseases such as HIV/AIDS. Pregnant women are also at higher risk of serious adverse consequences to themselves and their babies from some zoonotic diseases. *Toxoplasma gondii* is one such infectious organism that can be contracted from placental tissues of sheep or other animals, from raw meat or from the stool of cats. In healthy adults fever and muscle pain are often the only symptoms, but in unborn infants whose mothers become infected it can cause brain damage, and in immunocompromised patients it can cause meningoencephalitis. It is critical that training of farm employees and public health education programs aimed at farm families address the risks of zoonoses in these individuals in particular, and the importance of preventing inadvertent exposure to infectious material on contaminated clothing. A number of highly publicized incidents

involving the infection of farm visitors, particularly children visiting petting zoos and on farm field trips, and from pet ducks or chicks, illustrate the risk of introducing animals with pathogens to naïve human populations (CDC, 1992; CDC, 1997; CDC, 2001). Detailed guidelines for helping to ensure the safety of occasional farm visitors are available and should be consulted by producers involved in petting zoos or “agritourism” (Wash. State Dept. Health, 2001).

Control Measures

Control measures to help prevent exposure should include engineering controls to minimize the release of infectious organisms into the environment thus preventing unnecessary exposure. These should include the quarantine facility or area used to isolate sick animals, equipment and facilities to prevent spreading contaminated manure or bedding during cleanup, and having appropriate tools and supplies available to be used in such activities. Safe work practices to reduce contact with skin, avoid creating dusts or aerosols that could be inhaled, and to avoid splashing of material that could be ingested must be devised. Addressing related issues such as handling and disposal of sharps such as needles, scalpels, and disposal of animal carcasses will also assist in reducing the risk of zoonotic disease exposure from these sources. Personal protective equipment such as gloves, masks, goggles, and water-impervious coveralls or aprons will help avoid unnecessary exposure. It must be noted that standard exam gloves such as used in hospital or clinical settings are often not suitable for agricultural use. These tend to tear quickly in the rigorous environment and work practices. Stronger gloves that are available for industrial use are more suitable, though kitchen dishwashing gloves are often satisfactory if nothing else is readily available. Finally, to reduce the likelihood of humans infecting animals with zoonotic diseases, good personal hygiene and toilet habits should be followed. Workers must avoid defecation, urination and spitting in or near animal pens or food sources.

Planning

Development of a written risk assessment and an infection control plan is required for farm employees in some jurisdictions, but is advisable in all farm situations, including the small family or even hobby livestock operation. This process should include identifying potential hazards and workers at risk, and where and how they might contact the infectious materials or organisms. Workers should be informed of signs and symptoms, control measures, and exposure response procedures. This will involve developing written procedures for cleaning, disinfection and disposal of contaminated materials, and providing the training required to ensure everyone involved has sufficient knowledge of the program. The input of a veterinarian familiar with the species of animals on the farm and knowledgeable about zoonoses and occupational health and safety would be advisable in development of this plan.

Conclusion

Clearly, there is a need to address the potential hazards of zoonotic disease better. We must assist family farms and corporate livestock operations to assess risks, devise control measures, and develop plans to avoid or deal with potentially zoonotic infectious diseases on the farm. If our prevention and control of zoonotic diseases is to be improved, greater communication between veterinarians, physicians and public health officials at a local level is likely needed (Kahn, 2006). Initiatives such as the new Alberta Veterinary Research Institute at the University of Alberta, and the planned focus on “Ecohealth” at the new Faculty of Veterinary Medicine at the University of Calgary will assist in bridging these gaps and in training of veterinarians to take a “comparative medicine” approach to veterinary and human public health with respect to zoonoses. It is important to engage occupational health and safety professionals, family physicians, infectious disease specialists, public health officials, veterinary practitioners, veterinary researchers and government surveillance veterinarians in dialogue, communication and information sharing, through this type of collaborative comparative medicine initiative. As this type of approach grows in the future, prevention and control strategies for zoonoses will ultimately improve.

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Table 1: Selected Zoonotic Diseases of Occupational Significance to Agricultural Workers in Western Canada

<i>Disease</i>	<i>Organism</i>	<i>System Affected</i>	<i>Common Exposure</i>
Anthrax	<i>Bacillus anthracis</i>	Skin, respiratory	Cattle, sheep, pigs, bison
Avian Influenza	Influenza Viruses	Respiratory	Poultry, ducks
Bovine Tuberculosis (Considered eradicated in Canada)	<i>Mycobacterium bovis</i>	Lung, others	Cattle, bison, elk, other ungulates
Brucellosis - undulant fever (Considered eradicated in Canada)	<i>Brucella abortus</i>	Multiple, CNS, Heart,	Cattle, sheep, bison
Campylobacter gastroenteritis	<i>Campylobacter jejuni</i>	Gastrointestinal	Poultry, cattle, sheep, pigs
Chlamydia	<i>Chlamydia psittaci</i>	Reproductive Spontaneous Abortion	Lambing sheep, parrots
Chlamydia	<i>Chlamydia psittaci</i>	Respiratory Pneumonia	Birds
E. coli	Various types, 0157-H7	Gastrointestinal, kidneys	Cattle, other species, manure contaminated water or food
Erysipelas	<i>Erysipelothrix rhusiopathiae</i>	Skin, multiple organs	Pigs
Hantavirus	Hantavirus	Respiratory	Mouse droppings
Hydatid Disease	<i>Echinococcus</i> species tapeworms	Tumor like cysts: respiratory, liver	Sheep, dogs
Leptospirosis	<i>Leptospira</i> species	Multiple, spontaneous abortion	Cattle, pigs, rodents
Listeriosis, meningitis	<i>Listeria monocytogenes</i>	Fever, Gastrointestinal, reproductive miscarriage	Cattle, sheep, goats, poultry
Lyme Disease	<i>Borrelia burgdorferi</i>	Multiple, fevers, joint pain	Tick <i>Ixodes ricinus</i>
Parasitic Diarrhea	<i>Giardia</i> (beaver fever); <i>Cryptosporidium</i>	Gastrointestinal	Infected mammals
Pasteurellosis cellulitis	<i>Pasteurella multocida</i>	Skin, subcutaneous	Bites by cats, dogs
Plague “Black Death”	<i>Yersinia pestis</i>	Respiratory, skin,	Prairie Dogs
Q-Fever	<i>Coxiella burnetii</i>	Multiple, fevers, endocarditis	Sheep, cattle
Ringworm	<i>Trichophyton</i> spp.	Skin	Cattle, cats,
Roundworms	<i>Ascaris suum</i>	Gastrointestinal, respiratory	Pigs
Rabies	Rabies virus	Brain	Infected mammals, specifically bats, skunks, cats, dogs, raccoons, wolves, coyotes
Salmonellosis	<i>Salmonella typhimurium</i>	Gastrointestinal, respiratory,	Sheep, cattle, poultry, pigs
Streptococcus Meningitis	<i>Streptococcus suis</i>	Meningitis, toxic shock	Handling dead pigs or tissues
Tetanus	<i>Clostridium tetani</i>	Neuromuscular	Soil, sometimes contaminated with animal feces
Toxoplasmosis	<i>Toxoplasma gondii</i>	Mild Fever, Neurologic disease in unborn infants, or immunocompromised	Sheep (afterbirth), uncooked meat, cats
Tularemia	<i>Francisella tularensis</i>	Multiple: Severe fever, muscle pain	rabbits, wild rodents (beaver, muskrat), sheep
West Nile Virus and other Encephalitis	Arboviruses	CNS	Horses, wild birds. Mosquitoes are the vector

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