

MATERNAL HEALTH AND ZONOSIS

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Abstract

I completed my field experience at the Department of Public Health (DPH) at the Fort Riley Army Installation, Kansas. There are six sections within the DPH that each have a different job, but they all work together to protect the health of the soldiers, families, retirees, and civilian employees at Fort Riley. The six sections of the DPH are Environmental Health, Industrial Hygiene, Army Wellness Center, Army Public Health Nursing, Occupational Health, and the Army Hearing Program. Veterinary Services also works in partnership with DPH as well, but is not actually a section in the DPH. These seven different sections, in general function to provide safe work environments on post, provide counseling regarding how individuals can improve overall health and well-being, prevent injury and illness, and protect the safety of the food supplied and served on post.

My capstone project focused on zoonotic concerns in maternal health. Zoonosis is any disease naturally found in animals that can infect humans. There are more than 800 zoonotic pathogens that can potentially infect humans. Pregnant women are more susceptible to zoonotic disease due to immunosuppression, making them an important group to provide education on zoonosis prevention. I created fact sheets for veterinarians and human health care providers for four zoonotic diseases, Toxoplasmosis, Leptospirosis, Q fever, and Lymphocytic Choriomeningitis. I chose these four diseases because they not only present health risks for the mother but they also pose serious risks to fetal development and viability. There are many zoonotic diseases that a pregnant woman could be infected with but these four have the most

serious consequences for not only the mother's health but the fetus' health as well. Also, if an expecting mother practices the preventative measures for these four diseases then she has a very low risk of becoming infected with any zoonotic disease during her pregnancy. This project allowed me to combine my experience as a practicing veterinarian along with my experience from my MPH coursework and my field experience at the DPH. Researching these four diseases allowed me to use my virology, bacteriology, parasitology, and immunology knowledge from my veterinary degree and practice along with my epidemiology coursework for my MPH. My field experience also helped to tie together the research for my capstone project, my MPH coursework in Epidemiology, Social and Behavioral Bases of Public Health, and Administration of Health Care Organizations. My field experience allowed me to see the topics covered in these courses in actual day-to-day practice in a department of public health.

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Field Experience at Fort Riley Army Installation

I completed 240 hours of my field experience at the Department of Public Health at Fort Riley Army Installation, Kansas. The DPH is comprised of six sections and partners with Veterinary Services to promote and protect the health of the community at Fort Riley. The DPH is a part of the Irwin Army Community Hospital (IACH) at Fort Riley. The mission of the DPH is “To promote health and wellness, and prevent disease and injury of Soldiers and their families, military retirees, and Army Civilian employees at Fort Riley through workplace and community health.” (Fort Riley DPH pamphlet)



Figure 1. Fort Riley DPH logo

The DPH is comprised of Environmental Health, Industrial Hygiene, Army Wellness Center, Army Public Health Nursing, Occupational Health, and the Army Hearing Program. I spent time with each section in the DPH as well as Veterinary Services to learn how each fulfills the mission of DPH and promotes public health at Fort Riley.

Environmental Health

The Environmental Health (EH) section has several different responsibilities to help promote health and safety at Fort Riley. The main responsibilities of EH are to perform food service inspections and training, water quality surveillance, disease vector surveillance, hospital waste management, and Child Development Center sanitation inspections.

During my rotation at EH I observed and participated in the inspection of one of the Child Development Centers. Here EH not only did a food service inspection in the kitchen on site but the technician also did an inspection on the overall safety of the entire environment. We checked the cupboards in each of the infant rooms to ensure all baby food and formula was not expired. We observed teachers setting up to feed the children lunch to ensure tables were properly cleaned before the children sat down. The technician asked a few of the children to explain how they wash their hands to ensure that teachers were teaching the proper procedure and adhering to guidelines. We even checked the playgrounds to determine if the equipment appeared safe and in good condition.

I spent a day with the water quality technician. His job was to test the chlorine levels of the water in different sectors on post to ensure that it was adequate to kill disease causing bacteria. I had the opportunity to sample and test water at several different sites and record my results. We also collected water samples to test for the presence of coliforms. Additionally, we collected ice samples from several shopettes on

post to test for coliforms as well. Once we transported the samples back to the DPH, I assisted the technician in processing the water and ice samples for analysis.

Additionally, I assisted a technician in collecting mosquitos and ticks for vector surveillance. We placed several mosquito traps to sample the mosquitos in different areas on post for examination and identification. The traps had a small light that attracted the mosquito and a small fan to suck them into the trap. The traps were to be collected the next day. The mosquitos were identified and if they were species that were not indigenous to the area or known human disease vector they were sent to a lab for further testing. We also pulled a large white piece of fleece material through a field on post to see if we could find any ticks. We collected one tick that day. Ticks are also collected and examined to determine if they are human disease vectors just as the mosquitos.

Lastly, I observed one of technicians inspect some of the clinics in the hospital to ensure that they were following proper procedure of disposing of the regulated medical waste. We also inspected these clinics to ensure that they had MSDS manuals that were current and accurate for the hazardous materials they used in each area.

Industrial Hygiene

The main objective of the Industrial Hygiene (IH) section of the DPH is to promote workplace safety at Fort Riley. There are several different areas that they focus on to keep the workplace safe. They assess ventilation systems, conduct noise surveys, air sampling for chemicals and biologics such as molds and bacteria, as well as health risk assessment and ergonomic studies. During my field experience, I had the opportunity to observe a ventilation and noise assessment in a new paint booth on the

airfield. I also observed an ergonomic follow-up appointment. The technician previously had done an ergonomic study due to back and neck pain sitting at a desk for two different employees. After he took different measurements, he recommended different chairs, headrests, etc. that made sitting at a desk more comfortable and reduced strain on the body. Additionally, I assisted with an inspection at the hospital that identified potential hazardous materials that were used in each area of the hospital.

Army Wellness Center

The Army Wellness Center (AWC) is available to active duty soldiers, retirees, and family members. The Army Wellness Center's services include health assessments, physical fitness exercise testing, healthy nutrition metabolic testing, stress management, tobacco education, and behavior change strategies. During my rotation, I observed multiple health assessments and healthy nutrition metabolic tests. Some of these appointments were follow-ups to see how the person was progressing with diet and exercise changes they were prescribed previously. Other appointments were to assess body fat composition and resting metabolic rate to determine what caloric intake that individual needed to eat to lose weight. They used several pieces of equipment that I had never seen before to make these measurements. The first piece of equipment was an indirect calorimeter. The individual laid down and a plastic dome with a plastic drape called a canopy, covered the area around his head and chest to seal in the carbon dioxide and oxygen the individual was breathing out. The person had to lie there quietly and breath naturally for ten minutes but not fall asleep. This machine measured the amount of carbon dioxide and oxygen that the individual exhaled and then that was used to determine resting metabolic rate. They also had a Bodpod that

measured body fat percentage. An individual wears an outfit made of spandex in the Bodpod and it would measure body fat by measuring how much air the person displaced. Measurements were taken at each appointment, but there was also a lot of discussion about food choices, exercise, and strategies that the individual could use to make healthy changes; additionally, classes are offered weekly on sleep and stress management.

Army Public Health Nursing

Army Public Health Nursing (APHN) supports the health of active duty soldiers and their beneficiaries in multiple ways. They provide sexually transmitted infection (STI) counseling, tuberculosis screening, tobacco cessation counseling, inspections for the Child and Youth services, as well as community outreach. During my field experience, I spent a day with one of the civilian nurses and we performed an inspection on one of the youth centers at Fort Riley. The inspection was very detailed. This inspection ensured each child with a food allergy had the appropriate paperwork filed in the office as well as posted in the eating area. These postings had a picture of each child as well as what food they were allergic to as well as safe alternatives each child could eat. We also inspected each medication that was left by a parent. Each medication had to have the appropriate paperwork, correct dosing instructions, correct measuring spoon or cup, and not be expired. We randomly searched some of the back packs and lockers to ensure there was no prohibited items. We inspected each First Aid kit to make sure they were complete and in the proper locations. We checked the bottles of disinfectant to verify that they were in the correct location and that they were mixed properly and labeled correctly. We also watched at lunchtime to see if all the

children were washing their hands before they sat down to eat. I spent another day with a Nurse Practitioner (NP). His job was to educate soldiers who were trying to quit smoking. The AWC also has tobacco education, but the NP in APHN is able to prescribe drugs such as Chantix in addition to counseling. He also counseled spouses of active duty soldiers on what vaccines were required or recommended to travel outside of the United States for permanent change of station (PCS) overseas. He also discussed treatment options with individuals that had tested positive for tuberculosis. Three individuals, two soldiers and one civilian, were assigned to STI counseling. If a soldier or dependent tested positive for an STI they were referred to APHN after treatment. The nurses at APHN use the Center for Disease Control (CDC) guidelines to discuss transmission and prevention of STI. They also facilitated any further treatment or testing the individual may need. The nurses at APHN also used several data bases to track and report multiple communicable diseases.

Occupational Health

Occupational Health (OH) only deals with civilian employees and contractors working at Fort Riley. Every civilian employee before they are officially hired, once yearly while they are employed at Fort Riley, and before they leave a position must have a physical exam with the NP at OH. Each exam consists of vitals, height, weight, hearing testing, vision screening, and spirometry. Any vaccines that are required for a particular job are given here. Each contractor is required to have the same physical each time he deploys as well. OH is also responsible for monitoring work related injuries and worker's compensation claims. They also ensure that the worksite is safe

for each individual to prevent work related injuries. OH works with IH, EH, and the Army Hearing Program if needed to address and eliminate worksite safety concerns.

Army Hearing Program

The Army Hearing Program (AHP) is responsible for the hearing screening, health, and conservation for all active duty soldiers at Fort Riley. Additionally, AHP works with OH as well to preserve the hearing health of civilian employees. There are hearing booths at the processing center on Fort Riley. I had the opportunity to tour the processing center and observe some of the hearing tests. Each soldier gets a hearing test when they are processed into Fort Riley, before each deployment, and after they return from each deployment. Hearing is crucial to a soldier's job, but they experience high levels of noise from weapons firing, aircrafts and other equipment, which can quickly destroy hearing. AHP is able to determine if a soldier is developing hearing loss through this regular series of hearing tests and offer treatment and training in hearing conservation that includes fitting each soldier with appropriate hearing protection. The audiologist also trains technicians on how to use the equipment in the sound booth to perform hearing tests as well as the science of how we hear. I had the opportunity to observe some of the audiologist's training sessions. These sessions were very interesting and I learned a lot about how we hear and how to protect it on a daily basis, even in civilian life. I learned that if you need to raise your voice to be heard over a loud noise, such as a lawn mower, then you need to wear hearing protection because that level of noise can permanently damage your hearing. I also learned that once you damaged the fine hairs in the auditory canal by being exposed to a loud noise, then they are damaged forever and do not regenerate. I also had the opportunity to study a few

audiograms from hearing tests and see the difference between normal hearing and hearing loss.

Veterinary Services

The main responsibilities of Veterinary Services (VS) are animal preventative medicine and food sanitation and inspections. VS is technically not a section of the DPH at Fort Riley; however, they do partner at times during cases where zoonosis is a concern such as in animal bite cases. VS offers wellness exams, vaccines, heartworm and fecal testing, deworming, heartworm prevention and flea and tick prevention for pets of military families. Any concerns of zoonosis prevention and management can be discussed at these wellness visits by the staff veterinarian. Any military working dogs or horses at Fort Riley are also cared for by VS. If any of the Child Development Centers have pets on site then VS is responsible for ensuring that the animal is healthy, and kept in sanitary and appropriate conditions as well as discussing any zoonotic concerns with the Child Development Centers staff. Animal Preventative Medicine is only a small part of the responsibilities of VS. The largest focus of VS is food sanitation and inspections of the commissary, food service, shopettes, and Child Development Centers. I had the opportunity to assist one of the inspectors at the commissary and one of the Child Development Centers. Inspecting the commissary is a big job. Here VS must inspect that the produce and meat are being displayed in sanitary conditions as well as stored at the proper temperature. Each day the food that is delivered to the commissary is inspected by VS to confirm that all the required labeling is on each package and that each package has been stored correctly and is good quality. All the refrigerators, freezers, and storerooms are inspected to be sure that all the food is being

stored in sanitary and safe conditions according to food safety regulations. The VS inspectors also do off post inspections at the plants where the food is produced to ensure food safety on the production end. At the Child Development Centers, we examined to see if the cooks were storing the food in a sanitary manner and at the prescribed temperatures.

Discussion

I learned a lot about how the DPH operated as a whole at Fort Riley as well as the services provided by each department. It was very interesting to see how each individual department operated separately but also in partnership with each other to prevent injury and illness along with protecting and promoting the health of the community at Fort Riley. EH, APHN, IH, and VS all work together to ensure all the Child Development Centers are safe and healthy environments for each of the children. APHN and AWC work in conjunction to reduce the use of tobacco on post, which improves the health of not just the smoker but everyone around him. IH, OH, and AHP partner to ensure the soldiers and civilians on post have the education and resources to protect their hearing. Spending so much time at the DPH has changed my perception of what function a DPH has in the community. Before my field experience my perception was that a DPH was where you went for vaccines, birth control, and healthcare if you did not have insurance. A DPH is much more and my perception has been changed forever. The DPH is a very complex organization. This field experience was valuable because it gave me a chance to see epidemiology being used in a practical setting. APHN used epidemiology daily as they were tracking communicable diseases on post. My experience at APHN also gave me more perspective on some

social and behavioral aspects to public health as they related to STI and smoking. Assisting with vector surveillance during my EH rotation also showed me a practical aspect of bacteriology and parasitology in human health. I think that one of the biggest lessons that I learned from my field experience here is that public health work often happens quietly in the background and most people are not even aware how much work is being done to keep them safe and healthy. Several examples of this are the water quality testing done by EH and ergonomic studies done by IH. Before my field experience I never thought of their importance as they relate to public health. However, since completing my field experience I see how important they are to public health. Individuals working in public health work tirelessly to make sure we are all healthy even when we do not realize what work is being done. Public health in general and the DPH are extremely important and without it our communities would suffer.

Introduction

Zoonosis is defined as a disease that can be transmitted from animals, domestic or wild, to people (Kahn 556). Zoonosis is a big public health concern because there are more than 800 known pathogens that are zoonotic found worldwide. Approximately 20-30 of these zoonotic diseases are carried by cats and dogs (Wortinger 1). According to the American Veterinary Association 36.5% of households in the United States own dogs and 30.4% own cats (AVMA). With this many households in the U.S. owning pets it makes zoonosis an important concern in human health, animal health, and public health, especially since it has been estimated that about 75% of emerging diseases are zoonotic (Wortinger 1). Several groups of people are at a higher risk of becoming infected with a zoonotic disease including young children, the elderly, pregnant woman, and people who are immunocompromised (Weese 299).

Zoonotic diseases can be transmitted from animals to humans through direct contact, indirect contact, aerosol transmission, and through vectors such as mosquito, flea, and tick bites (Wortinger 1-2). Direct contact can result from ingestion, puncture wounds, needle sticks, bites, or exposure to mucous membranes. Indirect transmission occurs from contact with fomites from cleaning cages, equipment, or dirty laundry. Zoonotic diseases can be transmitted through aerosols when small particles are inhaled or mucous membranes come in contact with droplets containing a pathogen. Vectors infect humans with zoonotic diseases after feeding on infected animals then feeding on humans (Wortinger 1). The best prevention is understanding each individual's risk for infection with a zoonotic disease and knowing what steps are need to take to prevent infection.

Maternal Health and Zoonosis

An expecting mother has many different concerns regarding her health and the health of her unborn child during pregnancy. If the expecting mother owns pets or has exposure to animals during her pregnancy zoonosis is one of those concerns because pregnant women are at higher risk of infection. There are many organisms that are zoonotic and may affect the expecting mother's health, but I am going to focus on four organisms that will not only be detrimental to the expecting mother, but will also be detrimental to the health and life of the unborn child as well as a newborn. All of these diseases are preventable; however, if a woman does not know she is at risk for zoonotic infections, she cannot prevent infection.

Toxoplasmosis

Toxoplasmosis is caused by the protozoan *Toxoplasma gondii* (Acha 3: 76). Infection with this zoonotic organism can affect both fetuses and newborns (Acha 3: 77). If the mother is infected at early stages of pregnancy she may have a miscarriage or stillbirth. However, the newborn may be born with congenital abnormalities such as blindness or neurological issues such as hydrocephalus, microcephaly, or mental retardation (Brooks 1). Not all congenitally infected newborns have obvious clinical signs of infection at birth, but the majority will develop problems with their eyes, ears, and have learning and developmental problems (Weese 71-73). The CDC estimates that there are anywhere from 400-4000 cases of congenital toxoplasmosis per year in the United States (*Neglected* 2).

There are several sources of infection with *T. gondii*; these sources include feline (domestic or wild) feces, contaminated meat, or water and soil contaminated with feces

from infected felines. Felines are a definitive host for *T. gondii*. Infected felines will spread unsporulated oocysts in their feces which sporulate in 1-2 days in the environment. Sporulated oocysts are infective to any mammal that may eat it. Mammals that are not felines are intermediate hosts for *T. gondii*. In the intermediate host, the infective oocysts will become infective cysts in the muscle and organs; these cysts will infect any mammal that eats it; this is how felines become infected. Thankfully, cats usually only shed oocysts after the initial infection with *T. gondii*. The period of shedding generally only lasts 3-10 days, but could be as long as 20 days; this means an infected cat will not shed oocysts his whole life (Weese 68-69).

Typically cats infected with *T. gondii* do not show clinical signs; however, the cat may have mild diarrhea for about 10 days. Immunosuppressed cats or kittens that were infected through the placenta or mother's milk will show signs of systemic disease including fever, lethargy, anorexia, lameness, hepatitis, eye problems, or neurologic issues. Clinical signs in humans are fever, lethargy, sore throat, muscle pain, swollen lymph nodes, and enlarged spleen and liver. Clinical signs may last for 1-12 weeks but most cases are mild and do not require treatment. Approximately only 10-15% of humans infected with *T. gondii* show any clinical signs (Weese 71-72).

Toxoplasmosis can be found around the world. In the U.S., the CDC estimates that 22.5% of the population 12 years of age and older have been infected with *T. gondii* (Parasites). Toxoplasmosis is not a reportable disease so it is not easy to estimate the prevalence of the disease in the U. S. currently, however there are about 15,000 clinical cases per year (Weese 69). Toxoplasmosis is one of the leading causes of foodborne illness and deaths in the U.S. The CDC estimates toxoplasmosis is responsible for

approximately 327 deaths per year as well as 4,428 hospital stays per year (*Neglected* 2).

There are several simple things you can do to avoid infection with *T. gondii*:

1. Thoroughly cook all raw meat.
2. Do not allow cats to hunt outside or eat raw meat.
3. Clean the litter box at least once daily and then wash your hands well.

Pregnant woman should avoid cleaning the litter box or wear gloves and wash hands well when done.

4. Do not dispose of cat litter in the yard.
5. Wear gloves when gardening.
6. Do not drink raw milk.

If these simple rules are followed there is a very low risk of human infection with *T. gondii*. No correlation has been found between owning a cat and infection with *T. gondii* (Brooks 2).

Leptospirosis

Leptospirosis is caused by a gram-negative, spiral-shaped bacterium called *Leptospira interrogans*. This is a confusing group of organisms to classify because *L. interrogans* has more than 200 serovars (Weese 157). Geographically *Leptospira* spp. are found worldwide with a higher prevalence in tropical climates (Acha 1:158). In tropical regions, there are approximately 100 cases of leptospirosis per 100,000 people (Puliyath 2491). However, in more temperate regions the incidence of leptospirosis drops to less than 1 case per 100,00 people (Puliyath 2491).

There is the possibility of several outcomes if a pregnant woman becomes infected with *Leptospira* spp. If infected in the first trimester there is the possibility of miscarriage. Infection near term can lead to congenital leptospirosis, stillbirth, hepatorenal failure, jaundice, or developmental abnormalities. *Leptospira* spp. can be passed to a newborn through breast milk as well as through the placenta before birth (Puliyath 2492). Pregnant woman will experience headache, fever, chills, muscle pain, abdominal pain, vomiting, diarrhea, anorexia, enlarged lymph nodes, red throat, rash, and enlarged spleen and liver (Puliyath 2492). Unfortunately, the clinical signs of leptospirosis are very similar to influenza, dengue fever, meningitis, malaria, hepatitis, and urinary tract infections; this often leads to misdiagnosis (Puliyath 2493-2494).

People usually become infected with *Leptospira* spp. through contact with the urine of infected animals. However, infection may also result from contact with stagnant water, soil and vegetation that has been contaminated as well as rat infestations, or an unhygienic environment, all of which have been contaminated by infected urine (Puliyath 2491). Certain activities put people at higher risk for infection, such as raising livestock, working in a slaughter house, practicing veterinary medicine, agricultural farming, mining, gardening, and participating in aquatic sports. Infection usually occurs through abraded skin, contact with mucous membranes, ingestion, inhalation, and even sometimes through healthy skin. *Leptospira* spp. can live in freshwater up to sixteen days and live in the soil for as long as 24 days (Puliyath 2492).

A large part of leptospirosis prevention focuses on hygiene. The best prevention measures are:

1. Wash hands thoroughly.

2. Wear gloves or protective clothing when participating in high risk activities.
3. Drain lowlands or stagnant water if possible.
4. Control rodent infestations.
5. Dispose of garbage properly.
6. Control infection in domestic animals through vaccine and management.
7. Do not swim in freshwater that may be contaminated.

If these hygiene measures are followed, then there is a low risk of human infection (Acha 1:165).

Q Fever

Q fever is caused by *Coxiella burnetii*, which is a rickettsial disease (Acha 2:16). Infection from *C. burnetii* comes mainly from sheep, goats and cattle, however cats and dogs can also be a source for zoonotic concern (Weese 145). Q fever is an important maternal health concern because if a pregnant woman becomes infected she may have a spontaneous abortion, her baby may be born prematurely, or it may result in low birth weight (Weese 146). Immunosuppression during pregnancy may also result into a chronic Q fever infection in the mother (Weese 147).

Q fever is found distributed around the world (Acha 2: 17). The CDC estimates that in the U.S. there are approximately 50-60 cases are reported each year with an incidence of 0.28 cases per million people (Q fever). *C. burnetii* infection generally only causes clinical disease in people, while disease in animals usually is subclinical and goes unnoticed (Weese 146). *C. burnetii* is a highly infectious organism and it only takes exposure to a few organisms to cause clinical disease in a healthy person. *C.*

burnetii is shed by infected animals in feces, urine, milk, placenta, and secretions from the uterus. Direct contact with the organism is not always necessary for infection and ingestion and inhalation of the organism will also produce infection. The majority of infections occur after a pregnant animal gives birth due to the high numbers of bacteria present at that time (Weese 145). The highest risk of infection from pets is direct or indirect exposure to cats that have just given birth. Q fever infection from dogs is possible but rare (Weese 146).

Clinical signs in people infected with *C. burnetii* occur suddenly and include fever, sweating, lethargy, muscle pain, anorexia, chills, pain behind the eyes, headaches, vomiting, and diarrhea (Acha 2:19). Once infected the average incubation period is twenty days, but can range from fourteen to thirty-nine days (Acha 2:19). Other rickettsial diseases commonly cause rashes, but with Q fever development of a rash is rare. However, pneumonia and an enlarged spleen or liver also may develop. Clinical presentation of fever, hepatitis, and pneumonia are highly indicative of Q fever (Weese 146). Diagnosis of Q fever can be difficult due to the vague clinical signs, but if not treated quickly chronic disease is more likely (Weese 146).

The best preventative measure for a pregnant woman is just to avoid animals giving birth and any newborn animals, especially because of the possibility of aerosol transmission (Weese 148). Dogs and cats that may have contact with pregnant ruminants, especially sheep, should not be allowed to eat or touch placenta or fluid from the uterus. Always practice good hygiene if there is a possibility your pet has had contact with an animal that has just given birth (Weese 148).

Lymphocytic Choriomeningitis

Lymphocytic Choriomeningitis is a disease that is caused by a single stranded RNA virus, Lymphocytic Choriomeningitis Virus (LCMV). LCMV is an arenavirus and is transmitted by rodents (Bonthius 89). The main source of infection to humans is from wild mice, but pet hamsters and guinea pigs are also a concern (Weese 251). Pet rodents are infected with LCMV from wild mice at the breeder, pet store, or home (*Lymphocytic Choriomeningitis (LCM)*). LCMV is a maternal health concern because if a pregnant woman is infected in the first trimester of pregnancy the fetus may die; if the mother is infected in the second or third trimester the baby could have significant birth defects such as eye problems, developmental retardation, or hydrocephalous (*Lymphocytic Choriomeningitis (LCM)*). Infected mothers transmit LCMV to her fetus through the placenta (Bonthius 90). This congenital infection commonly causes chorioretinitis, inflammation of the choroid and retina, and severe vision loss, but the child usually suffers more from the neurologic problems caused by the virus (Bonthius 92). LCMV infection in a fetus can cause the brain to be too large (macrocephaly) due to hydrocephalus or too small (microcephaly) because the virus prevents the brain from growing normally (Bonthius 92). Congenital LCMV infection may be underdiagnosed in cases of congenital neurologic and eye diseases (Bonthius 90). Several other infectious diseases can be transmitted across the placenta and cause similar damage to the fetus making diagnosis of LCMV difficult. These include *Toxoplasma gondii*, rubella virus, cytomegalovirus, herpes simplex virus, and syphilis. The acronym "TORCHS" is used to describe this group of pathogens (Bonthius 93).

LCMV is shed by rodents in their feces, urine, and saliva. An infected rodent can shed for as long as eight months. Humans are infected by inhalation of aerosolized virus most commonly but bites and direct contact with rodents can also be modes of transmission. There are a few cases of infection from an organ transplant (Weese 252). The majority of human infections show no clinical signs or may result in a mild disease (Weese 252). Clinical signs in humans occur in two phases. Clinical signs usually emerge eight to thirteen days after the initial exposure to LCMV and symptoms include: fever, lethargy, decreased appetite, muscle pain, headaches, nausea, and vomiting. Other symptoms may include pain in the throat, joints, chest, testicles, and salivary glands, as well as a cough. This first phase may last up to a week. A few days after recovering from the initial symptoms, the second phase begins. The symptoms in the second phase are neurological and are due to meningitis, encephalitis, or meningoencephalitis. People may experience a fever, headache, stiff neck, tiredness, confusion, and sensory and motor deficits (*Lymphocytic Choriomeningitis (LCM)*). Infected rodents are usually asymptomatic (Weese 252).

Prevention is aimed at sanitation, hygiene, and avoidance of rodents:

1. Control wild rodent populations in homes, pet stores, and breeding facilities.
2. Do not allow pet rodents to roam free in your house if there is a possibility it can be exposed to wild rodents.
3. Safely handle pet rodents to avoid bites.
4. Wash hands well after handling pet rodents, their bedding, or cleaning cages.
5. Do not bring new pet rodents into the home of a pregnant woman.

6. Pregnant woman should not have contact with any rodent or area that may be contaminated with rodent feces or urine (Weese 253).

Discussion

All four of these diseases can potentially be detrimental to a mother, her unborn child, or her newborn. Fortunately, with proper education on disease risk and prevention the potential hazards of these zoonotic organisms can be greatly reduced. Prevention starts with first knowing your individual risk factors for exposure to a particular organism. These risk factors include pet ownership, especially if a new cat or rodent has been added to the household recently, exposure to pregnant goats and sheep, rodent infestations in the home, gardening, farming, and consumption of undercooked or raw meat. Good personal and environmental hygiene are also very important factors in preventing these diseases. Pregnant women who have pets and are in direct contact with animals or animal feces and urine, should discuss any potential risks with a veterinarian and physician. If an expecting mother is ill, she should immediately see her physician. Any exposure to animals, direct or indirect should also be reported to her physician to rule out infection with a zoonotic disease, or aid in a quick diagnosis so that treatment may start early if there has been an infection.

Conclusion

Completing my field experience and capstone project were great educational experiences for me. It allowed me to see how a DPH operates on a day-to-day basis. Not only did I observe a lot of daily activities, but I also had the opportunity to get some hands on experience on some of my rotations. I enjoyed helping with the inspections at the hospital and Child Development Centers on post as well as performing some of the water chlorine level tests. It was also interesting to see how VS worked in conjunction with the DPH, especially for cases of possible zoonosis. While I was doing my field experience there was a possible exposure to a cat with tularemia, and they were having problems with bats in people's offices in one of the buildings. In the case of the bats, IH worked with VS to educate the staff regarding rabies exposure in the building with the bats and work on a solution to prevent the bats from entering the offices. I unfortunately do not know what they ultimately decided. I have been a veterinarian for eleven years and my job has a public health aspect to it already. I discuss zoonosis concerns with my clients on a regular basis. These discussions range from can my pet give me worms, mites, heartworms, fungal/bacterial infections, or I am pregnant, do I have to give up my cat? I unfortunately do not have the opportunity as a veterinarian to collaborate with human health care colleagues on any zoonotic concern. After completing my field experience, I have a better understanding of human health and public health, and I feel that there is a gap between human public health and veterinary public health regarding zoonosis. I feel that overall public health could be improved in the area of zoonosis if veterinarians, physicians, and other human health care providers actually collaborated to identify risk factors for zoonosis as well as provided education

on prevention, and aid in diagnosis so that treatment can be started early. I feel that my DVM degree and my MPH degree are a perfect complement to each other and will allow me to help bridge this gap between animal and human health.

Completing my capstone project helped me delve more deeply into zoonosis and I feel that because of this project and my field experience I will be better prepared to discuss zoonotic concerns with my clients and colleagues in the future; this will help me to start to bridge that gap between human and veterinary public health. Creating the information sheets will also be a great resource that I can share with my clients during zoonosis discussions as well as colleagues that need more information on zoonosis in maternal health. I plan to create a website and make these fact sheets available to print as a pdf to other veterinarians as well as human health care providers. I want to work with the Kansas Veterinary Medical Association as well to make these fact sheets available through their website. I am going to contact all the veterinary and physicians' offices in Manhattan, KS as well to inform them that these fact sheets are available for their use on my website.

References

Acha, Pedro N., Szyfres, Boris. *Zoonoses and Communicable Diseases Common to Man and Animals*. 3rd ed., vol. 1, Bacterioses and Mycoses, Pan American Health Organization, 2003, p. 157-167.

Acha, Pedro N., Szyfres, Boris. *Zoonoses and Communicable Diseases Common to Man and Animals*. 3rd ed., vol. 2, Chlamydioses, Rickettsioses, and Viroses, Pan American Health Organization, 2003, pp. 16-27, 193-199.

Acha, Pedro N., Szyfres, Boris. *Zoonoses and Communicable Diseases Common to Man and Animals*. 3rd ed., vol. 3, Parasitoses, Pan American Health Organization, 2003, pp. 76-86.

American Veterinary Medical Association. "U.S. Pet Ownership and Demographic Sourcebook 2012". www.avma.org.

Bonthius DJ. "Lymphocytic choriomeningitis virus: An under-recognized cause of neurologic disease in the fetus, child, and adult". *Seminars in pediatric neurology*, vol. 19, no. 3, 2012, pp. 89-95.

Brooks, Wendy. "Toxoplasmosis". *Veterinary Information Network (VIN)*. July 21, 2009.

Centers for Disease Control and Prevention. "Lymphocytic Choriomeningitis (LCM)", May 6, 2014. www.cdc.gov/vhf/lcm/pdf/factsheet.pdf

Centers for Disease Control and Prevention. "Toxoplasmosis". *Neglected Parasitic Infections in the United States*.

www.cdc.gov/parasites/resources/pdf/npi_toxoplasmosis.pdf

Centers for Disease Control and Prevention.

<http://emergency.cdc.gov/agent/qfever/clinicians/epidemiology.asp>

Centers for Disease Control and Prevention.

www.cdc.gov/parasites/toxoplasmosis/epi.html#mom

Fort Riley Department of Public Health information pamphlet, February 25, 2015.

Kahn, Laura H. "Confronting Zoonoses, Linking Human and Veterinary Medicine". *Emerging Infectious Diseases*, vol. 12, no. 4, April 2006, pp. 556-561.

Puliyath, G., Singh, S. "Leptospirosis in Pregnancy". *European Journal of Clinical Microbiology and Infectious Disease*, vol. 31, 2012, pp. 2491-2496.

Weese, J. Scott, Fulford, Martha B. *Companion Animal Zoonoses*. Wiley-Blackwell, 2011, pp. 67-75, 145-148, 157-164, 251-253. 299-309.

Wortinger, Ann, "Zoonosis: What Is All the Fuss About?", Wild West Veterinary Conference 2015, pp. 1-5.

Appendix A: Toxoplasmosis

Toxoplasmosis prevention in pregnancy

Toxoplasmosis is caused by a protozoan called *Toxoplasma gondii*. Infection of a pregnant woman can lead to a miscarriage, stillbirth, or congenital abnormalities such as blindness, neurologic problems, and mental retardation.

Sources of Infection:

- Domestic or wild feline feces
- Contaminated meat
- Water or soil contaminated with feces from infected felines.



Clinical signs in cats:

Infected cats may have some mild diarrhea for about 10 days, but MOST cats show NO clinical signs of infection with *T. gondii*.

Figure 2



T. gondii oocysts

Clinical signs in humans:

- Fever
- Lethargy
- Sore throat
- Muscle pain
- Swollen lymph nodes
- Enlarged spleen and liver

Prevention:

- Thoroughly cook all raw meat
- Do not allow cats to hunt outside or eat raw meat
- Litter box should be cleaned at least once daily and wash hands well
- Pregnant woman should avoid cleaning litter box or wear gloves and wash hands well when done
- Do not dispose of cat litter in the yard
- Wear gloves when gardening
- Do not drink raw milk

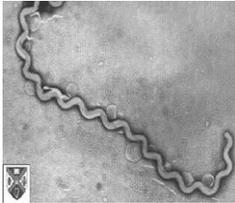


Do I have to get rid of my cat if I am pregnant? NO. Not if you follow the prevention tips listed above you do not need to rehome your cat. Contact your veterinarian or physician with any questions.

Appendix B: Leptospirosis

Leptospirosis prevention in pregnancy

Leptospirosis is caused by a spiral shaped bacterium called *Leptospira interrogans*.



L. interrogans

Figure 3

Infection of a pregnant woman can lead to miscarriage, stillbirth, liver or kidney failure of the fetus, jaundice, or developmental abnormalities. The infection can be transmitted from the mother through the placenta or breastmilk.

Sources of infection:

- Urine of infected mammals
- Stagnant water, soil, or vegetation contaminated by infected urine
- Rat infestations
- Any environment they may be contaminated with mammal urine



Infection can occur through abrasions on the skin, contact with mucous membranes, ingestion, and inhalation.

Clinical signs:

- Headache
- Fever/chills
- Muscle pain
- Abdominal pain
- Vomiting and diarrhea
- Anorexia
- Enlarged lymph nodes
- Red throat
- Rash
- Enlarged spleen and liver

Prevention:

- Thoroughly wash hands
- Wear gloves or protective clothing when participating in high risk activities
- Drain lowlands or eliminate stagnant water
- Control rodent infestations
- Proper garbage disposal
- Control infection in domestic animals through vaccination and management
- Do not swim in fresh water that may be contaminated

Contact your veterinarian or physician with any questions.



Appendix C: Q Fever

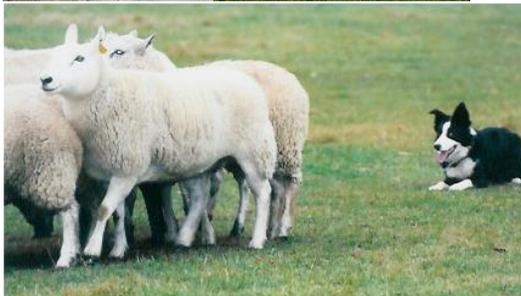
Q Fever prevention in pregnancy

Q fever is a rickettsial disease caused by *Coxiella burnetii*. Infection in pregnant woman can cause spontaneous abortion, a premature birth, or result in low birth weight. Due to immunosuppression during pregnancy, the mother may also become chronically infected.



Sources of infection:

- Cats that have recently given birth
- Ruminants (sheep and goats) that are pregnant or have just given birth
- Dogs that have eaten or touched placenta or uterine fluid after a mammal has given birth-especially sheep



Clinical signs:

- Fever
- Sweating
- Lethargy
- Muscle pain
- Anorexia
- Chills
- Pain behind the eyes
- Headaches
- Vomiting
- Diarrhea



Prevention:

- Pregnant woman should avoid animals giving birth and any newborn animals, such as stray, pregnant cats
- Prevent cats and dogs from having contact with ruminants, especially sheep that are pregnant or have just given birth
- Do not allow dogs and cats to eat or have contact with placenta or uterine fluid from ruminants
- Practice good hygiene if your pet may have had contact with and animal that has just given birth

Contact your veterinarian or physician with any questions.

Appendix D: Lymphocytic Choriomeningitis

Lymphocytic Choriomeningitis prevention in pregnancy

Lymphocytic choriomeningitis is a disease caused by the Lymphocytic Choriomeningitis Virus (LCMV). Infection in pregnant woman can result in fetal death or cause significant birth defects such as eye problems, developmental retardation, and neurologic problems.



Sources of infection:

- Feces, urine, and saliva
 - Wild mice
 - Pet hamsters
 - Pet guinea pigs
- Direct contact with infected rodents
- Inhalation of aerosolized virus from feces, urine, or saliva of infected rodents



Clinical signs:

- First phase
 - Fever
 - Lethargy
 - Decreased appetite
 - Muscle pain
 - Headaches
 - Nausea
 - Vomiting
 - Other symptoms include: pain in throat, joints, chest, testicles, and salivary gland as well as a cough
- Second phase (full recovery for first phase)
 - Fever
 - Headache
 - Stiff neck
 - Tiredness
 - Confusion
 - Motor and sensory deficits

Prevention:

- Control wild rodent infestations
- Pregnant woman should not have contact with any rodents or area that may be contaminated with rodent feces or urine
- New pet rodents should not be brought into the home of a pregnant woman

Contact your veterinarian or physician with any questions.