Equine Biological Risk Management

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Introduction

Although horses are considered by some to be companion animals, the equine industry is a major economic force in the U.S. There are 7.1 million people involved in the equine industry and 6.9 million horses in the U.S. The U.S. horse industry also has a total impact of $112.1 billion on the U.S. Gross Domestic Product, an amount that is greater than the motion picture industry. The horse industry is only slightly smaller than apparel and textile product manufacturing.

Biological risk management (BRM) is an important and complex aspect of rearing equine. Few farm or facility owners have plans in place or understand the basic practices that can be implemented to minimize the risk of infectious agents to their animals. This document highlights the importance of BRM in equine facilities through risk analysis. In looking at total risk analysis, we will take into consideration risk perception, hazard identification, risk assessment, risk management, and risk communication.

Risk Perception

Risk perception is what those involved with the operation believe about the real and potential risks of infectious and zoonotic disease. These perceptions may be influenced by what has been encountered on the farm in the past, or by what owners, staff and clients may have read in magazines, in newspapers or on the internet.

Obstacles and challenges to educating about risk management may be encountered. Many individuals have negative perceptions associated with risk management, most of which are based on a perceived lack of necessity or on economic grounds. Efforts to exclude disease are often thought of as costly, cumbersome, and unnecessary if a complete vaccination program is in place. However, this is not the case. A recent outbreak at a college facility in Ohio illustrates the need for re-examination of the commonly held but inaccurate perception that vaccination is 100% effective protection against disease.

In January and February of 2003 an outbreak of equine herpesvirus type-1 (EHV-1) swept through the University of Findlay in Ohio. In January, approximately 30 horses were shipped to the University of Findlay training facility where approximately 145 horses are housed in three connecting barns. Resident horses are vaccinated for influenza and equine herpesvirus every two months. New arrivals are required to have been vaccinated 10-45 days prior to arrival at the facility.

By the second week in January, some horses began exhibiting signs of mild depression, inappetance, and fever. Over the next few days, 118 horses had a fever and 45 horses had neurologic signs. Equine herpesvirus type-1 was isolated from the ill horses. The University of Findlay immediately instituted quarantine procedures for the facility, which remained in effect for 21 days after the last fever was recorded. Fortunately, the outbreak was confined to the facility and did not spread to nearby areas.

Due to the number of animals infected and the design of the facility, it is believed that the virus spread throughout the facility by aerosol transmission. The exact cause of introduction of the virus was never determined. In the end, approximately 85% of all horses at the facility developed a fever, and 14 horses died or were euthanized.

Although outbreaks of EHV-1 are not uncommon, what made this outbreak unusual was the high mortality rate. Although these horses were vaccinated against herpesvirus, vaccination does not protect against the neurologic form of the disease. This example illustrates the need for every facility, regardless of vaccine protocols, to be vigilant about the management of infectious disease risks.

Hazard Identification

An important step in the process of risk management is the identification of the diseases most likely to affect an operation. Owners will already have an idea of infectious agents they have encountered on the farm and may have knowledge of other endemic agents in the area. Some diseases have widespread geographic distribution and should be included as potential hazards on any farm list. One must also always be aware of foreign animal disease, emerging animal disease, bioterrorism, and agroterrorism agents. The enormous impact of West Nile Virus (WNV) on the equine population is a potent example of an emerging infectious disease that has now become established in the U.S.

West Nile Virus is a disease that can cause inflammation of the brain and the spinal cord, and is spread by the bite of an infected mosquito. The disease was previously seen only in Africa, Asia, and southern Europe. However, this all changed when WNV was detected in the United States in 1999. In the year 2000, there were 60 confirmed cases of WNV in seven different states. Of these 60 cases, 37 horses survived and 23 (38%) died or were euthanized. In 2001, there were 738 cases of equine WNV from 20 states with an outcome of 32% mortality. By 2002, WNV had spread to 40 states and infected 14,717 horses. The number of WNV cases finally decreased in 2003 to 5,181 due in part to a vaccine that became widely available in late 2001. West Nile Virus is now considered endemic in the U.S. This example shows how quickly a devastating disease can move through a susceptible population and become established in a country.

Risk Assessment

In order to accurately assess the levels of risk in equine facilities, a review of the types of facilities commonly used to house horses and other equine is in order. According to the Equine '98 National Animal Health Monitoring System (NAHMS) study, 78.4% of equine operations have stalls available for their horses. Most operations consist of a barn or shelter that can be used to confine the horse and is connected to a pasture, paddock or dry lot that allows the horse to exercise. The number and activities of the horses are generally what distinguishes one facility from another. Boarding and training facilities usually have a high volume of horses with a rapid turnover rate. Breeding farms also tend to have a high number of horses with a high turnover rate. Breeding farms present a unique challenge in that young, susceptible foals are present. Farm and ranch settings tend to have working horses that remain in the same facility until sold or

deceased. The animals may leave periodically to travel to recreational events or to be bred but generally remain in the same facility.

Other operations exist that do not fall into the above categories and some may have a combination of one or more types of facilities on one premise. It is important to evaluate the facility and identify unique characteristics that may provide unique risks to infectious agents.

It is also important to evaluate the types of horses located at a facility. Horses will vary on their ability to carry or transmit disease based on their age, sex, work load, and other factors. High performance horses such as racing, showing/competition, and working horses tend to have a high workload and are exposed to many other horses from different backgrounds thereby increasing the risk of disease transmission.

The risk of zoonotic disease is always a factor when owning or working with equine, so the human population must also be considered and characterized as potential vectors or victims of infectious/zoonotic diseases. *Leptospira*, rabies, and *Salmonella* are just a few of the zoonotic diseases that can be carried by horses. Owners, workers, and visitors should all be aware of the potential of zoonotic and equine specific agents that could be carried to and from horses and follow appropriate biosecurity measures.

Risk assessment deals with the likelihood of disease introduction and the estimation of potential consequences, which includes not only the illness or death of animals, but also loss of client confidence, public image and staff morale.

In 1996 Colorado State University Veterinary Hospital experienced an outbreak of *Salmonella infantis* among their large animals, primarily horses. Fecal samples from 28 horses were negative for *S. infantis* at the time of the horses' admission to the hospital, but were positive after hospitalization for at least 72 hours. Environmental sampling of the hospital detected *S. infantis* from rectal thermometers, hands of hospital personnel, and from the aisle of a stall that had been disinfected twice after housing a horse that was shedding *S. infantis*.

After detection of the outbreak, the teaching hospital was closed to new admissions. In the end, the outbreak involved 59 animals (primarily horses) and the death of three animals was attributed to complications from *S. infantis* infection. The hospital lost an estimated $300,000 in revenue during the epidemic, and required an additional $250,000 in facilities renovation. The financial impact was probably even greater, as these figures did not account for losses such as diminished client confidence, morale problems among hospital staff, and the disruption of veterinary student education.

The bottom line is, if a disease were to enter a facility, would it spread? A walk through assessment will help characterize and clarify potential areas of exposure and reveal areas in need of improvement.

Risk Management

Risk management is the process of identifying, selecting, and implementing measures that can be applied to reduce the level of risk. Options will need to be explored and

changes will have to be assessed for feasibility and efficacy. Risks may be deemed to be acceptable or unacceptable, and potential prevention and control options deemed desirable or unnecessarily burdensome.

Risk management plans should include management aimed at general farm practices, modes of transmission for disease agents and individual operation guidelines that are geared towards individual facility issues. As the name states, individual operation guidelines must be tailored for an individual facility and the issues that are specific to that farm. Obviously, these guidelines cannot be generated until a facility walk-through has been completed, and the assessor is familiar with the facility and its capabilities.

General Farm Practices

Perhaps the easiest way to assess the general management issues of an equine operation that could impact biosecurity is through a life-cycle analysis of animals housed at the facility. When looking at horse age from a disease risk standpoint, three groups tend to form: late gestation mares and foals, geriatric horses, and the group of "horses in between." These main groups can then be further classified based on performance (activity) level.

Foaling represents a significantly higher disease risk period for both the mare and the foal. During late gestation the mare's immune system is reduced, and after birth, the neonatal foal has limited immune capabilities for many months. The risks can be minimized by providing a clean, hygienic foaling environment, by ensuring that every foal ingests an adequate amount of quality colostrum, and by testing the foal at 24 hr of age to check for adequate blood IgG levels.

If pastures are used for foaling, they should be well drained and away from bottomlands, with no standing water (which tend to collect contaminants and breed vectors). Depending on prevailing weather conditions, wind breaks and/or shade may be desirable. Foaling on clean, dry pasture has been shown to reduce the incidence of respiratory and gastrointestinal diseases; however, it does not prevent the spread of reproductive diseases as mares have access to birthing products (amniotic fluid, placenta, etc.).

Many breeders prefer to foal mares in large foaling stalls. If this is the foaling method of choice, then ideally, each mare should have her own foaling stall and stalls should be deeply bedded with an absorbent material. Stalls should be promptly cleaned after foaling to minimize contaminants in the newborn foal's environment. Foaling stalls should also be meticulously cleaned and disinfected in between each use.

Soon after birth the navel of the foal should be coated in a disinfectant such as 7% iodine or a 0.5% chlorhexidine solution. The navel is a prime entry spot for disease organisms, and is in constant contact with the environment as the foal spends a majority of time laying down. Failure to disinfect the navel or allowing the environment to be contaminated increases the risk of navel infection and/or septicemia.

To ensure that the foal receives quality colostrum, the mare's colostrum should be checked with a colostrometer within 6 hours after foaling. The colostrum should

measure 1.06 or greater. Good quality colostrum can be collected from mares that produce large amounts, or from mares that have lost their foal. To collect colostrum, the mare's udder should be cleaned and employees with clean hands (or wearing latex/nitrile gloves) should collect the colostrum into a clean storage container. If the colostrum will not be used within 2-4 hrs, it should be refrigerated. If the colostrum will not be used within 24 hrs, it should be stored in a non-frost free freezer. Colostrum stored in frost free freezers is constantly going through freeze/thaw cycles which over time can diminish quality. Frozen colostrum should be discarded after one year to ensure quality is maintained.

Blood IgG levels should be obtained from the foal by 24 hr of age. Levels greater than 800 mg/dl are ideal. If IgG levels are less than 400 mg/dl the foal is at a high risk of developing neonatal infections. At risk foals can be managed by receiving intravenous plasma to raise circulating IgG levels.

Care needed for the nursing foal is usually minimal, provided the mare is receiving adequate nutrition and the foal received adequate colostrum. However, potential risks are encountered when new animals (horses, dogs, wildlife, etc.) are brought in contact with the young foal. This practice should be discouraged because of the tremendous susceptibility of the foal to any novel pathogens.

The weaning period is one of the greatest periods of stress and disease for foals. Similar to foaling, the environment in which weaning takes place greatly impacts the likelihood of disease. If weaning is done in a stall or small paddock, the stocking density is typically increased, enhancing the transmissibility of disease via aerosol, direct contact, oral, and vector. However, the feed and water sources are better controlled, and contact with other animals can be more effectively limited. Pasture weaning typically offers the benefits of lower stocking density, but it is more difficult to control water quality and exposure to other animals including wildlife. Another consideration is whether the mare or the foal (or both) are moved for weaning. Ideally, the mare is removed and the foal is left in familiar surroundings. This limits the exposure of the foal to new pathogens during this stressful period. Also, co-mingling of groups of foals should be avoided during the weaning period.

Unless the young growing horse is showing in competition, most young horses are minimally managed. These horses are often turned out to pasture in groups until formal training begins. After this time, disease risks are based more on stress/training level, housing, and exposure, and less on the age of the animal.

When multiple animals are housed at the same facility, it is recommended that they be separated into groups based on age and stage of production (performance, broodmare, idle). As mentioned previously, foals, yearlings, and pregnant mares are at greatest risk. Additionally, young animals may be more susceptible to some diseases than are older animals. Rigorous performance training and transportation can also increase stress levels and decrease immunity in performance horses. Therefore, intermingling of animals of different ages or different performance levels increases the risk to all populations. Each operation should establish an order of susceptibility for the populations on their farm. All animal work and facility design should then proceed from lowest risk-most susceptible populations to highest risk-greatest resistance populations.

This would include the order of feeding (although it would be preferred to use different equipment for each group), and location of designated pastures, barns and facilities (most susceptible should be prevented from potential contact with manure storage, neighboring operations, isolation and treatment facilities, and other areas of high risk).

The extent and effectiveness of segregation measures will depend on physical proximity, and other factors. For example, fence line contact may reduce transmission of some orally acquired diseases, but will not stop transmission of aerosol or direct contact pathogens. Multiple fence separation is therefore considered better. Sharing of feed or water sources can also pose a risk, such as a stream running through multiple pastures or common use of feed buckets. Contact with neighboring operations and wildlife presents another, potentially greater, threat to all animals on an operation. While these likely cannot be eliminated, they may be minimized by providing greatest protection to the most susceptible population(s).

Just as the young foals are susceptible to disease, geriatric horses also have increased disease susceptibility. Although the exact age at which a horse is considered geriatric is debatable, a general rule is that horses 18-20 years old are entering their golden years. There are four main factors that influence a geriatric horse's ability to stay healthy: decreased nutrient absorption, poor teeth, decreased immune response and age-related disease. Decreased ability of the intestine to absorb phosphorus, vitamins, and protein has been reported in aged horses. This decrease in nutrient absorption not only affects overall body condition but also the functional ability of the immune system. An increase in dental problems also contributes to nutritional problems when food is improperly chewed or not consumed due to tooth pain. Therefore, proper nutrition of the geriatric horse becomes an integral part of managing disease in this population.

Although there appears to be little effect of aging on the innate immune response, acquired immunity is affected by aging. Antibody response to vaccination is decreased in older horses and T cell function is lowered. Geriatric horses are also prone to develop age-related disorders such as liver failure, kidney disease, tumors, and anemia. Although these are not considered infectious diseases, they can influence the immune system and thus contribute to a geriatric horse's increased susceptibility to disease.

Other management decisions that relate more to the stage of production can still have a significant impact on facility biosecurity. One example would be artificial insemination (AI) in breeding animals. Artificial insemination enables owners to use well-proven, high quality stallions and to maximize genetic improvement. A negative impact may occur in that mares are often confined in a relatively small area during the breeding season to facilitate heat detection. This increases the stocking density, and subsequently the risk of disease transmission. However, AI reduces the likelihood of venereal transmission (see section on "Reproduction"), assuming semen is obtained in a hygienic manner and proper AI technique is used. Use of shipped, cooled semen or frozen semen also allows mares and foals to remain at home instead of being exposed to pathogens at a new facility. The same is true for stallions which can be collected in an isolated facility and not risk exposure to multiple mares.

Health Protocols

Arguably, the greatest impact on disease management is determined by the measures directly taken to prevent and treat disease. The first step is to develop a standard (and preferably written) health protocol. The protocol should define goals and outline specific means of ensuring the objectives of the facility are achieved. This should include standard operating procedures for: identifying, examining, separating and treating sick animals; administration of routine health procedures and schedules (vaccinations, deworming, castration, etc.); and general husbandry procedures.

In order to detect a disease early and prevent its spread, an owner must frequently observe the animals for signs of disease, and promptly separate potentially unhealthy animals. The duration of isolation will depend on the disease, the facility and the animals at risk. The ability to effectively isolate sick animals will be greatly impacted by the quality, location and management of treatment and isolation facilities. Preferably, treatment areas for sick animals should not be used for healthy animals; at the very least, thorough cleaning and disinfection should be done after use for ill animals (see Disinfection 101 for information on disinfection). Additionally, all treatment items (syringes, needles, thermometers, etc.) should be thoroughly disinfected or properly disposed of after use. Finally, owners, veterinarians, employees and anyone else interacting with the animals should be certain to limit the potential of spreading disease from affected to susceptible animals. This involves always treating, feeding, or handling the most susceptible animals first and sick animals last, while taking appropriate disinfection precautions between groups. When disease diagnosis is uncertain or a disease of severe consequence is suspected, producers should recognize the importance of having a veterinarian examine affected animals, collect and submit proper diagnostic samples, and perform necropsies.

Vaccination should not be a substitute for proper BRM practices, but should be an integral part of a comprehensive BRM plan. It is important that all horses be vaccinated for diseases that are prevalent in the area and which for which a proven vaccine is available. Not all diseases can be vaccinated against, and some vaccines are less effective than others. Although vaccines are not 100% effective for disease prevention, they can greatly reduce disease incidence and can also reduce the severity of clinical signs for some diseases. Vaccination protocols should be reviewed annually. As a reference, the AAEP Guideline for Vaccination is included as a handout.

New Introductions and Animals Returning to the Farm

The most effective way to prevent introducing a new disease would be to prevent incorporating new animals into the herd. This is obviously not an option for many equine operations, so accepted risk reduction practices need to be established. Risk can be minimized by limiting the frequency and number of new introductions and by establishing a strict isolation procedure for new arrivals.

Continual introductions to an established group of horses results in not only social stress, but also repeated exposure to new pathogens. Purchases should be limited to a minimal number of sources, preferably with a known and trusted horse health program. It is not unreasonable to request records of vaccinations, illness and treatment of purchased animals. A veterinary purchase exam or health certificate examination can also ensure that animals are not showing any outward signs of disease at the time of

purchase. However, it is important to remember that horses can be infected and shedding pathogens prior to the time they exhibit outward clinical signs of illness. New purchases should ideally arrive with a health certificate, negative Coggins test, and be vaccinated for diseases of concern at least 2-4 weeks prior to arrival at the new facility.

There are inherent risks associated with purchasing animals of certain ages. This should be recognized and used to guide purchase decisions. For example, purchasing young (less than 2 yrs of age) animals has a greater risk of introducing certain illnesses such as diarrhea and respiratory diseases. Horses that have been previously bred could introduce reproductive diseases such as contagious equine metritis. Older animals are also more likely to have contracted chronic or latent infections. Susceptibility and/or clinical signs can also change with age. Younger naïve horses are often more likely to show clinical signs than are many older animals and some diseases cause more severe clinical signs in older animals. Also, older animals can develop tolerance to a disease and may not show clinical signs but could be a carrier. For example, an older horse can harbor *Streptococcus equi* in the guttural pouches but not show any clinical signs of the disease. Issues like these should be considered when choosing what diseases to test for and what age of horse to purchase.

It is generally recommended that newly acquired animals be quarantined. The same policy should also apply to animals returning to the operation, whether it is returning from a weekend show, or from months away at a training facility. The isolation facility should be capable of preventing contact with all other animals, including those in the herd of origin, neighboring operations and wildlife. The isolation facility must protect from all of the potential routes of transmission, and receive the same biosecurity scrutiny as all other areas of the operation. It is preferred that the isolation facility be located on the perimeter of the operation. This ensures ease of movement by allowing arriving horses to be unloaded directly at the isolation facility without having to be transported through any other portion of the operation. Like all other facilities, the isolation area should be cleaned and disinfected between uses (See Disinfection 101 for information on disinfection).

Length of isolation will depend on the degree of risk considered acceptable and the diseases of concern. If health status is unknown, quarantine times as long as 30 days have been recommended. This will allow adequate time for clinical signs to develop if the animal is incubating an acute infection. However, it does not eliminate the risk of chronic or latent infections that may not show symptoms for long periods of time (if ever). When health status and history are known and indicate low risk, quarantine periods of three to seven days have been recommended. In general, quarantine periods should exceed the incubation period of the disease of concern.

When animals are taken off of the operation (such as to shows, trail rides, races, breeding facilities, and facilities for embryo collection) and then returned, they should be handled as a new introduction. Additional measures should also be taken during their time away to limit their contact with other horses at the new facility. This includes prohibiting sharing of trailers, stalls, and feed or water with animals from other operations. Other items to consider include: halters and lead ropes, grooming supplies, feed and water containers, reproductive equipment (artificial vaginas for semen collection, speculums, etc.), saddle pads and blankets, among others. These items

should either not be shared or should be properly cleaned and disinfected between animals. Diligent efforts should be made to prevent fecal contamination of feed, water or the immediate environment by other animals. Direct contact with other animals should be minimized while the horse is away from the home facility.

Visitors and Human Foot Traffic

Vehicles present a tremendous opportunity for transporting many organisms and efficiently delivering them to susceptible animals in a short time. The first step in controlling the threats posed by vehicle traffic is to understand who brings vehicles onto the operation, what vehicles, where have they been, where (at the facility) they go, why, and how often. This scrutiny should be applied equally to all arrivals, including facility owners and family members, employees, buyers, veterinarians, delivery and service vehicles and visitors. All vehicle types should be examined, from cars and trucks to tractors and other equipment, trailers, and any other mobile objects that are brought on the property. An effective means of doing this is to create a visitors' log, where everyone is required to sign in and provide the above information.

Foot traffic also poses a significant risk. In order to keep track of who comes and goes, everyone who does not reside at the facility should be required to sign a visitor's log book. At the time of signing in, visitors should also be instructed on what areas are acceptable or unacceptable for foot traffic. It is important to inquire about visitors' contact with animals on other operations, and ask those at high risk of transmitting disease to take additional precautions (change clothes or return at another time). Regardless, restricted areas should be delineated and animal contact should be limited to the minimum necessary.

Owners can also consider requiring all visitors to put on clean coveralls and overboots. Providing clean coveralls and boots for visitors covers organic debris that may be on the visitor's clothing and can provide a barrier to disease introduction. Another option is to install a foot bath at the main entrance with the requirement that all visitors disinfect their footwear. There are limitations to the effectiveness of this, however. All debris must be cleaned off first, and the disinfectant solution must be kept under appropriate conditions (proper concentration, proper temperature, free of organic debris, etc.) A footbath that does not meet these conditions may in fact create a false sense of security while providing little to no protection.

Once the general management program of a facility has been reviewed, more specific recommendations can be made to limit disease transmission based upon routes of transmission.

Disease Transmission Management

Pathogenic agents can be spread from animal-to-animal or animal-to-human and vice versa, through five main routes of transmission: aerosol, oral, direct contact, fomite, and vector. Many disease agents, such as *Rhodococcus equi*, can also survive for extended periods of time in soil or other organic material and can then be acquired by animals or humans through inhalation (aerosol), oral consumption, direct contact, or via fomites. While not a route of transmission, environmental contamination must always be taken into consideration.

For the purpose of the BRM materials, zoonotic transmission (disease transmission from animals to humans) is considered a sixth route of transmission. Human exposure will actually occur through one of the other five routes of transmission, but because of its importance it is addressed as a separate route of transmission.

Each of these routes will be discussed and control strategies to manage disease risk recommended in the coming sections. Keep in mind, however, that these are general recommendations for managing disease transmission; more specialized management steps may be needed for specific disease control. Additionally, for diseases of unknown etiology, such as with Mare Reproductive Loss Syndrome, often the mode of transmission is not known for months.

In reviewing this material, it is imperative to understand that the focus is on routes of transmission, not specific disease entities. Assessing risk based on route of transmission provides a more complete and holistic approach and avoids emphasizing specific disease(s). The only references made to specific diseases, syndromes or infectious agents in this material are for illustrative purposes only, and there are no specific recommendations provided as to vaccination, treatment or testing procedures. This focus will make the information applicable to a variety of audiences and remain relevant even as scientific advances improve our understanding of diseases.

Aerosol

The ability of pathogens to survive and be transmitted in the air varies by organism as well as other factors such as temperature, humidity, and wind speed. However, the greater the distance of separation between an infected and a susceptible animal, the less likely transmission will occur. Direct contact between an infected and susceptible animal will almost invariably result in exposure, while pathogen concentration in the air decreases exponentially with distance. Therefore, increasing distance between susceptible animals and wildlife, animals from other operations, and new introductions should decrease the chance of infection via the aerosol route.

Appropriate ventilation is extremely important in reducing airborne disease transmission. Many horses spend large amounts of time confined in stalls in an indoor environment. Proper ventilation should ensure that the enclosure has the proper humidity and minimal odor. The idea humidity for horses is 50 – 75%. Increased humidity contributes to mold and bacterial growth, while low humidity levels cause an increase in dust. Air (odor) quality is also affected by ventilation. Respiratory problems can occur in foals when ammonia levels are only 10 ppm. This level is quite low and is below the detection level of many people.

A general rule of thumb for average temperatures and humidity is that there should be 8-10 air exchanges per hour, or that all the air in the building should be replaced every 6-7 minutes. The air exchange rate is increased for warmer temperatures and decreased for cooler temperatures. The temptation to close up a barn during cold weather should be avoided. As long as a horse is able to remain dry, cold weather rarely adversely affects health. However, inadequate ventilation due to a closed up barn will have an adverse affect on health.

Stocking density is also very important in determining disease spread within a population. This is because it influences not only the direct contact of susceptible animals with infected individuals, but it also influences the airborne pathogen load. This is particularly important when groups of horses are in a confined environment, such as at a feed trough, water tank, or while in a small corral. Excitement and stress of the animals play a role in aerosol transmission in these situations as well. Increased activity in a confined space creates dust, and raises the respiratory rate of the horses, leading to more coughing, increased respiratory effort, and decreased efficacy of clearance mechanisms. These factors increase the airborne pathogen load shed by infected animals, and the amount inhaled and transported to the deep lung tissues by susceptible animals. Thus, stocking density should be kept at the minimum acceptable level, situations that lead to congregation should be limited (i.e., provide multiple feeders and water sources), and stress and excitement should be minimized.

General recommendations for stocking density are difficult to make, since it is influenced by size of the animal, geographic region, and other environmental factors. However, a few general recommendations are available. In non-arid regions, 2-4 acres of pasture per horse are recommended if turnout time is unlimited and no supplemental feed is given. For shared feed bunk space, 36 inches should be allowed per adult horse.

Overhead sprinkler systems are sometimes used in areas where summer heat can be extreme. The system is used to cool the horses, but can also help reduce the airborne pathogen load by decreasing dust, pollen, and fungal spores that often cause upper respiratory tract problems. Care should be taken, however, to ensure that the sprinklers are adjusted properly so as to not create a muddy and overly moist environment where pathogens would thrive.

Oral

Oral transmission involves the consumption of pathogenic agents in contaminated feed, water or licking/chewing on contaminated environmental objects. Feed and water contaminated with feces or urine are frequently the cause of oral transmission of disease agents. Contaminated environmental objects could include equipment, feed bunks, water troughs, fencing, salt and mineral blocks, and other items a horse may lick or chew.

Controlling the source of feed and the feed quality is important for minimizing oral disease transmission. For many horse facilities, the principle feed source is pasture. Efforts to protect pasture include avoiding fertilization with high risk materials (non-composted manure), frequently dragging the fields to break up fecal piles (organisms die more rapidly when exposed to heat, sunlight, and wind), and avoiding overgrazing, which forces animals to graze closer to the ground and nearer to fecal piles.

In addition to pasture, all consumed products should be evaluated. This includes hay, grain, mineral mixes, and other supplements. However, even the best feed can become a disease risk if not handled and stored correctly. This typically means preventing access and contamination from any animals, including wildlife, birds, vermin and scavengers, as well as dogs, cats, horses and other livestock which may urinate, defecate or otherwise introduce disease. Equine protozoal myeloencephalitis is one disease which can be transmitted by ingestion of feed contaminated with opossum feces. For certain

feedstuffs, like hay and grain, proper storage may also mean protection from weather (to prevent spoilage and mold growth).

Feeding hay can present a unique challenge for disease control when horses are group fed. Use of hay rings or similar feeding methods congregates horses in a small area and can lead to environmental contamination with feces and urine. Dispersing the hay (scattering flakes or unrolling large round bales) reduces animal congregation, but can lead to contamination of the hay when the horses lay on it or soil it. Regardless of the method used, frequent changing of the feeding area and minimizing stocking density are beneficial.

Water sources are another risk factor for disease transmission. Water may be derived from natural sources (ponds and streams) or specifically designated sources (buckets, troughs, automatic waterers). Natural sources are often used in pastures because of convenience and reduced expense. However, artificial sources are preferable because of the increased ability to control water quality and prevent contamination. There is a great deal of variation in types of watering containers used and this greatly impacts the measures necessary to properly clean and maintain the water supply. Regardless, containers should be examined regularly for functionality and cleanliness. Containers should be cleaned of all organic debris, including manure, bedding, feed, leaves and other plant material. These provide a source and sustenance for many pathogens.

Water sources (whether natural or well/faucet) should be tested yearly. Tests for total dissolved solids reveals the sum of all minerals, bacteria, nitrates, algae, and solid particles in the water and levels below 1,000 ppm are considered satisfactory for livestock. Coliform bacteria counts should also be completed. High coliform counts may signal contamination from manure or a septic tank.

If horses are allowed to drink directly from natural sources, owners should consider the risk of contamination by wildlife, fecal material, urine, and environmental toxins. Streams pose an additional threat, due to the potential contamination from upstream.

Because many of the diseases contracted through the oral route originate from fecal contamination, waste management is vitally important in controlling these pathogens. A 1000 pound horse can produce approximately 50 pounds of manure per day (nine tons per year). This requires frequent waste removal, once to several times per day depending on housing, weather conditions (in hot weather, horses tend to drink more resulting in more frequent urination), and stocking density. Waste should be transported to a designated storage or disposal area that is out of contact with animals. Manure storage areas should be well-drained, level areas that prevent pooling of polluted runoff. It is also recommended that manure be composted to destroy bacteria and parasite eggs. Waste management equipment should also be designated for that sole purpose; equipment should not be used for other purposes, such as feed delivery.

Owners must recognize that they may unwittingly be permitting exposure of their animals to waste from other facilities by streams and waterways, or direct runoff. Such exposure may be transient (such as following a hard rain), but no less significant. A thorough examination of the operation's perimeter is required to assess where such points of access may occur and how they can be controlled.

The survival of pathogens within manure depends on a variety of factors including sunlight, drying, freezing/thawing cycles, high temperature, high/low pH, exposure to oxygen, ammonia concentration, types of pathogen present and the adsorption of the pathogen to soil. Generally speaking, the risk of spreading disease will be lowered by exposing the waste material to environmental conditions. The most important means of accomplishing this is to adequately disperse the material. Dragging pastures to break up and disperse fecal piles is often recommended to allow exposure of pathogens and parasites to environmental conditions. Because this practice does disperse the pathogens over a wider area, dragging should only be done in pastures that currently are not occupied and horses should be kept off the pasture for approximately two weeks.

Feces from other species can also serve to transmit disease to horses. While it is virtually impossible to exclude wildlife from a pasture, every effort should be made to prevent access of animals to stored feed and feeding areas. Birds and vermin are quite effective at transmitting disease and are common in feed storage areas. Owners should recognize that even domestic animals pose risks because dogs, cats, goats, sheep and cattle can all introduce disease to horses.

Feed and water sources during travel must also be considered. If possible, feed and water from the "home facility" should be used so that quality and source are known. Water sources at an away facility may not be tested, and quality may be poor. Feed and hay may not be stored in closed containers and could be contaminated with feces from rodents and wildlife. Owners should be very selective about feed and water provided to horses when traveling if sources from home cannot be provided.

Direct contact

Direct contact requires the presence of an agent or organism in the environment or within an infected animal. A susceptible animal becomes exposed when the agent directly touches open wounds, mucous membranes, or the skin through blood, saliva, nose to nose contact, rubbing, or biting. It is important to note that depending on the disease agent, it is possible for direct contact transmission to occur between animals of different species, as well as to humans.

One of the most important efforts to reduce transmission via direct contact is the isolation of ill or newly introduced animals. As mentioned previously, it would be preferable to have a dedicated facility for isolation. Regardless, the facility should be thoroughly cleaned and disinfected after housing sick animals, particularly if the pathogen was an agent that persists in the environment.

Unfortunately, not all infectious animals show clinical signs of disease. In order to minimize disease transmission from carrier animals, fence line contact should be limited, both to animals from neighboring farms and also to animals from different groups on the same operation. Although it increases material and labor costs, double fencing is ideal to prevent contact across fence lines. Additionally, stocking density should be kept at the lowest acceptable level, and congregation of animals minimized.

Fomites play a major role in transmission of direct contact diseases. It is imperative that producers recognize that virtually anything that contacts an infected animal and then contacts a susceptible animal can transmit that infection. The "Fomites" section of this document should be reviewed and considered in relation to direct contact diseases.

Reproductive

For the purposes of this presentation, reproductive transmission will encompass those diseases spread through venereal and in-utero routes. Venereal transmission is the spread of pathogenic agents from animal-to-animal through coitus. In-utero transmission is the spread of pathogenic agents from dam to offspring during gestation.

The main risk associated with reproductive transmission is often related to the new introduction of breeding animals (see section on New Introductions). Depending on the infectious agent, clinical symptoms may appear in the stallion, mare, both, or signs in a carrier animal may not be visible.

Reproductive diseases can be greatly reduced or eliminated by using AI. However, diseases can be transmitted if proper hygiene and protocols are not followed. Use of sterile technique and semen extenders containing antibiotics will greatly limit disease risk with AI. Similar precautions should be taken when collecting and transferring embryos.

Stallions should have a thorough breeding examination prior to the start of the breeding season to ensure the stallion is healthy and capable of breeding mares. All visiting mares should be cultured for uterine bacterial infection prior to mating (ideally, this should be done prior to the mare arriving at the facility). Regardless of whether natural service or AI is used, stallions should be washed with warm water only prior to breeding (excessive use of soap can disturb the normal flora of the penis and should only be used initially when the stallion is excessively dirty) and mares should be washed with soap and water.

For AI, each stallion should have its own artificial vagina that should be cleaned after each use. When performing insemination, basic hygiene principles apply. Hands should be thoroughly washed and disposable sterile gloves worn. Coveralls or clothing and foot wear should be clean and free of organic matter (feces, urine, saliva, milk) from other animals so that the sterile pipette does not become contaminated. Keeping the pipette clean is essential to minimize pathogen entry into the vagina and/or uterus. Gloves, palpation sleeves, and pipettes should be disposed of after inseminating each animal. Similar precautions should be taken when collecting and transferring embryos.

Fomites

Fomite transmission requires an inanimate object to carry a pathogen from one susceptible animal to another. Virtually any object can serve as a fomite, and many can harbor and introduce diseases normally classified in one of the other transmission routes (oral or aerosol for example). Therefore, in order to have a successful BRM plan for the other routes of transmission, it is vitally important that all potential fomites be recognized and handled appropriately. Examples of fomites include contaminated vehicles, shovels, clothing, buckets, brushes, tack, and clippers.

As with direct contact, one of the most important means of controlling fomite transmission is appropriate recognition and separation of ill horses. Ideally, all ill animals should be immediately moved to an isolation area and handled and treated by separate personnel. If this is not possible, contact between animals should be limited, and ill animals should be handled only after all healthy animals have been handled. Additionally, the preferred option would be to have dedicated equipment, brushes, and tack for the isolation facility or ill horse. This may not be feasible in some circumstances, and careful disinfection must be implemented to accomplish similar results.

Any item that could potentially contact fecal material also poses a risk as a fomite. Equipment, such as pitchforks, rakes, shovels and wheelbarrows, can be some of the most problematic fomites. While it would be preferable to have dedicated equipment for manure removal, this often is not possible. It is essential that separate equipment be used for handling manure and feed, or at a minimum, all items must be thoroughly cleaned and disinfected before being used for feed items.

Owners should limit, to the greatest extent possible, the use of shared items between horses. Shared halters, brushes, clippers, and other tack items can transmit disease agents. Even when used for an individual horse, items should be cleaned and disinfected on a regular basis (daily, weekly, or monthly, depending on item and frequency of use). Shared items should always be cleaned and disinfected between uses.

Use of products from a multi-dose source can also present a risk of disease spread. Employees should be cautious to use aseptic technique in drawing medication from multi-dose bottles. Even antibiotics can support growth of some organisms, and can result in serious complications when contaminated products are administered parenterally.

Traffic

Traffic transmission is a subtype of fomite transmission in which a vehicle, trailer, or human causes the spread of a pathogenic agent through contaminated tires, wheel wells, undercarriage, clothing, or shoes/boots by spreading organic material to another location.

Humans can serve as fomites. This is commonly the result of contamination of clothing, shoes, or even skin. For this reason, it is imperative that people follow proper hygiene and biosecurity standards, such as frequent hand washing, removal of dirty clothing, and cleaning of boots/shoes. When proper hand washing facilities aren't available, waterless disinfectants (60-95% alcohol) can be used. However, waterless disinfectants will be ineffective if hands are grossly contaminated with dirt, blood, feces, or other material.

Other objects have the potential to introduce as well as spread disease at a facility. Items of concern would include those that leave or move around the facility, such as vehicles and equipment (including trailers, tractors, and implements). Vehicles, tractors and implements, four wheelers and other machinery often are used in multiple settings within a facility. This presents a significant hazard of transporting fecal material from one group of animals to another. Similarly, the fecal material may be deposited in feed or water and then disseminated to other animals. Any item that has been potentially

exposed to a location with a large number of animals should also be considered a risk. Such locations would include auctions, shows, races, other points of animal concentration (particularly if the animals come from multiple sources), and even veterinary clinics.

All trucks, trailers, and vans used to transport horses should be cleaned and disinfected regularly, preferably after each use. Accumulation of manure, feed and bedding is a perfect medium for organism survival and multiplication. Cleaning of vans, trailers and trucks should also include the outside surfaces as pathogens can be abundant in the environments they drive through.

No one should be permitted to drive a soiled vehicle into an animal area. It is not unreasonable to request visitors maintain a reasonably sanitary vehicle or park at the perimeter of the facility. Similarly it is not unreasonable to insist that visitors not drive through susceptible areas, such as feed areas, water sources, foaling areas and such.

The simplest and most effective measure is to have a designated parking area at the perimeter of the facility and request that all visitors be restricted to using facility-owned vehicles. This is not always possible, as in the case of feed deliveries, veterinarians, and equipment service and repair personnel. If visitors are required to drive into the facility, posted signage should be available to direct these persons on the proper protocol to minimize disease spread. The drive path should also not have direct animal contact.

Implementation of some of these ideas may be beyond the commitment most owners are willing to make. Potential or perceived obstacles, including facility redesign, new construction, and perceived inconvenience to visitors may discourage many owners. However, for some high traffic- high risk operations, or for owners with extremely valuable animals, all of these options should be considered. Furthermore, cost and convenience should never serve as an excuse to compromise the BRM plan of an operation.

Veterinarians must remember that they set the example of traffic control, use of disposable boots and footbaths, and proper hand washing. When schedules become busy, it is often easy to neglect these practices and essentially serve as effective fomites.

Vector

Vector transmission occurs when an insect acquires a pathogen from one animal and transmits it to another. Diseases can be transmitted by vectors either mechanically or biologically. Mechanical transmission means that the disease agent does not replicate or develop in/on the vector; it is simply transported by the vector from one animal to another (flies). Biological transmission occurs when the vector uptakes the agent, usually through a blood meal from an infected animal, replicates and/or develops it, and then regurgitates the pathogen onto or injects it into a susceptible animal. Fleas, ticks, and mosquitoes are common biological vectors of disease.

The occurrence of vector-borne diseases is dependent upon the prevalence of the disease agent and its distribution, as well as the abundance, life expectancy and feeding habits of the vector. Regardless of whether transmission is mechanical or biological, the

most effective means to prevent transmission is elimination of the insect, or at minimum, separation from the host. An integrated approach is best, where efforts are directed at eliminating the vectors, reducing their breeding areas, and limiting contact/exposure of horses.

Eliminating the insect

Chemical insecticides are frequently used to control insects, but this is invariably ineffective as a sole measure. If chemical compounds are used, it is imperative that the manufacturer's instructions be followed. Inappropriate use can present a hazard to the animals and/or environment, can greatly reduce efficacy (using a water based product just prior to rain on animals housed outdoors), and lead to insect resistance. Some horses also have skin sensitivities and may react to harsh chemicals. Only use chemicals approved for use on horses or in animal facilities, and use caution with animals known to have skin sensitivities.

Methods of killing insects include:

- Direct treatment of horses with pour-ons or sprays
  - Effective but short-lived duration
  - Insect resistance is a problem
- Spraying premises with knockdown insecticides
  - Effective in smaller areas; inefficient in larger areas
  - Must be used the same day they are mixed up
  - Duration short-lived (1-2 hour action)
  - Effectiveness dependent upon weather conditions (target air temperature between 65-90^{o}F for best results)
- Spraying with residual products
  - Remain active for several days
  - Apply to shaded areas only, as ultraviolet light breaks down chemicals
  - Rain will wash away spray so must be reapplied
- Biological control, such as parasitic wasps which feed on fly larvae, or birds that eat insects.
  - Effective but requires repeated introduction of control organism
  - Birds present their own biological disease risks such as spreading salmonellosis, which should be considered
  - If used in conjunction with sprays, the parasitic insect may be killed

Separating host and vector

Separation of host and vector is needed when a specific region is heavily populated with insects and premise treatment is not practical. This may be necessary to prevent exposure to standing water where mosquitoes lay their eggs, streams where black flies reproduce, and wooded areas heavily infested with ticks. In these cases, the most

effective measure may be to fence off these regions during principle insect seasons or confine animals to a building that can be insect-proofed or sprayed with an approved insecticide. In the case of mosquitoes, it is also beneficial to keep horses stabled in the early evening and morning when mosquitoes are most active.

Breeding area control

There are various diseases spread through vectors to horses (see handout) and each insect has a unique lifecycle that needs to be understood in order to implement specific control measures. This is not an all inclusive list, but rather gives a starting point for control strategies. Most insects can be controlled by:

- Eliminating standing water, especially wet, muddy areas (mosquitoes)
- Eliminating decaying organic matter weekly (flies)

Wet areas may occur around water and feed troughs, in areas where animals congregate, and in old buckets and tires. Measures to control these include filling in low lying areas, moving feeding sites away from wet areas, and removing old buckets and tires.

Decaying organic matter includes spoiled feed, soiled bedding, open manure piles, etc. Prompt removal of these materials limits the ability of insects to breed and feed on them. Dragging dry lots and pastures to disperse fecal piles also reduces the breeding and development of flies. A similar approach involves the use of insect growth regulators in feed, which prevents maturation of insect eggs laid in fecal piles. For best effectiveness, the feed supplement must be fed prior to the presence of flies, which can be difficult to predict.

Summary

In summary, there are five main routes of disease transmission. Each has specific management protocols that can be established to minimize disease introduction and spread. It is important to assess a facility, identify areas of risk, and use the suggested management strategies to help prevent challenges in the future.

Zoonotic Disease and Health Concerns of Employees

Working with animals carries with it an inherent risk of dealing with disease. Humans are susceptible to diseases transmitted through the same routes mentioned previously. Fortunately, many diseases of horses do not affect people. However, there are certain diseases that can spread from horses to people, and it is important that managers and employees are aware of this risk.

As people age, their reflexes and immune systems decline. They are not as able to react to a fractious animal or recover from injury or illness. Considerations need to be made for those older individuals. This age group often is the most experienced, and therefore likely to work directly with the adult horses and young foals. There are many zoonotic diseases that this population should be aware of including encephalitis viruses, salmonellosis, leptospirosis, brucellosis, staphylococcus and streptococcus infections, *E.*

coli, cryptosporidiosis, ringworm, and the most serious- rabies. There are ways to prevent such infections, such as wearing personal protective equipment (gloves, masks, palpation sleeves, coveralls, boots and others) in situations that may predispose them to exposure.

Other at-risk clients and their employees may include: children under the age of 5, pregnant women, and immune compromised individuals. While the most profound immune suppression is caused by HIV/AIDS, other diseases and conditions that can compromise the immune system include tuberculosis, bone marrow or organ transplants, radiation, chemotherapy, chronic corticosteroid therapy, chronic renal failure, or implanted medical devices (pacemakers, defibrillators, artificial heart valves, artificial knee or hip joints). Persons with diabetes, alcoholism with liver cirrhosis, malnutrition or autoimmune diseases, splenectomy patients, and those on long-term hemodialysis also have compromised immune systems. It is important to note that some of these conditions or diseases may have a social stigma, making it difficult for a client or employee to share their personal health information. This again makes it vital for veterinarians to educate their clients about zoonotic diseases. *Rhodococcus equi* is becoming increasingly recognized as a pathogen in immunocompromised people. Although the exact role of horses in these cases is unclear, clients should be made aware of the possibility for infection.

Children under the age of five have naïve immune systems, just like neonatal foals. There are many pathogens on a horse facility, some of which are zoonotic, so educating young people about their risks and how they can protect themselves is essential. It is important to remember that many zoonotic diseases that rarely affect healthy adults can cause severe disease (and even death) in young children.

Another consideration on today's equine facilities is the immigrant worker. Some facilities sponsor immigrants for week to year long internship experiences, while others employ permanent immigrant workers. Diseases prevalent in some of these countries could predispose these workers to infection with a zoonotic disease. The communication barrier may increase their risk of exposure and hinder disease education, so working with knowledgeable translators and ensuring proper medical care will keep this at risk population safe and continue their employment at the facility.

Human health can also be threatened by biological agents used for horses. Oxytocin and prostaglandins have detrimental effects on pregnancy and should never be handled by pregnant women. Other products may have toxic potential if accidentally injected or absorbed via mucous membranes (eg. the sedative detomidine). Proper identification of hazardous agents and increased care in handling these agents can reduce risk.

Biological agent precautions that should be followed include:

- Biological agents should be stored in a cabinet or refrigerator designated for that purpose. Food for human consumption should never be stored with biologicals.
- Injection needle caps should never be removed by grasping with the mouth.
- Hands should be washed after handling of any biologicals.

Proper and frequent hand washing is the best way to prevent many of the zoonotic diseases. The following hand washing technique is recommended:

- Wet hands and forearms with warm water.
- Add at least 3-5 mls of soap (the size of an olive).
- Lather up and vigorously scrub each side of the hands beyond the wrist for 10-30 seconds.
- Cleaning under rings and cleaning dirty fingernails.
- Rinse under warm water until no soap residue remains.
- Dry hands with a disposable towel (using a multi-use towel can spread disease between individuals).

Hands should be washed immediately after handling sick animals, after coming in contact with feces or urine from horses, after using the restroom, and prior to eating.

Risk Communication

Risk communication is a two-way, interactive process that has been occurring throughout the risk assessment between the facility owner, risk assessor (veterinarian), staff and other interested parties. Information has been collected, the analysis has occurred, and now information needs to be delivered to those affected by the risk assessment and risk management plan.

One of the major barriers to effective risk communication is inadequate planning and preparation. Before designing an educational program, it is important to consider who is best suited to communicate the message, what message will be most effective, and when and where the information should be communicated.

In large operations, the biological risk management plan may be formulated by upper management, and therefore, some employees may not understand the importance of the plan. Risk management plans must be understood, supported, and adopted by every employee for effective implementation. Because many employees may not understand disease transmission routes and the chain of events involved in disease spread, this communication can be difficult and employees may not fully appreciate the significance of the measures they are asked to follow.

Characteristics of effective risk communication:

- It must be adapted to meet the needs of the audience. If bilingual information is required, make sure it is provided.
- It should present the important information in more than one way (appeal to both visual and auditory learners).
- Keep sessions focused to a maximum of three main points.
- Limit meetings to a maximum of 45 minutes.
- Sessions are more valuable if they are timely and the participants can apply the new information immediately.

- Sessions should cover what, when, where, how, by whom, and why.
- If possible, limit groups to 20 people. It is normally easier to interact with smaller groups.
- Give participants the opportunity to discuss, share information, and provide input.
- Schedule meetings earlier in the day. Meetings at the end of the working day are less effective.

Educational programs that inform employees and other affected individuals of the risk assessment and management plan can take many forms, and may include:

- Face to face/group meetings (one of the best communication forms if the presenter and participants have open dialogue)
- Newsletter or bulletin
- Videos, CD's or web-based instruction
- Posted signs or information panels placed around the workplace
- Employee questions and suggestions (question/answer board, suggestion box, question period during meetings, etc.)
- Mentoring of new employees by experienced employees
- Knowledge testing
- Recognition or incentive program that rewards employees when BRM goals are reached

Educational programs should not be limited to one form. Facility owners may incorporate many of the above mentioned education forms to create a program that fits the needs of their facility.

The on-line database provided with these materials generates graphic results that can be shown to clients if so desired. Handouts listing diseases and their routes of transmission, vaccination recommendations, and a sample visitor log have also been provided. These are just a few examples of educational materials that can be provided to horse owners.

Proper communication of the risk management plan is of utmost importance for effective infectious disease control. When communication is effective and efficient, disease spread can often be minimized and controlled. However, few management plans are successful if records are not kept or some form of risk management audit performed so that progress can be measured. Part of the risk communication process should include helping to ensure that some system is put in place to measure progress.

Conclusion

This document illustrates the best available "standard operating procedures" for a wide range of management practices. Each veterinarian should perform a thorough assessment to identify opportunities for improvement. Then the management

suggestions should be considered as to which ones are most practical, applicable, and economically feasible. Most recommendations can be implemented independent of others. This will result in tailoring the BRM program for each producer based upon his/her preferences, resources, risk perception and risk tolerance. Some suggestions may not be feasible for a given facility; but recognizing what is optimum helps establish long term goals.

The final report graphs that are generated by the on-line database are meant as a visual aid to illustrate potential areas of action. The various risk factors identified have not been quantified or prioritized. Remember that the results should not be interpreted as an arbitrary number which is required for a facility to "pass," or even that comparable scores for two different facilities mean they face equal risk. Instead, the reports are meant to be used to identify if a particular area seems to represent a disproportionate risk and help track progress over time through continued assessments. The management recommendations are made to minimize circumstances that could potentially result in the spread of infectious diseases.

Biological risk management is an essential component of keeping any equine facility as disease secure as possible. Risks of disease transmission cannot be completely eliminated, but by employing some basic hygienic and risk management principles, these risks can be effectively managed and significantly reduced. It may take time to persuade some clients to adopt certain principles, but the results will reflect the efficacy of this program, and others will follow suit in time.

240 Eastern Equine Encephalitis (EEE) Virus, Venezuelan Equine Encephalitis (VEE) Virus, and Western Equine Encephalitis (WEE) Virus. 242 Rift Valley Fever Virus (RVFV). 244.Â Risk of occupationally acquired illnesses from biological threat agents in unvaccinated laboratory workers. Biosecur Bioterror. 2004;2:281-93. 8 Biosafety in Microbiological and Biomedical Laboratories.Â Risk assessment is an important responsibility for directors and principal investigators of microbiological and biomedical laboratories. Institutional biosafety committees (IBC), animal care and use committees, biological safety professionals, and laboratory animal veterinarians share in this responsibility. 38. In the management of biological risk in all its containment and transitional facilities, these responsibilities are assigned to the following roles: Deputy Vice-Chancellor (Research) is to: assume overall legal responsibility for the Universityâ€™s containment/transitional facilities (as the licensed operator).Â monitor and review biological risk management and containment performance within their remit. provide input to the annual programme of internal inspection and review. Group services managers are to: ensure adequate resource within their remit to meet biological risk management and containment requirements. ensure that succession plans are in place for key personnel. Equine Biological Risk Management. March 2005. This would include the order of feeding (although it would be preferred to use different equipment for each group), and location of designated pastures, barns and facilities (most susceptible should be prevented from potential contact with manure storage, neighboring operations, isolation and treatment facilities, and other areas of high risk).Â Equine Biological Risk Management. March 2005. Health Protocols Arguably, the greatest impact on disease management is determined by the measures directly taken to prevent and treat disease.