Gloves, gowns, and booties: Reviewing Biosecurity Measures

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Take Home Message

A good biosecurity plan provides value to the care of all patients. No one plan fits all situations and should be based on the type of practice, a knowledge of potential pathogens, a knowledge of potential disinfectant and cleaning procedures, and good communication with staff members and clientele.

Introduction/Purpose

Veterinarians are given a high level of trust when presented with a patient. The owner of that patient does not expect for their horse to contract a contagious disease, despite being stalled in a hospital. This trust is important to our client relationship and limiting the spread of contagious diseases is based on good biosecurity. However biosecurity is not free. There are costs associated with cleaning agents, disinfectants, lab tests, gloves, gowns, boots, and man power. Theses expenses must be weighed against the potential loss of revenue and reputation associated with an outbreak of a contagious disease. Instituting some level of biosecurity will also help bring awareness to the level of colonization of horses in the local community, as well as, identifying isolates and sources of hospital acquired diseases.

This paper will discuss common pathogens monitored in a biosecurity program, appropriate methods of cleaning, disinfectants, methods of avoiding contamination, and development of an appropriate biosecurity plan.

PATHOGENS

BACTERIAL

Salmonella spp

Salmonellosis is an enteric disease caused by *Salmonella enterica.* There are multiple serogroups and over 2000 serovars, all of which are potentially pathogenic. The serovars Anatum, Newport, Agona, Infantis, and Braenderup were the most frequent isolates from horses with gastrointestinal disease presented to the Brazos Valley Equine Hospital (BVEH) in Navasota over the last 5 years (table 1). Identifying the serovar is valuable to tracking isolates in potential outbreaks as antibiograms do not adequately identify specific isolates. Table 2 shows the resistance patterns of 55 isolates from 21 different serovars.

Salmonella bacteria are transmitted by the fecal-oral route and the specific isolate, as well as, the health status of the patient will determine the number of organisms necessary to cause disease. Approximately 0.8% of horses are shedding salmonella[1], while one study found 18% of samples from diarrhea horses to be positive for *Salmonella.*[2] This is consistent with findings at BVEH where 17% of cultures taken from high risk horses were positive (table 1). Risk factors for Salmonellosis include transportation (stress), surgery, diet changes, antimicrobial therapy, colic, and diarrhea.[3] Clinical findings in Salmonellosis can range from inapparent infections, to lethargy and loose stool, to acute SIRS with diarrhea, to peracute death. Diagnosis is based on isolation of the bacteria from feces by either culture or PCR.

*Salmonella enteric*a is one of the major pathogens we try to prevent with biosecurity measures. Depending on the prevalence in the hospital population screening every horse should be considered. In all equine hospital situations, cases meeting specific criteria (fever, low WBC, reflux, colic, anorexia, diarrhea) should be isolated with barrier precautions. Horses should be housed in appropriate high risk biosecurity stalls. Foot baths, boots and gloves at a minimum should be utilized. After discharge the stall should be stripped of all bedding and all equipment (twitches, nasogastric tubes, thermometers, stethoscopes, etc) should be disinfected. A two step cleaning and disinfection process should be followed. Drag cloth samples optimized to find *Salmonella enteric*a should be utilized post disinfecting and prior to housing any new patients in that stall.

Streptococcus equi subsp. equi

S. equi disease is one of the oldest recognized infections in horses. Multiple presentations are associated with infections including: lymph node abscess, nasal discharge, guttural pouch infection, abdominal abscess, lymphangitis, brain abscess, purpura hemorrrhagica, myositis, glomerulnephritis, and myocarditis. Typical clinical signs include depression, fever, draining/swollen retropharyngeal lymph nodes and nasal discharge. Once infected most horses will recover in 2-3 weeks, but some persistent infections may develop in the guttural pouches leading to chronic unapparent shedding. Diagnosis is based on isolation of bacteria by either PCR or culture. Serologic tests are available, but current tests have been less than useful in the author's clinical experience.

S. equi is one of the more contagious diseases seen in equine medicine and early identification and isolation is the most useful tool to prevent further spread during an outbreak. Rectal temperatures should be taken daily. Horses should be tested and segregated into shedding and non-shedding groups. Positive horses should be investigated for possible guttural pouch involvement. Water sources should be cleaned daily. Once clinically recovered horses should be tested to confirm they are no longer shedding bacteria. In a hospital environment, all guttural pouch empyema and retropharyngeal lymphadenopathy cases should be handled as *S equi* positive. At a minimum gloves should be required for all patient contact. Appropriate hygiene and hand care should be emphasized. After discharge the stall should be stripped and standard disinfectant procedures should be followed. Housing facilities contaminated with *S. equi* are a potential source for additional infections. However despite older literature claiming a long survival in the environment, recent studies using real world scenarios showed rapid death (1-3 days) of the bacteria.[4]

Methicillin Resistant *staph auerus*

The emergence of multidrug resistance has led to the recognition of methicillin resistant staphylococcus auerus (MRSA) in equine cases. As a normal skin flora MRSA colonize the nares of people and horses and is an emerging pathogen in horses. Multiple studies by Scott Weese have documented MRSA colonization in horse farms (~5%) and teaching hospitals (~3%).[5] The isolate that seems to have adapted to the horse is CMRSA-5 also known as USA500. The bacteria can cause SIRS in people, but is more commonly a joint, incisional, and catheter problem in horses. It is spread to the horse by caretakers and vice versa. It can cause infections in people.

MRSA is identified by culture and sensitivity. Additional confirmatory testing is done by detection of the mecA gene. Treatment depends on the location of the infection and sensitivity of the bacteria. Appropriate methods to avoid exposure are critical to prevent infections. Good hand hygiene, proper wound care, judicious use of antimicrobials, and asepsis all have a roll in prevention. Appropriate use of gloves when examining all patients may help to prevent colonization of personnel. Horses colonized with MRSA should be considered infectious and appropriate barrier precautions taken. Any item that has been in contact with the horse should be disinfected or discarded. Staph is susceptible to most disinfectants provided that appropriate removal of organic debris and cleaning has been performed. On the farm isolation of the horse to prevent nose to nose and nose to hand contact should be recommended.

Clostridium

The genus Clostridium is very broad and diverse. Two species are thought to be the primary gastrointestinal pathogens in horses; Clostridium difficile, and Clostridium perfringens. Both are recognized causes of antimicrobial-associated diarrhea and both produce exotoxins that cause disease. Use of antimicrobials leads to changes in the gastrointestinal flora of horses which may lead to an increased susceptibility for colonization. Typical disease associated with Clostridium is acute colitis.

Diagnosis requires identification of the toxins or identification of toxigenic strains with PCR. Clostridial disease occurs in people, but this author is unaware of any reports of zoonotic transmission from an equine patient. However clinical isolates are identical to human isolates and appropriate care should be taken. [6] Appropriate barrier precautions should be taken to prevent spread of the organism to other horses. Because they are spore-forming, clostridia can persist in the environment for long periods of time. Elimination of the bacteria from the environment is very difficult and efforts should be directed at reducing or controlling levels. Use of accelerated hydrogen peroxide, bleach, and peroxygen disinfectants may be effective against spores after a thorough cleaning.

VIRAL

Rotavirus

Rotavirus is a double stranded non-enveloped RNA virus. There are multiple groups of *Rotavirus,* but the Equine specific isolates are in group A. The virus remains stable in the environment for months. Clinically affected animals shed large volumes of the virus in feces, and fecal-oral is the primary route of transmission. The incubation period can be as short as 24 hours.

There are multiple tests available to diagnose *Rotavirus* including electron microscopy, latex agglutination test kits, ELISAs, PCR and *immunoassays*. Most have acceptable sensitivity and specificity but require multiple samples to confirm a patient is negative. The disease can be prevented through a combination of mare vaccination and husbandry practices. It is primarily a disease of breeding operations with large number of foals. Large numbers of viral particles are excreted from diarrheic foals so appropriate barrier precautions should be observed. Manure and bedding from the mare and foal should be considered infectious. The virus is resistant to iodophors, quartenary ammonium, chlorine and hypochlorite disinfectants. Phenol and peroxygen compounds are appropriate disinfectants

Influenza

Influenza is a enveloped single stranded RNA virus. There are three different *Influenza* virus: A, B, and C. *Influenza A* is the primary pathogen of horses. The lipid envelope of the virus contains both hemagglutinin (HA) and neuraminidase (NA). Further isolation into subtypes is based on the properties of the HA and NA components of the virus. Most equine disease is restricted to H7N7 (A/equine/1) and H3N8 (A/equine/2). A/equine/1 has not been isolated in an outbreak since the late 1970s, while A/equine/2 continues to remain clinically relevant. Inhalation is the primary route of transmission and the virus attacks respiratory epithelial cells. The incubation period is 2-3 days and viral shedding may occur for 6-7 days.

RT-PCR has become the most frequently used diagnostic test. Additional tests include paired serology, virus isolation, IFAT, and ELISAs. Two stall side antigen-capture ELISA tests are used on horses: Flu OIA assay, and the Directigen Flu-A assay. The disease occurs most commonly in 2-3 year olds, but can affect any age. Vaccines are available to try and prevent disease. The intranasal vaccine rapidly generates a local immunity and is the author's preferred vaccine in high risk individuals. If appropriate husbandry and quarantine practices are followed, infections can be substantially controlled. Shared air space, equipment, and water sources may all be important in the spread of the disease, as such isolation and appropriate barrier precautions are warranted.

EHV-1/EHV-4

Equine Herpes Virus

Herpes viruses are enveloped double stranded DNA virus. There are 9 herpes virus's categorized in horses, although only 5 are known to infect horses. EHV-1 and EHV-4 are the best understood and thought to be the most important. The major reservoir for herpes virus is latently infected cohorts and most individuals are thought to be infected within the first few months of life. Infection is spread by direct horse to horse contact, as well as, indirectly from personnel and equipment. EHV-1 and EHV-4 cause respiratory disease, abortion, and neurologic disease. Following infection the virus replicate in the URT endothelial cells quickly spreading to lymph nodes within 2 days. Once the virus is actively replicating in the lymph nodes it is spread throughout the body. The virus may be shed in the nasal secretions for 14 days and detected in the blood for 21 days.[7]

RT-PCR is the most frequently used test, although virus isolation and paired serology may be used in some cases. A PCR positive on blood indicates active viral replication, while PCR on nasal swabs may pick up dead virus. It is very difficult currently to identify a horse with a latent infection, and experimentally requires very high doses of corticosteroids to cause recrudescence.[8] Even though most of the diseases secondary to EHV-1 and EHV-4 are mild and self limiting, vaccination strategies should include herpes. The author prefers to use a high antigen load vaccine as either a modified live or killed viral vaccine. The disease is best controlled through appropriate management strategies. Isolation of new arrivals, isolation of sick individuals, and not traveling with or showing sick horses are critical to any disease program, but especially so for any farms with concerns about herpes infections (brood mare farms). The virus is generally thought to be short lived (less than 7 days) in the environment, although it has survived up to 35 days under some conditions.[9] Abortions secondary to herpes have the potential to

contaminate the environment with large viral loads. After an effective cleaning, phenols and peroxygen compounds will be appropriate disinfectants

Due to recent outbreaks around the country secondary to EHV-1, additional discussion will be given to this problem. Equine Herpes Myeloencephalopathy (EHM) is a neurologic condition caused by infection with EHV. The majority of EHV-1 strains that cause neurologic disease have a single base pair substitution on gene 30.[10] Clinical signs generally occur within 6-10 days post infection. There are few if any symptoms prior to neurologic disease other than fever. Clinical signs include: ataxia, paresis, recumbency, bladder dysfunction, loss of anal tone, and occasional brain stem signs. Clinical signs usually reach peak intensity by 48 hours. This virus is not more contagious than any other strain of herpes, but may be increasingly in frequency due to increasing circulation in the horse community. Experimentally vaccination with high antigen load vaccines have limited or prevented clinical signs associated with infection of a neurologic strain of EHV-1.

Other Pathogens to consider

In addition to the above, there are many other less common pathogens to consider when developing a biosecurity plan. Equine infectious anemia virus is a federally controlled disease. Admitting a horse with EIA can lead to quarantine of a practice. Vesicular stomatitis is another controlled disease that may impact a hospital's ability to practice. Rabies is a differential for every neurologic horse in Texas and appropriate pre-cautions should be taken with personnel and barrier protection. Equine viral arteritis virus is a respiratory pathogen that causes infertility and abortion. Recognizing the necessary barriers and precautions that are necessary when dealing with an EVA positive patient are critical to preventing the spread throughout the barn. Ectoparasites can spread from horse to horse directly of via fomites. Dermatophytes and dermatophilosis are two additional skin problems that can be contagious. Rhodococcus equi is another environmental pathogen. However it is not thought necessary to isolate infected foals at this time.

DISINFECTANTS

Only after a thorough cleaning, should a disinfectant be applied to the area. An adequate review of disinfectants is often lacking in medical texts, but a nice review has been published recently.[11] In general gram+, gram-, enveloped viruses are susceptible to most disinfectants. Spore forming bacteria, non-enveloped virus, and oocyst are more difficult to kill. The stability of an organism outside the hose will also impact the effectiveness of a disinfectant. For example EHV-1 and influenza do not live long outside of a host, while Clostridium and Salmonella can survive in the environment for long periods of time.

Cleaning is the process where all visible debris is removed. This is a critical component of disinfection as even the best products are rendered in-effective in the presence of much organic material. Dirt, feces, and bedding not only inactivate some products, they also act as a barrier between the target bacteria and the disinfectant. Removal of as much organic material as possible is important and effective cleaning can remove much as 90% of the bacterial load in the environment.[11] **Cleaning is manual labor.** A suggested protocol for cleaning is presented in Table 3. Scrubbing with anionic detergents loosen organic debris, emulsify fats, and loosen bacterial biofilms. The choice of the cleaning agent should be considered when choosing a disinfectant to avoid any adverse chemical reactions. Use of high pressure systems should also be avoided when the surface contains much organic material. High pressure washers will effectively clean a surface, but will also aerosolize and spread infectious agents to areas more difficult to adequately clean.

Even with an excellent cleaning and choice of a appropriate disinfectant, errors can lead to lack of efficacy. Most disinfectants require at least 10 minutes of wet contact time. If they are applied and then immediately rinsed away, they will not be effective. Disinfectant concentrations vary and most need to be diluted. Excessive dilution has little effect, while excessively strong may be more irritating and toxic. Label instructions should always be followed. The disinfection process can be divided into three levels based on the potential transmission of disease.[11] High level disinfection should eliminate all virus and vegetative bacteria. Examples of items requiring this level of disinfection include endotrachael tubes and some

surgical equipment. An intermediate level should eliminate all vegetative bacteria and most viruses. Examples of items needing intermediate level of disinfection include dental equipment, endoscopes, some nasogastric tubes and community thermometers. Low level disinfection should eliminate most bacteria. Examples of items needing a low level of disinfection include individual thermometers, twitches, feed and water buckets, muzzles, most nasogastric tubes, and stethoscopes.

The choice of a disinfectant should be based partially on the surface with nonporous surfaces (stainless steel) being easier to disinfect than non-porous surfaces (wood flooring in stall). Painting or sealing porous surfaces will make disinfection less challenging. The organism targeted will also help determine the choice of disinfectant. A perfect disinfectant should have the following characteristics: germicidal against all pathogens, nontoxic to animals and humans, environmentally safe and biodegradable, economic and easy to use, unaffected by organic matter, non destructive to stall and trailer surfaces, and stable on a variety of surfaces at a variety of temperatures.[11] The following is a summary of different disinfectants.

Alcohols have a rapid germicidal activity against bacteria, fungi, and some virus. They are relatively non-toxic although highly flammable. They do not work in the presence of organic material. In the veterinary environment they are typically only useful as a component of a hand sanitizer. Most hand sanitizers are 60-70% alcohol although recent suggestions have been to use a concentration of 80% or higher.[12]

Aldehydes are very effective, stable disinfectants and work in the presence of organic material. Unfortunately they are also toxic to patients and personnel. Formaldehyde and glutaraldehyde are two examples of aldehydes, of which glutaraldehyde (Cidex) is the most frequently used. Glutaraldehyde can be used to disinfect surgical instruments and equipment.

Biguanidines are cationic compounds that are incompatible with anionic detergents. Chlorhexadine is the most frequently used example. It is inactivated in the presence of organic material. It works best a concentrations ranging from 0.01% to 0.1%. and at a pH of 7.0. Chlorhexadine may have some residual activity. It is not frequently used as an environmental disinfectant.

Chlorine compounds are effective disinfectants killing a wide range of bacteria and virus. They are rapidly inactivated in the presence of organic material. They lack stability and should be used soon after mixing. The most commonly used example is hypochlorite (bleach). It is cheap, readily available, but lacks usefulness in most equine environments. Caution should be taken when using this product in combination with other disinfectants or in the presence of ammonia (ureine) due to the potential for toxic gas formation (chloroform, chlorine gas, etc). Chlorine compounds are also corrosive to metals and concrete. Despite these limitations, bleach is one of the limited disinfectants available that will kill spores and non-enveloped virus. It is commonly diluted 1:64.

Iodine compounds are commonly used in veterinary medicine. They are highly dependent on pH and concentration. The amount of free iodine in the solution determines its effectiveness. They are germicidal and may be effective in the presence of organic debris. Povidone-iodine is the more frequently used example. It is not routinely used as an environmental disinfectant.

Peroxygen compounds are a relatively new class of disinfectants, although hydrogen peroxide has been used since the late 19th century. Hydrogen peroxide vaporizes to gas which is irritating and is toxic to tissue. However the germicidal effect of hydrogen peroxide can be enhanced by combining with surfactants and organic acids, while reducing is toxicity.

Accelerate Hydrogen Peroxide is a new product by Virox making its way into the US Market (Accel). It appears to be non-toxic, sporocidal, effective against non-enveloped virus, stable across a wide range of temperatures and in the presence of organic material and has limited corrosiveness to metal surfaces. It has some detergent effects and can be used in the cleaning step.

Potassium peroxymonosulfate is another new product by Vétoquinol that is currently available in the US (Trifectant or Virkon). It is effective as a foot bath despite gross contamination with organic debris. It has

activity against spores and non-enveloped virus. It has limited effectiveness against fungi. It is non-toxic, biodegradable, and has limited corrosiveness to metal surfaces. Like Accel it has some detergent properties and can be used in the cleaning process.

Phenols have broad germicidal activity against bacteria, fungi, and enveloped virus. They are active in the presence of organic debris and have some residual activity if left to dry on surfaces. In higher concentrations they produce irritating fumes and can cause some skin irritation. They are relatively non-corrosive. While they do have some detergent properties, they do not mix with cationic and nonionic detergents. They are also toxic to cats.

Quarternary Ammonium compounds are cationic chemicals and incompatible with anionic detergents. Commonly known as quats, they are inactive in the presence of organic debris, but kill bacteria and virus on clean surfaces. When combined with nonionic detergents they can be effective cleaners of environmental surfaces. They are generally stable, nonirritating and have low toxicity. They can be very effective in combination with phenols and have some residual activity after drying.

Protective Barriers

No barrier is useful without compliance. Too strict or cumbersome of guidelines will lead to a breakdown in protection. A tiered approach with the most stringent guidelines on the most significant biosecurity threats may improve compliance. (Table 4)

Gloves are one of the most important and abused tools in preventing the spread of disease, as hand contamination is the most important vector in iatrogenic disease spread. Rubbing one's face, nose, eyes, or touching other patients eliminates the value of using gloves to protect the patient and to prevent colonization of the operator. When use properly, they are a single use disposable item. Multiple boxes can be dispensed around the hospital or dedicated to one stall. Gloves are not a substitute for appropriate hand washing.

Boots can be utilized as either disposable shoe covers or as dedicated waterproof footwear. The former is easier to utilize, but repeated use of the same boot cover will lead to possible contamination of the operator's standard footwear. Having a dedicated pair of footwear for isolation areas that require the removal of one's standard shoes is an option, but is more cumbersome.

Foot baths and mats can be placed at entrance to barns and individual stalls. The author prefers foot mats over foot baths. However each must be cleaned frequently with removal of the organic debris. Use of an appropriate disinfectant that is not inactivated by organic material is required. Levels should be check frequently and solutions to refill the mats easily available.

Gowns and coveralls can be used to cover one's clothing. Gowns provide the advantage of limiting contamination from dirty shoes, but may not provide complete coverage when examining a recumbent foal or down horse. Coveralls will provide coverage to the limbs when one is kneeling in the bedding, but repeated passage of footwear down the pants legs can lead to contamination. Alternatively disposable coveralls are an option, but changing out of the coveralls without self contamination is difficult. Complete changing of clothes or dedicating personnel to high risk areas only is one method to avoid spreading disease. However, with attention to proper procedures and common sense gowns and coverall are effective methods to contain infections in one area.

Masks have some impact on the transfer of viruses and bacteria from the care giver to the horse. They are a reminder to the wearer not to touch their mouth or nose which is an important colonization site for bacteria. Like gloves they may give the wearer a false sense of security.

Barriers to the flow of traffic are important considerations in a biosecurity plan. Avoid carrying and disposing of contaminated fecal material along the same routes as human traffic and feed wagons. Setting up physical barriers around a stall may help to keep visitors and non-essential personnel away from the isolation case. It should be noted that microorganisms do not respect barriers and common sense is still important. Evaluate how the water drains from a stall. Does it drain out to a central drain in the hallway?

Create a plan

Developing a biosecurity plan requires an understanding of which pathogens are potential problems in your patient population. An emergency referral hospital will be different from an outpatient sports medicine practice. The commitment to environmental monitoring needs to be weighed against the

cost to the facility. However, culturing patients and monitoring the environment is a small part of a biosecurity plan. The facility should make a commitment to perioperative antibiotics on elective and routine surgeries. The facility should make a commitment to cleaning equipment and removing feces quickly. The personnel must make a commitment to washing hands and maintaining hygiene. Where and how feces and bedding are disposed can have a critical effect on the success of any plan. Feeding animals out of the doorway and not putting the tip of the water hose in the bucket are also important in limiting the spread of disease.

Biosecurity plans can range from simple to involved. Every facility should have some level of a plan to prevent spreading infectious diseases. Following the biosecurity plan requires discipline and having all team members involved. It takes a team effort to execute a biosecurity program and one individual to circumvent it. Plans should be practical and easy to follow to avoid the laziness and impatience that will often occur.

Communicating that plan with clientele has been beneficial to our facility. We present the need for biosecurity testing and barriers as a hospital policy designed to keep healthy horse's safe and limit the exposure of critical cases to pathogens. Being up front and open with clients has been worthwhile for BVEH and improved our reputation. Some authors have suggested obtaining informed consent from clients. Perhaps the most difficult aspect is counseling clients on how to handle a culture positive horse after discharge. The need for isolation at home is weighed against the potential for the horse in question to contaminate the farm or infect herd mates.

Summary

In today's day and age with the understanding and increase in infectious diseases, every veterinary team should talk about biosecurity. Understanding the pathogens involved, effective methods of cleaning, and effective methods of preventing the spread of disease are crtical to development of the plan. Involving all members of the veterinary team is critical in executing any biosecurity plan. Having a plan in place to prepare for protecting patients is important to establish trust and protect a reputation with the horse owning public.

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TABLES

TABLE 1

Salmonella Serovars identified at BVEH

655 cultures from December 1, 2005 to August 1, 2011. 117 positive (17%).

1 – Salmonella Uganda (Jan 2006)

1 – Untypable (Nov 2009) *alpaca

1 – rubislaw (Jan 2009)

64 - not typed due to environmental (17), rechecks, not submitted, or unable to find record

1 – panama (Nov 2006)

1 – Norwich (July 2008)

5 – Newport (Jan 2008, Aug 2009, Nov 2009, March 2010, Sept 2010)

1 – Muenster (Jan 2007)

2 – Mississippi (Jul 2006, April 2007)

1 – Litchfield (Apr 2009, May 2009) *Same farm

1 – Javiana (June 2011)

1 – IV Rougho:z4,z32:~ (July 2010)

4 – infantis (March 2008, April 2008, Dec 2009, Feb 2010)

1 – give (Apr 07)

1 – gaminara and Newport (Aug 09) *same fecal sample

1 – derby (May 09)

1 – bredeney (Jul 2010)

3 – braenderup (Dec 08, Jan 09, Sep 2010)

2 – Barranquilla (Nov 09, Dec 09)

1 – anatum var. 15+, 34+ (Nov 07)

16 – anatum (Mar 07, Oct 07, Nov 07, Jun 08, Nov 08, Feb 09, Apr 09, May 09, Aug 09, Sep 09, Jan 2010)

3 – agona (Jul 07, Aug 07, May 08)

TABLE 2

Antibiotic Resistance of Salmonella isolates from December 1, 2005 to August 1, 2011

4 - Erythromycin, Oxacillin, Penicillin, Rifampin

30 – Clindamycin, Erythromycin, Oxacillin, Penicillin, Rifampin

1 – Clindamycin, Erythromycin, Oxacillin, Penicillin, Rifampin, tetracycline, TMS

1 - Clindamycin, Erythromycin, Oxacillin, Penicillin, Rifampin, Chloramphenicol

5 – Clarithromycin, Erythromycin, Oxacillin, Penicillin, Rifampin

7 – Clarithromycin, Erythromycin, Oxacillin, Penicillin, Rifampin, Gentocin

5 – Clarithromycin, Erythromycin, Oxacillin, Penicillin, Rifampin, Azithromycin

1 - Ampicillin, Cefazolin, Cephalothin, Clindamycin, Erythromycin, Oxacillin + 2% NaCl, Penicillin, Rifampin,Tetracycline, Ticarcillin

1- Amoxicillin/clavulanic acid, ampicillin, cefazolin, cefoxitin, cefpodoxime, ceftiofur, cephalothin, chloramphenicol, clindamycin, erythromycin, oxacillin + 2% NaCl, penicillin, rifampin, tetracycline

TABLE 3

Cleaning/Disinfection Protocol at Brazos Valley Equine Hospital

1. Remove equipment (buckets, balls, etc)
2. Remove all bedding, hay and feed material
3. Rinse surface with water hose to loosen debris
4. Apply detergent and scrub surface to remove all organic debris
5. Apply detergent to buckets and scrub
6. Rinse surface and inspect for dirty areas
7. Clean, repair, replace or seal surface as necessary
8. Rinse buckets
9. Allow surface to dry thoroughly (fan dry)
10. Apply disinfectant to all surfaces including buckets
11. Allow disinfectant to dry to maximize contact time
12. Rinse buckets thoroughly
13. Culture stall surfaces with moist gauze sponges or swiffer pad

Table 4

BVEH Biosecurity Protocol Hospital Biosecurity Plan

HIGH RISK A

-Any horse with 2 or more of: colic, fever, low WBC count, diarrhea, reflux, anorexia

- Blue boots and gloves for any entrance into stall
- Foot mats
- Three fecal cultures (including first reflux) at least 12 hours apart
    - -Mares of foals with diarrhea get surveillance culture
- When discharged stall stripped and disinfected
    - Shavings removed and scrubbed with Trifectant
    - Diarrhea stains scrubbed off wall
    - Tektrol disinfectant
- If patient culture positive, stall closed until stall culture negative

HIGH RISK B

-Any horse with fever

-CBC and fibrinogen
-Respiratory exam
-Gloves for any patient handling
-PCR for strangles, influenza and herpes unless other cause of fever identified

HIGH RISK C

-Any horse with a nasal discharge or persistent cough

-CBC and fibrinogen
-Rebreathing bag exam
-Endoscopy +/- culture
-Gloves for any patient handling
-Fever or guttural pouch disease will move to isolation

-Any horse with incisional or jugular vein infection

-Aerobic culture for identification and sensitivity
-Handling with gloves for all treatments and bandage changes
-Positive for MRSA will move to isolation