# BACTERIAL ISOLATES AND ANTIMICROBIAL SUSCEPTIBILITY PHENOTYPES OF EQUINE SPECIMENS SUBMITTED TO THE OKLAHOMA ANIMAL DISEASE AND DIAGNOSTIC LABORATORY 2005 – 2007

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in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
July, 2008

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ACKNOWLEDGMENTS

I wish to thank my thesis adviser Dr. Brenda Love for providing me with the opportunity and guidance to explore an area of science and medicine that proved to be fascinating beyond my expectations. Many thanks also to Dr. Todd Holbrook, my residency adviser and committee chair for mentorship not limited to this project, and to Dr. Reed Holyoak for his candid edits of this document and willingness to step into the role of committee member on short notice.

Sincere thanks to my other equine medicine service colleagues Dr. Lyndi Gilliam and Dr. Heath Qualls for covering some of my clinical responsibilities and giving me time to complete the writing of this document.

Thanks also to Merry Bryson and Laura Dye for assistance with the creation of the research data base used in this project, and many thanks to David Maxwell for technical assistance in the preparation of the final version of this document.

Special thanks to all of our microbiologically challenged equine patients and the owners willing to seek diagnostics and treatment for them at the BVMTH. Without them, our clinical education and opportunity for scientific study would not exist.

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# CHAPTER I

# INTRODUCTION

Antimicrobial resistance is a problem of longstanding, serious concern in both human and veterinary medicine. Physicians and scientists described emerging resistance to major classes of antibiotics including sulphonamides[1], penicillin[2,3] and streptomycin[4] within a few years of their discoveries in the 1930's and 1940's. Veterinary researchers observed in vitro resistance to penicillin in organisms isolated from cases of bovine mastitis around that same time.[5] The problem intensified throughout the latter half of the twentieth century. Methicillin-resistant *Staphylococcus aureus* (MRSA) was isolated in hospitalized human patients barely a year after that drug's first use in 1960.[6] Reports of MRSA in the veterinary literature appear in the early 1970's, again in association with bovine mastitis.[7]

Additional nuances arose going into the twenty-first century, including the appearance of genetically unique strains of bacteria in cases of community acquired MRSA,[6] increased resistance in anaerobic isolates such as *Bacteroides fragilis*,[8] emergence of vancomycin resistant strains of *Staphylococcus aureus*,[9] *Enterococcus* species [10] and others, and resistant gram negatives such as *Klebsiella* species and *Acinetobacter baumannii*.[11]

The veterinary literature again mirrored these concerns, with increased investigation into MRSA infections in horses and companion animals,[12,13] vancomycin-resistant *Enterococcus* species, [14] and resistance patterns of gram negative pathogens. [15,16]

Strategies to minimize antimicrobial resistance in the interest of public health and animal well-being have been promoted by governments, medical and veterinary organizations,[17] researchers and clinicians since the problem was first recognized. Early efforts included Great Britain's Penicillin Act of 1947 and subsequent Aureomycin and Chloramphemicol Regulation of 1951 that eliminated free access to antibiotics by the general public, theoretically reducing the risk of selective pressure from unnecessary use or inappropriate dosing.[18] As the microbiological complexities of antibiotic resistance became clearer, myriad other proposed strategies focused on reduced use of antimicrobials,[19] implementation of more appropriate dosing regimens,[20] development of new antimicrobial drugs and vaccines,[6] susceptibility testing of anaerobic isolates,[8] increased attention to the effect of antibiotic residues in the environment and the role of commensals as reservoirs of resistance,[11] isolation of patients harboring resistant bacteria,[21] and uniform preparation of annual antibiograms to track resistance and improve therapy.[22]

While antibiotic resistance in clinical veterinary medicine has traditionally paralleled discoveries in human clinical medicine, the two have been inextricably linked by the issue of antibiotic use in food animals.[23,24] A similar point of debate has been the significance of working in close proximity to animals on human acquisition of multi-drug resistant zoonoses. Veterinary personnel historically have been the target of such research, with variable conclusions drawn over time.[25-27] Attention is increasingly being focused on the transmission of resistant pathogens between companion animals, horses and their owners, particularly as concerns methicillin-resistant *Staphylococcus aureus*.[28-30] Furthermore, organisms such as *Streptococcus equi zooepidemicus* that are typically associated with equine disease occasionally are reported to cause serious disease in humans that live or work in proximity to horses.[31-33] *Rhodococcus equi* emerged as a pathogen of human concern following reports of increased incidence in patients with Human Immunodeficiency Virus (HIV) infection.[34] Both veterinary and human literature demonstrate a rise in concern for public health in venues such as petting zoos,[35,36] a topic gaining importance in human medicine due to the prevalence of animal assisted therapies for the ill, disabled, elderly and immunocompromised.[37,38]

In light of this, an in-depth understanding of the institutional, local and regional microbial population is a prerequisite for effective and responsible antimicrobial use by veterinary hospital clinicians and field practitioners. Consideration of the potential impact of biosecurity and antibiotic protocols on the health of patients, staff, clients, and the general public is of paramount importance. To that end, the current project was undertaken with the goal of providing a baseline analysis of bacterial isolates from equine specimens submitted to the Oklahoma Animal Disease and Diagnostic Laboratory (OADDL) from the Boren Veterinary Medical Teaching Hospital (BVMTH), the Oklahoma State University College of Veterinary Health Sciences Ranch (CVHSR) and the regional veterinary community (RVC). The objectives of this retrospective study were as follows:

1. To describe the general characteristics of equine submissions to OADDL, including demographics, sample sources, bacteria isolated, and antimicrobial sensitivities.

2. To describe major differences in these characteristics between samples submitted from the BVMTH and CVHSR, and samples submitted from the RVC.

3. To describe major differences in these characteristics over time.

4. To discuss the status of antimicrobial isolation and resistance patterns at the BVMTH, CVHSR and in the RVC in the context of current veterinary literature.

5. To perform a detailed analysis of possible nosocomial infections in BVMTH cases, including oxacillin-resistant *Staphylococcus aureus,* multi-drug resistant *Enterococcus faecalis*, and others.

6. To generate current antibiograms for major equine pathogens for the BVMTH and for the RVC.

7. To generate meaningful discussion regarding current antibiotic use and biosecurity practices by CVHS facilities and regional practitioners.

8. To pinpoint areas for further research by CVHS clinical and research personnel.

# CHAPTER II

# REVIEW OF LITERATURE

## Overview of Equine Microbiology

Current literature in equine medicine encompasses a broad range of topics in both clinical and research microbiology, including nosocomial infections,[39,40] zoonotic transmission of disease[41,42] and multi-drug resistance.[43] Efforts to describe the microbiological environment encountered in equine practice range from broad retrospective surveys of multiple pathogens [44,45] to detailed molecular characterization of individual isolates.[46,47] Salient characteristics including disease presentations, reported trends in antimicrobial resistance and zoonotic concerns are summarized below for the principal bacterial organisms encountered in equine clinical practice. Brief literature reviews are provided regarding the pertinent microbiology of major organ system diseases and the one common device-associated infection in equine veterinary medicine, the intravenous catheter.

***Escherichia coli***

*Escherichia coli* is a commensal organism in the gastrointestinal tracts of most mammals, but also may be associated with disease.[48] Some studies have shown that horses have greater diversity in commensal *E.coli* strains than other species,[49] although the medical significance of this has not been investigated. Clinical disease caused by *E.coli* in horses includes neonatal sepsis,[50,51] and the organism has been reported in association with fertility problems in mares. [52]

*E. coli* is an organism of significance in the etiogenesis of antimicrobial resistance, being well-documented as a reservoir for transmissible drug resistance plasmids.[23,53,54] In vitro, conjugal transfer of resistance genes from equine clinical *E. coli* isolates to clinical, multi-drug resistant *Salmonella* isolates has been demonstrated.[16]

Reports of antimicrobial resistance in equine *E. coli* isolates are widespread geographically and over time. *E.coli* isolated from large animals in a Pennsylvania veterinary teaching hospital from 1985 to 1990 showed overall better susceptibility to amikacin (98.91%) than gentamicin (80.29%), but susceptibility to amikacin showed a decreasing trend over the five years of the study. [55] Multi-drug resistant *E. coli* isolated from septicemic foals in a California veterinary teaching hospital in the early 1990's showed resistance patterns to ampicillin, cephalothin, chloramphenicol, gentamicin, kanamycin, streptomycin, triple sulfonamides, tetracycline and trimethoprim sulfonamides.[53] Antimicrobial resistance was found in *E. coli* isolates from 107 of 143 (74.8%) horses in an abbatoir study in Australia in 1993. All isolates showed streptomycin resistance, with variable resistance to gentamicin, tetracycline, chloramphenicol, sulphafurazole, ampicillin, trimethoprim, and furazolidone. [56] Susceptibilities of *E. coli* isolates from equine clinic and field service cases at a western Canadian veterinary teaching hospital between 1998 and 2003 included amikacin (100%), ceftiofur (94%), enrofloxacin (91%), amoxicillin/CA (84%), spectinomycin (81%), gentamicin (80%), tetracycline (65%), ampicillin (62%), trimethoprim sulfamethoxazole (62%) neomycin (61%) cephalothin (50%), erythromycin (6%), and penicillin (0%).[45]

In a population of horses in Colorado examined in 2002 through 2005, *E.coli* from the feces of hospitalized horses receiving and not receiving antimicrobial therapy showed increased resistance to antibiotics relative to control horses in the community. Resistance to trimethoprim sulfamethoxazole was most common, followed by gentamicin and tetracycline, and multi-drug resistance was frequently observed. [57] Extended-spectrum cephalosporin resistant *E.coli* was isolated from purulent debris, stomach, synovial tissue and uterine fluid of horses in the Netherlands studied in 2003 through 2005. Multi-drug resistance to ampicillin, amoxicillin/CA, cephalexin, ceftiofur, ceftazidime, cefotaxime, streptomycin, gentamicin, kanamycin, chloramphenicol, tetracycline, norfloxacin, sulfamethoxazole and trimethoprim was noted in these isolates.[16]

***Streptococcus species***

The most common streptococcal pathogens in equine disease include the Lancefield Group C beta-hemolytic streptococci, *Streptococcus equi zooepidemicus, Streptococcus* *equi equi*, and *Streptococcus dysgalactiae equisimilis*. [58] *Streptococcus equi zooepidemicus* is a commensal of the equine upper respiratory tract, and is also one of the most frequently isolated organisms in equine clinical disease.[45,59] This organism is associated with a broad range of pathological conditions, including respiratory, reproductive, [59-61] and ophthalmologic disease.[62] *Streptococcus dysgalactiae equisimilis* is a commensal of the skin and mucosa, and has been associated with lymphadenitis and placentitis [59] as well as upper respiratory disease. [59,60] *Streptococcus equi equi* is the causative organism of upper respiratory infection and lymphadenopathy. [59] α-Hemolytic streptococci have been reported in association with equine respiratory, reproductive, urinary tract and ocular disease, as well as neonatal septicemia[45] and mastitis.[63]

Streptococcal species traditionally have shown less of a predilection for the development of significant resistance than other species of bacteria. [64] *Streptococcus equi zooepidemicus* isolates are reported to be consistently susceptible to beta-lactam and potentiated sulfonamide antibiotics. [65] Documentation of significant resistance trends was not apparent in current literature, though concern was transiently expressed about the possibility of resistance to trimethoprim sulfamethoxazole.[65] A recent large-scale evaluation of equine isolates submitted to a university diagnostic lab showed susceptibility of *Streptococcus equi zooepidemicus* to ceftiofur (100%), cephalothin (99%), penicillin (95%), ampicillin (92%), enrofloxacin (91%), erythromycin (91%), amoxicillin/CA (87%), spectinomycin (87%), gentamicin (85%), tetracycline (59%), trimethoprim sulfamethoxazole (55%), neomycin (20%) and amikacin (5%).[45]

Antibiotic susceptibility of *Streptococcus equi equi* isolates in a recent retrospective of specimens submitted to a university diagnostic laboratory showed good susceptibility to most antimicrobials tested, including ceftiofur (100%), cephalothin (100%), penicillin (100%), ampicillin (100%), erythromycin (100%), amoxicillin/CA (100%), spectinomycin (100%), enrofloxacin (95%), gentamicin (95%), tetracycline (92%), trimethoprim sulfamethoxazole (79%), neomycin (0%) and amikacin (0%).[45]

Resistance to α-hemolytic *Streptococcus* species was reported in 1988 to sulphonamide, nalidixic acid, gentamicin, kanamycin, neomycin and fucidin in strains isolated from milk of a mastitic mare and her septic foal; sensitivity was noted to ampicillin.[63] Sensitivity to α-hemolytic *Streptococcus* species reported recently by a university veterinary diagnostic laboratory included ceftiofur (100%), cephalothin (100%), spectinomycin (100%), tetracycline (93%), penicillin (89%), ampicillin (89%), erythromycin (89%), gentamicin (89%), enrofloxacin (86%), amoxicillin/CA (83%), trimethoprim sulfamethoxazole (75%), amikacin (55%) and neomycin (53%).[45]

***Salmonella species***

Equine Salmonellosis is a frequently observed disease with considerable zoonotic potential. Clinical disease due to *Salmonella* infection in equine patients is most commonly colitis, but other manifestations such as neonatal sepsis may occur.[66] Zoonotic outbreaks of equine origin have been documented in venues where horses and humans coexist in close contact, such as veterinary hospitals.[42]

The epidemiology of equine Salmonellosis varies with report. In one study of 1,451 hospitalized horses, 46 (3.2%) cultured positive for *Salmonella* with less than half of these (20) having positive cultures on admission.[67] Another study of asymptomatic hospitalized horses showed 7 of 250 (2.8%) to be *Salmonella* positive, while a population of 75 mares on a stud farm showed no positive *Salmonella* cultures. [68] In one abbatoir study, samples from ileal swabs of 39 of 143 (27.3%) horses cultured positive for *Salmonella*. [56] A seasonal incidence has been observed in some studies, with cases clustered in late summer and early fall. [67] It is not uncommon for Salmonellosis to occur in outbreaks. [69-71]

The most common serotype causing disease in both horses and humans is *S.* Typhimurium. *S.* Anatum is also frequently cultured, but less likely to be associated with clinical disease. [56,67,68] One study showed an increasing frequency of *Salmonella* Typhimurium DT104 at a veterinary teaching hospital, in which up to 92% of *Salmonella* isolates were of this type. [72]

Because of the high risk of zoonotic transmission, drug resistance in *Salmonella* species is of particular interest. Concern over plasmid-mediated multi-drug resistance in *Salmonella* species was documented in the literature over three decades ago. A 1971 multi-species survey study that included a small number of horses found that 935 of 1,251 isolates showed resistance to one or more of 11 antimicrobials tested. The most frequent resistance was observed to ampicillin, dihydrostreptomycin, sulfamethoxypyridazine, and tetracycline. *S.* Typhimurium showed the highest incidence of multi-drug resistance among serotypes tested. [73] A retrospective covering the years 1973 through 1979 revealed that most equine isolates were resistant to streptomycin and sulfonamides, but that only rarely were isolates resistant to more than two antimicrobials.[74] By the next decade, emerging resistance to chloramphenicol, ampicillin and gentamicin was observed in a study including primarily equine and environmental samples from a veterinary hospital. [75] Resistance in *Salmonella* Typhimurium DT104 has been found to ampicillin, tetracycline, gentamicin, sulfonamides and amikacin in Canada between 1997 and 2000. [72] Similar strains isolated in the Netherlands between 1993 and 2000 showed frequent resistance to ampicillin and tetracycline, though susceptibility improved over time. Resistance was also shown to trimethoprim/sulfonamide, kanamycin, gentamicin and enrofloxacin, and strains intermediate to ceftiofur were noted. [76] A national survey of multiple species in 1997 and 1998 including healthy and clinically ill animals showed emerging resistance to extended-spectrum cephalosporins most common in turkeys, horses, cats and dogs. [77] In 2000 an outbreak of multidrug-resistant *Salmonella* Typhimurium in an equine hospital occurred with resistance reported to amoxicillin, ampicillin, cefazolin, cefoxitin, ceftiofur, cephalothin, chloramphenicol, gentamicin, ormethoprim, rifampin, tetracycline, ticarcillin and trimethoprim/sulfadiazine and intermediate status to cefotaxime. [78]

Emerging multi-drug resistance in equine isolates of *S.* Anatum was found to ampicillin, tetracylines, chloramphenicol, carbenicillin, ticarcillin, gentamicin, tobramycin, trimethoprim sulfamethoxazole and cephalothin in a veterinary hospital in Pennsylvania. [66] Multi-drug resistant *S.* Anatum was the primary serotype (69.2%) identified in ileal samples from horses in an abbatoir study in Australia, with all isolates resistant to streptomycin, and variable resistance to sulphafurazole and tetracycline.[56]

Emergent multi-drug resistant *S.* Agona was reported in a population of horses in Kentucky in 1986, showing very low susceptibility to most antimicrobials tested including erythromycin (0%), penicillin (0%), tetracycline (1.2%), triple sulfonamide (2.4%), ampicillin (3.6%), carbenicillin (3.6%), kanamycin (3.6%), cephalothin (4.8%), chloramphenicol (4.8%), gentamicin (4.8%), streptomycin (9.6%), neomycin (16.9%), trimethoprim sulfamethoxazole (84.3%), nitrofurantoin (100%), polymyxin B (100% ) and amikacin (100%).[79]

An outbreak of multi-drug resistant *Salmonella* Heidelberg in a veterinary hospital showed concurrent resistance to ampicillin, streptomycin, tetracycline, chloramphenicol, sulphathiazole, trimethoprim, kanamycin, spectinomycin, and gentamicin. [43]

Multi-drug resistant *Salmonella* Infantis, in which 80.3% of isolates were resistant to at least one antimicrobial, and 67.8% were resistant to five or more antimicrobials, persisted in a veterinary teaching hospital environment for nine years.[80]

***Staphylococcus aureus***

*Staphylococcus aureus* (*S. aureus*) is found in the upper respiratory and gastrointestinal tracts of clinically normal horses, and is reported commonly in incision and wound infections, intravenous catheter infections and bacteremia as well as pneumonia, implant infections, septic arthritis, umbilical infections, abscesses and osteomyelitis. [27,81]

Multi-drug resistant strains of *S. aureus* are an increasingly important cause of nosocomial infections in both human and veterinary medicine. [82] Concern regarding evolving resistance of *S. aureus* in equine patients has been reported since the 1970's, with one early report indicating nearly 84% of equine isolates were resistant to one or more antibiotics. [83] Another report in 1991 showed 59.2% of *S. aureus* strains tested were resistant to at least one antibiotic. [81] Tetracycline and spectinomycin resistant *S. aureus* was reported in reproductive tract isolates from horses in 1998. [84] Recently reported susceptibilities for all *S. aureus* isolates from a veterinary teaching hospital diagnostic laboratory included amikacin (100%), gentamicin (100%), trimethoprim sulfamethoxazole (100%), cephalothin (100%), enrofloxacin (97%), ceftiofur (97%), tetracycline (97%), amoxicillin/CA (94%), erythromycin (84%), neomycin (83%), ampicillin (55%), penicillin (55%) and spectinomycin (29%).[45] Methicillin resistant *S. aureus* (MRSA) was reported in a wound in a horse in 1997. [85]

Epidemiology of MRSA in horses and humans that work with horses varies across reports. One prevalence study conducted with specimens from Ontario, Canada and New York State in 2003 showed MRSA in 4.7% of horses tested, and in 13% of humans tested at the same locations. [86] A multi-species, multi-center study conducted in 2001 and 2002, and involving veterinary teaching hospitals across the country showed that in 22% of equine patients with a *S. aureus* infection, methicillin resistance was present. [12] A surveillance study conducted in 2002 and 2003 in a tertiary care veterinary teaching hospital in Canada showed that over half of MRSA positive horses in the study period had MRSA at the time of admission, while 44% acquired nosocomial infections. [87] A study in 2005 showed no MRSA in a community-based population of 300 horses in Slovenia, although 42% were colonized with methicillin resistant coagulase negative staphylococci.[13] Similar results were found in 50% of a population of 100 horses, both hospitalized and in the community, in 2005 in Denmark,[88] and in a group of 200 clinically healthy horses in 2004 in the Netherlands, of which 22.5% harbored a methicillin resistant coagulase negative staphylococci identified as *Staphlyococcus sciuri*. [89] Prevalence of MRSA in a population of equine veterinarians attending an international conference in 2006 was 10.1%.[90] It is of interest that while MRSA is a significant problem in one tertiary care teaching hospital in Canada, another Canadian veterinary teaching hospital with a 75% first opinion caseload reported minimal resistance in their *S. aureus* isolates.[45]

Susceptibility studies of MRSA to other antibiotics indicate that multi-drug resistance is often present in these strains. Reported susceptibilities of equine MRSA in one report included clindamycin (100%), imipenem (100%), amikacin (95%), chloramphenicol (95%), erythromycin (75%), rifampin (70%), enrofloxacin (36%), gentamicin (14%), oxacillin (0%), trimethoprim sulfamethoxazole (0%) and tetracycline (0%).[86] Another study of equine and human MRSA showed susceptibilities of doxycycline (100%), minocycline (100%), rifampin (29%), trimethoprim sulfamethoxazole (21%), erythromycin (14%), gentamicin (12%) and tetracycline (4%).[27]

Intensifying the concern over MRSA in horses is mounting evidence of zoonotic transmission. Strains of MRSA isolated from equine patients and the humans treating them have been found to be identical, [91] though other comparisons of equine and human types of methicillin resistant *S. aureus* show them to be unrelated in origin. [47] Recent studies suggest that transmission occurs between horses and humans in both directions. [27,41] Intra-hospital spread of a single MRSA strain has been reported. [92] In a cross species study, strain variability within individual institutions suggested a predominance of community acquired rather than hospital acquired MRSA. [12] Environmental contamination has also been proposed as a factor in institutional spread of MRSA. [46]

Variable risk factors have been identified for the acquisition of MRSA by horses. One study showed the only risk factor significantly associated with MRSA colonization in a horse population to be living on a farm with greater than 20 horses,[86] while another described previous identification of MRSA in the horse, colonized horses on the same farm, antimicrobial administration within 30 days, admission to the NICU, and admission to a hospital on a non-surgical service as significant. [93] Risk factors associated with nosocomial MRSA include administration of ceftiofur or aminoglycosides during hospitalization. Horses with MRSA on admission were more likely to develop clinically apparent MRSA infections. [87] Horses with nosocomial MRSA have significantly longer hospitalization than horses without MRSA or horses with community acquired MRSA, [87] although specific associated costs have not been reported.

Numerous strategies for treatment and elimination of MRSA have been described. MRSA has been eliminated from one large farm with the implementation of management and screening practices, and minimal antimicrobial therapy. [94] Vancomycin has been used in some cases for the treatment of MRSA and resistant enterococcus infections. [95] Simple handwashing has been shown to be protective for the presence of MRSA in veterinary personnel. [90]

***Pseudomonas aeruginosa***

Although relatively little has been written specifically pertaining to non-ophthalmologic antimicrobial resistance in equine *Pseudomonas* isolates, multi-drug resistant *Pseudomonas aeruginosa* (*P. aeruginosa*) isolates have been identified in canine [96] and human [97] critical care environments.

Equine isolates of *P. aeruginosa* have been shown to have greater susceptibility to amikacin than gentamicin, 89.66% versus 73.10% in one study in 1997. [55] Recently reported data on *P. aeruginosa* isolates from equine clinical cases at a veterinary teaching hospital showed limited susceptibility to most antimicrobials tested, including amikacin (92%), gentamicin (56%), enrofloxacin (30%), amoxicillin/CA (13%), neomycin (13%), spectinomycin (7%), ceftiofur (0%), tetracycline (0%), ampicillin (0%), trimethoprim sulfamethoxazole (0%) cephalothin (0%), erythromycin (0%), penicillin (0%).[45]

***Klebsiella pneumoniae***

*Klebsiella pneumoniae* (*K. pneumoniae*) may be part of normal flora in nasal passages, feces and the mare's caudal reproductive tract and has been isolated from the semen of healthy stallions,[98] but may also be associated with pathology including respiratory disease, endometritis,[98] infertility,[15,99] and neonatal septicemia. [50] This organism is rarely reported in association with abortion and meningitis. [99]

Extended spectrum cephalosporin resistance due to extended spectrum ß-lactamases has been reported in *K. pneumoniae* clinical isolates from purulent material and feces of a geriatric horse and two foals. These isolates showed concurrent resistance to ampicillin, cephalexin, ceftiofur, ceftazidime, cefotaxime, streptomycin, gentamicin, kanamycin, chloramphenicol, tetracycline, trimethoprim and sulfamethozole. [16] A recent survey of *Klebsiella* species isolates from uterine infections in mares showed 100% susceptibility to amoxicillin/CA, cephalexin, and gentamicin, with good susceptibility shown to chloramphenicol (97%), cefazolin (89%), tetracycline (89%) and trimethoprim/sulfamethoxazole (89%). Clear patterns of multi-drug resistance were not noted in this study.[15] Equine isolates of *K. pneumoniae* may be more susceptible to amikacin (96.80%) than gentamicin (63.20%). [55] Susceptibility to spectinomycin was greater for uterine isolates of *K. pneumoniae* than for isolates from other tissues in an Oklahoma study encompassing the years 1983 to 1987. [100] A recent multi-species study of clinical *Klebsiella* isolates identified three of 17 *K. pneumoniae* isolates as being multi-drug resistant; these isolates were obtained from horses with endometritis, cystitis and a liver abscess.[101]

***Staphylococcus xylosus* and other *Staphylococcus species***

Staphylococci other than *S. aureus* are also frequently isolated from the skin of clinically normal animals. In one horse population, 89.5% cultured Staphylococci. The most frequent isolate was *S. sciuri* in 76.5% of horses, with *S. xylosus* found in 23.5%. Other species isolated included *S. hominis*, *S. capitis*, *S. saprophyticus* and *S. epidermidis* along with four unidentified species. Two to three different Staphylococcus species were found in 41.2% of colonized horses.[102] *Staphylococcus sciuri* and *S. xylosus* are more frequently isolated from normal skin relative to skin lesions, which more frequently culture *S. aureus*, *S. intermedius* and *S. hyicus*. [103]

Methicillin resistant coagulase negative Staphylococcus species have been isolated from the nasal passages in up to 50% of horses, including *S. epidermidis*, *S. sciuri*, *S. vitulinus* and *S. haemolyticus,* and were often multi-drug resistant.[88] Coagulase negative staphylococci possessing the gene for methicillin resistance, including *Staphylococcus sciuri* and *Staphylococcus lentus*, have been isolated from non-reproductive specimens in a group of healthy broodmares.[104] This is of particular concern as there is some evidence for transferability of the methicillin resistance gene (*mecA*) from coagulase negative *Staphylococcus* to *S. aureus*.[105]

Other research has shown increases in the percentage of multi-drug resistance in Staphylococci isolated from the skin of horses following hospitalization, [105] and resistance to tetracycline concurrent with at least five other antimicrobials including ampicillin, chloramphenicol, neomycin, streptomycin, erythromycin, or trimethoprim sulfamethoxazole has been documented in *S. epidermidis*, *S. haemolyticus*, *S. intermedius*, *S. sciuri* and *S. xylosus*.[84] A chloramphenicol resistance plasmid was identified in *S. sciuri* isolated from the prepuce of a clinically normal stallion.[106]

***Enterococcus species***

Enterococci are gram positive bacteria formerly categorized as Streptococcus group D, and show intrinsic resistance to some antimicrobials including aminoglycosides, lincosamides and trimethoprim. Enterococci have shown an increased likelihood to develop resistance relative to other Streptococci, [64] although *Enterococcus* isolates reported recently from equine clinical cases at a veterinary teaching hospital showed some susceptibility to all antimicrobials tested, including amoxicillin/CA (100%), ampicillin (96%), penicillin (86%), gentamicin (75%), trimethoprim sulfamethoxazole (68%), spectinomycin (67%), tetracycline (64%), erythromycin (50%), enrofloxacin (46%), cephalothin (36%), neomycin (33%), ceftiofur (29%) and amikacin (25%). [45] Vancomycin-resistant Enterococci including *E. faecalis* and *E. faecium* are the species of greatest concern as they tend to be concurrently resistant to most other antibiotics as well. Emergence of vancomycin resistance is theorized to be due in part to the past use of the glycopeptide feed additive avoparcin in cattle in Europe, though the problem is not limited to this geographic area.[64] Vancomycin resistant *Enterococcus* species have been isolated in horses in Europe.[10,14] Relative to swine and human isolates, the equine isolates showed less multi-drug resistance.[10]

***Actinobacillus species***

*Actinobacillus* species are commensals of the mucous membranes, oral cavity and respiratory tract of healthy animals, and are also agents of equine disease.[107] *Actinobacillus equuli* (*A. equuli*) has been reported in conjunction with peritonitis,[108] endocarditis,[109] pulmonary hemorrhage,[110] and soft tissue infections.[111] *Actinobacillus suis* (*A. suis*) has been associated with respiratory, reproductive and soft tissue infections,[112] as well as neonatal septicemia.[113] Untyped *Actinobacillus* (*Actinobacillus sp*.) infections have occurred in postoperative infections[114] and neonatal bacteremia.[115]

Concerns about antimicrobial resistance in *Actinobacillus* species are reported rarely. A case series of horses with *A. equuli* peritonitis revealed that 79% of isolates for which sensitivities were performed were susceptible to all antibiotics tested, with sporadic resistance to penicillin and trimethoprim sulphadimidine in the others.[108] *A. equuli* isolated from cellulitis in a foal in Italy in 2008 was susceptible to amikacin, amoxicillin-CA, ceftiofur, cefazolin and trimethoprim sulfonamide.[111] Susceptibility data for *A. equuli* from a veterinary teaching hospital in Canada showed good susceptibility to most antimicrobials tested, including amoxicillin/CA (100%), cephalothin (100%), enrofloxacin (100%), ceftiofur (98%), tetracycline (93%), trimethoprim sulfamethoxazole (93%), ampicillin (91%), gentamicin (79%), penicillin (67%), neomycin (47%), amikacin (46%), spectinomycin (40%), erythromycin (39%).[45]

Nine clinical isolates of *A. suis* from horses in New Zealand between 1978 and 1980 were susceptible to all antibiotics tested, including benzyl penicillin, ampicillin, streptomycin, tetracycline, neomycin and kanamycin.[112] A report of *A. suis* from two foals in Wisconsin in 1996 showed one susceptible to all antimicrobials tested, while the other was resistant to amikacin and penicillin, and intermediate to ceftiofur, gentamicin, tetracycline and tobramycin.[113]

Multi-drug resistance was a concern in one report of *Actinobacillus sp.* isolated obtained between 1995 and 2000 from postsurgical cases in Pennsylvania. While all isolates were susceptible to amikacin, ceftiofur, cephalothin, chloramphenicol, enrofloxacin, gentamicin, polymixin B and rifampin, all were resistant to penicillin, bacitracin and vancomycin with variable resistance to ampicillin, oxacillin and ticarcillin.[114] In a Swedish veterinary hospital in 1999, an antimicrobial susceptibility analysis was suggestive of acquired resistance to penicillin, ampicillin, streptomycin and trimethoprim-sulfa in some isolates of *Actinobacillus*.[107] *Actinobacillus sp* isolates from a Canadian veterinary teaching hospital showed good susceptibility to most antimicrobials tested, including enrofloxacin (100%), ampicillin (95%), ceftiofur (95%), cephalothin (95%), trimethoprim sulfamethoxazole (95%) amoxicillin/CA (91%), tetracycline (91%), gentamicin (73%), penicillin (68%), amikacin (33%), neomycin (25%), spectinomycin (18%), and erythromycin (14%). [45]

***Rhodococcus equi***

*Rhodococcus equi* is most commonly associated with pyogranulomatous pneumonia in foals, as well as diarrhea, uveitis, polysynovitis and abscesses. *Rhodococcus equi* infections have historically been treated with a combination of erythromycin and rifampin, though resistance to rifampin has been reported. [116,117] Fluoroquinolone resistance has also been reported.[118] Clarithromycin[119] and doxycycline[120] have been recommended as possible alternative treatments.

### *Other Bacterial Infections of Horses*

Other less frequently isolated bacteria still play a role in equine disease, particularly in critical care settings. Emergent multi-drug resistance has been reported in the human medical literature for bacteria such as *Acinetobacter baumannii*[121] and *Serratia marscens*[122] that also have been known to cause infection in hospitalized horses. Nosocomial outbreaks of multi-drug resistant strains of both bacteria have also been reported in companion animal medicine.[123,124]

*Acinetobacter baumannii* has been reported as a cause of intravenous catheter infections in horses with consistent resistance to amoxicillin, amoxicillin/CA, ceftiofur, tetracycline and potentiated sulfonamides and variable resistance to gentamicin, flumequine and enrofloxacin.[125] A strain of *Acinetobacter baumannii* isolated from a skin lesion of a horse during an outbreak in a veterinary teaching hospital in Switzerland in 2001 was resistant to amoxicillin, cefoperazone, ticarcillin, gentamicin, sulfonamides, sulfonamide-trimethoprim, tetracycline, and chloramphenicol, and was susceptible to caftazidime, imipenem, and ciprofloxacin.[39] A DNA fragment from an equine isolate of *Acinetobacter baumannii* was found to be similar to a resistance plasmid previously identified in *Klebsiella pneumoniae*, *Serratia marcescens* and *Escherichia coli*.[126]

Nosocomial infection was suspected in a subset of horses with *Serratia species* infection in one report. The most common isolate, *Serratia marcescens*, showed consistent resistance to penicillin and variable resistance to chloramphenicol and gentamicin. [127] An isolated report of *Serratia marcescens* sensitive to trimethoprim sulfadiazine was the cause of fatal endocarditis in a horse. [128] *Serratia marcescens* associated with abortion in a mare was susceptible only to ceftiofur out of fifteen antibiotics tested. [129] A strain of *Serratia marcescens* causing septicemia in two horses receiving intravenous infusions from a common source was susceptible to amikacin, gentamicin, chloramphenicol and trimethoprim sulphamethoxazole.[130]

## Microbiology of Equine Pathogens by Body System

### *Reproductive*

Mare reproductive tract samples are among the most common equine specimens submitted to veterinary diagnostic laboratories.[45] *Streptococcus equi zooepidemicus* and *E. coli* are frequently reported as the most common isolates from uterine cultures. A 1979 study of 498 positive uterine culture results produced ß-hemolytic Streptococci (39%), *E. coli* (27%) and *Klebsiella pneumoniae* (7%).[131] In a recent study from a university teaching hospital diagnostic laboratory, uterine culture isolates included *Streptococcus equi zooepidemicus* (35.6%) followed by *E. coli* (13.8%).[45] A recent (2008) retrospective of antimicrobial susceptibility of isolates from mares with fertility problems showed the most frequent isolates to be *Streptococcus* group C (31.7%) and *E. coli* (18.4%).[52] Streptococci in the 1979 study showed 100% susceptibility to ampicillin, penicillin, cephaloridine and chloramphenicol, while *E. coli* showed 100% susceptibility to chloramphenicol and gentamicin. In the university study cited above, the *Streptococcus* species showed most uniform susceptibility to amoxicillin/CA (82.7%) with significant resistance to kanamycin, gentamicin and enrofloxacin. The *E.coli* isolates showed good susceptibility to multiple antibiotics including amoxicillin/CA (78.1%), enrofloxacin (75.3%), gentamicin (73.5%), trimethoprim sulphamethoxazole (71.9%), and kanamycin (67.2%). [52]

Another study reported slightly different results with *E. coli* (43.5%) being the most frequent, and ß-hemolytic streptococci (12.9%) the second most common isolate. Sensitivity of the ß-hemolytic streptococci included decreased susceptibility to clindamycin (90%), trimethoprim sulphamethoxazole (90%), oxytetracycline (29%), gentamicin (19%) and neomycin (13%), though all isolates were susceptible to penicillin, ampicillin, cephalothin and chloramphenicol. For the *E. coli* isolates, no resistance was noted to enrofloxacin, though 3% were intermediate. Reported susceptibilities included nitrofurantoin (99%), gentamicin (96%), chloramphenicol (94%), neomycin (93%), ampicillin (86%), trimethoprim sulphamethoxazole (85%), oxytetracycline (81%), streptomycin (51%) and cephalothin (18%).[132]

*Streptococcocus equi zooepidemicus* was the sole focus of another study of uterine isolates from mares with endometritis; susceptibility was high to ampicillin (100%), cephalexin (100%) and gentamicin (98.5%) and enrofloxacin and trimethoprim sulphamethoxazole were considered acceptable. The susceptibility to gentamicin was reported to be considerably higher than in other studies. [133]

### *Respiratory*

Frequently cultured specimens from the equine respiratory tract include transtracheal washes, nasal swabs and guttural pouch washes. Common respiratory isolates in one large scale study included *Streptococcus equi zooepidemicus* (40.5%), *Actinobacillus suis* (22.6%) and *Actinobacillus equuli* (15.4%); significant problems with resistance were not noted. [45]

### *Gastrointestinal*

The mammalian gastrointestinal tract is a rich source of microbial life. As pertains to the more focused issue of antimicrobial resistance, commensal organisms of the gastrointestinal tract may serve as reservoirs for transmission of resistance plasmids to more pathogenic bacteria. *E. coli* has demonstrated this characteristic, transferring resistance genes to clinical isolates of multi-drug resistant *Salmonella*.[16] Enterococcus species demonstrate the ability to acquire significant multi-drug resistance, potentially causing untreatable infections.[64] Vancomycin resistant *Enterococcus faecium* was identified in fecal samples from 8% of clinically normal horses tested. [14] Another study found similar results, with 6.7% of equine samples containing vancomycin resistant *Enterococcus casseliflavus* or *Enterococcus faecium*. [10]

### *Blood Cultures*

Blood cultures from septic foals historically produce gram negative bacteria including *E. coli*, *Actinobacillus spp*, and *K. pneumoniae*; recent results from a university hospital retrospective were consistent with this. [45] Mixed infections with gram positive or anaerobic bacteria in addition to gram negative bacteria occurred in approximately half of the septic foals in one report.[50] A more recent study showed that while *E. coli* was still the most common isolate, 33.8% of foal blood cultures returned only a gram positive organism. *E. coli* isolates in this study showed 80% susceptibility to amikacin, and 80% susceptibility to gentamicin. [51]

***Ocular***

*Streptococcus equi zooepidemicus* is frequently reported as the most common isolate in surveys of equine bacterial keratitis.[45] A recent retrospective found 33.3% of isolates to be *Streptococcus equi zooepidemicus*; all were susceptible to ciprofloxacin, cephalothin and chloramphenicol, with decreased susceptibility to gentamicin (82.4%), bacitracin (64.3%), polymyxin B (21.4%) and neomycin (6%). *Pseudomonas aeruginosa* and *Staphylococcus spp.* each accounted for 11.8% of the isolates in this study. All *Pseudomonas* isolates were susceptible to ciprofloxacin, gentamicin, neomycin, polymyxin B and tobramycin. [134] Another study found *Pseudomonas aeruginosa* (22%) and *Streptococcus equi zooepidemicus* (20%) to be the most common isolates, although in this report the *Streptococcus* isolates showed increasing resistance to gentamicin over the ten year retrospective period while the *Pseudomonas* isolates showed increasing resistance to both gentamicin and tobramycin. [135] A retrospective examining susceptibilities of ß-hemolytic streptococci isolated from equine ulcerative keratitis showed 100% susceptibility to bacitracin, carbenicillin, cephalothin, and chloramphenicol with 100% resistance to kanamycin and neomycin. Susceptibility to other antibiotics included trimethoprim sulfa (90.9%), ampicillin (54.5%), gentamicin (45.5%), polymyxin B (18.2%), enrofloxacin (18.2%) and tobramycin (9.1%).[62]

***Intravenous Catheters***

Scattered reports exist in the literature pertaining to intravenous catheter infections in horses. Commonly isolated organisms include coagulase negative Staphylococci, *Corynebacterium* species, *Enterobacter* species and Streptococci.[136] *Acinetobacter baumannii* was isolated in catheter tips from seven horses. All strains showed resistance to amoxicillin with or without clavulanic acid, ceftiofur, tetracycline and potentiated sulfonamides, and two were resistant to fluoroquinolones. All were intermediate or resistant to gentamicin and susceptible to neomycin. Clinical indication of catheter infection was evident in only three horses with positive cultures. [125] In one study of long term catheterization in colic cases, *Enterobacter* and *Staphylococcus aureus* were cultured from one third of the horses. [137]

# CHAPTER III

# METHODOLOGY

Data describing equine specimens submitted to OADDL is stored across multiple automated databases including the University Veterinary Information System (UVIS), its now defunct predecessor the Veterinary Laboratory Information Management System (VetLIMS), and the Sensititre microbiology system. Additional demographic data regarding equine patients hospitalized at the Boren Veterinary Teaching Hospital (BVTH) is stored in the Medical Information Management System (MIMS), and detailed case management data is stored in paper records in the Medical Records Department.

To create the most comprehensive single research database file possible, bacterial isolate and sensitivity data for the years 2005 through 2007 were exported from Sensititre to a Microsoft Excel[a] spreadsheet. Patient and client demographic data for the same years were extracted from UVIS and exported to another Excel spreadsheet. Records were matched manually to determine specimens that were submitted to OADDL by the BVMTH, and those samples that were submitted by the RVC. Individual case data were obtained from MIMS or paper records as required.

Data wer analyzed using both Excel and Microsoft Access[b]. Analysis included description of isolates by organism, by body system of origin, and by location of origin (BVMTH and CVHSR versus RVC). For the most frequently isolated pathogens, phenotypic susceptibility typing was performed. Although this method is less definitive as molecular typing for describing the epidemiology of infectious diseases, it nonetheless provides valuable initial information on the microbial environment. [82] Antibiograms were developed for each of these pathogens for both the BVMTH/CVHSR and the RVC. Duplicate isolates from a single patient were removed prior to susceptibility analysis. Research in humans suggests that removal of duplicate isolates results in significantly different antibiogram patterns than when repeat isolates from chronically, critically ill patients are included in the analysis.[138] All antibiograms were compiled using only those specimens of known origin. Samples from 2005 classified as “Unknown” due to the lack of available data for VetLIMS to identify the origin were excluded from susceptibility calculations, thus sample sizes from 2005 were small.

CHAPTER IV

# FINDINGS

## Overall Findings

During the three year period studied 1,885 bacterial isolates from equine specimens were cultured and had sensitivities performed at OADDL. Of this total, 1,610 were first isolates. Complete data was unavailable to classify 427 first isolates as coming from BVMTH facilities versus the RVC. Regional veterinary community specimens totaled 639, with CVHS facility specimens including 497 from BVMTH and 47 from the CVHSR.

**Table 1**
**Bacteriology Specimens by Location of Origin**
***(First Isolates)***

| | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Regional Veterinary Community (RVC) | 61 | 320 | 258 | 639 |
| Boren Veterinary Medical Teaching Hospital (BVMTH) | 47 | 221 | 229 | 497 |
| Unknown | 417 | 9 | 1 | 427 |
| College of Veterinary Health Sciences Ranch (CVHSR) | 5 | 19 | 23 | 47 |
| **Total** | **530** | **569** | **511** | **1610** |

Specimens were submitted from 51 of Oklahoma's 77 counties, as detailed in the table below.

**Table 2**
**Total Submissions by County**

| County | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| Payne | 60 | 303 | 345 | 708 | 37.6% |
| Unspecified | 496 | 30 | 10 | 536 | 28.4% |
| Le Flore | 20 | 83 | 126 | 229 | 12.1% |
| Logan | 12 | 107 | 13 | 132 | 7.0% |
| Oklahoma | 2 | 21 | 23 | 46 | 2.4% |
| McClain | | 7 | 19 | 26 | 1.4% |
| Creek | 3 | 14 | 6 | 23 | 1.2% |
| Carter | 1 | 8 | 11 | 20 | 1.1% |
| Mayes | | 13 | 4 | 17 | 0.9% |
| Canadian | | 10 | 5 | 15 | 0.8% |
| Garvin | 1 | 4 | 7 | 12 | 0.6% |
| Other (41 Counties) | 17 | 55 | 49 | 121 | 6.4% |
| **Total** | **612** | **655** | **618** | **1885** | **100.0%** |

*Escherichia coli* (15.7%), *Streptococcus equi zooepidemicus* (13.7%) and all *Salmonella* species (11.9%) were the most common bacteria isolated overall. First isolates showed the same distribution of organisms with *E. coli* (14.3%), *Streptococcus equi zooepidemicus* (12.7%) and all *Salmonella* species (10.9%). Tables A-1 and A-2 provide detail on all bacteria isolated. The frequency of isolation of individual bacteria varied with location. *E. coli* and *Streptococcus equi zooepidemicus* were the most common isolates from the BVMTH and RVC, but this was reversed for CVHSR specimens. The third most common isolate at the BVMTH remained *Salmonella* species, while it was *Pseudomonas aeruginosa* for the RVC and *Klebsiella pneumoniae* at the CVHSR. Tables A-3, A-4 and A-5 detail isolate frequencies for each location.

Reproductive system specimens were the most common of all submissions to OADDL at 35.1%, with 16.3% gastrointestinal specimens and 16.2% respiratory tract samples. Table A-6 details these findings. The most common specimen submitted from the BVMTH was feces (17.9%) followed by lower respiratory tract samples (16.5%), blood cultures (8.0%), intravenous catheters (6.8%) and eye swabs (5.0%) Nearly half (48.8%) of all RVC specimens were uterine samples, followed by lower respiratory tract samples (9.5%). Specimen sources from the CVHSR included uterus (51.1%) and feces (19%). Tables A-7, A-8 and A-9 detail specimen samples by location of origin.

**Findings by Organism**

***Escherichia coli***

*Escherichia coli (E. coli)* and *E. coli beta* together equaled 310 (16.4%) total isolates and 245 (15.2%) first isolates. Fourteen of these isolates were *E. coli beta*; all were first isolates. The most common sources of *E. coli* were the mare reproductive tract and the gastrointestinal system. *E. coli* was isolated from numerous other sources as shown in Table 3.

**Table 3**
**All *E. coli* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Uterus/Vagina/Cervix | 45 | 57 | 37 | 139 |
| Feces/GI Tract | 19 | 24 | 23 | 66 |
| Wound/Incision/Skin Lesion | 7 | 7 | 4 | 18 |
| Blood Culture | 7 | 8 | 2 | 17 |
| TTW/Lung | 5 | 3 | 6 | 14 |
| Urine/Urolith | 6 | 3 | 2 | 11 |
| Umbilicus | 6 | 2 | | 8 |
| Abscess | 1 | 3 | 2 | 6 |
| Other | 3 | 1 | 2 | 6 |
| Liver | | 3 | 2 | 5 |
| Bone/Cartilage/Joint Fluid | 2 | 1 | 1 | 4 |
| Abdominal Fluid | | 3 | | 3 |
| Thorax | | | 3 | 3 |
| Milk | | | 3 | 3 |
| Urethra | 2 | | | 2 |
| Catheter | | 1 | | 1 |
| Cerebrospinal Fluid | | | 1 | 1 |
| Eye | 1 | | | 1 |
| Lymph Node | | | 1 | 1 |
| Semen | | | 1 | 1 |
| **Total** | **104** | **116** | **90** | **310** |

Ninety four *E. coli* susceptibility phenotypes were identified; these are detailed in Table A-10. A single antimicrobial susceptibility phenotype designated Phenotype 1 accounted for 26.5% of all *E. coli* isolates, and showed resistance only to rifampin. This phenotype was present in all years and from all locations of origin. The next seven most frequent phenotypes, including 5 to 13 isolates, showed resistance not only to rifampin, but to varying combinations of erythromycin, oxacillin, penicillin, spectinomycin, tetracycline and trimethoprim sulfamethoxazole. The remaining isolates showed numerous patterns of multi-drug resistance. There were no antimicrobials tested for which all isolates were susceptible. Twenty phenotypes (28 isolates) showed resistance to enrofloxacin, while a further seven single-isolate phenotypes were intermediate. One isolate was intermediate to imipenem, and one was susceptible only to imipenem. Nearly one-third (31%) of isolates were resistant to one antibiotic, 68% were resistant to two or more, and 50% were resistant to five or more.

A trend toward decreasing susceptibility to cephalosporins was present in both BVMTH/ CVHSR and RVC isolates over the three year period. Tables A-11 and A-12 show susceptibility percentages for isolates for each location.

***Streptococcus equi zooepidemicus***

*Streptococcus equi zooepidemicus* was the second most frequently isolated organism overall (258; 13.7%) and for first isolates (205; 12.7%). The mare reproductive tract (98; 37.9%) and the lower respiratory tract (54; 20.9%) were the most frequent sources of *Streptococcus equi zooepidemicus*. Table 4 below summarizes the sources of all *Streptococcus equi zooepidemicus* isolates.

**Table 4**
**All *Streptococcus equi zooepidemicus* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Uterus/Vagina/Cervix | 47 | 36 | 15 | 98 |
| Lung/TTW | 13 | 22 | 19 | 54 |
| Wound/Incision/Skin Lesion | 6 | 8 | 5 | 19 |
| Nasal/Sinus/Guttural Pouch | 7 | 5 | 7 | 19 |
| Other | 4 | 8 | 5 | 17 |
| Abscess | 6 | 5 | 5 | 16 |
| Thorax/Pleura | 2 | | 7 | 9 |
| Sheath/Penis/Urethra | 1 | 3 | 1 | 5 |
| Bone/Tendon/Joint | 3 | | 1 | 4 |
| Abdominal | 2 | 1 | | 3 |
| Eye/Conjunctiva | | 3 | | 3 |
| Umbilicus | | 2 | 1 | 3 |
| Catheter | | | 2 | 2 |
| Urine | 1 | | 1 | 2 |
| Blood | 1 | | | 1 |
| Lymph Node | | 1 | | 1 |
| Milk | 1 | | | 1 |
| Pericardium | 1 | | | 1 |
| **Total** | **95** | **94** | **69** | **258** |

Of all 205 first isolate *Streptococcus equi zooepidemicus* specimens 47% (97) were submitted by the RVC, 23% (48) by the BVMTH and 5% (11) by the CVHSR. Nearly one-quarter (24%) of the samples did not have a location of origin specified.

Ninety-five individual sensitivity patterns were identified from *Streptococcus equi zooepidemicus* first isolates. Phenotype 1 was the most common, accounting for 15.6% (32) of all *Streptococcus equi zooepidemicus* isolates and occurring in all years and all locations. Regional veterinary community submissions accounted for 62.5% (20) of Phenotype 1 isolates.

Phenotype 1 was susceptible to all antibiotics tested with the exception of being intermediate to erythromycin. Phenotypes 2 and 3 accounted for 5.4% (11) and 4.8% (10) of *Streptococcus equi zooepidemicus* isolates respectively, and were identical to Phenotype 1 with the exception that Phenotype 2 was resistant to tetracycline and Phenotype 3 was intermediate to enrofloxacin. Individual isolates showed more frequent intermediate and resistant status to cephalosporins, imipenem, chloramphenicol and tetracycline. Only one isolate, a 2006 RVC sample, showed resistance to trimethoprim/sulphamethoxazole. Sixty-nine phenotypes were single isolates. Thirty-two percent (31) of RVC isolates had unique sensitivity patterns, compared with 40% (19) of BVMTH isolates and 45% (5) of CVHSR isolates.

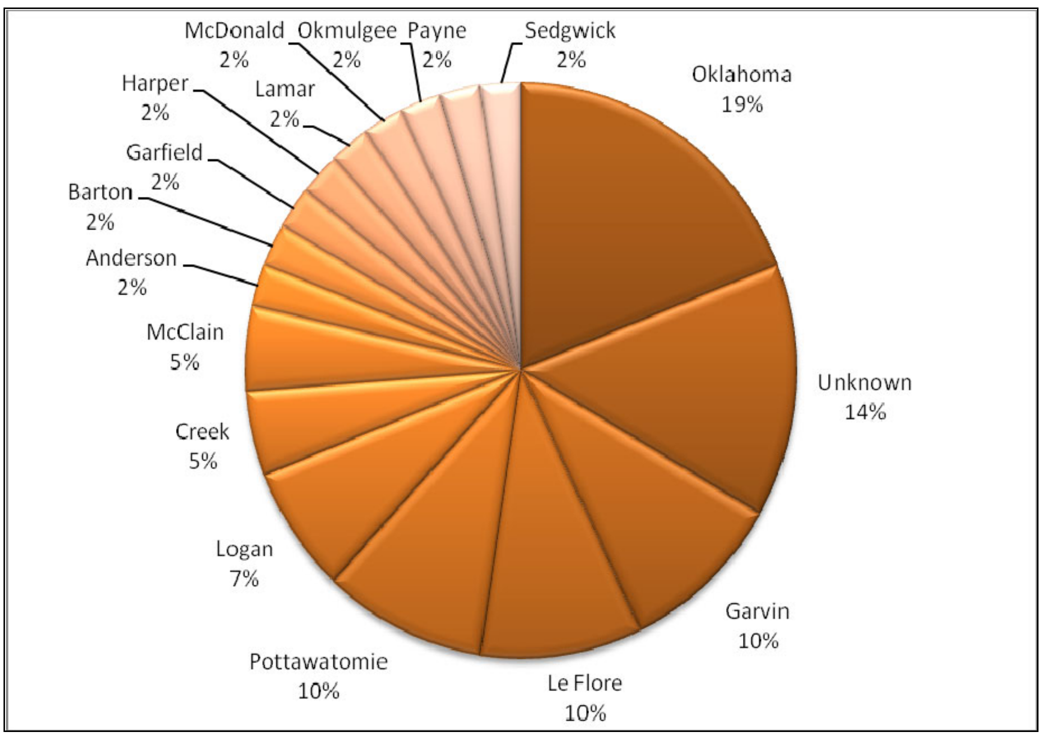
No phenotype was susceptible to all antimicrobials tested, though 42% of isolates showed intermediate status to at least one antimicrobial, but no resistance. Only 7% of isolates were resistant to five or more antibiotics. All phenotypes with resistance to greater than three antimicrobials were single isolates. Table A-13 provides detailed data on all susceptibility phenotypes for *Streptococcus equi zooepidemicus* isolates.

Different susceptibility trends were observed in BVMTH and CVHSR versus RVC isolates over the three year retrospective period. Improved susceptibility to amikacin, ampicillin and gentamicin was noted in BVMTH and CVHSR samples, while susceptibility to amoxicillin/CA, cephalosporins, chloramphenicol, erythromycin, oxacillin, penicillin and rifampin decreased. Specimens from the RVC showed decreased susceptibility to amikacin and tetracycline, with transient resistance noted in 2006 to imipenem and trimethoprim sulfamethoxazole. Complete antibiograms are shown in Tables A-14 and A-15.

### *Salmonella*

*Salmonella* was the third most frequently isolated bacteria in this study. A total of 224 (11.9%) *Salmonella* isolates were received, with 175 (10.9%) of these being first isolates. Approximately two-thirds of the specimens were submitted by the BVMTH and the remainder by the RVC. Samples submitted by the RVC came from 16 of Oklahoma's 77 counties; 14% (6) of RVC samples did not have a county specified.

**Figure 1**
***RVC Salmonella* Isolates by County**




The most frequent *Salmonella* isolate overall for the study period was Group B (24%), though this varied by year. In 2005, 38% of isolates were Group C2 while 30% were

Group B. In 2006, Group C2 made up just 8% of the year's total, while Salmonella Group B remained consistent at 27%. In that period, unidentified *Salmonella* isolates increased from 8% to 52% of the annual total. In 2007 64% of isolates were unidentified, 15% were *Salmonella* Group C1 and 13% were Group B. Table A-16 provides a detailed breakdown of *Salmonella* first isolates.

Of 224 total *Salmonella* isolates, 210 (93.7%) came from the gastrointestinal tract. Table 5 shows the remaining sources of *Salmonella* cultures.

**Table 5**
**All *Salmonella* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Gastrointestinal | 70 | 80 | 60 | 210 |
| Joint | 1 | 1 | 3 | 5 |
| TTW/Lung | | | 2 | 2 |
| Lymph Node | 1 | | 1 | 2 |
| Blood Culture | 1 | | | 1 |
| Catheter | 1 | | | 1 |
| Cerebrospinal Fluid | 1 | | | 1 |
| Placenta | | 1 | | 1 |
| Umbilicus | | | 1 | 1 |
| **Total** | **75** | **82** | **67** | **224** |

Fourteen susceptibility phenotypes were identified for Group B isolates. Phenotype 1 accounted for 54.7% (23) of Group B first isolates, and occurred with similar frequency in both BVMTH and RVC specimens. This phenotype was resistant to clindamycin, erythromycin, oxacillin, penicillin, rifampin and spectinomycin, and was susceptible to all other antibiotics tested. Phenotype 2 was limited to 5 isolates identified in February and March, 2005. Resistance was present to all antibiotics except amikacin, enrofloxacin and imipenem. Four Phenotype 2 samples were from feces and one was from a catheter tip; although specimen origin data was unavailable the catheter tip makes it likely that these were BVMTH samples. Phenotype 3 included three specimens submitted in 2006, one from the RVC and two from the BVMTH. This differed from Phenotype 2 in being sensitive to gentamicin, marbofloxacin and trimethoprim/sulfamethoxazole and intermediate to ticarcillin and ticarcillin/CA. The remaining eleven phenotypes were single isolates. Five were from the BVMTH, three were from unknown origin, two were from the RVC and one was from the VMR. All Group B isolates were resistant to five or more antimicrobials tested. Details of Group B susceptibility phenotypes are presented in Table A-17.

Group C1 included seven susceptibility phenotypes. Phenotype 1 accounted for 63.6% of Group C1 isolates, and identified in BVMTH and RVC specimens across all years. This phenotype was sensitive to all antibiotics tested except clindamycin, erythromycin, oxacillin, penicillin and rifampin. Phenotype 2 was identified in 2 samples in 2005, while Phenotype 3 was identified in one specimen each in 2005 and 2006. The remaining phenotypes were single isolates. Ninety-five percent of isolates were resistant to five or more antibiotics. Details of Group C1 susceptibility phenotypes are presented in Table A-18.

Group C2 included fifteen susceptibility phenotypes. Phenotype 1 made up 30% of Group C2 isolates, and was resistant only to clindamycin, erythromycin, oxacillin, penicillin and rifampin. This phenotype was present in all years, and in both BVMTH and RVC specimens. Phenotype 2 made up 20% of Group C2 isolates and was present in

2005 only. Resistance in this phenotype included amoxicillin/CA, ampicillin, cefazolin, cefoxitin, cefpodoxime, ceftiofur, cephalothin, chloramphenicol, erythromycin, oxacillin, penicillin, rifampin, sulphadimethoxine, spectinomycin, tetracycline, ticarcillin, and ticarcillin/CA. Phenotypes 3 and 4 both were present in 2005 only, and showed susceptibility patterns identical to Phenotype 2 except that Phenotype 3 was intermediate to ticarcillin/CA and Phenotype 4 was intermediate to ticarcillin. Phenotypes 5 through 14 were found in single isolates in 2005, and Phenotype 15 in a single isolate in 2006. Ninety-three percent of Group C2 isolates were resistant to five or more antimicrobials. Details of Group C2 susceptibility patterns are shown in Table A-19.

A single Group D isolate was identified in a RVC fecal specimen in 2006. The isolate was sensitive to amikacin, gentamicin, enrofloxacin, marbofloxacin, imipenem, and trimethoprim/sulfamethoxazole, intermediate to ticarcillin and ticarcillin/CA, but resistant to all other antibiotics tested.

The seven Group E isolates were identified in an eight month period from June 25, 2005 to February 22, 2006. The last three were BVMTH isolates; location of origin of the first four was unknown due to unavailable automated data for that time period. The first five isolates showed an identical susceptibility pattern, resistant only to rifampin. The sixth isolate occurred after a change in testing protocol, and showed resistance to clindamycin in addition to rifampin; the previous five isolates were not tested for clindamycin. The final isolate showed resistance to rifampin, clindamycin and tetracycline.

Untyped Salmonella species included 20 susceptibility phenotypes. Phenotype 1 included 63.3% of all untyped isolates, and was present in all years and from BVMTH and RVC specimens. Phenotype 1 was resistant to clindamycin, erythromycin, oxacillin, penicillin, rifampin and spectinomycin. Phenotype 2 was isolated from four RVC specimens (three different veterinary hospitals and one breeding farm) in 2006 and 2007. This phenotype was resistant or intermediate to all antibiotics tested except amikacin, gentamicin, imipenem and marbofloxacin. Phenotype 3 was found in one RVC specimen and 2 BVMTH specimens in 2006 and 2007; it was identical to Phenotype 1 except for resistance to tetracycline. Phenotypes 4 and 5 included two specimens each, and the remainders were single isolates. Phenotype 12 was a unique susceptibility pattern identified in a foal at the CVHSR in 2007. Ninety-nine percent of isolates were resistant to five or more antimicrobials. Detailed susceptibility patterns of all untyped Salmonella isolates are shown in Table A-20.

Tables A-21 and A-22 show annual antibiograms for all *Salmonella* isolates for the BVMTH and RVC respectively. Emerging resistance to fluoroquinolones was noted for both locations. Improved susceptibility to tetracycline was also noted in both groups.

***Staphylococcus aureus***

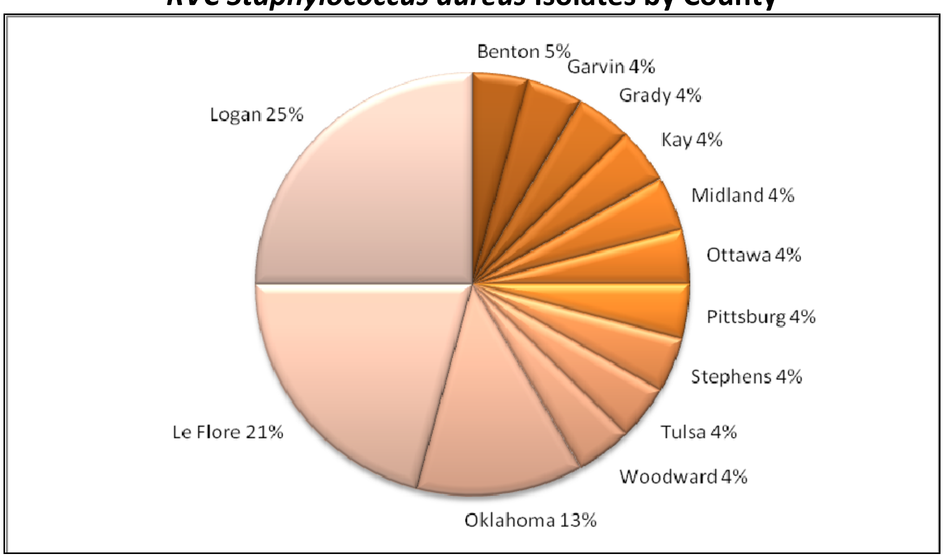
*Staphylococcus aureus (S. aureus)* was the fourth most common isolate, making up 4.2% (80) overall and 3.5% (57) first isolates. Soft tissue sources provided 23.7% (19) of all *S. aureus* isolates. Table 6 below details all sources of *S. aureus*.

**Table 6**
**All *Staphylococcus aureus* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Wound/Incision/Skin Lesion | 3 | 7 | 9 | 19 |
| Abscess | 3 | 5 | 6 | 14 |
| Transtracheal Wash | | 1 | 9 | 10 |
| Other | 2 | 3 | 4 | 9 |
| Uterus | 1 | 3 | 2 | 6 |
| Thorax/Pleura | | | 5 | 5 |
| Urine | 2 | 2 | | 4 |
| Bone/Tendon/Joint | 2 | | 1 | 3 |
| Eye | 1 | | 2 | 3 |
| Umbilicus | | 1 | 2 | 3 |
| Abdominal Fluid | 1 | | | 1 |
| Catheter | | | 1 | 1 |
| Hair | | | 1 | 1 |
| Nasal Swab | 1 | | | 1 |
| **Total** | **16** | **22** | **42** | **80** |

The BVMTH and the RVC each provided 42% (24) of all *S. aureus* first isolates. The remaining 16% (9) were unidentified. Regional veterinary community *S. aureus* was cultured from specimens originating in 13 Oklahoma counties.

**Figure 2**
***RVC Staphylococcus aureus* Isolates by County**



Twenty-four susceptibility phenotypes were identified. Phenotypes 1 and 2 each accounted for 19.2% (11) isolates. Phenotype 1 was identified in 2 specimens from 2005, 2 from 2006 and 7 from 2007. The two 2005 samples were unidentified as to location, and the remaining 9 came from the BVMTH. This was a multi-drug resistant strain, with resistance to oxacillin and all other antibiotics tested except chloramphenicol, enrofloxacin, rifampin and tetracycline. Phenotype 2 was identified in 2006 and 2007 in both RVC and BVMTH samples, and was susceptible to all antibiotics tested. While 28% of all *S. aureus* isolates showed no resistance, 40% were resistant to five or more antimicrobials tested.

Seven phenotypes (1, 4, 10, 11, 14, 18 and 20) including 20 isolates showed oxacillin resistance, strongly suggestive of methicillin resistant *Staphylococcus aureus* (MRSA). Phenotype 1 included 11 isolates, Phenotype 4 included 4 isolates and the others were single isolates. Three of the isolates (1 of the Phenotype 4, and Phenotypes 11 and 20) came from the RVC, and the rest from the BVMTH. Detailed susceptibility patterns for all phenotypes are provided in Table A-23. The epidemiology of the BVMTH isolates is detailed in the Case Studies section below. Tables A-24 and A-25 provide annual antibiograms, however the number of isolates for each year was small.

***Pseudomonas aeruginosa***

*Pseudomonas aeruginosa (P. aeruginosa)* made up 3.8% (72) of all isolates, and 3.2% (53) of first isolates. Uterine specimens accounted for 38.8% (28) of all *P. aeruginosa* isolates. Table 7 summarizes all *P. aeruginosa* isolates by source.

**Table 7**
**All *Pseudomonas aeruginosa* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Uterus | 6 | 11 | 11 | 28 |
| Semen | 1 | 3 | 4 | 8 |
| Thorax | | | 8 | 8 |
| Miscellaneous Swabs/Fluid | 3 | 2 | 1 | 6 |
| Sinus/Nasal Passages | 3 | 1 | 1 | 5 |
| Trachea/Lung | 1 | 2 | 1 | 4 |
| Urine | | 1 | 2 | 3 |
| Wounds/Skin Lesions | 1 | 1 | 1 | 3 |
| Eye Swab | | 2 | | 2 |
| Urethra | 2 | | | 2 |
| Blood Culture | | | 1 | 1 |
| Guttural Pouch Swab | 1 | | | 1 |
| Sheath | 1 | | | 1 |
| **Grand Total** | **19** | **23** | **30** | **72** |

Fifty-three percent (28) of *P. aeruginosa* isolates came from the RVC, while 21% (11) came from the BVMTH, 2% (1) came from the CVHSR and 25% (13) were unknown. Twenty susceptibility phenotypes were identified. Phenotype 1 accounted for 20.8% (11) of first isolates and was resistant to amoxicillin/CA, ampicillin, all cephalosporins, rifampin, tetracycline and trimethoprim sulphamethoxazole. Phenotype 2 was identical to Phenotype 1 except for being susceptible to trimethoprim sulfamethoxazole. There was no antimicrobial to which 100% susceptibility was observed; amikacin was the closest with one isolate showing an intermediate status. Virtually all isolates showed resistance to five or more antimicrobials. The susceptibility patterns of all phenotypes are detailed in Table A-26.

Antibiograms were constructed using very small sample sizes and are shown in Tables A-27 and A-28. CVHS facility isolates showed increasing resistance to amikacin, enrofloxacin and trimethoprim sulfamethoxazole. Community isolates showed increasing resistance to gentamicin and improved susceptibility to trimethoprim sulfamethoxazole.

***Klebsiella pneumoniae***

*Klebsiella pneumoniae (K. pneumoniae)* was the sixth most common isolate overall, accounting for 3.1% (58) total isolates and 3.2% (50) of first isolates. The greatest proportion of *K. pneumoniae* isolates came from uterine specimens at 27.6% (16), with transtracheal washes second at 17.2% (10). Table 8 details all sources of *K. pneumoniae*.

**Table 8**
**All *Klebsiella pneumoniae* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Uterus | 1 | 6 | 9 | 16 |
| Transtracheal Wash | 1 | 7 | 2 | 10 |
| Semen | 6 | 2 | | 8 |
| Incision | | 4 | | 4 |
| Placenta | 1 | | 3 | 4 |
| Feces | 1 | | 2 | 3 |
| Urine | | 2 | | 2 |
| Abscess | 1 | | | 1 |
| Blood Culture | | 1 | | 1 |
| Catheter | | | 1 | 1 |
| Ear Swab | | 1 | | 1 |
| Liver | | | 1 | 1 |
| Urethra | | | 1 | 1 |
| Sinus | 1 | | | 1 |
| Umbilicus | | 1 | | 1 |
| Vagina | 1 | | | 1 |
| Other | 1 | | 1 | 2 |
| **Total** | **14** | **24** | **20** | **58** |

Forty-four percent of *K. pneumoniae* isolates came from RVC specimens, with 34.0% from the BVMTH, 6.0% from the CVHSR and 16.0% unidentified. Twenty-two resistance phenotypes were identified, with Phenotype 1 accounting for 50% of the isolates. This phenotype was present across all years and from all locations. Resistance was common among *K. pneumoniae* isolates, with 98% being resistant to five or more antibiotics. Imipenem was the only antimicrobial to which all isolates were susceptible.

***ß-Streptococcus***

Untyped *ß-Streptococcus* accounted for 2.6% (49) of all isolates, and 3.0% (48) of first isolates. Over half (51.0%) came from uterine cultures; sources of the remaining isolates are detailed in Table 9.

**Table 9**
**All ß-*Streptococcus* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Uterus | 9 | 7 | 9 | 25 |
| Transtracheal Wash | 1 | 4 | 1 | 6 |
| Miscellaneous Swabs/Fluid | 3 | 2 | | 5 |
| Abscess | 2 | | | 2 |
| Guttural Pouch | 2 | | | 2 |
| Umbilicus | 1 | 1 | | 2 |
| Vagina | 1 | | 1 | 2 |
| Abdominal Swab | | 1 | | 1 |
| Eye Swab | | 1 | | 1 |
| Joint | 1 | | | 1 |
| Lymph Node | | | 1 | 1 |
| Urine | | 1 | | 1 |
| **Total** | **20** | **17** | **12** | **49** |

Forty-six percent of *ß-Streptococcus* isolates came from the RVC, with 19% from the BVMTH, 2% from the CVHSR and 33% from unknown locations.

Thirty-seven resistance phenotypes were identified. The most common phenotype included five isolates and was susceptible to all antibiotics tested. No drug resistance was seen in 27% of isolates, with only 8% showing resistance to five or more antimicrobials. Resistance was most common to tetracycline and sulphadimethoxine. Table A-32 details susceptibility of all *ß-Streptococcus* isolates. Annual antibiograms are provided in Tables A-33 and A-34, although the sample size for this organism was small.

***Streptococcus equi equi***

*Streptococcus equi equi (S. equi equi)* accounted for 2.2% (41) of all isolates, and 2.3% (38) of first isolates. Specimen types are summarized in table 10.

**Table 10**
**All *Streptococcus equi equi* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Abscess | 9 | 3 | 4 | 16 |
| Nasal Swab | 3 | 3 | 1 | 7 |
| Guttural Pouch | 3 | | 2 | 5 |
| Lymph Node | 1 | 1 | 1 | 3 |
| Transtracheal Wash | 1 | | 2 | 3 |
| Thorax | | 1 | 1 | 2 |
| Uterus | | | 2 | 2 |
| Other | | | 1 | 1 |
| Skin | | | 1 | 1 |
| Urine | 1 | | | 1 |
| **Total** | **18** | **8** | **15** | **41** |

Specimens from the RVC accounted for 47.4% of *S. equi equi* first isolates. The BVMTH made up 21.1% of the isolates and 31.6% of isolates were unidentified. Of the 38 total first isolates, 37 susceptibility phenotypes were defined; these are detailed in Table A-35. Resistance was absent in 16% of isolates, while 39% showed resistance to five or more antibiotics.

Due to a single BMVTH *S. equi equi* isolate in 2005 and none in 2006, one cumulative antibiogram was constructed, show in Table A-36. The most notable trends in the RVC annual antibiograms was a decrease in susceptibility to chloramphenicol and complete resistance to tetracycline in 2007. Table A-37 shows the details of the RVC annual antibiograms.

### *Streptococcus dysgalactiae equisimilis*

*Streptococcus dysgalactiae equisimilis* made up 2.1% (39) of all isolates, and 2.3% (37) of first isolates. Uterine cultures provided 53.8% of the isolates; Table 11 below shows the sources of all isolates. The RVC provided most of the specimens producing *Streptococcus dysgalactiae equisimilis* at 45.9%, with 16.2% coming from the BVMTH and 5.4% from the CVHSR. Unidentified samples totaled 32.4%.

**Table 11**
**All *Streptococcus dysgalactiae equsimilis* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Uterus | 13 | 6 | 2 | 21 |
| Abscess | | 2 | 2 | 4 |
| Wounds, Skin Lesions | 1 | 3 | 1 | 5 |
| Eye Swab | | 2 | | 2 |
| Sinus/Nasal Passages | 1 | 1 | | 2 |
| Placenta | 1 | | | 1 |
| Thorax | | | 1 | 1 |
| Trachea | | | 1 | 1 |
| Joint | | | 1 | 1 |
| Other | | | 1 | 1 |
| **Total** | **16** | **14** | **9** | **39** |

About one-third (35%) of isolates showed no resistance, while one-quarter (24%) were resistant to five or more antibiotics. Table A-38 provides detail of susceptibility phenotypes for *Streptococcus dysgalactiae equisimilis*. Tables A-39 and A-40 contain annual antibiograms.

***Staphylococcus xylosus***

*Staphylococcus xylosus* (*S. xylosus*) made up 1.9% (36) of all isolates and 1.9% (31) of first isolates. Uterine cultures provided the majority of isolates, 55.5%. *S. xylosus* isolates came primarily from the RVC (54.5%) with 21.2% from BVMTH specimens. Unidentified samples made up 21.2% of the total. Table 12 detailed the sources of all *S. xylosus* isolates.

**Table 12**
**All *Staphylococcus xylosus* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Uterus | 5 | 5 | 10 | 20 |
| Blood Culture | 1 | 3 | 3 | 7 |
| Wounds, Skin Lesions | 1 | | 2 | 3 |
| Joint Swab | 2 | | | 2 |
| Abscess | | | 1 | 1 |
| Eye | | | 1 | 1 |
| Lymph Node | | | 1 | 1 |
| Other | | | 1 | 1 |
| **Total** | **9** | **8** | **19** | **36** |

Table A-41 details the antimicrobial susceptibility phenotypes of all *S. xylosus* phenotypes. Multi-drug resistance was common, with 47% of isolates resistant to two to four antimicrobials, and 34% resistant to five or more. Four isolates were resistant to oxacillin; all were multi-drug resistant, and one was resistant to all antimicrobials tested. Tables A-42 and A-43 show annual antibiograms for the BVMTH and the RVC.

***Staphylococcus species***

Untyped *Staphylococcus* species made up 1.6% (31) of all isolates, and 1.9% (31) of first isolates. Uterine cultures accounted for 54.8% of Staphylococcus species. Table 13 details the sources of all isolates. Most isolates came from RVC (48.4%) specimens, with 22.6% coming from the BVMTH and 29.0% unidentified.

**Table 13**
**All *Staphylococcus species* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Uterus | 5 | 4 | 8 | 17 |
| Eye | 3 | | 1 | 4 |
| Blood Culture | 1 | | 2 | 3 |
| Catheter | | | 1 | 1 |
| Wounds, Skin Lesions | | 2 | | 2 |
| Other | 1 | 1 | | 2 |
| Lymph Node | | | 1 | 1 |
| Urine | | 1 | | 1 |
| **Total** | **10** | **8** | **13** | **31** |

Table A-44 summarizes the susceptibility phenotypes of all *Staphylococcus* species. Thirteen percent of isolates showed no resistance, 23% were resistant to one antimicrobial, and the remaining isolates were resistant to two or more antimicrobials. Two isolates were oxacillin resistant, one of which was resistant to all antimicrobials tested. Tables A-45 and A-46 show annual antibiograms for the BVMTH and RVC.

### *Enterococcus species*

*Enterococcus* species made up 1.8% (34) of all isolates, and 1.7% (27) of first isolates. Uterine cultures made up 35.2%, while incisional infections and urine cultures accounted for 14.7% each. *Enterococcus* species were isolated primarily from BVMTH specimens (48.1%), with 25.9% coming from the RVC, 7.4% from the CVHSR and 18.5% from unknown origins. Table 14 details all sources of *Enterococcus* species.

**Table 14**
**All *Enterococcus species* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Uterus | 3 | 4 | 5 | 12 |
| Incision Line | | 1 | 4 | 5 |
| Urine | 1 | | 4 | 5 |
| Wounds, Skin Lesions | 2 | 1 | 1 | 4 |
| Blood Culture | | | 2 | 2 |
| Catheter | | | 2 | 2 |
| Semen | | 2 | | 2 |
| Thoracic Fluid | | | 1 | 1 |
| Other | 1 | | | 1 |
| **Total** | **7** | **8** | **19** | **34** |

Twenty-seven susceptibility phenotypes were identified for Enterococcus isolates. Multi-drug resistance was common as seen in Table A-47, with 81% of isolates showing resistance to five or more antimicrobials. Only 7% of isolates showed no resistance. Tables A-48 and A-49 show annual antibiograms for the BVMTH and RVC.

### *Actinobacillus equuli*

*Actinobacillus equuli* (*A. equuli*) made up 1.0% (19) of all isolates, and 1.1% (18) of first isolates. Lower respiratory specimens produced 57.8% of *A. equuli* isolates. Table 15 shows the remainder of the specimen sources. Fifty percent of the *A. equuli* isolates came from the BVMTH, 17% from the RVC and 6% from the CVHSR. The origin was not known on 28%.

**Table 15**
**All *Actinobacillus equuli* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| TTW, Lung | 5 | 2 | 4 | 11 |
| Uterus | | 2 | | 2 |
| Abscess | | | 1 | 1 |
| Blood Culture | 1 | | | 1 |
| Nasal Swab | 1 | | | 1 |
| Wounds, Skin Lesions | 1 | | | 1 |
| Other | 2 | | | 2 |
| **Total** | **10** | **4** | **5** | **19** |

Resistance was relatively uncommon, with 50% of isolates showing no resistance at all, and the remaining isolates showing resistance to one (28%) or two (22%) antibiotics. Table A-50 details resistance phenotypes for *A. equuli* isolates. Annual antibiograms are presented in Tables A-51 and A-52 for BVMTH and RVC isolates.

***Actinobacillus suis***

*Actinobacillus suis* (*A. suis*) made up 1.1% (20) of all isolates, and 1.2% (20) of first isolates. Lower respiratory tract specimens accounted for 35% of all isolates. Table 16 details specimen sources of *A. suis*. Forty percent of isolates came form each the BVMTH and the RVC, and the remainder were unidentified.

**Table 16**
**All *Actinobacillus suis* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Transtracheal Wash | 1 | 5 | 1 | 7 |
| Nasal Swab | 1 | 2 | | 3 |
| Uterus | 1 | 1 | | 2 |
| Blood Culture | 1 | 1 | | 2 |
| Wound, Skin Lesion | 1 | 1 | | 2 |
| Abscess | | 1 | | 1 |
| Eye | 1 | | | 1 |
| Guttural Pouch | | | 1 | 1 |
| Joint | | | 1 | 1 |
| **Total** | **6** | **11** | **3** | **20** |

Resistance was relatively uncommon, with 60% of isolates showing no resistance. Twenty percent were resistant to one antimicrobial, and 20% were resistant to two to four antimicrobials. Susceptibility patterns of all *A. suis* phenotypes are detailed in Table A-53, while Tables A-54 and A-55 present annual antibiograms.

### *Actinobacillus species*

Untyped *Actinobacillus* species made up 1.0% (18) of all isolates and 1.1% (18) of first isolates. Lower respiratory tract samples accounted for one-third of the specimen sources. The RVC provided 38.8% of the samples, with 33.3% from the BVMTH and 11.1% from the CVHSR; a further 11.1% were unidentified as to origin.

**Table 17**
**All *Actinobacillus species* Isolates by Specimen Source**

| | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| TTW/Lung | | 2 | 4 | 6 |
| Uterus | 1 | 1 | 1 | 3 |
| Abscess | | 1 | 1 | 2 |
| Abdominal Fluid | | 1 | | 1 |
| Blood Culture | 1 | | | 1 |
| Lymph Node | | 1 | | 1 |
| Nasal Wash | | | 1 | 1 |
| Urine | | | 1 | 1 |
| Vagina | | | 1 | 1 |
| Other | 1 | | | 1 |
| **Total** | **3** | **6** | **9** | **18** |

Twenty-eight percent of isolates showed no resistance, while 44% were resistant to only one antimicrobial. Table A-56 details all susceptibility phenotypes for untyped *Actinobacillus* species, and annual antibiograms are presented in Tables A-57 and A-58.

### *Rhodococcus equi*

Fifteen *Rhodococcus equi* isolates had sensitivities performed on them during the study period; over one-half of these were respiratory specimens. Table 18 summarizes all sources of *Rhodococcus equi*.

**Table 18**
**All *Rhodococcus equi* Isolates by Specimen Source**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| TTW/Lung | 5 | 2 | 1 | 8 |
| Abdominal Fluid | 1 | | | 1 |
| Abscess | 1 | | 1 | 2 |
| Lymph Node | 1 | | 1 | 2 |
| Nasal Swab | | 1 | | 1 |
| Feces | | 1 | | 1 |
| **Total** | **8** | **4** | **3** | **15** |

The majority of *Rhodococcus equi* (57.1) isolates did not have a location of origin specified. The RVC provided 35.7% and the BVMTH 7.1%. Table A-59 details the antimicrobial sensitivities for *Rhodococcus equi* isolates. One isolate was susceptible to all antimicrobials tested, while seven were resistant to two to four antimicrobials and six were resistant to five or more. Two of the fourteen isolates (14.2%) were resistant to rifampin, and two (14.2%) were resistant to erythromycin. One isolate was resistant to both erythromycin and rifampin. Table A-60 provided a cumulative antibiogram for *Rhodococcus equi* first isolates. All isolates are considered together due to the small sample size.

## Findings by Body System

### ***Reproductive Tract***

Reproductive tract specimens were the most common sample in the study overall, and for the CVHSR and RVC whereas less than 5% of BVMTH specimens fell into this category. Tables 19, 20 and 21 below detail isolates from uterine cultures submitted from each of these three locations. Noticeable differences exist in organisms isolated from mares in each location. *Streptococcus equi zooepidemicus* and *E. coli* were the most common isolates from the CVHSR. In the small sample size from the BVMTH, *E.coli* accounted for 42.9% of isolates, with a complete absence of *Streptococcus equi zooepidemicus*. *E. coli* (21.8%) and *Streptococcus equi zooepidemicus* (11.9%) were the most common isolates from the RVC. The RVC sample was characterized by a much greater diversity in microbial isolates; though it was also much larger.

**Table 19**
**First Isolate Uterine Cultures from the CVHSR**

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *Streptococcus equi ss zooepidemicus* | 1 | 6 | 3 | 10 | 41.7% |
| *E. coli* | | 2 | 1 | 3 | 12.5% |
| *Actinobacillus species* | 1 | 1 | | 2 | 8.3% |
| *Streptococcus dysgalactiae ss equisimilis* | | 1 | 1 | 2 | 8.3% |
| *Actinobacillus equuli ss equuli* | | 1 | | 1 | 4.2% |
| *Enterococcus faecalis* | | | 1 | 1 | 4.2% |
| *Enterococcus species* | | 1 | | 1 | 4.2% |
| *Pasteurella pneumotropica* | | | 1 | 1 | 4.2% |
| *Pseudomonas aeruginosa* | 1 | | | 1 | 4.2% |
| *Pseudomonas fluorescens* | 1 | | | 1 | 4.2% |
| *Streptococcus beta* | | | 1 | 1 | 4.2% |
| **Total** | **4** | **12** | **8** | **24** | **100.0%** |

**Table 20**
**First Isolate Uterine Cultures from the BVMTH**

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *E. coli* | | 3 | 3 | 6 | 42.9% |
| *Actinobacillus suis* | | 1 | | 1 | 7.1% |
| *Enterococcus faecalis* | | 1 | | 1 | 7.1% |
| *Enterococcus species* | | | 1 | 1 | 7.1% |
| *Escherichia hermannii* | 1 | | | 1 | 7.1% |
| *Klebsiella pneumoniae ss pneumoniae* | | 1 | | 1 | 7.1% |
| *Pseudomonas aeruginosa* | | 1 | | 1 | 7.1% |
| *Staphylococcus aureus ss aureus* | | 1 | | 1 | 7.1% |
| *Streptococcus beta* | | 1 | | 1 | 7.1% |
| **Total** | **1** | **9** | **4** | **14** | **100.0%** |

**Table 21**
**First Isolate Uterine Cultures from the RVC**

| Organism | 2005 | 2006 | 2007 | Total | % |
|---|---|---|---|---|---|
| *E. coli* | 5 | 40 | 23 | 68 | 21.8% |
| *Streptococcus equi ss zooepidemicus* | 2 | 24 | 11 | 37 | 11.9% |
| *Pseudomonas aeruginosa* | | 5 | 9 | 14 | 4.5% |
| *Staphylococcus xylosus* | | 5 | 9 | 14 | 4.5% |
| *Streptococcus beta* | 1 | 5 | 8 | 14 | 4.5% |
| *Klebsiella pneumoniae ss pneumoniae* | | 4 | 9 | 13 | 4.2% |
| *Staphylococcus species* | | 4 | 8 | 12 | 3.8% |
| *Citrobacter koseri* | | 4 | 6 | 10 | 3.2% |
| *Staphylococcus beta haemolytic* | | 3 | 5 | 8 | 2.6% |
| *Streptococcus dysgalactiae ss equisimilis* | 2 | 5 | 1 | 8 | 2.6% |
| *Enterococcus species* | | 3 | 4 | 7 | 2.2% |
| *Gram negative non fermenter* | | 3 | 4 | 7 | 2.2% |
| *Enterobacter aerogenes* | | 4 | 2 | 6 | 1.9% |
| *Enterobacter cloacae* | | 2 | 3 | 5 | 1.6% |
| *Enterobacter species* | | 2 | 3 | 5 | 1.6% |
| *Streptococcus species* | 1 | 1 | 3 | 5 | 1.6% |
| *Corynebacterium species* | | 2 | 2 | 4 | 1.3% |
| *E. coli beta* | 1 | 1 | 2 | 4 | 1.3% |
| *Streptococcus alpha haemolytic* | | 3 | 1 | 4 | 1.3% |
| *Acinetobacter lwoffi* | | 3 | | 3 | 1.0% |
| *Bacillus species* | | | 3 | 3 | 1.0% |
| *Enterobacter amnigenus* | 1 | 2 | | 3 | 1.0% |
| *Enterococcus faecalis* | | 1 | 2 | 3 | 1.0% |
| *Gram negative rod* | | 1 | 2 | 3 | 1.0% |
| *Pseudomonas species* | | 2 | 1 | 3 | 1.0% |
| *Staphylococcus aureus ss aureus* | | 1 | 2 | 3 | 1.0% |
| *Citrobacter freundii* | | 2 | | 2 | 0.6% |
| *Comamonas testosterone* | | | 2 | 2 | 0.6% |
| *Escherichia hermannii* | | | 2 | 2 | 0.6% |
| *Gram negative organism* | | 1 | 1 | 2 | 0.6% |
| *Klebsiella oxytoca* | | | 2 | 2 | 0.6% |
| *Pasturella species* | | | 2 | 2 | 0.6% |
| *Pseudomonas fluorescens* | | 1 | 1 | 2 | 0.6% |
| *Ralstonia pickettii* | | 1 | 1 | 2 | 0.6% |
| *Serratia marcescens* | 1 | | 1 | 2 | 0.6% |
| *Staphylococcus epidermidis* | | 1 | 1 | 2 | 0.6% |
| *Staphylococcus intermedius* | | | 2 | 2 | 0.6% |
| *Stenotrophomonas maltophilia* | 1 | | 1 | 2 | 0.6% |
| *Streptococcus equi ss equi* | | | 2 | 2 | 0.6% |
| *Other (single isolates)* | 1 | 10 | 9 | 20 | 6.4% |
| **Total** | **16** | **146** | **150** | **312** | **100.0%** |

Table A-61 shows comparative cumulative antibiograms for the combined CVHSR and BVMTH, and RVC *E. coli* and *Streptococcus equi zooepidemicus* isolates. Though numbers are small, some differences are apparent. *E.coli* susceptibility to trimethoprim sulphamethoxazole for RVC isolates was much lower at 72% than for CVHSR/BVMTH isolates at 100%. *Streptococcus equi zooepidemicus* isolates from the CVHSR/BVMTH appeared less susceptible than RVC isolates to amikacin (40% versus 59%), cefpodoxime (40% versus 78%), enrofloxacin (40% versus 76%) and gentamicin (60% versus 89%).

***Respiratory Tract***

While *Streptococcus equi zooepidemicus* was the most common transtracheal wash isolate for both BVMTH and RVC submissions, as a percent of total isolates it was twice as frequently cultured in RVC specimens (31.9%) as in BVMTH specimens (16.0%). *E. coli* was considerably less common in RVC samples (2.3%) than in BVMTH samples (8.6%). Tables 22 and 23 detail all transtracheal wash first isolates.

**Table 22**
**First Isolate Transtracheal Wash Cultures from the BVMTH**

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *Streptococcus equi ss zooepidemicus* | | 7 | 6 | 13 | 16.0% |
| *Actinobacillus equuli ss equuli* | 2 | 2 | 3 | 7 | 8.6% |
| *E. coli* | 1 | 2 | 4 | 7 | 8.6% |
| *Klebsiella pneumoniae ss pneumonia* | | 5 | 2 | 7 | 8.6% |
| *Actinobacillus suis* | | 3 | 1 | 4 | 4.9% |
| *Streptococcus alpha haemolytic* | 2 | 2 | | 4 | 4.9% |
| *Actinobacillus species* | | 1 | 2 | 3 | 3.7% |
| *Actinobacillus ureae* | | | 3 | 3 | 3.7% |
| *Pasteurella aerogenes atypical* | | 3 | | 3 | 3.7% |
| *Pasturella species* | | | 3 | 3 | 3.7% |
| *Bordetella bronchiseptica* | | 1 | 1 | 2 | 2.5% |
| *Enterobacter cloacae* | 1 | 1 | | 2 | 2.5% |
| *Staphylococcus aureus ss aureus* | | 1 | 1 | 2 | 2.5% |
| *Streptococcus beta* | | 1 | 1 | 2 | 2.5% |
| *Streptococcus equi ss equi* | | | 2 | 2 | 2.5% |
| *Streptococcus mitis* | 1 | 1 | | 2 | 2.5% |
| *Actinobacillus lignieresii* | | | 1 | 1 | 1.2% |
| *Chryseobacterium indologenes* | | 1 | | 1 | 1.2% |
| *Citrobacter species* | | | 1 | 1 | 1.2% |
| *Corynebacterium species* | | | 1 | 1 | 1.2% |
| *Escherichia hermannii* | | 1 | | 1 | 1.2% |
| *Flavobacterium species* | | | 1 | 1 | 1.2% |
| *Gram negative non fermenter* | | 1 | | 1 | 1.2% |
| *Pasteurella pneumotropica* | | 1 | | 1 | 1.2% |
| *Pseudomonas aeruginosa* | | | 1 | 1 | 1.2% |
| *Salmonella subgenus 1* | | | 1 | 1 | 1.2% |
| *Sphingobacterium multivorum* | | 1 | | 1 | 1.2% |
| *Sphingomonas paucimobilis* | | 1 | | 1 | 1.2% |
| *Staphylococcus haemolyticus* | | | 1 | 1 | 1.2% |
| *Streptococcus dysgalactiae ss equisimilis* | | | 1 | 1 | 1.2% |
| *Streptococcus suis* | | 1 | | 1 | 1.2% |
| **Total** | **7** | **37** | **37** | **81** | **100.0%** |

**Table 23**
**First Isolate Transtracheal Wash Cultures from the RVC**

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *Streptococcus equi ss zooepidemicus* | 2 | 9 | 3 | 14 | 31.8% |
| *Actinobacillus ureae* | | 5 | | 5 | 11.4% |
| *Streptococcus beta* | 1 | 3 | | 4 | 9.1% |
| *Actinobacillus species* | | 1 | 1 | 2 | 4.5% |
| *Actinobacillus suis* | | 2 | | 2 | 4.5% |
| *Klebsiella pneumoniae ss pneumoniae* | | 2 | | 2 | 4.5% |
| *Pseudomonas aeruginosa* | 1 | 1 | | 2 | 4.5% |
| *Rhodococcus equi* | | 2 | | 2 | 4.5% |
| *Actinobacillus equuli ss equuli* | | | 1 | 1 | 2.3% |
| *Actinobacillus lignieresii* | | | 1 | 1 | 2.3% |
| *Bordetella bronchiseptica* | | 1 | | 1 | 2.3% |
| *E. coli* | 1 | | | 1 | 2.3% |
| *Enterobacter aerogenes* | | 1 | | 1 | 2.3% |
| *Enterobacter cloacae* | 1 | | | 1 | 2.3% |
| *Pasteurella aerogenes atypical* | | 1 | | 1 | 2.3% |
| *Pasteurella pneumotropica* | | 1 | | 1 | 2.3% |
| *Pasturella species* | | 1 | | 1 | 2.3% |
| *Pseudomonas aeruginosa/putida* | | 1 | | 1 | 2.3% |
| *Ralstonia pickettii* | | 1 | | 1 | 2.3% |
| **Total** | **6** | **32** | **6** | **44** | 100.0% |

### *Gastrointestinal Tract*

Cultures from gastrointestinal tract specimens included 18.4% foals less than one month of age and 30.9% adults as detailed in Table 24 below.

**Table 24**
**All First Isolate Gastrointestinal Cultures by Age**

| Age | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| Less than 1 month | 1 | 21 | 19 | 41 | 18.4% |
| 1 to 6 months | 1 | 6 | 12 | 19 | 8.5% |
| 7 months to 1 year | 0 | 3 | 6 | 9 | 4.0% |
| Greater than 1 year | 1 | 40 | 28 | 69 | 30.9% |
| Unknown | 72 | 12 | 1 | 85 | 38.1% |
| **Total** | **75** | **82** | **66** | **223** | **100.0%** |

**Table 25**
**First Isolate Gastrointestinal Cultures**

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *Salmonella* | 55 | 60 | 46 | 161 | 72.9% |
| *E. coli* | 15 | 20 | 15 | 50 | 22.6% |
| *Klebsiella pneumoniae ss pneumonia* | 1 | | 2 | 3 | 1.4% |
| *Escherichia fergusonii* | 1 | | 1 | 2 | 0.9% |
| *Citrobacter freundii* | | 1 | | 1 | 0.5% |
| *Enterobacter aerogenes* | 1 | | | 1 | 0.5% |
| *Enterobacter cloacae* | 1 | | | 1 | 0.5% |
| *Gram negative non fermenter* | | | 1 | 1 | 0.5% |
| *Rhodococcus equi* | | 1 | | 1 | 0.5% |
| **Total** | **74** | **82** | **65** | **221** | **100.0%** |

The most common gastrointestinal tract isolate was *Salmonella* at 72.9%. All E. coli isolates from patients for whom ages were known came from foals less than one month of age, except for one yearling and one three-month-old.

***Blood Cultures***

Of 51 isolates from the blood cultures of 43 neonatal patients, *E. coli* was the most frequently cultured organism. Across the three year study period, *E. coli* fell from 50.0% of all isolates in 2005 to 10.5% of all isolates in 2007. *Staphylococcus xylosus* and *Staphylococcus* species increased from 7.1% each in 2005 to 15.8% and 10.5% respectively in 2007. The remainder of the isolates are detailed below in Table 26. Susceptibilities of neonatal blood culture isolates of *E. coli* were equal or better for all antimicrobials tested relative to all other *E. coli* isolates as detailed in Table A-68.

**Table 26**
**First Isolate Neonatal Blood Cultures in the BVMTH**

| Organism | 2005 | %2005 | 2006 | %2006 | 2007 | %2007 | Total | % Total |
|---|---|---|---|---|---|---|---|---|
| *E. coli* | 7 | 50.0% | 6 | 33.3% | 2 | 10.5% | 15 | 29.4% |
| *Staphylococcus xylosus* | 1 | 7.1% | 1 | 5.6% | 3 | 15.8% | 5 | 9.8% |
| *Corynebacterium species* | | | 4 | 22.2% | | | 4 | 7.8% |
| *Staphylococcus species* | 1 | 7.1% | | | 2 | 10.5% | 3 | 5.9% |
| *Streptococcus α hemolytic* | 1 | 7.1% | 1 | 5.6% | 1 | 5.3% | 3 | 5.9% |
| *Acinetobacter baumannii* | | | | | 2 | 10.5% | 2 | 3.9% |
| *Acinetobacter lwoffi* | | | | | 2 | 10.5% | 2 | 3.9% |
| *Enterococcus species* | | | | | 2 | 10.5% | 2 | 3.9% |
| *Gram negative diplococcus* | | | | | 2 | 10.5% | 2 | 3.9% |
| *Micrococcus species* | | | 2 | 11.1% | | | 2 | 3.9% |
| *Actinobacillus equuli ss equuli* | 1 | 7.1% | | | | | 1 | 2.0% |
| *Actinobacillus species* | 1 | 7.1% | | | | | 1 | 2.0% |
| *Citrobacter species* | 1 | 7.1% | | | | | 1 | 2.0% |
| *E. coli beta* | | | 1 | 5.6% | | | 1 | 2.0% |
| *Enterobacter cloacae* | | | | | 1 | 5.3% | 1 | 2.0% |
| *Gram negative non fermenter* | | | 1 | 5.6% | | | 1 | 2.0% |
| *Klebsiella pneumoniae ss* | | | 1 | 5.6% | | | 1 | 2.0% |
| *Kluyvera ascorbata* | | | | | 1 | 5.3% | 1 | 2.0% |
| *Lactobacillus species* | | | 1 | 5.6% | | | 1 | 2.0% |
| *Pseudomonas aeruginosa* | | | | | 1 | 5.3% | 1 | 2.0% |
| *Salmonella sp. group C2* | 1 | 7.1% | | | | | 1 | 2.0% |
| **Total** | **14** | **100.0%** | **18** | **100.0%** | **19** | **100.0%** | **51** | **100.0%** |

Eight neonates (18.6%) had two organisms each in their blood cultures, including

- *Staphylococcus* species and *E. coli*
- *α-hemolytic Streptococcus* and *Citrobacter* species
- *E. coli* and *Micrococcus* species
- α-hemolytic *Streptococcus* and *Corynebacterium* species
- *Micrococcus* species and a gram-negative non-fermenter
- *Acinetobacter baumannii* and *Kluyvera ascorbata*
- *Acinetobacter baumanni* and *Acinetobacter lwoffi*
- *Staphylococcus xylosus* and *Acinetobacter lwoffi*

Three adult equine blood cultures produced *Actinobacillus suis*, *Streptococcus* species and *Staphylococcus* species.

### ***Intravenous Catheters***

Thirty-five isolates were cultured from twelve catheter tips of eleven VTH patients during the three year study period. The most common single isolate at 9% was *Acinetobacter baumannii*. All three horses culturing *A. baumannii* from their catheters were critically ill patients with lengthy hospitalizations. Two were foals, one with neonatal hypoxic ischemic encephalopathy and another with suspected alloimmune thrombocytopenia. The third was an adult with pleuropneumonia secondary to a penetrating chest wound. All *Enterococcus* species together accounted for 17%, including two isolates each of *Enterococcus faecalis*, *Enterococcus faecium* and unspeciated *Enterococcus*. *Pantoea agglomerans*, *Serratia marcescens* and unspeciated *Enterobacter* each accounted for 6% of isolates. Table 27 summarizes all BVMTH catheter isolates.

**Table 27**
**Intravenous Catheter Isolates in the BVMTH**

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *Acinetobacter baumannii* | | | 3 | 3 | 9% |
| *Enterobacter species* | | 2 | | 2 | 6% |
| *Enterococcus faecalis* | | 1 | 1 | 2 | 6% |
| *Enterococcus faecium* | | 1 | 1 | 2 | 6% |
| *Enterococcus species* | | | 2 | 2 | 6% |
| *Gram negative non fermenter* | | 2 | | 2 | 6% |
| *Pantoea agglomerans* | | | 2 | 2 | 6% |
| *Serratia marcescens* | | | 2 | 2 | 6% |
| *Acinetobacter lwoffi* | | 1 | | 1 | 3% |
| *Chryseobacterium meningosepticum* | | | 1 | 1 | 3% |
| *Citrobacter species* | | | 1 | 1 | 3% |
| *Corynebacterium species* | | 1 | | 1 | 3% |
| *Enterobacter cloacae* | | | 1 | 1 | 3% |
| *Flavimonas oryzihabitans* | | 1 | | 1 | 3% |
| *Klebsiella oxytoca* | | | 1 | 1 | 3% |
| *Klebsiella pneumoniae ss pneumonia* | | | 1 | 1 | 3% |
| *Micrococcus luteus* | | 1 | | 1 | 3% |
| *Providencia rettgeri* | | | 1 | 1 | 3% |
| *Salmonella group – B* | 1 | | | 1 | 3% |
| *Staphylococcus aureus ss aureus* | | | 1 | 1 | 3% |
| *Staphylococcus beta haemolytic* | | | 1 | 1 | 3% |
| *Staphylococcus epidermidis* | | | 1 | 1 | 3% |
| *Staphylococcus haemolyticus* | | | 1 | 1 | 3% |
| *Staphylococcus species* | | | 1 | 1 | 3% |
| *Stenotrophomonas maltophilia* | | | 1 | 1 | 3% |
| *Streptococcus equi ss zooepidemicus* | | | 1 | 1 | 3% |
| **Total** | **1** | **10** | **24** | **35** | **1** |

### *Ocular*

Twenty-five isolates from 15 patients included 12.0% Staphylococcus species and 8.0% *Pseudomonas aeruginosa, Streptococcus dysgalactiae equisimilis and Streptococcus equi zooepidemicus*. Three patients had two isolates, two had three isolates and one had four isolates. Table 28 provides the detail on ocular cultures.

**Table 28**
**Ocular Culture Isolates in the BVMTH**

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *Staphylococcus species* | 2 | | 1 | 3 | 12.0% |
| *Pseudomonas aeruginosa* | | 2 | | 2 | 8.0% |
| *Streptococcus dysgalactiae ss equisimilis* | | 2 | | 2 | 8.0% |
| *Streptococcus equi ss zooepidemicus* | | 2 | | 2 | 8.0% |
| *Achromobacter xylo ss xylosoxidans* | 1 | | | 1 | 4.0% |
| *Aerococcus viridians* | | 1 | | 1 | 4.0% |
| *Bacillus species* | | 1 | | 1 | 4.0% |
| *Cedecea lapagei* | 1 | | | 1 | 4.0% |
| *Enterobacter aerogenes* | | 1 | | 1 | 4.0% |
| *Enterococcus durans* | | 1 | | 1 | 4.0% |
| *Escherichia hermannii* | | 1 | | 1 | 4.0% |
| *Kocuria rosea* | 1 | | | 1 | 4.0% |
| *Micrococcus luteus* | | 1 | | 1 | 4.0% |
| *Micrococcus species* | 1 | | | 1 | 4.0% |
| *Pseudomonas putida* | | 1 | | 1 | 4.0% |
| *Pseudomonas species* | 1 | | | 1 | 4.0% |
| *Staphylococcus aureus ss aureus* | | | 1 | 1 | 4.0% |
| *Staphylococcus xylosus* | | | 1 | 1 | 4.0% |
| *Streptococcus beta* | | 1 | | 1 | 4.0% |
| *Streptococcus beta haemolytic* | | | 1 | 1 | 4.0% |
| **Total** | **7** | **14** | **4** | **25** | **100.0%** |

Three ocular cultures submitted by RVC practitioners produced *Actinobacillus suis*, *Staphylococcus aureus* and *Pseudomonas mendocina*. Four specimens did not have an origin available.

### ***Possible Hospital Acquired Bacterial Infections***

Clusters of multi-drug resistant bacterial isolates known to be involved in nosocomial infections in human and veterinary medicine occurred during the study period. These included methicillin resistant *Staphylococcus aureus*, *Enterococcus faecalis*, *Acinetobacter baumanni* and *Serratia marcescens*. Table A-62 summarizes patient data for cases involved.

### ***Oxacillin Resistant Staphylococcus aureus***

From all *S. aureus* isolates identified, 37 were oxacillin-resistant. Four of these came from an unknown source in 2005, and are excluded from further analysis. Sources of these isolates were an incision infection (February), an abscess (April), unspecified fluid (April), and a fracture (June). Four isolates came from the RVC. These included two specimens from the same mare on a large breeding farm in 2006, and two specimens from soft tissue sources from horses at other locarions, one in 2005 and one in 2007. The antibiograms of the two isolates from the broodmare were slightly different, with one being susceptible to trimethoprim sulfamethoxazole and one being resistant. The antibiograms of the two soft tissue samples differed from each other, and from the uterine sample.

The remaining 29 isolates came from fourteen patients at the BVMTH. The isolates were identified between April of 2006 and December of 2007. The last new case was in June of 2007, with the isolates from July to December of that year being repeat cultures. Nine patients had one isolate, four patients had two isolates and one patient had twelve isolates. Five different susceptibility phenotypes were identified among the 29 isolates. Phenotypes 1, 2 and 5 occurred once each in April of 2006, November of 2006 and December of 2007. Phenotype 4 occurred three times, in November of 2006, May of 2007 and June of 2007. The remaining 23 isolates (79.3%) were of Phenotype 3. Table A-63 and A-64 present the details of these cases ordered by patient and by date of occurrence.

In Horse 3, who had two isolates, these were identified from the same specimen and differed only in susceptibility to tetracycline. In Horse 11 with twelve isolates, the eleventh and twelfth isolates came from the same transtracheal wash and differed in that one was identical to the previous ten isolates, including showing resistance to clindamycin and erythromycin, and the other differed only in being susceptible to these two drugs. Horse 9 cultured a trimethoprim sulfamethoxazole resistant isolate in April, 2007 and an isolate susceptible to this drug one month later. These were the only two cultures from that horse.

***Enterococcus faecalis***

Twenty-four total isolates of *Enterococcus faecalis* were identified. Six of these were unidentified specimens from 2005, and are excluded from further analysis. Six additional specimens came from the RVC. Three of these were from three different horses at the same large equine clinic during a two month period in 2007; all three strains showed different susceptibility patterns. The remaining three were from different veterinary clinics, and all showed different susceptibility patterns. Two isolates came from the CVHSR; one of these was from the uterus of a mare that spent time in the BVMTH with her foal during the time the isolates were cultured from patients there.

The remaining ten isolates came from seven BVMTH patients between February, 2006 and July, 2007. Two horses had catheter infections, three horses had incisional infections, one had a uterine infection and one an umbilical infection. Multi-drug resistance was characteristic of all isolates. One patient had a catheter isolate that was intermediate to amoxicillin/CA and chloramphenicol, and resistant to everything else. Another patient had a catheter infection with two isolates of *E. faecalis* that had different susceptibilities. This patient also had two different phenotypes of oxacillin-resistant *S. aureus*. Three other patients with the *E. faecalis* also had oxacillin-resistant *S. aureus*. Susceptibility phenotypes of E. faecalis isolates are presented in Table A-65.

***Acinetobacter baumannii***

A total of ten *A. baumanni* isolates were cultured in the three year study period. Two *A. baumannii* isolates cultured from a uterus and an unspecified tissue specimen, were submitted by RVC practitioners.

The remaining eight *A. baumannii* specimens came from BVMTH patients, one in October, 2006 and the remainder clustered between April and July 2007. The 2006 isolate was an ophthalmology patient, and the others included three catheter infections, two blood cultures and a thoracic cavity infection. All isolates were susceptible to amikacin and imipenem, with resistance to most other antimicrobials tested. Susceptibility phenotypes of *A. baumannii* isolates are shown in Table A-66.

### *Serratia marcescens*

Eight *S. marcescens* isolates were cultured, including three from two uterine cultures and a draining tract were submitted by RVC practitioners. The remaining five isolates came from four BVMTH patients between April and August, 2007. One patient had two isolates with different susceptibility phenotypes cultured from an intravenous catheter. All isolates were susceptible to imipenem and fluoroquinolones, with resistance to most other antimicrobials tested. Phenotypes are detailed in Table A-67.

### Cumulative Antibiograms

Tables A-68 and A-69 provide summary antibiograms for the twelve most common equine pathogens for the CVHS locations and the RVC for the 2007 calendar year. Table A-70 represents an effort to define the degree of multi-drug resistance present in isolates of each organism.

# CHAPTER V

# CONCLUSION

Bacterial isolates from equine specimens submitted to OADDL by the BVMTH, the CVHSR and the RVC over a three year period provide significant insight to the institutional and regional microbiological environment.  The major weakness of this study was the very small sample sizes for some of the pathogens examined, so that comparisons across years, and between the BVMTH, RVC and CVHSR should be made in consideration of that fact.

From a broad perspective, the types of submission, organisms, susceptibilities and trends in equine clinical microbiology are consistent with what is reported in current literature, with a few notable differences.

The overall character of the submissions likely reflects the nature of veterinary practice in each location. The high percentage of reproductive specimens in the RVC submissions is likely representative of the high level of breeding activity in this region. The greater variety of BVMTH specimens including blood cultures, intravenous catheters, fecal cultures, and ocular samples reflects the added focus of the BVMTH on critical care and specialty practice. Respiratory specimens were common from both the BVMTH and the RVC, consistent with the prevalence of infectious respiratory disease in equine practice.

The preponderance of *E. coli* and *Streptococcus equi zooepidemicus* as the two most common organisms isolated from equine specimens is not surprising. This finding is consistent with other large-scale retrospective studies using data from veterinary teaching hospital diagnostic laboratories, although some variations in reporting exists.[45,139] *Salmonella* was the third most common isolate from BVMTH specimens and the fourth most common from the RVC behind *Pseudomonas aeruginosa*. In two similar studies, *Salmonella* was not listed in the top ten[139] or fourteen[45] isolates. This may represent a greater than average prevalence of *Salmonella* in horses in Oklahoma relative to other parts of North America, and a possible area of further study. *Actinobacillus* species were less commonly isolated in the present study relative to some other reports. First isolates at OADDL included *A. suis* (1.2%), *A. equuli* (1.1%) and *Actinobacillus* species (1.1%) as compared to 7%, 4% and 2% at a western Canadian equine veterinary teaching hospital.[45]

*Actinobacillus* species also were less prevalent in foal blood cultures than in other reports, making up only 4% of the total, and occurring only in the first year. In other studies, *Actinobacillus* species accounted for 20%, [107] 25% [140] and 30% [115] of neonatal blood cultures. The prevalence of *E. coli* in neonatal blood cultures is consistent with other reports, as is the increase in gram-positives over time. [51,140]

Assessing the level of antimicrobial resistance of OADDL isolates in comparison to what is reported in the literature is somewhat difficult due to the differences in susceptibility testing, antimicrobial panels and reporting methods. The label "multi-drug resistant" lacks a uniform definition throughout the literature, for example in some studies this is defined as resistance to a specific number of antimicrobials,[101] whereas in other it is resistance to chosen set of specific drugs.[97] General trends and conclusions may nonetheless be identified and targeted for further study.

As indicated in Table A-70, multi-drug resistance in the general sense was evident in numerous bacterial organisms analyzed in this study, and this tended to occur in organisms that are documented in the literature to have a known or emergent trend toward multi-drug resistance.

While the most frequent *E. coli* isolates showed good susceptibility to antimicrobials tested, individual isolates showed resistance to penicillins, cephalosporins, macrolides, aminoglycosides, lincosamides, potentiated sulfonamides and fluroquinolones. Similar multi-drug resistance has been reported in equine isolates within the past year. [16] This is of concern due to the demonstrated ability of *E. coli* to transfer some types of resistance to other potential, zoonotic pathogens, including *Salmonella*.[16,54]

In spite of differing approaches to testing and describing antimicrobial resistance patterns across the literature, it appears that the level of resistance present in OADDL *E.coli* isolates may be greater than in other survey reports. One recent hospital-based study reported 73% of hospitalized horses receiving antibiotics and 50% of those not receiving antibiotics cultured *E.coli* resistant to one or more antimicrobial,[57] whereas 100% of OADDL isolates were resistant to at least one antimicrobial. In that same study, 23% of hospitalized horses receiving antimicrobials and 5% of those not receiving antimicrobials showed resistance to six or more antimicrobials, whereas in the OADDL population this number was 45.3%. Unlike the present study, these were all fecal cultures and the antimicrobial history of each patient was known.

One non-hospital based survey conducted in 1993 showed 15.9% of isolates resistant to one or more antimicrobial and 6.5% resistant to at least three,[56] whereas this was 100% and 68.2% respectively for all OADDL first isolates. Overall susceptibility of 2007 BVMTH *E. coli* isolates to most antimicrobials except cephalothin was slightly less than for a recent retrospective at a teaching hospital in western Canada where the caseload is about 75% first opinion.[45] The susceptibility pattern of RVC *E. coli* isolates was slightly better.

Overall multi-drug resistance was relatively low for *Streptococcus equi zooepidemicus* with 42% of isolates susceptible to all antimicrobials tested. This is consistent with what is reported in the literature.[64] The overall susceptibility of OADDL isolates was much greater for amikacin and trimethoprim sulfamethoxazole than those recently reported by another veterinary teaching hospital.[45] What is not clearly shown by the susceptibility or resistance analysis is the predominance of intermediate strains; this is similar to what is currently reported with "resistant" *S. pneumoniae* infections humans.[64] Ongoing study tracking intermediate strains as well as minor fluctuations in MIC would provide a more sensitive indicator of resistance patterns.

Multi-drug resistance was the rule rather than the exception for *Salmonella* isolates in all populations in this study. While the most common isolates of each *Salmonella* species showed relatively good susceptibility to major drug classes including cephalosporins and fluoroquinolones, each species had many isolates that were resistant to these antimicrobials. As made evident in the above literature review on *Salmonella* susceptibility patterns, increasing resistance has been seen across time, in a wide geographic area, and to all major classes of antibiotics. Given the apparently greater frequency with which Salmonella is isolated in horses under veterinary care in Oklahoma, this may be an area for further study of this organism and its susceptibilities in a large number of both hospitalized horses and those in the general population.

Multi-drug resistance in commensal organisms known to be reservoirs for resistance was also found in the OADDL isolates. Methicillin resistance has been documented in coagulase negative *Staphylococcus* and while many of these organisms are opportunistic, the risk of resistance transfer to pathogenic species such as *S. aureus* is real.[105] Four isolates of S. xylosus in this study showed oxacillin resistance; it is of interest that the two for which a location of origin was available were community rather than hospital isolates. *Enterococcus* isolates were also highly resistant. The primary concerns with this organism are its ability to acquire resistance readily, in particular to glycopeptides antimicrobials such as vancomycin. Though this was not evaluated for these isolates, the predominance of multi-drug resistant *Enterococcus* isolates would make such an investigation an interesting area of further research.

Numerous strains of oxacillin resistant *S. aureus* were isolated, suggestive of the presence of MRSA. Overall, resistance of *S. aureus* to tetracycline diminished. Similar to a study reported by eight veterinary diagnostic laboratories, suspected MRSA strains were multi-drug resistant.[12]

One of the most interesting and clinically relevant observations coming out of the analysis of this data is the pattern of occurrence for hospital infections including most notably *Staphylococcus aureus* and *Salmonella* that are suggestive of nosocomial spread. The observation of these types of patterns retrospectively is not unexpected, as one report suggests that nosocomial infection in equine patients is not uncommon, with 21.9% of horses receiving cultures in a 6-month period having acquired gram-negative aerobic infections.[40]

At the BVMTH, the oxacillin-resistant *Staphylococcus aureus* occurred in 14 patients providing 29 samples, of which 23 showed the same susceptibility phenotype. On an ongoing basis, confirmation of newly isolated strains as methicillin resistant *Staphylococcus aureus* (MRSA) would be ideal. The establishment of possible epidemiological relationships inclusive of both equine patients and hospital personnel through molecular typing techniques would enhance the health and safety of both patients and personnel, while developing a database to contribute to the knowledge of the epidemiologic and pathogenic role of this organism in equine medicine.

During the same time period as the suspected *Staphylococcus aureus* outbreak, and in many of the same patients, other organisms commonly associated with hospital-acquired infections were isolated. These included *Acinetobacter baumannii*, *Serratia marcescens* and *Enterococcus faecalis*. The occurrence of these infections in common patients is detailed in Table A-62. While susceptibility patterns of many of these isolates were not identical, molecular typing techniques would help to establish if these infections were hospital acquired, or merely coincidental in the large caseload of critically ill patients being cared for in the BVMTH at that time. This knowledge in turn could help identify areas for improvement in BVMTH biosecurity, and in existing techniques for procedures such as the placement of intravenous catheters. The current study provides a foundation for enhancing the quality of care in the BVMTH, as well as veterinary knowledge in the area of equine critical care clinical microbiology. Current literature supports this approach, with one report of molecular analysis following clinical observation of multi-drug resistant phenotypes revealing patterns of nosocomial infection for both *Acinetobacter baumannii* and *Enterococcus faecium*. [39]

*Salmonella* isolates were characterized by a cluster of Group E isolates in an eight month period in 2005 and 2006. Limited data was available on the 2005 isolates and the 2006 isolates came from a single BVMTH patient, so the significance of this cluster of may be questionable. While extreme drug resistance was not identified, the identification of Group E isolates began and ended abruptly. This is again the type of retrospective observation that may provide useful information as to emergent pathogens or current biosecurity practices.

This report included the analysis of voluminous amounts of equine clinical microbiology data in the hopes of enhancing clinical practice in the BVMTH, providing useful information to the regional practitioners that submit specimens to OADDL, and enhancing the body of veterinary knowledge pertaining to antimicrobial resistance in common equine pathogens. Ongoing tracking of these pathogens, the creation of annual antibiograms and the incorporation of molecular typing techniques where appropriate will build on the foundation provided by this document for ongoing expansion of this knowledge.

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APPENDICES

**Table A-1**
**Summary Data by Organism**
***(Duplicates Not Removed)***

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *E. coli* | 98 | 112 | 86 | 296 | 15.7% |
| *Streptococcus equi ss zooepidemicus* | 95 | 94 | 69 | 258 | 13.7% |
| *Salmonella species* | 6 | 41 | 44 | 91 | 4.8% |
| *Staphylococcus aureus ss aureus* | 16 | 22 | 42 | 80 | 4.2% |
| *Pseudomonas aeruginosa* | 19 | 23 | 30 | 72 | 3.8% |
| *Klebsiella pneumoniae ss pneumoniae* | 14 | 24 | 20 | 58 | 3.1% |
| *Salmonella group - B* | 19 | 25 | 9 | 53 | 2.8% |
| *Streptococcus beta* | 20 | 17 | 12 | 49 | 2.6% |
| *Streptococcus equi ss equi* | 18 | 8 | 15 | 41 | 2.2% |
| *Salmonella sp. group C2* | 32 | 5 | 2 | 39 | 2.1% |
| *Streptococcus dysgalactiae ss equisimilis* | 16 | 14 | 9 | 39 | 2.1% |
| *Staphylococcus xylosus* | 9 | 8 | 19 | 36 | 1.9% |
| *Enterococcus species* | 7 | 8 | 19 | 34 | 1.8% |
| *Streptococcus alpha haemolytic* | 13 | 13 | 6 | 32 | 1.7% |
| *Staphylococcus species* | 10 | 8 | 13 | 31 | 1.6% |
| *Salmonella species group C1* | 12 | 8 | 10 | 30 | 1.6% |
| *Enterobacter aerogenes* | 8 | 12 | 6 | 26 | 1.4% |
| *Enterobacter cloacae* | 10 | 7 | 9 | 26 | 1.4% |
| *Gram negative non fermenter* | 7 | 12 | 7 | 26 | 1.4% |
| *Enterococcus faecalis* | 6 | 11 | 7 | 24 | 1.3% |
| *Actinobacillus suis* | 6 | 11 | 3 | 20 | 1.1% |
| *Actinobacillus equuli ss equuli* | 10 | 4 | 5 | 19 | 1.0% |
| *Corynebacterium species* | 5 | 11 | 3 | 19 | 1.0% |
| *Pseudomonas species* | 11 | 3 | 5 | 19 | 1.0% |
| *Actinobacillus species* | 3 | 6 | 9 | 18 | 1.0% |
| *Staphylococcus beta haemolytic* | 5 | 3 | 9 | 17 | 0.9% |
| *Citrobacter koseri* | 4 | 6 | 6 | 16 | 0.8% |
| *Acinetobacter lwoffi* | 4 | 5 | 6 | 15 | 0.8% |
| *Enterobacter species* | 7 | 5 | 3 | 15 | 0.8% |
| *Pasturella species* | 3 | 4 | 8 | 15 | 0.8% |
| *Rhodococcus equi* | 8 | 4 | 3 | 15 | 0.8% |
| *Streptococcus species* | 4 | 4 | 7 | 15 | 0.8% |
| *E. coli beta* | 6 | 4 | 4 | 14 | 0.7% |
| *Stenotrophomonas maltophilia* | 4 | 5 | 4 | 13 | 0.7% |
| *Proteus mirabilis* | 4 | 4 | 4 | 12 | 0.6% |
| *Citrobacter freundii* | 3 | 6 | 2 | 11 | 0.6% |
| *Acinetobacter baumannii* | | 2 | 8 | 10 | 0.5% |
| *Bacillus species* | 5 | 2 | 3 | 10 | 0.5% |
| *Escherichia hermannii* | 4 | 3 | 3 | 10 | 0.5% |
| *Staphylococcus intermedius* | 4 | 3 | 3 | 10 | 0.5% |
| *Actinobacillus ureae* | | 6 | 3 | 9 | 0.5% |
| *Enterobacter amnigenus* | 5 | 4 | | 9 | 0.5% |
| *Enterococcus faecium* | 3 | 4 | 2 | 9 | 0.5% |
| *Pseudomonas fluorescens* | 5 | 2 | 2 | 9 | 0.5% |
| *Morganella morgani ss morganii* | 1 | 4 | 3 | 8 | 0.4% |
| *Pantoea agglomerans* | 3 | 3 | 2 | 8 | 0.4% |
| *Salmonella group - E* | 6 | 2 | | 8 | 0.4% |
| *Serratia marcescens* | 1 | 1 | 6 | 8 | 0.4% |
| *Staphylococcus epidermidis* | 3 | 2 | 3 | 8 | 0.4% |
| *Staphylococcus haemolyticus* | 3 | 1 | 4 | 8 | 0.4% |
| *Citrobacter species* | 5 | | 2 | 7 | 0.4% |

**Table A-1**
**Summary Data by Organism**
***(Duplicates Not Removed)***

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *Klebsiella oxytoca* | 3 | | 4 | 7 | 0.4% |
| *Bordetella bronchiseptica* | 1 | 2 | 3 | 6 | 0.3% |
| *Flavimonas oryzihabitans* | 1 | 1 | 4 | 6 | 0.3% |
| *Pasteurella aerogenes atypical* | 2 | 4 | | 6 | 0.3% |
| *Gram negative diplococcus* | | | 5 | 5 | 0.3% |
| *Ralstonia pickettii* | | 3 | 2 | 5 | 0.3% |
| *Actinobacillus lignieresii* | | 1 | 3 | 4 | 0.2% |
| *Gram negative rod* | | 1 | 3 | 4 | 0.2% |
| *Micrococcus luteus* | | 2 | 2 | 4 | 0.2% |
| *Micrococcus species* | 2 | 2 | | 4 | 0.2% |
| *Pasteurella pneumotropica* | 1 | 2 | 1 | 4 | 0.2% |
| *Staphylococcus hyicus* | 1 | | 3 | 4 | 0.2% |
| *Staphylococcus warneri* | 1 | | 3 | 4 | 0.2% |
| *Aero. hydrophilia ss hydrophilia* | 1 | 1 | 1 | 3 | 0.2% |
| *Aeromonas caviae* | 2 | 1 | | 3 | 0.2% |
| *Corynebacterium pseudotuberculosis* | | 1 | 2 | 3 | 0.2% |
| *Escherichia fergusonii* | 1 | 1 | 1 | 3 | 0.2% |
| *Kocuria rosea* | 2 | 1 | | 3 | 0.2% |
| *Lactobacillus species* | 1 | 2 | | 3 | 0.2% |
| *Leclercia adecarboxylata* | 2 | 1 | | 3 | 0.2% |
| *Proteus penneri* | 2 | | 1 | 3 | 0.2% |
| *Providencia rettgeri* | | 2 | 1 | 3 | 0.2% |
| *Streptococcus beta haemolytic* | | 1 | 2 | 3 | 0.2% |
| *Achromobacter xylo ss dentrificans* | 1 | 1 | | 2 | 0.1% |
| *Achromobacter xylo ss xylosoxidans* | 2 | | | 2 | 0.1% |
| *Chryseobacterium indologenes* | | 2 | | 2 | 0.1% |
| *Chryseobacterium meningosepticum* | | 1 | 1 | 2 | 0.1% |
| *Comamonas testosteroni* | | | 2 | 2 | 0.1% |
| *Enterobacter gergoviae* | | 2 | | 2 | 0.1% |
| *Flavobacterium species* | | 1 | 1 | 2 | 0.1% |
| *Gram negative organism* | | 1 | 1 | 2 | 0.1% |
| *Kluyvera ascorbata* | 1 | | 1 | 2 | 0.1% |
| *Ochrobactrum anthropi* | 1 | 1 | | 2 | 0.1% |
| *P. pseudo. ss pseudoalcaligenes* | | | 2 | 2 | 0.1% |
| *Proteus vulgaris* | 1 | | 1 | 2 | 0.1% |
| *Providencia stuartii* | 1 | | 1 | 2 | 0.1% |
| *Pseudomonas mendocina* | | | 2 | 2 | 0.1% |
| *Raoultella planticola* | | 2 | | 2 | 0.1% |
| *Streptococcus beta group - C* | | 2 | | 2 | 0.1% |
| *Streptococcus bovis* | 1 | 1 | | 2 | 0.1% |
| *Streptococcus mitis* | 1 | 1 | | 2 | 0.1% |
| *Streptococcus suis* | 1 | 1 | | 2 | 0.1% |
| *Streptococcus uberis* | 1 | 1 | | 2 | 0.1% |
| *Aerococcus viridans* | | 1 | | 1 | 0.1% |
| *Alcaligenes faecalis ss faecalis* | 1 | | | 1 | 0.1% |
| *Cedecea lapagei* | 1 | | | 1 | 0.1% |
| *Citrobacter amalonaticus* | | 1 | | 1 | 0.1% |
| *Citrobacter diversus* | 1 | | | 1 | 0.1% |
| *Delftia acidovorans* | | | 1 | 1 | 0.1% |
| *Enterobacter sakazakii* | 1 | | | 1 | 0.1% |
| *Enterococcus durans* | | 1 | | 1 | 0.1% |

**Table A-1**
**Summary Data by Organism**
***(Duplicates Not Removed)***

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *Gram positive rod* | | | 1 | 1 | 0.1% |
| *Pasteurella aerogenes* | | | 1 | 1 | 0.1% |
| *Pasturella multocida ss multocida* | | 1 | | 1 | 0.1% |
| *Pseudomonas aeruginosa/putida* | | 1 | | 1 | 0.1% |
| *Pseudomonas alcaligenes* | | 1 | | 1 | 0.1% |
| *Pseudomonas putida* | | 1 | | 1 | 0.1% |
| *Psychrobacter phenylpyruvicus* | | | 1 | 1 | 0.1% |
| *Rhodococcus species* | 1 | | | 1 | 0.1% |
| *Salmonella choleraesuis ss arizonae* | | | 1 | 1 | 0.1% |
| *Salmonella group D* | | 1 | | 1 | 0.1% |
| *Salmonella subgenus 1* | | | 1 | 1 | 0.1% |
| *Serratia plymuthica* | | 1 | | 1 | 0.1% |
| *Serratia rubidaea* | 1 | | | 1 | 0.1% |
| *Sphingobacterium multivorum* | | 1 | | 1 | 0.1% |
| *Sphingomonas paucimobilis* | | 1 | | 1 | 0.1% |
| *Staphylococcus hominis ss hominis* | | 1 | | 1 | 0.1% |
| *Staphylococcus saprophyticus ss saprophyticus* | | 1 | | 1 | 0.1% |
| *Staphylococcus simulans* | 1 | | | 1 | 0.1% |
| *Streptococcus mutans* | 1 | | | 1 | 0.1% |
| ***Total*** | **612** | **655** | **618** | **1885** | **100.0%** |

**Table A-2**
**Summary Data by Organism**
***(First Isolates)***

| Organism | 2005 | % 2005 | 2006 | % 2006 | 2007 | %2007 | Total | % Total |
|---|---|---|---|---|---|---|---|---|
| *E. coli* | 78 | 15% | 90 | 16% | 63 | 12% | 231 | 14.3% |
| *Streptococcus equi ss zooepidemicus* | 70 | 13% | 81 | 14% | 54 | 11% | 205 | 12.7% |
| *Salmonella species* | 5 | 1% | 32 | 6% | 34 | 7% | 71 | 4.4% |
| *Staphylococcus aureus ss aureus* | 16 | 3% | 17 | 3% | 24 | 5% | 57 | 3.5% |
| *Pseudomonas aeruginosa* | 16 | 3% | 17 | 3% | 20 | 4% | 53 | 3.3% |
| *Klebsiella pneumoniae ss pneumoniae* | 10 | 2% | 20 | 4% | 20 | 4% | 50 | 3.1% |
| *Streptococcus beta* | 19 | 4% | 17 | 3% | 12 | 2% | 48 | 3.0% |
| *Salmonella group - B* | 18 | 3% | 17 | 3% | 7 | 1% | 42 | 2.6% |
| *Streptococcus equi ss equi* | 17 | 3% | 8 | 1% | 13 | 3% | 38 | 2.4% |
| *Streptococcus dysgalactiae ss equisimilis* | 15 | 3% | 14 | 2% | 8 | 2% | 37 | 2.3% |
| *Staphylococcus xylosus* | 8 | 2% | 7 | 1% | 18 | 4% | 33 | 2.0% |
| *Staphylococcus species* | 10 | 2% | 8 | 1% | 13 | 3% | 31 | 1.9% |
| *Salmonella sp. group C2* | 23 | 4% | 5 | 1% | 2 | 0% | 30 | 1.9% |
| *Enterococcus species* | 7 | 1% | 6 | 1% | 14 | 3% | 27 | 1.7% |
| *Enterobacter aerogenes* | 8 | 2% | 12 | 2% | 6 | 1% | 26 | 1.6% |
| *Streptococcus alpha haemolytic* | 12 | 2% | 10 | 2% | 4 | 1% | 26 | 1.6% |
| *Enterobacter cloacae* | 10 | 2% | 6 | 1% | 7 | 1% | 23 | 1.4% |
| *Gram negative non fermenter* | 6 | 1% | 11 | 2% | 6 | 1% | 23 | 1.4% |
| *Salmonella species group C1* | 9 | 2% | 5 | 1% | 8 | 2% | 22 | 1.4% |
| *Actinobacillus suis* | 6 | 1% | 11 | 2% | 3 | 1% | 20 | 1.2% |
| *Enterococcus faecalis* | 5 | 1% | 9 | 2% | 6 | 1% | 20 | 1.2% |
| *Corynebacterium species* | 5 | 1% | 11 | 2% | 3 | 1% | 19 | 1.2% |
| *Actinobacillus equuli ss equuli* | 9 | 2% | 4 | 1% | 5 | 1% | 18 | 1.1% |
| *Actinobacillus species* | 3 | 1% | 6 | 1% | 9 | 2% | 18 | 1.1% |
| *Pseudomonas species* | 10 | 2% | 3 | 1% | 4 | 1% | 17 | 1.1% |
| *Staphylococcus beta haemolytic* | 5 | 1% | 3 | 1% | 9 | 2% | 17 | 1.1% |
| *Citrobacter koseri* | 3 | 1% | 6 | 1% | 6 | 1% | 15 | 0.9% |
| *Pasturella species* | 3 | 1% | 4 | 1% | 8 | 2% | 15 | 0.9% |
| *Streptococcus species* | 4 | 1% | 4 | 1% | 7 | 1% | 15 | 0.9% |
| *Acinetobacter lwoffi* | 4 | 1% | 5 | 1% | 5 | 1% | 14 | 0.9% |
| *E. coli beta* | 6 | 1% | 4 | 1% | 4 | 1% | 14 | 0.9% |
| *Enterobacter species* | 6 | 1% | 5 | 1% | 3 | 1% | 14 | 0.9% |
| *Rhodococcus equi* | 8 | 2% | 3 | 1% | 3 | 1% | 14 | 0.9% |
| *Citrobacter freundii* | 3 | 1% | 6 | 1% | 2 | 0% | 11 | 0.7% |
| *Proteus mirabilis* | 4 | 1% | 4 | 1% | 3 | 1% | 11 | 0.7% |
| *Stenotrophomonas maltophilia* | 3 | 1% | 4 | 1% | 4 | 1% | 11 | 0.7% |
| *Bacillus species* | 5 | 1% | 2 | 0% | 3 | 1% | 10 | 0.6% |
| *Staphylococcus intermedius* | 4 | 1% | 3 | 1% | 3 | 1% | 10 | 0.6% |
| *Acinetobacter baumannii* | | 0% | 2 | 0% | 7 | 1% | 9 | 0.6% |
| *Actinobacillus ureae* | | 0% | 6 | 1% | 3 | 1% | 9 | 0.6% |
| *Escherichia hermannii* | 4 | 1% | 3 | 1% | 2 | 0% | 9 | 0.6% |
| *Enterobacter amnigenus* | 4 | 1% | 4 | 1% | | 0% | 8 | 0.5% |
| *Pantoea agglomerans* | 3 | 1% | 3 | 1% | 2 | 0% | 8 | 0.5% |
| *Pseudomonas fluorescens* | 4 | 1% | 2 | 0% | 2 | 0% | 8 | 0.5% |
| *Serratia marcescens* | 1 | 0% | 1 | 0% | 6 | 1% | 8 | 0.5% |
| *Citrobacter species* | 5 | 1% | | 0% | 2 | 0% | 7 | 0.4% |
| *Enterococcus faecium* | 2 | 0% | 4 | 1% | 1 | 0% | 7 | 0.4% |
| *Klebsiella oxytoca* | 3 | 1% | | 0% | 4 | 1% | 7 | 0.4% |
| *Salmonella group - E* | 5 | 1% | 2 | 0% | | 0% | 7 | 0.4% |
| *Staphylococcus epidermidis* | 3 | 1% | 1 | 0% | 3 | 1% | 7 | 0.4% |
| *Staphylococcus haemolyticus* | 3 | 1% | 1 | 0% | 3 | 1% | 7 | 0.4% |
| *Bordetella bronchiseptica* | 1 | 0% | 2 | 0% | 3 | 1% | 6 | 0.4% |

**Table A-2**
**Summary Data by Organism**
***(First Isolates)***

| Organism | 2005 | % 2005 | 2006 | % 2006 | 2007 | %2007 | Total | % Total |
|---|---|---|---|---|---|---|---|---|
| *Morganella morgani ss morganii* | 1 | 0% | 3 | 1% | 2 | 0% | 6 | 0.4% |
| *Pasteurella aerogenes atypical* | 2 | 0% | 4 | 1% | | 0% | 6 | 0.4% |
| *Flavimonas oryzihabitans* | 1 | 0% | 1 | 0% | 3 | 1% | 5 | 0.3% |
| *Ralstonia pickettii* | | 0% | 3 | 1% | 2 | 0% | 5 | 0.3% |
| *Actinobacillus lignieresii* | | 0% | 1 | 0% | 3 | 1% | 4 | 0.2% |
| *Gram negative rod* | | 0% | 1 | 0% | 3 | 1% | 4 | 0.2% |
| *Micrococcus luteus* | | 0% | 2 | 0% | 2 | 0% | 4 | 0.2% |
| *Micrococcus species* | 2 | 0% | 2 | 0% | | 0% | 4 | 0.2% |
| *Pasteurella pneumotropica* | 1 | 0% | 2 | 0% | 1 | 0% | 4 | 0.2% |
| *Staphylococcus warneri* | 1 | 0% | | 0% | 3 | 1% | 4 | 0.2% |
| *Aero. hydrophilia ss hydrophilia* | 1 | 0% | 1 | 0% | 1 | 0% | 3 | 0.2% |
| *Aeromonas caviae* | 2 | 0% | 1 | 0% | | 0% | 3 | 0.2% |
| *Corynebacterium pseudotuberculosis* | | 0% | 1 | 0% | 2 | 0% | 3 | 0.2% |
| *Escherichia fergusonii* | 1 | 0% | 1 | 0% | 1 | 0% | 3 | 0.2% |
| *Gram negative diplococcus* | | 0% | | 0% | 3 | 1% | 3 | 0.2% |
| *Kocuria rosea* | 2 | 0% | 1 | 0% | | 0% | 3 | 0.2% |
| *Lactobacillus species* | 1 | 0% | 2 | 0% | | 0% | 3 | 0.2% |
| *Leclercia adecarboxylata* | 2 | 0% | 1 | 0% | | 0% | 3 | 0.2% |
| *Proteus penneri* | 2 | 0% | | 0% | 1 | 0% | 3 | 0.2% |
| *Providencia rettgeri* | | 0% | 2 | 0% | 1 | 0% | 3 | 0.2% |
| *Staphylococcus hyicus* | 1 | 0% | | 0% | 2 | 0% | 3 | 0.2% |
| *Streptococcus beta haemolytic* | | 0% | 1 | 0% | 2 | 0% | 3 | 0.2% |
| *Achromobacter xylo ss dentrificans* | 1 | 0% | 1 | 0% | | 0% | 2 | 0.1% |
| *Achromobacter xylo ss xylosoxidans* | 2 | 0% | | 0% | | 0% | 2 | 0.1% |
| *Chryseobacterium indologenes* | | 0% | 2 | 0% | | 0% | 2 | 0.1% |
| *Chryseobacterium meningosepticum* | | 0% | 1 | 0% | 1 | 0% | 2 | 0.1% |
| *Comamonas testosteroni* | | 0% | | 0% | 2 | 0% | 2 | 0.1% |
| *Enterobacter gergoviae* | | 0% | 2 | 0% | | 0% | 2 | 0.1% |
| *Flavobacterium species* | | 0% | 1 | 0% | 1 | 0% | 2 | 0.1% |
| *Gram negative organism* | | 0% | 1 | 0% | 1 | 0% | 2 | 0.1% |
| *Kluyvera ascorbata* | 1 | 0% | | 0% | 1 | 0% | 2 | 0.1% |
| *Ochrobactrum anthropi* | 1 | 0% | 1 | 0% | | 0% | 2 | 0.1% |
| *P. pseudo. ss pseudoalcaligenes* | | 0% | | 0% | 2 | 0% | 2 | 0.1% |
| *Proteus vulgaris* | 1 | 0% | | 0% | 1 | 0% | 2 | 0.1% |
| *Pseudomonas mendocina* | | 0% | | 0% | 2 | 0% | 2 | 0.1% |
| *Raoultella planticola* | | 0% | 2 | 0% | | 0% | 2 | 0.1% |
| *Streptococcus bovis* | 1 | 0% | 1 | 0% | | 0% | 2 | 0.1% |
| *Streptococcus mitis* | 1 | 0% | 1 | 0% | | 0% | 2 | 0.1% |
| *Streptococcus suis* | 1 | 0% | 1 | 0% | | 0% | 2 | 0.1% |
| *Streptococcus uberis* | 1 | 0% | 1 | 0% | | 0% | 2 | 0.1% |
| *Aerococcus viridans* | | 0% | 1 | 0% | | 0% | 1 | 0.1% |
| *Alcaligenes faecalis ss faecalis* | 1 | 0% | | 0% | | 0% | 1 | 0.1% |
| *Cedecea lapagei* | 1 | 0% | | 0% | | 0% | 1 | 0.1% |
| *Citrobacter amalonaticus* | | 0% | 1 | 0% | | 0% | 1 | 0.1% |
| *Citrobacter diversus* | 1 | 0% | | 0% | | 0% | 1 | 0.1% |
| *Delftia acidovorans* | | 0% | | 0% | 1 | 0% | 1 | 0.1% |
| *Enterobacter sakazakii* | 1 | 0% | | 0% | | 0% | 1 | 0.1% |
| *Enterococcus durans* | | 0% | 1 | 0% | | 0% | 1 | 0.1% |
| *Gram positive rod* | | 0% | | 0% | 1 | 0% | 1 | 0.1% |
| *Pasteurella aerogenes* | | 0% | | 0% | 1 | 0% | 1 | 0.1% |
| *Pasturella multocida ss multocida* | | 0% | 1 | 0% | | 0% | 1 | 0.1% |

**Table A-2**
**Summary Data by Organism**
***(First Isolates)***

| Organism | 2005 | % 2005 | 2006 | % 2006 | 2007 | %2007 | Total | % Total |
|---|---|---|---|---|---|---|---|---|
| *Providencia stuartii* | | 0% | | 0% | 1 | 0% | 1 | 0.1% |
| *Providencia stuartiiT* | 1 | 0% | | 0% | | 0% | 1 | 0.1% |
| *Pseudomonas aeruginosa/putida* | | 0% | 1 | 0% | | 0% | 1 | 0.1% |
| *Pseudomonas putida* | | 0% | 1 | 0% | | 0% | 1 | 0.1% |
| *Psychrobacter phenylpyruvicus* | | 0% | | 0% | 1 | 0% | 1 | 0.1% |
| *Rhodococcus species* | 1 | 0% | | 0% | | 0% | 1 | 0.1% |
| *Salmonella choleraesuis ss arizonae* | | 0% | | 0% | 1 | 0% | 1 | 0.1% |
| *Salmonella group D* | | 0% | 1 | 0% | | 0% | 1 | 0.1% |
| *Salmonella subgenus 1* | | 0% | | 0% | 1 | 0% | 1 | 0.1% |
| *Serratia plymuthica* | | 0% | 1 | 0% | | 0% | 1 | 0.1% |
| *Serratia rubidaea* | 1 | 0% | | 0% | | 0% | 1 | 0.1% |
| *Sphingobacterium multivorum* | | 0% | 1 | 0% | | 0% | 1 | 0.1% |
| *Sphingomonas paucimobilis* | | 0% | 1 | 0% | | 0% | 1 | 0.1% |
| *Staphylococcus hominis ss hominis* | | 0% | 1 | 0% | | 0% | 1 | 0.1% |
| *Staphylococcus saprophyticus ss saprophyticus* | | 0% | 1 | 0% | | 0% | 1 | 0.1% |
| *Staphylococcus simulans* | 1 | 0% | | 0% | | 0% | 1 | 0.1% |
| *Streptococcus beta group - C* | | 0% | 1 | 0% | | 0% | 1 | 0.1% |
| *Streptococcus mutans* | 1 | 0% | | 0% | | 0% | 1 | 0.1% |
| **Total** | **530** | **100%** | **569** | **100%** | **511** | **100%** | **1610** | **100.0%** |

**Table A-3**
**Summary Data By Organism for BVMTH Specimens**
***(First Isolates)***

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *E. coli* | 6 | 26 | 24 | 56 | 11.3% |
| *Streptococcus equi ss zooepidemicus* | 5 | 22 | 22 | 49 | 9.9% |
| *Salmonella species* | | 19 | 22 | 41 | 8.2% |
| *Staphylococcus aureus ss aureus* | | 11 | 13 | 24 | 4.8% |
| *Klebsiella pneumoniae ss pneumoniae* | | 12 | 5 | 17 | 3.4% |
| *Enterococcus species* | 2 | 1 | 10 | 13 | 2.6% |
| *Salmonella group - B* | 1 | 9 | 3 | 13 | 2.6% |
| *Pseudomonas aeruginosa* | | 5 | 6 | 11 | 2.2% |
| *Salmonella species group C1* | 1 | 4 | 6 | 11 | 2.2% |
| *Streptococcus alpha haemolytic* | 3 | 5 | 3 | 11 | 2.2% |
| *Actinobacillus equuli ss equuli* | 3 | 2 | 4 | 9 | 1.8% |
| *Streptococcus beta* | | 7 | 2 | 9 | 1.8% |
| *Actinobacillus suis* | | 6 | 2 | 8 | 1.6% |
| *Enterobacter cloacae* | 3 | 2 | 3 | 8 | 1.6% |
| *Streptococcus equi ss equi* | 1 | | 7 | 8 | 1.6% |
| *Acinetobacter baumannii* | | 1 | 6 | 7 | 1.4% |
| *Actinobacillus species* | | 2 | 5 | 7 | 1.4% |
| *Corynebacterium species* | | 6 | 1 | 7 | 1.4% |
| *Enterococcus faecalis* | | 5 | 2 | 7 | 1.4% |
| *Staphylococcus species* | 2 | 1 | 4 | 7 | 1.4% |
| *Staphylococcus xylosus* | | 2 | 5 | 7 | 1.4% |
| *Gram negative non fermenter* | | 5 | 1 | 6 | 1.2% |
| *Pasturella species* | | 2 | 4 | 6 | 1.2% |
| *Salmonella sp. group C2* | | 4 | 2 | 6 | 1.2% |
| *Streptococcus dysgalactiae ss equisimilis* | | 3 | 3 | 6 | 1.2% |
| *Acinetobacter lwoffi* | 1 | 1 | 3 | 5 | 1.0% |
| *E. coli beta* | | 3 | 2 | 5 | 1.0% |
| *Morganella morgani ss morganii* | | 3 | 2 | 5 | 1.0% |
| *Pantoea agglomerans* | 1 | 2 | 2 | 5 | 1.0% |
| *Proteus mirabilis* | | 3 | 2 | 5 | 1.0% |
| *Serratia marcescens* | | | 5 | 5 | 1.0% |
| *Actinobacillus ureae* | | 1 | 3 | 4 | 0.8% |
| *Bordetella bronchiseptica* | | 1 | 3 | 4 | 0.8% |
| *Escherichia hermannii* | 2 | 2 | | 4 | 0.8% |
| *Pasteurella aerogenes atypical* | 1 | 3 | | 4 | 0.8% |
| *Staphylococcus epidermidis* | 2 | | 2 | 4 | 0.8% |
| *Streptococcus species* | | 2 | 2 | 4 | 0.8% |
| *Citrobacter species* | 1 | | 2 | 3 | 0.6% |
| *Enterobacter aerogenes* | | 2 | 1 | 3 | 0.6% |
| *Enterobacter species* | | 3 | | 3 | 0.6% |
| *Enterococcus faecium* | | 2 | 1 | 3 | 0.6% |
| *Flavimonas oryzihabitans* | | 1 | 2 | 3 | 0.6% |
| *Gram negative diplococcus* | | | 3 | 3 | 0.6% |
| *Micrococcus luteus* | | 2 | 1 | 3 | 0.6% |
| *Micrococcus species* | 1 | 2 | | 3 | 0.6% |
| *Pseudomonas species* | 1 | | 2 | 3 | 0.6% |
| *Salmonella group - E* | 1 | 2 | | 3 | 0.6% |
| *Actinobacillus lignieresii* | | 1 | 1 | 2 | 0.4% |
| *Chryseobacterium meningosepticum* | | 1 | 1 | 2 | 0.4% |
| *Citrobacter freundii* | 1 | 1 | | 2 | 0.4% |
| *Citrobacter koseri* | 1 | 1 | | 2 | 0.4% |
| *Corynebacterium pseudotuberculosis* | | | 2 | 2 | 0.4% |
| *Klebsiella oxytoca* | | | 2 | 2 | 0.4% |

**Table A-3**
**Summary Data By Organism for BVMTH Specimens**
***(First Isolates)***

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *Lactobacillus species* | | 2 | | 2 | 0.4% |
| *Proteus penneri* | 1 | | 1 | 2 | 0.4% |
| *Proteus vulgaris* | 1 | | 1 | 2 | 0.4% |
| *Providencia rettgeri* | | 1 | 1 | 2 | 0.4% |
| *Staphylococcus beta haemolytic* | | | 2 | 2 | 0.4% |
| *Staphylococcus haemolyticus* | | | 2 | 2 | 0.4% |
| *Staphylococcus warneri* | | | 2 | 2 | 0.4% |
| *Stenotrophomonas maltophilia* | | 1 | 1 | 2 | 0.4% |
| *Streptococcus mitis* | 1 | 1 | | 2 | 0.4% |
| *Achromobacter xylo ss xylosoxidans* | 1 | | | 1 | 0.2% |
| *Aerococcus viridans* | | 1 | | 1 | 0.2% |
| *Bacillus species* | | 1 | | 1 | 0.2% |
| *Cedecea lapagei* | 1 | | | 1 | 0.2% |
| *Chryseobacterium indologenes* | | 1 | | 1 | 0.2% |
| *Enterobacter amnigenus* | 1 | | | 1 | 0.2% |
| *Enterococcus durans* | | 1 | | 1 | 0.2% |
| *Escherichia fergusonii* | | 1 | | 1 | 0.2% |
| *Flavobacterium species* | | | 1 | 1 | 0.2% |
| *Gram negative rod* | | | 1 | 1 | 0.2% |
| *Gram positive rod* | | | 1 | 1 | 0.2% |
| *Kluyvera ascorbata* | | | 1 | 1 | 0.2% |
| *Kocuria rosea* | 1 | | | 1 | 0.2% |
| *Ochrobactrum anthropi* | | 1 | | 1 | 0.2% |
| *Pasteurella pneumotropica* | | 1 | | 1 | 0.2% |
| *Pasturella multocida ss multocida* | | 1 | | 1 | 0.2% |
| *Providencia stuartii* | | | 1 | 1 | 0.2% |
| *Pseudomonas fluorescens* | | 1 | | 1 | 0.2% |
| *Pseudomonas putida* | | 1 | | 1 | 0.2% |
| *Psychrobacter phenylpyruvicus* | | | 1 | 1 | 0.2% |
| *Ralstonia pickettii* | | | 1 | 1 | 0.2% |
| *Raoultella planticola* | | 1 | | 1 | 0.2% |
| *Rhodococcus equi* | | 1 | | 1 | 0.2% |
| *Salmonella subgenus 1* | | | 1 | 1 | 0.2% |
| *Sphingobacterium multivorum* | | 1 | | 1 | 0.2% |
| *Sphingomonas paucimobilis* | | 1 | | 1 | 0.2% |
| *Staphylococcus hyicus* | | | 1 | 1 | 0.2% |
| *Streptococcus beta haemolytic* | | | 1 | 1 | 0.2% |
| *Streptococcus suis* | | 1 | | 1 | 0.2% |
| **Total** | **47** | **221** | **229** | **497** | **100.0%** |

**Table A-4**
**Summary Data by Organism for RVC Specimens**
***(First Isolates)***

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *E. coli* | 6 | 61 | 33 | 100 | 15.6% |
| *Streptococcus equi ss zooepidemicus* | 8 | 52 | 29 | 89 | 13.9% |
| *Pseudomonas aeruginosa* | 3 | 12 | 13 | 28 | 4.4% |
| *Salmonella species* | 1 | 13 | 11 | 25 | 3.9% |
| *Staphylococcus aureus ss aureus* | 7 | 6 | 11 | 24 | 3.8% |
| *Klebsiella pneumoniae ss pneumoniae* | 3 | 7 | 12 | 22 | 3.4% |
| *Streptococcus beta* | 4 | 9 | 9 | 22 | 3.4% |
| *Staphylococcus xylosus* | | 5 | 13 | 18 | 2.8% |
| *Streptococcus equi ss equi* | 4 | 8 | 6 | 18 | 2.8% |
| *Streptococcus dysgalactiae ss equisimilis* | 3 | 10 | 4 | 17 | 2.7% |
| *Staphylococcus species* | | 6 | 9 | 15 | 2.3% |
| *Enterobacter aerogenes* | | 10 | 4 | 14 | 2.2% |
| *Citrobacter koseri* | 1 | 5 | 6 | 12 | 1.9% |
| *Salmonella group - B* | 1 | 7 | 3 | 11 | 1.7% |
| *Enterobacter cloacae* | 2 | 4 | 4 | 10 | 1.6% |
| *Staphylococcus beta haemolytic* | | 3 | 7 | 10 | 1.6% |
| *Gram negative non fermenter* | | 4 | 5 | 9 | 1.4% |
| *Actinobacillus suis* | 2 | 5 | 1 | 8 | 1.3% |
| *Actinobacillus species* | | 3 | 4 | 7 | 1.1% |
| *Enterococcus species* | | 3 | 4 | 7 | 1.1% |
| *Stenotrophomonas maltophilia* | 1 | 3 | 3 | 7 | 1.1% |
| *Streptococcus species* | 2 | 1 | 4 | 7 | 1.1% |
| *Citrobacter freundii* | | 4 | 2 | 6 | 0.9% |
| *Corynebacterium species* | | 4 | 2 | 6 | 0.9% |
| *Enterobacter amnigenus* | 2 | 4 | | 6 | 0.9% |
| *Enterococcus faecalis* | | 3 | 3 | 6 | 0.9% |
| *Pasturella species* | | 2 | 4 | 6 | 0.9% |
| *Pseudomonas species* | 1 | 3 | 2 | 6 | 0.9% |
| *Staphylococcus intermedius* | | 3 | 3 | 6 | 0.9% |
| *Acinetobacter lwoffi* | | 4 | 1 | 5 | 0.8% |
| *Actinobacillus ureae* | | 5 | | 5 | 0.8% |
| *Enterobacter species* | | 2 | 3 | 5 | 0.8% |
| *Rhodococcus equi* | | 2 | 3 | 5 | 0.8% |
| *Streptococcus alpha haemolytic* | | 4 | 1 | 5 | 0.8% |
| *Bacillus species* | | 1 | 3 | 4 | 0.6% |
| *E. coli beta* | 1 | 1 | 2 | 4 | 0.6% |
| *Escherichia hermannii* | 1 | 1 | 2 | 4 | 0.6% |
| *Ralstonia pickettii* | | 3 | 1 | 4 | 0.6% |
| *Actinobacillus equuli ss equuli* | 1 | 1 | 1 | 3 | 0.5% |
| *Gram negative rod* | | 1 | 2 | 3 | 0.5% |
| *Leclercia adecarboxylata* | 2 | 1 | | 3 | 0.5% |
| *Pseudomonas fluorescens* | | 1 | 2 | 3 | 0.5% |
| *Salmonella species group C1* | | 1 | 2 | 3 | 0.5% |
| *Serratia marcescens* | 1 | 1 | 1 | 3 | 0.5% |
| *Acinetobacter baumannii* | | 1 | 1 | 2 | 0.3% |
| *Actinobacillus lignieresii* | | | 2 | 2 | 0.3% |
| *Aero. hydrophilia ss hydrophilia* | | 1 | 1 | 2 | 0.3% |
| *Comamonas testosteroni* | | | 2 | 2 | 0.3% |
| *Enterobacter gergoviae* | | 2 | | 2 | 0.3% |
| *Gram negative organism* | | 1 | 1 | 2 | 0.3% |
| *Klebsiella oxytoca* | | | 2 | 2 | 0.3% |

**Table A-4**
**Summary Data by Organism for RVC Specimens**
***(First Isolates)***

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *Pasteurella pneumotropica* | 1 | 1 | | 2 | 0.3% |
| *Proteus mirabilis* | | 1 | 1 | 2 | 0.3% |
| *Pseudomonas mendocina* | | | 2 | 2 | 0.3% |
| *Staphylococcus epidermidis* | | 1 | 1 | 2 | 0.3% |
| *Staphylococcus haemolyticus* | | 1 | 1 | 2 | 0.3% |
| *Staphylococcus hyicus* | 1 | | 1 | 2 | 0.3% |
| *Streptococcus beta haemolytic* | | 1 | 1 | 2 | 0.3% |
| *Achromobacter xylo ss dentrificans* | | 1 | | 1 | 0.2% |
| *Aeromonas caviae* | | 1 | | 1 | 0.2% |
| *Bordetella bronchiseptica* | | 1 | | 1 | 0.2% |
| *Citrobacter amalonaticus* | | 1 | | 1 | 0.2% |
| *Citrobacter species* | 1 | | | 1 | 0.2% |
| *Corynebacterium pseudotuberculosis* | | 1 | | 1 | 0.2% |
| *Delftia acidovorans* | | | 1 | 1 | 0.2% |
| *Enterococcus faecium* | | 1 | | 1 | 0.2% |
| *Flavimonas oryzihabitans* | | | 1 | 1 | 0.2% |
| *Flavobacterium species* | | 1 | | 1 | 0.2% |
| *Kluyvera ascorbata* | 1 | | | 1 | 0.2% |
| *Kocuria rosea* | | 1 | | 1 | 0.2% |
| *Micrococcus luteus* | | | 1 | 1 | 0.2% |
| *P. pseudo. ss pseudoalcaligenes* | | | 1 | 1 | 0.2% |
| *Pantoea agglomerans* | | 1 | | 1 | 0.2% |
| *Pasteurella aerogenes* | | | 1 | 1 | 0.2% |
| *Pasteurella aerogenes atypical* | | 1 | | 1 | 0.2% |
| *Providencia rettgeri* | | 1 | | 1 | 0.2% |
| *Pseudomonas aeruginosa/putida* | | 1 | | 1 | 0.2% |
| *Raoultella planticola* | | 1 | | 1 | 0.2% |
| *Salmonella choleraesuis ss arizonae* | | | 1 | 1 | 0.2% |
| *Salmonella group D* | | 1 | | 1 | 0.2% |
| *Salmonella sp. group C2* | | 1 | | 1 | 0.2% |
| *Serratia plymuthica* | | 1 | | 1 | 0.2% |
| *Staphylococcus hominis ss hominis* | | 1 | | 1 | 0.2% |
| *Staphylococcus saprophyticus ss saprophyticus* | | 1 | | 1 | 0.2% |
| *Staphylococcus warneri* | | | 1 | 1 | 0.2% |
| *Streptococcus beta group - C* | | 1 | | 1 | 0.2% |
| *Streptococcus bovis* | | 1 | | 1 | 0.2% |
| *Streptococcus uberis* | | 1 | | 1 | 0.2% |
| **Total** | **61** | **320** | **258** | **639** | **100.0%** |

**Table A-5**
**Summary Data by Organism for CVHSR Specimens**
***(First Isolates)***

| Organism | 2005 | 2006 | 2007 | Total | % Total |
|---|---|---|---|---|---|
| *Streptococcus equi ss zooepidemicus* | 1 | 6 | 3 | 10 | 21.3% |
| *E. coli* | | 2 | 6 | 8 | 17.0% |
| *Klebsiella pneumoniae ss pneumoniae* | | | 3 | 3 | 6.4% |
| *Actinobacillus species* | 1 | 1 | | 2 | 4.3% |
| *Enterococcus faecalis* | | 1 | 1 | 2 | 4.3% |
| *Enterococcus species* | | 2 | | 2 | 4.3% |
| *Streptococcus dysgalactiae ss equisimilis* | | 1 | 1 | 2 | 4.3% |
| *Streptococcus species* | | 1 | 1 | 2 | 4.3% |
| *Acinetobacter lwoffi* | | | 1 | 1 | 2.1% |
| *Actinobacillus equuli ss equuli* | | 1 | | 1 | 2.1% |
| *Chryseobacterium indologenes* | | 1 | | 1 | 2.1% |
| *Corynebacterium species* | | 1 | | 1 | 2.1% |
| *Enterobacter aerogenes* | | | 1 | 1 | 2.1% |
| *Enterococcus faecium* | | 1 | | 1 | 2.1% |
| *Escherichia fergusonii* | | | 1 | 1 | 2.1% |
| *Gram negative non fermenter* | | 1 | | 1 | 2.1% |
| *P. pseudo. ss pseudoalcaligenes* | | | 1 | 1 | 2.1% |
| *Pasteurella pneumotropica* | | | 1 | 1 | 2.1% |
| *Pseudomonas aeruginosa* | 1 | | | 1 | 2.1% |
| *Pseudomonas fluorescens* | 1 | | | 1 | 2.1% |
| *Pseudomonas species* | 1 | | | 1 | 2.1% |
| *Salmonella group - B* | | | 1 | 1 | 2.1% |
| *Salmonella species* | | | 1 | 1 | 2.1% |
| *Streptococcus beta* | | | 1 | 1 | 2.1% |
| **Total** | **5** | **19** | **23** | **47** | **100.0%** |

**Table A-6**
**Summary of Bacteriology Specimens by Body System**

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| **Reproductive System** | **229** | **232** | **202** | **663** |
| *Uterus* | 190 | 191 | 176 | 557 |
| *Vagina* | 9 | 4 | 3 | 16 |
| *Cervix* | 4 | 1 | | 5 |
| *Clitoris* | | | 1 | 1 |
| *Placenta* | 2 | 1 | 3 | 6 |
| *Milk* | 1 | 3 | 5 | 9 |
| *Urethra* | 9 | 2 | 3 | 14 |
| *Penis* | | 2 | 1 | 3 |
| *Semen* | 6 | 26 | 10 | 42 |
| *Sheath* | 8 | 2 | | 10 |
| **Gastrointestinal System** | **99** | **118** | **92** | **309** |
| *Feces* | 89 | 87 | 78 | 254 |
| *Intestinal Contents* | 4 | 19 | 9 | 32 |
| *Abdominal Fluid* | 6 | 7 | | 13 |
| *Liver* | | 5 | 3 | 8 |
| *Stomach Contents* | | | 2 | 2 |
| **Respiratory System** | **89** | **101** | **116** | **306** |
| *Trachea/Bronchi/Lung* | 51 | 83 | 66 | 200 |
| *Guttural Pouch* | 10 | | 6 | 16 |
| *Sinus/Nasal Passages* | 25 | 17 | 11 | 53 |
| *Thorax/Pleura* | 3 | 1 | 33 | 37 |
| ***Soft Tissue*** | **73** | **94** | **85** | **252** |
| *Abscess* | 26 | 24 | 36 | 86 |
| Incisions | 6 | 25 | 17 | 48 |
| Wounds/Skin Lesions | 41 | 45 | 32 | 118 |
| **Hemolymphatic** | **21** | **36** | **57** | **114** |
| *Blood* | 16 | 22 | 22 | 60 |
| *IV Catheter* | 1 | 11 | 27 | 39 |
| *Lymph Node* | 4 | 3 | 8 | 15 |
| **Urinary** | **32** | **23** | **30** | **85** |
| *Urine* | 18 | 14 | 22 | 54 |
| *Urolith/Calculus* | 2 | | | 2 |
| *Umbilicus* | 12 | 9 | 7 | 28 |
| *Kidney* | | | 1 | 1 |
| **Ocular** | **18** | **15** | **6** | **39** |
| *Eye* | 17 | 14 | 6 | 37 |
| *Conjunctiva* | 1 | 1 | | 2 |
| **Musculoskeletal** | **18** | **5** | **8** | **31** |
| *Joint* | 12 | 3 | 8 | 23 |
| *Bone* | 3 | 1 | | 4 |
| *Tendon/Sheath* | 3 | | | 3 |
| *Cartilage* | | 1 | | 1 |
| **Other** | **33** | **31** | **22** | **86** |
| *CSF* | 1 | | 1 | 2 |
| *Ear Swab* | | 2 | | 2 |
| *Hair* | | | 2 | 2 |
| *Pericardial Swab* | 1 | | | 1 |
| *Miscellaneous Swabs/Fluids* | 31 | 29 | 19 | 79 |
| **Total** | **612** | **655** | **618** | **1885** |

**Table A-7**
**BVMTH Specimens by Body System**
***(First Isolates)***

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| **Reproductive System** | **1** | **12** | **9** | **22** |
| Uterus | 1 | 9 | 4 | 14 |
| Vagina | | 1 | 3 | 4 |
| Placenta | | 1 | | 1 |
| Milk | | | 2 | 2 |
| Penis | | 1 | | 1 |
| **Gastrointestinal System** | **6** | **54** | **45** | **105** |
| Feces | 3 | 45 | 41 | 89 |
| Abdominal Fluid | 3 | 6 | | 9 |
| Liver | | 3 | 3 | 6 |
| Stomach Contents | | | 1 | 1 |
| **Respiratory System** | **10** | **41** | **62** | **113** |
| Trachea/Bronchi/Lung | 7 | 37 | 38 | 82 |
| Guttural Pouch | | | 2 | 2 |
| Sinus/Nasal Passages | 2 | 4 | 5 | 11 |
| Thorax/Pleura | 1 | | 17 | 18 |
| **Soft Tissue** | **15** | **37** | **43** | **95** |
| Abscess | | 7 | 20 | 27 |
| Incisions | 2 | 13 | 12 | 27 |
| Wound/Skin Lesion | 13 | 17 | 11 | 41 |
| **Hemolymphatic** | **0** | **30** | **44** | **74** |
| Blood | | 20 | 20 | 40 |
| IV Catheter | | 10 | 24 | 34 |
| **Urinary** | **2** | **10** | **10** | **22** |
| Urine | 2 | 3 | 10 | 15 |
| Umbilicus | | 7 | | 7 |
| **Ocular** | **7** | **15** | **4** | **26** |
| Eye | 7 | 14 | 4 | 25 |
| Conjunctiva | | 1 | | 1 |
| **Musculoskeletal** | **1** | **4** | **0** | **5** |
| Joint | | 2 | | 2 |
| Bone | 1 | 1 | | 2 |
| Cartilage | | 1 | | 1 |
| **Other** | **5** | **18** | **12** | **35** |
| Ear Swab | | 2 | | 2 |
| Miscellaneous Swabs/Fluid | 5 | 16 | 12 | 33 |
| **Total** | **47** | **221** | **229** | **497** |

**Table A-8**
**RVC Specimens by Body System**
***(First Isolates)***

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| **Reproductive System** | **23** | **170** | **162** | **355** |
| Uterus | 16 | 146 | 150 | 312 |
| Vagina | 2 | 2 | | 4 |
| Cervix | | 1 | | 1 |
| Placenta | 2 | | 1 | 3 |
| Milk | | 3 | | 3 |
| Urethra | | 2 | 3 | 5 |
| Semen | 2 | 14 | 8 | 24 |
| Sheath | 1 | 2 | | 3 |
| **Gastrointestinal System** | **2** | **36** | **15** | **53** |
| Feces | 1 | 19 | 6 | 26 |
| Intestinal Contents | 1 | 17 | 8 | 26 |
| Stomach Contents | | | 1 | 1 |
| **Respiratory System** | **10** | **51** | **22** | **83** |
| Trachea/Bronchi/Lung | 7 | 40 | 14 | 61 |
| Guttural Pouch | | | 3 | 3 |
| Sinus/Nasal Passages | 3 | 10 | 5 | 18 |
| Thorax/Pleura | | 1 | | 1 |
| **Soft Tissue** | **11** | **42** | **27** | **80** |
| Abscess | 6 | 15 | 10 | 31 |
| Incisions | | 5 | | 5 |
| Wounds/Skin Lesions | 5 | 22 | 17 | 44 |
| **Hemolymphatic** | **0** | **3** | **8** | **11** |
| Lymph Node | | 3 | 8 | 11 |
| **Urinary** | **0** | **2** | **6** | **8** |
| Urine | | 1 | | 1 |
| Kidney | | | 1 | 1 |
| Umbilicus | | 1 | 5 | 6 |
| **Ocular** | **2** | **0** | **1** | **3** |
| Eye | 2 | | 1 | 3 |
| **Musculoskeletal** | **0** | **1** | **8** | **9** |
| Joint | | 1 | 8 | 9 |
| **Other** | **13** | **15** | **9** | **37** |
| Hair | | | 2 | 2 |
| Miscellaneous Swabs/Fluids | 13 | 15 | 7 | 35 |
| **Total** | **61** | **320** | **258** | **639** |

**Table A-9**
**CVHS Ranch Specimens by Body System**
***(First Isolates)***

| Source | 2005 | 2006 | 2007 | Total |
|---|---|---|---|---|
| Uterus | 4 | 12 | 8 | 24 |
| Feces | | | 9 | 9 |
| Semen | | 7 | | 7 |
| Placenta | | | 2 | 2 |
| Clitoral Swab | | | 1 | 1 |
| Other | 1 | | 3 | 4 |
| **Total** | **5** | **19** | **23** | **47** |

**Table A-10**
***Escherchia coli* Phenotypes**
***(First Isolates)***

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | PT 6 | PT 7 | PT 8 | PT 9 | PT 10 | PT 11 | PT 12 | PT 13 | PT 14 | PT 15 | PT 16 | PT 17 | PT 18 | PT 19 | PT 20 | PT 21 | PT 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Amoxicillin/CA | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | R | R | R | S | R |
| Ampicillin | S | S | S | S | S | S | S | S | R | R | R | R | R | S | R | R | R | R | R | R | R | R |
| Cefazolin | S | S | S | S | S | S | S | S | S | S | I | S | I | S | S | R | S | R | S | R | S | R |
| Cefoxitin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | R | I | R | S | R |
| Cefpodoxime | S | NT | NT | S | NT | NT | S | NT | S | S |  | S | I | S | I |  | S | NT | NT | R | S | R |
| Ceftiofur | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | R | S | R | S | R |
| Cephalothin | S | S | S | I | I | S | S | S | S | I | R | S | R | S | R | R | R | R | R | R | I | R |
| Chloramphenicol | S | S | S | S | S | S | S | S | S | S | R | R | R | R | R | R | S | R | S | S | S | R |
| Enrofloxacin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | R | R | S | S | R |
| Clindamycin | NT | NT | NT | NT | NT | NT | NT | NT | NT | R | NT | NT | R | R | R | NT | NT | NT | NT | NT | NT | R |
| Erythromycin | NT | R | R | NT | R | R | NT | R | NT | NT | R | NT | NT | R | NT | R | NT | R | R | NT | NT | NT |
| Gentamicin | S | S | S | S | S | S | S | S | R | R | R | R | R | S | R | R | R | R | R | S | S | R |
| Imipenem | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | S | NT | NT | S | NT | NT | S | NT | S | S | NT | S | S | S | S | NT | S | NT | NT | S | S | R |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | NT | R | R | NT | R | R | NT | R | NT | NT | R | NT | NT | R | NT | R | NT | R | R | NT | NT | NT |
| Penicillin | NT | R | R | NT | R | R | NT | R | NT | NT | R | NT | NT | R | NT | R | NT | R | R | NT | NT | NT |
| Rifampin | R | R | R | R | R | I | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Sulphadimethoxime | NT | S | R | NT | S | S | NT | S | NT | NT | R | NT | NT | NT | NT | R | NT | R | S | NT | NT | NT |
| Spectinomycin | NT | I | I | NT | I | I | NT | R | NT | NT | R | NT | NT | NT | NT | R | NT | R | R | NT | NT | NT |
| Tetracycline | S | S | S | S | S | S | R | S | R | S | R | R | R | R | R | R | S | R | S | R | R | R |
| Ticarcillin | S | S | S | S | S | S | S | S | R | R | R | R | R | S | R | R | R | R | R | I | R | R |
| Ticarcillin/CA | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | I | S | R | S | R | S | I |
| TMS | S | S | R | S | S | S | S | S | R | R | R | R | R | S | S | R | R | R | S | S | S | S |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| N | 65 | 13 | 11 | 10 | 8 | 8 | 7 | 5 | 5 | 5 | 4 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 2005 | 8 | 13 | 3 | 3 | 8 | 3 | 3 | 5 | 1 |  | 4 | 1 |  |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |
| 2006 | 34 |  | 4 | 3 |  | 5 | 1 |  | 2 | 4 |  | 2 | 3 |  | 1 | 1 | 1 | 1 |  |  |  | 2 |
| 2007 | 23 |  | 4 | 4 |  |  | 3 |  | 2 | 1 |  |  |  | 3 |  |  |  |  | 1 | 1 | 1 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| UN | 6 | 13 | 3 | 2 | 8 | 3 |  | 5 | 1 |  | 3 | 1 |  |  | 1 | 1 |  | 1 | 1 | 1 |  |  |
| RVC | 38 |  | 5 | 6 |  | 2 | 5 |  | 3 | 4 |  | 2 |  | 1 | 1 | 1 | 1 |  | 1 |  | 1 | 2 |
| BVMTH | 17 |  | 2 | 1 |  | 3 | 2 |  | 1 |  | 1 |  | 3 | 2 |  |  | 1 | 1 |  | 1 | 1 |  |
| VMR | 4 |  | 1 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Table A-10**
***Escherchia coli* Phenotypes**
***(First Isolates)***

| Antibiotic | PT 23 | PT 24 | PT 25 | PT 26 | PT 27 | PT 28 | PT 29 | PT 30 | PT 31 | PT 32 | PT 33 | PT 34 | PT 35 | PT 36 | PT 37 | PT 38 | PT 39 | PT 40 | PT 41 | PT 42 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Amoxicillin/CA | S | S | S | S | R | I | S | R | S | S | R | S | R | S | S | S | S | S | S | S |
| Ampicillin | R | S | R | R | R | R | R | R | R | S | R | R | R | R | R | S | R | R | S | R |
| Cefazolin | S | S | R | S | R | R | R | R | S | S | I | S | R | S | S | S | S | S | S | S |
| Cefoxitin | S | S | S | S | R | S | S | R | S | S | R | S | R | S | S | S | S | S | S | S |
| Cefpodoxime | S | S | R | S | R | R | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Ceftiofur | S | S | R | S | R | R | I | R | S | S | R | S | R | S | S | S | S | S | S | S |
| Cephalothin | S | I | R | S | R | R | R | R | S | S | R | S | R | I | S | I | S | I | S | R |
| Chloramphenicol | S | S | R | R | R | S | R | S | R | S | I | S | R | R | S | S | S | S | S | R |
| Enrofloxacin | S | S | R | R | R | R | S | I | I | S | I | S | S | R | S | S | S | S | S | S |
| Clindamycin | R | R | R | R | R | R | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Erythromycin | NT | NT | NT | NT | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Gentamicin | S | S | R | R | R | R | R | S | R | S | S | R | R | R | S | S | I | R | S | R |
| Imipenem | S | S | S | S | S | S | S | I | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | S | S | R | R | R | R | S | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | NT | NT | NT | NT | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Penicillin | NT | NT | NT | NT | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Rifampin | R | I | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Sulphadimethoxime | NT | NT | NT | NT | NT | NT | NT | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Spectinomycin | NT | NT | NT | NT | NT | NT | NT | I | I | R | R | R | R | R | I | I | R | R | R | R |
| Tetracycline | S | S | R | R | R | R | R | S | R | R | S | S | R | R | S | S | R | S | S | R |
| Ticarcillin | R | S | R | R | R | R | R | R | R | I | I | R | R | R | R | S | R | R | S | R |
| Ticarcillin/CA | S | S | S | S | I | R | S | R | S | S | R | S | R | S | S | S | S | S | S | I |
| TMS | R | S | R | R | R | R | R | NM | R | R | S | R | R | R | R | R | R | R | R | R |
| | | | | | | | | | | | | | | | | | | | | |
| N | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2006 | 2 | 2 | 2 | 1 | | | | | | | | | | | | | | | | |
| 2007 | | | | 1 | 2 | 2 | 2 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| UN | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| RVC | 1 | 2 | 2 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | |
| BVMTH | 1 | | | 1 | 1 | 1 | 1 | | | | | | | | | | | | | |
| VMR | | | | | | | | | | | | | | | | | | | | |

**Table A-10**
***Escherchia coli* Phenotypes**
***(First Isolates)***

| Antibiotic | PT 43 | PT 44 | PT 45 | PT 46 | PT 47 | PT 48 | PT 49 | PT 50 | PT 51 | PT 52 | PT 53 | PT 54 | PT 55 | PT 56 | PT 57 | PT 58 | PT 59 | PT 60 | PT 61 | PT 62 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Amoxicillin/CA | S | S | S | S | I | S | R | S | I | S | S | S | S | S | S | S | S | S | S | S |
| Ampicillin | R | S | R | S | R | S | R | R | R | S | R | R | R | R | R | R | R | R | S | R |
| Cefazolin | S | S | S | S | S | S | R | R | R | S | S | S | S | S | S | S | S | S | I | I |
| Cefoxitin | S | S | S | S | I | S | R | I | R | S | S | S | S | S | S | S | S | S | S | S |
| Cefpodoxime | NT | NT | NT | NT | NT | NT | NT | R | R | S | S | S | S | S | S | S | S | S | I | I |
| Ceftiofur | S | S | S | S | S | S | R | S | R | S | S | S | S | S | S | S | S | S | S | S |
| Cephalothin | I | S | I | I | R | S | R | R | R | S | I | S | I | I | I | I | S | I | S | R |
| Chloramphenicol | S | S | R | S | R | S | R | R | R | R | R | S | S | R | R | S | R | R | NM | S |
| Enrofloxacin | S | S | S | S | I | S | S | R | R | R | R | I | S | S | S | S | S | S | S | S |
| Clindamycin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | R | R | R | R | R | R | R | R |
| Erythromycin | R | R | R | R | R | R | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Gentamicin | R | S | R | S | R | S | R | R | R | R | R | R | S | R | R | R | S | S | R | R |
| Imipenem | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | NT | NT | NT | NT | NT | NT | NT | R | R | R | R | S | S | S | S | S | S | S | S | S |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | R | R | R | R | R | R | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Penicillin | R | R | R | R | R | R | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Rifampin | R | R | R | R | R | I | R | R | R | R | R | R | R | I | R | R | R | R | R | R |
| Sulphadimethoxime | R | S | R | R | R | R | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | R | I | R | R | R | S | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | R | I | R | R | R | R | R | R | R | R | R | S | S | R | S | S | R | R | S | R |
| Ticarcillin | R | S | R | S | R | S | I | R | R | S | R | R | R | R | R | R | R | R | S | R |
| Ticarcillin/CA | S | S | S | S | I | S | R | S | I | S | S | S | S | S | I | I | S | S | S | S |
| TMS | R | S | R | S | R | S | S | S | R | R | R | S | S | R | R | S | R | R | S | R |
| | | | | | | | | | | | | | | | | | | | | |
| N | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| 2006 | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2007 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| UN | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | |
| RVC | | | | | | | | | | 1 | | | | 1 | 1 | 1 | 1 | | 1 | |
| BVMTH | | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | | 1 |
| VMR | | | | | | | | | | | | | | | | | | | | |

## Table A-10
### *Escherchia coli* Phenotypes
***(First Isolates)***

| Antibiotic | PT 63 | PT 64 | PT 65 | PT 66 | PT 67 | PT 68 | PT 69 | PT 70 | PT 71 | PT 72 | PT 73 | PT 74 | PT 75 | PT 76 | PT 77 | PT 78 | PT 79 | PT 80 | PT 81 | PT 82 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | R | S | R | S | R | S | S | R | R | S | S | S | S | S | S | S | S |
| Amoxicillin/CA | R | S | R | R | S | R | R | R | S | S | R | R | S | S | S | S | S | S | I | I |
| Ampicillin | R | R | R | R | S | R | R | R | R | I | R | R | R | R | R | R | R | S | R | R |
| Cefazolin | R | S | R | R | S | R | R | R | S | S | R | R | S | S | S | S | S | S | R | S |
| Cefoxitin | R | S | R | R | S | R | R | R | S | S | R | R | I | S | S | S | S | S | S | I |
| Cefpodoxime | R | S | R | R | S | R | R | R | S | S | R | R | S | S | S | S | S | S | R | S |
| Ceftiofur | R | S | R | R | S | R | R | R | S | S | R | R | S | S | S | S | S | S | S | S |
| Cephalothin | R | S | R | R | R | R | R | R | I | S | R | R | I | S | I | S | I | S | R | I |
| Chloramphenicol | R | S | R | R | S | R | R | R | S | S | R | R | R | S | S | S | R | S | S | S |
| Enrofloxacin | R | S | R | R | S | S | S | R | S | S | S | R | R | S | S | R | S | S | S | S |
| Clindamycin | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Erythromycin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | R | R | R | R | R | R |
| Gentamicin | R | S | S | R | S | R | R | R | R | S | R | R | R | R | R | R | R | S | R | R |
| Imipenem | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | R | S | R | R | S | S | S | R | S | S | S | R | R | S | S | R | S | S | S | S |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | R | R | R | R | R | R |
| Penicillin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | R | R | R | R | R | R |
| Rifampin | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Sulphadimethoxime | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | I | S | R | R | S | R | R | R | R | S | R | R | S | S | R | R | R | I | R | S |
| Ticarcillin | R | R | R | R | S | R | R | R | R | R | R | I | R | R | R | R | R | I | R | R |
| Ticarcillin/CA | I | S | R | R | S | I | I | I | S | S | R | I | S | S | I | S | I | S | I | S |
| TMS | R | S | R | R | S | R | R | R | S | S | R | R | R | R | R | R | R | S | R | R |
| | | | | | | | | | | | | | | | | | | | | |
| N | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | | | | | | | | | | | | | | | | | | | | |
| 2006 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | |
| 2007 | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | | | | | | | |
| UN | | | | | | | | | | | | | | | | | | | | |
| RVC | 1 | | | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | | | 1 | 1 | 1 | | 1 | 1 |
| BVMTH | | 1 | 1 | | | | | | | | | | 1 | 1 | | | | | | |
| VMR | | | | | | | | | 1 | | | | | | | | | 1 | | |

**Table A-10**

***Escherchia coli* Phenotypes**

***(First Isolates)***

| Antibiotic | PT 83 | PT 84 | PT 85 | PT 86 | PT 87 | PT 88 | PT 89 | PT 90 | PT 91 | PT 92 | PT 93 | PT 94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | I | S | S | R | S | S | S | S | S |
| Amoxicillin/CA | R | S | S | R | S | S | R | R | R | S | S | S |
| Ampicillin | I | R | S | R | S | R | R | R | R | R | R | R |
| Cefazolin | R | R | S | R | S | S | R | R | R | S | S | S |
| Cefoxitin | R | R | S | R | S | S | R | R | S | S | S | I |
| Cefpodoxime | S | I | S | S | S | S | R | R | S | S | S | S |
| Ceftiofur | S | R | S | S | S | S | R | R | S | S | S | S |
| Cephalothin | R | R | S | R | S | S | R | R | R | I | S | S |
| Chloramphenicol | S | R | S | R | S | S | R | R | S | S | R | S |
| Enrofloxacin | S | S | I | S | S | S | S | S | S | S | S | I |
| Clindamycin | R | R | R | R | R | R | R | R | R | R | R | R |
| Erythromycin | R | R | R | R | R | R | R | R | R | R | R | R |
| Gentamicin | S | S | S | R | S | S | R | R | S | R | R | R |
| Imipenem | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | S | S | S | S | S | S | S | S | S | S | S | R |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | R | R | R | R | R | R | R | R | R | R | R | R |
| Penicillin | R | R | R | R | R | R | R | R | R | R | R | R |
| Rifampin | R | R | R | R | I | R | R | R | R | R | I | R |
| Sulphadimethoxime | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | S | S | S | R | S | R | R | R | S | R | R | R |
| Ticarcillin | S | S | S | R | S | R | R | S | S | R | R | R |
| Ticarcillin/CA | S | S | S | R | S | S | I | I | S | I | S | S |
| TMS | S | R | S | S | R | S | R | R | S | S | S | R |
| | | | | | | | | | | | | |
| N | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | | | | | | | | | | | | |
| 2006 | | | | | | | | | | | | |
| 2007 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | | | | |
| UN | | | | | | | | | | | | |
| RVC | | | 1 | 1 | | | | | | | | |
| BVMTH | 1 | 1 | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| VMR | | | | | | | | | | | | |

**Table A-11**

***Escherichia coli* Antibiogram by Year**

**Percent Susceptible**

**BVMTH and CVHSR Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 100% | 100% | 97% |
| Amoxicillin/CA | 100% | 94% | 78% |
| Ampicillin | 17% | 58% | 50% |
| Cefazolin | 83% | 81% | 72% |
| Cefoxitin | 100% | 90% | 78% |
| Cefpodoxime | 100% | 81% | 78% |
| Ceftiofur | 100% | 94% | 78% |
| Cephalothin | 33% | 65% | 63% |
| Chloramphenicol | 67% | 77% | 72% |
| Enrofloxacin | 67% | 90% | 88% |
| Clindamycin | -- | 0% | 0% |
| Erythromycin | -- | -- | 0% |
| Gentamicin | 33% | 74% | 66% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | 83% | 90% | 88% |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | -- | -- | 0% |
| Penicillin | -- | -- | 0% |
| Rifampin | 0% | 0% | 0% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 33% | 74% | 53% |
| Ticarcillin | 17% | 58% | 59% |
| Ticarcillin/CA | 100% | 94% | 81% |
| TMS | 50% | 65% | 59% |
| **N** | **6** | **31** | **32** |
| ***BVMTH*** | ***6*** | ***29*** | ***26*** |
| ***CVHSR*** | | ***2*** | ***6*** |

**Table A-12**
***Escherichia coli* Antibiogram by Year**
**Percent Susceptibility**
**RVC Specimens**
***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 100% | 92% | 97% |
| Amoxicillin/CA | 100% | 85% | 83% |
| Ampicillin | 100% | 52% | 69% |
| Cefazolin | 100% | 79% | 86% |
| Cefoxitin | 100% | 85% | 89% |
| Cefpodoxime | 100% | 77% | 86% |
| Ceftiofur | 100% | 81% | 91% |
| Cephalothin | 86% | 56% | 66% |
| Chloramphenicol | 86% | 69% | 86% |
| Enrofloxacin | 86% | 84% | 86% |
| Clindamycin | -- | 0% | 0% |
| Erythromycin | -- | 0% | 0% |
| Gentamicin | 86% | 55% | 71% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | 86% | 84% | 89% |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | -- | 0% | 0% |
| Penicillin | -- | 0% | 0% |
| Rifampin | 0% | 0% | 0% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 57% | 65% | 66% |
| Ticarcillin | 100% | 52% | 69% |
| Ticarcillin/CA | 100% | 79% | 83% |
| TMS | 86% | 55% | 71% |
| **N** | **7** | **62** | **35** |

**Table A-13**

***Streptococcus equi zooepidemicus* Phenotypes**

***(First Isolates)***

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | PT 6 | PT 7 | PT 8 | PT 9 | PT 10 | PT 11 | PT 12 | PT 13 | PT 14 | PT 15 | PT 16 | PT 17 | PT 18 | PT 19 | PT 20 | PT 21 | PT 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | I | S | S | S | I | I | I | S | I | I | I | I | I | S | I | I | S | S |
| Amoxicillin/CA | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Ampicillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Cefazolin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Cefoxitin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Cefpodoxime | S | S | S | I | S | NT | S | NT | NT | S | S | I | NT | NT | S | I | I | S | NT | NT | NT | NT |
| Ceftiofur | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Cephalothin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Chloramphenicol | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Enrofloxacin | S | S | I | S | S | I | I | S | I | I | I | S | I | I | I | S | S | S | R | I | S | S |
| Clindamycin | S | S | S | S | S | NT | NT | NT | NT | NT | S | S | NT | NT | S | S | S | S | NT | NT | NT | NT |
| Erythromycin | I | I | I | R | I | S | S | S | S | I | I | I | S | S | I | R | I | I | S | S | S | S |
| Gentamicin | S | S | S | S | S | S | S | S | S | S | S | S | A | S | S | S | S | S | S | S | S | S |
| Imipenem | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | S | S | S | S | S | NT | NT | NT | NT | S | S | S | NT | NT | S | S | S | S | NT | NT | NT | NT |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Penicillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Rifampin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Sulphadimethoxime | NT | NT | NT | NT | NT | R | R | R | R | NT | NT | NT | R | R | NT | NT | NT | NT | R | R | S | R |
| Spectinomycin | NT | NT | NT | NT | NT | R | I | I | R | NT | NT | NT | R | I | NT | NT | NT | NT | R | I | I | R |
| Tetracycline | S | R | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | I | S | R | S | S |
| Ticarcillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Ticarcillin/CA | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| TMS | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| | | | | | | | | | | | | | | | | | | | | | | |
| **N** | 32 | 11 | 10 | 8 | 6 | 7 | 6 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 |
| 2005 | 8 | | 2 | | | 7 | 6 | 4 | 4 | 4 | | | 3 | 3 | | | 1 | | 2 | 2 | 2 | 2 |
| 2006 | 17 | 7 | 2 | 6 | 5 | | | | | | 2 | 1 | | | 2 | 2 | 1 | 2 | | | | |
| 2007 | 7 | 4 | 6 | 2 | 1 | | | | | | 2 | 3 | | | 1 | 1 | 1 | 1 | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| UN | 4 | | | | | 7 | 6 | 4 | 4 | 3 | | | 3 | 3 | | | | | | | | |
| RVC | 20 | 6 | 6 | 3 | 4 | | | | | | 2 | 2 | | | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 2 |
| BVMTH | 7 | 4 | 4 | 4 | 2 | | | | | 1 | 1 | 2 | | | 1 | | | | | | | |
| VMR | 1 | 1 | | 1 | | | | | | | 1 | | | | | | | | | | 1 | |

**Table A-13**

***Streptococcus equi zooepidemicus* Phenotypes**

***(First Isolates)***

| Antibiotic | PT 23 | PT 24 | PT 25 | PT 26 | PT 27 | PT 28 | PT 29 | PT 30 | PT 31 | PT 32 | PT 33 | PT 34 | PT 35 | PT 36 | PT 37 | PT 38 | PT 39 | PT 40 | PT 41 | PT 42 | PT 43 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | R | R | S | S | S | I | I | S | R | R | R | I | I | S | I | I | I | S | I |
| Amoxicillin/CA | S | S | S | S | S | S | S | S | S | S | S | S | I | S | S | S | S | S | S | S | S |
| Ampicillin | S | S | S | S | S | S | S | S | S | S | S | R | R | S | S | S | S | S | S | S | I |
| Cefazolin | S | S | S | S | S | S | S | S | S | S | S | R | R | S | S | S | S | S | S | S | S |
| Cefoxitin | S | S | S | S | S | S | R | S | S | S | S | R | R | S | S | S | S | S | S | S | S |
| Cefpodoxime | S | I | S | S | I | I | NT | NT | NT | NT | NT | NT | NT | NT | S | NT | S | S | I | S | I |
| Ceftiofur | S | S | S | S | S | S | S | S | S | S | S | R | R | S | S | S | S | S | S | S | S |
| Cephalothin | S | S | S | S | S | S | S | S | S | S | S | R | R | S | S | S | S | S | S | S | S |
| Chloramphenicol | S | S | S | S | S | S | I | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Enrofloxacin | I | I | I | I | I | S | S | S | I | I | R | R | R | S | S | S | S | I | I | S | I |
| Clindamycin | NT | S | S | S | S | S | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Erythromycin | I | I | I | I | R | I | R | S | S | S | S | I | R | S | I | S | I | I | I | R | R |
| Gentamicin | S | S | I | I | S | S | S | S | S | S | I | R | S | I | I | S | S | S | I | S | S |
| Imipenem | S | S | S | S | S | S | R | S | S | S | S | R | R | S | S | S | S | S | S | S | S |
| Marbofloxacin | I | S | S | S | S | S | NT | NT | NT | NT | NT | NT | NT | NT | S | NT | S | I | S | S | I |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | S | S | S | S | S | S | S | S | S | S | S | S | NM | S | S | S | S | S | S | S | S |
| Penicillin | S | S | S | S | S | S | S | S | S | S | S | R | R | S | S | S | S | S | S | S | S |
| Rifampin | S | S | S | S | S | S | R | S | S | S | S | NM | I | S | S | S | S | S | S | S | S |
| Sulphadimethoxime | NT | NT | NT | NT | NT | NT | R | R | S | S | R | R | R | R | NT | R | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | NT | NT | NT | S | I | I | R | I | R | R | I | NT | S | NT | NT | NT | NT | NT |
| Tetracycline | S | S | S | R | S | R | R | I | S | S | S | S | S | S | S | R | S | R | S | R | R |
| Ticarcillin | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | S |
| Ticarcillin/CA | S | S | S | S | S | S | I | S | S | S | S | I | I | S | S | R | S | S | S | S | S |
| TMS | S | S | S | S | S | S | S | S | NM | S | S | S | S | S | S | S | S | S | S | S | S |
| | | | | | | | | | | | | | | | | | | | | | |
| **N** | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| 2005 | 2 | 1 | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| 2006 | | | 1 | 1 | 1 | | | | | | | | | | | | | | | | |
| 2007 | | 1 | | | 1 | 2 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| UN | 1 | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| RVC | | 1 | 1 | | 1 | 2 | | | | | | | | | | | | | | 2 | |
| BVMTH | 1 | 1 | | 1 | | | | | | | | | | | | | | | | | 1 |
| VMR | | | | | 1 | | | | | | | | | | | | | | 1 | | |

**Table A-13**

***Streptococcus equi zooepidemicus* Phenotypes**

***(First Isolates)***

| Antibiotic | PT 44 | PT 45 | PT 46 | PT 47 | PT 48 | PT 49 | PT 50 | PT 51 | PT 52 | PT 53 | PT 54 | PT 55 | PT 56 | PT 57 | PT 58 | PT 59 | PT 60 | PT 61 | PT 62 | PT 63 | PT 64 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | R | R | S | S | R | I | R | I | I | S | R | I | S | R | I | I | I | R |
| Amoxicillin/CA | S | S | S | S | S | R | S | R | S | S | R | S | S | S | S | S | S | S | S | S | S |
| Ampicillin | I | S | S | S | S | R | R | R | S | S | R | S | S | S | I | I | S | S | S | S | I |
| Cefazolin | S | S | S | S | S | R | S | R | S | S | R | S | S | S | S | S | S | S | S | S | S |
| Cefoxitin | S | S | S | S | S | R | S | R | S | S | R | S | S | S | S | S | S | S | S | S | S |
| Cefpodoxime | S | S | I | I | I | R | S | R | S | I | R | S | S | I | I | S | S | S | S | S | S |
| Ceftiofur | S | R | S | S | S | R | S | R | S | S | R | S | S | S | S | S | S | S | S | S | S |
| Cephalothin | S | S | S | S | S | R | R | I | S | S | R | S | S | S | S | S | S | S | S | S | S |
| Chloramphenicol | S | NM | I | S | S | R | S | R | I | I | I | S | S | S | I | S | S | S | I | S | S |
| Enrofloxacin | S | S | S | I | S | I | S | R | I | I | S | S | I | S | S | S | S | S | I | I | I |
| Clindamycin | S | R | S | S | S | R | R | R | R | I | R | S | S | S | R | S | S | S | S | R | S |
| Erythromycin | R | I | I | R | I | R | R | R | I | R | R | I | I | R | R | I | I | R | I | I | I |
| Gentamicin | S | S | S | I | I | S | S | R | S | I | I | I | S | I | I | S | I | S | S | S | I |
| Imipenem | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | S | S | S | I | S | S | S | R | S | S | S | S | S | S | S | S | S | S | I | S | S |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | NM | S | S | S | S | R | R | R | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Penicillin | R | S | S | S | S | R | R | R | S | S | R | S | S | S | S | I | S | S | S | S | S |
| Rifampin | NM | S | S | S | S | R | I | R | S | S | R | S | S | S | S | S | S | S | S | S | S |
| Sulphadimethoxime | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | S | R | S | S | S | R | S | R | R | R | R | S | R | S | R | S | S | S | R | R | R |
| Ticarcillin | S | S | S | S | S | R | S | R | S | S | R | S | S | S | S | I | S | S | S | S | S |
| Ticarcillin/CA | S | S | S | S | S | I | S | R | S | S | S | S | S | S | S | S | S | S | S | S | S |
| TMS | S | S | S | S | S | R | S | S | NM | S | S | S | S | S | S | S | S | S | S | S | S |
| | | | | | | | | | | | | | | | | | | | | | |
| **N** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | | | | | | | | | | | | | | | | | | | | | |
| 2006 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2007 | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| UN | | | | 1 | | | | | | | | | | | | | | | | | |
| RVC | 1 | | 1 | | 1 | 1 | | 1 | 1 | | 1 | | | | | 1 | 1 | 1 | 1 | | |
| BVMTH | | 1 | | | | | 1 | | | | | 1 | 1 | | 1 | | | | | | 1 |
| VMR | | | | | | | | | | 1 | | | | 1 | | | | | | 1 | |

**Table A-13**

***Streptococcus equi zooepidemicus* Phenotypes**

***(First Isolates)***

| Antibiotic | PT 65 | PT 66 | PT 67 | PT 68 | PT 69 | PT 70 | PT 71 | PT 72 | PT 73 | PT 74 | PT 75 | PT 76 | PT 77 | PT 78 | PT 79 | PT 80 | PT 81 | PT 82 | PT 83 | PT 84 | PT 85 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | I | I | I | I | I | R | S | I | S | I | I | S | I | I | S | I | S | I | I | S |
| Amoxicillin/CA | R | S | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S |
| Ampicillin | R | I | S | R | S | S | S | I | S | S | I | S | S | S | S | R | S | S | S | S | I |
| Cefazolin | S | S | S | R | S | S | S | R | S | S | S | S | S | S | S | R | S | S | S | S | S |
| Cefoxitin | R | S | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S |
| Cefpodoxime | R | S | S | R | I | I | S | S | S | S | S | S | S | S | I | R | I | S | S | S | S |
| Ceftiofur | S | S | S | R | S | S | R | S | S | S | S | S | R | S | S | R | S | S | S | R | S |
| Cephalothin | S | S | S | S | S | S | S | I | S | S | S | S | S | S | S | R | S | S | S | S | S |
| Chloramphenicol | S | S | S | I | S | S | I | S | S | S | S | S | I | S | S | I | S | S | I | I | S |
| Enrofloxacin | S | S | I | R | I | I | S | S | S | I | S | S | S | S | I | I | S | R | I | S | S |
| Clindamycin | R | S | S | R | S | S | R | NM | S | S | S | I | R | S | S | R | S | S | I | R | R |
| Erythromycin | R | I | I | R | R | R | R | R | I | I | R | I | R | I | R | R | R | I | I | I | R |
| Gentamicin | S | S | I | I | S | S | S | S | S | S | S | S | S | S | I | S | S | S | S | S | S |
| Imipenem | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | S | S | S | R | S | S | S | S | S | S | S | S | S | S | I | S | S | I | S | S | S |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | S | S | S | S | S | S | S | S | S | S | NM | S | S | S | S | S | S | S | S | S | R |
| Penicillin | S | S | S | S | S | S | S | R | S | S | I | S | S | S | S | R | S | S | S | S | R |
| Rifampin | NM | S | S | R | R | S | S | R | S | S | S | S | S | S | S | R | S | S | S | S | I |
| Sulphadimethoxime | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | S | S | I | R | S | S | R | I | I | I | S | R | R | R | S | I | R | S | R | R | S |
| Ticarcillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Ticarcillin/CA | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| TMS | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| | | | | | | | | | | | | | | | | | | | | | |
| **N** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | | | | | | | | | | | | | | | | | | | | | |
| 2006 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | |
| 2007 | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | | | | | | | | |
| UN | | | | | | | | | | | | | | | | | | | | | |
| RVC | | | 1 | 1 | 1 | | 1 | 1 | | 1 | 1 | 1 | | | | | 1 | | 1 | 1 | 1 |
| BVMTH | 1 | 1 | | | | 1 | | | 1 | | | | 1 | 1 | | 1 | | 1 | | | |
| VMR | | | | | | | | | | | | | | | 1 | | | | | | |

**Table A-13**

***Streptococcus equi zooepidemicus* Phenotypes**

***(First Isolates)***

| Antibiotic | PT 86 | PT 87 | PT 88 | PT 89 | PT 90 | PT 91 | PT 92 | PT 93 | PT 94 | PT 95 |
|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | R | S | R | S | S | I | S | S |
| Amoxicillin/CA | S | S | S | S | I | S | S | S | S | R |
| Ampicillin | S | S | S | S | S | S | I | I | I | R |
| Cefazolin | S | S | S | S | S | S | S | S | S | R |
| Cefoxitin | S | S | S | S | S | S | S | S | S | R |
| Cefpodoxime | S | I | S | S | S | S | S | S | S | I |
| Ceftiofur | S | S | S | S | S | S | S | R | R | R |
| Cephalothin | S | S | S | S | S | S | S | S | S | R |
| Chloramphenicol | I | S | S | S | S | S | S | S | S | S |
| Enrofloxacin | S | S | R | S | I | S | S | S | S | S |
| Clindamycin | S | S | S | S | S | I | NM | R | R | R |
| Erythromycin | I | R | I | I | I | I | R | R | R | R |
| Gentamicin | S | S | I | I | I | S | S | S | S | S |
| Imipenem | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | S | S | S | S | S | S | S | S | S | R |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | S | S | S | S | S | S | NM | R | R | R |
| Penicillin | S | S | S | S | S | S | S | R | R | R |
| Rifampin | S | S | S | S | S | S | NM | R | R | R |
| Sulphadimethoxime | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | S | R | R | S | S | S | R | R | S | S |
| Ticarcillin | S | S | S | S | S | S | S | S | S | S |
| Ticarcillin/CA | S | S | S | S | S | S | S | S | S | S |
| TMS | S | S | S | S | S | S | S | S | S | S |
| | | | | | | | | | | |
| **N** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | | | | | | | | | | |
| 2006 | | | | | | | | | | |
| 2007 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | | |
| UN | | | | | | | | | | |
| RVC | | | 1 | 1 | | 1 | 1 | 1 | 1 | |
| BVMTH | 1 | 1 | | | 1 | | | | | 1 |
| VMR | | | | | | | | | | |

**Table A-14**

***Streptococcus equi zooepidemicus*** **Antibiogram by Year**

**Percent Susceptible**

**BVMTH and CVHSR Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 50% | 50% | 84% |
| Amoxicillin/CA | 100% | 96% | 88% |
| Ampicillin | 83% | 82% | 92% |
| Cefazolin | 100% | 100% | 92% |
| Cefoxitin | 100% | 96% | 92% |
| Cefpodoxime | 60% | 71% | 60% |
| Ceftiofur | 100% | 96% | 88% |
| Cephalothin | 100% | 96% | 92% |
| Chloramphenicol | 100% | 93% | 88% |
| Enrofloxacin | 33% | 68% | 60% |
| Clindamycin | -- | 79% | 88% |
| Erythromycin | 17% | 0% | 0% |
| Gentamicin | 83% | 79% | 92% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | 60% | 100% | 88% |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | 100% | 96% | 96% |
| Penicillin | 100% | 96% | 92% |
| Rifampin | 100% | 96% | 92% |
| Sulphadimethoxime | 100% | -- | -- |
| Spectinomycin | 0% | -- | -- |
| Tetracycline | 83% | 61% | 72% |
| Ticarcillin | 100% | 100% | 100% |
| Ticarcillin/CA | 100% | 100% | 100% |
| TMS | 100% | 100% | 100% |
| **N** | **6** | **28** | **25** |
| ***BVMTH*** | ***5*** | ***22*** | ***22*** |
| ***CVHSR*** | ***1*** | ***6*** | ***3*** |

**Table A-15**

***Streptococcus equi zooepidemicus* Antibiogram by Year**

**Percent Susceptible**

**RVC Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 100% | 62% | 59% |
| Amoxicillin/CA | 100% | 94% | 100% |
| Ampicillin | 100% | 87% | 83% |
| Cefazolin | 100% | 90% | 100% |
| Cefoxitin | 100% | 94% | 100% |
| Cefpodoxime | 88% | 71% | 79% |
| Ceftiofur | 100% | 90% | 90% |
| Cephalothin | 100% | 92% | 100% |
| Chloramphenicol | 100% | 85% | 93% |
| Enrofloxacin | 63% | 75% | 76% |
| Clindamycin | -- | 88% | 75% |
| Erythromycin | 0% | 0% | 0% |
| Gentamicin | 100% | 87% | 93% |
| Imipenem | 100% | 98% | 100% |
| Marbofloxacin | 100% | 94% | 100% |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | 100% | 96% | 89% |
| Penicillin | 100% | 88% | 86% |
| Rifampin | 100% | 88% | 89% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 75% | 65% | 59% |
| Ticarcillin | 100% | 92% | 100% |
| Ticarcillin/CA | 100% | 96% | 100% |
| TMS | 100% | 98% | 100% |
| **N** | **8** | **52** | **29** |

**Table A-16**
**Summary of *Salmonella* Isolates**
***(First Isolates)***

| Organism | 2005 | % 2005 | 2006 | % 2006 | 2007 | % 2007 | Total | % Total |
|---|---|---|---|---|---|---|---|---|
| ***Salmonella group - B*** | | | | | | | | |
| Community | 1 | 2% | 7 | 11% | 3 | 6% | 11 | **6%** |
| Ranch | | | | | 1 | 2% | 1 | **1%** |
| Unknown | 16 | 27% | 1 | 2% | | | 17 | **10%** |
| VTH | 1 | 2% | 9 | 15% | 3 | 6% | 13 | **7%** |
| ***Salmonella group - B Total*** | ***18*** | ***30%*** | ***17*** | ***27%*** | ***7*** | ***13%*** | ***42*** | ***24%*** |
| | | | | | | | | |
| ***Salmonella species group C1*** | | | | | | | | |
| Community | | | 1 | 2% | 2 | 4% | 3 | **2%** |
| Unknown | 8 | 13% | | | | | 8 | **5%** |
| VTH | 1 | 2% | 4 | 6% | 6 | 11% | 11 | **6%** |
| ***Salmonella species group C1 Total*** | ***9*** | ***15%*** | ***5*** | ***8%*** | ***8*** | ***15%*** | ***22*** | ***13%*** |
| | | | | | | | | |
| ***Salmonella sp. group C2*** | | | | | | | | |
| Community | | | 1 | 2% | | | 1 | **1%** |
| Unknown | 23 | 38% | | | | | 23 | **13%** |
| VTH | | | 4 | 6% | 2 | 4% | 6 | **3%** |
| ***Salmonella sp. group C2 Total*** | ***23*** | ***38%*** | ***5*** | ***8%*** | ***2*** | ***4%*** | ***30*** | ***17%*** |
| | | | | | | | | |
| ***Salmonella group D*** | | | | | | | | |
| Community | | | 1 | 2% | | | 1 | **1%** |
| ***Salmonella group D Total*** | | | ***1*** | ***2%*** | | | ***1*** | ***1%*** |
| | | | | | | | | |
| ***Salmonella group - E*** | | | | | | | | |
| Unknown | 4 | 7% | | | | | 4 | **2%** |
| VTH | 1 | 2% | 2 | 3% | | | 3 | **2%** |
| ***Salmonella group - E Total*** | ***5*** | ***8%*** | ***2*** | ***3%*** | | | ***7*** | ***4%*** |
| | | | | | | | | |
| ***Salmonella choleraesuis ss arizonae*** | | | | | | | | |
| Community | | | | | 1 | 2% | 1 | **1%** |
| ***Salmonella choleraesuis ss arizonae Total*** | | | | | ***1*** | ***2%*** | ***1*** | ***1%*** |
| | | | | | | | | |
| ***Salmonella subgenus 1*** | | | | | | | | |
| VTH | | | | | 1 | 2% | 1 | **1%** |
| ***Salmonella subgenus 1 Total*** | | | | | ***1*** | ***2%*** | ***1*** | ***1%*** |
| | | | | | | | | |
| ***Salmonella species*** | | | | | | | | |
| Community | 1 | 2% | 13 | 21% | 11 | 21% | 25 | **14%** |
| Ranch | | | | | 1 | 2% | 1 | **1%** |
| Unknown | 4 | 7% | | | | | 4 | **2%** |
| VTH | | | 19 | 31% | 22 | 42% | 41 | **23%** |
| ***Salmonella species Total*** | ***5*** | ***8%*** | ***32*** | ***52%*** | ***34*** | ***64%*** | ***71*** | ***41%*** |
| | | | | | | | | |
| ***Subtotal*** | | | | | | | | |
| Community | ***2*** | 3% | ***23*** | 37% | ***17*** | 32% | 42 | **24%** |
| Ranch | | | | | ***2*** | 4% | 2 | **1%** |
| Unknown | ***55*** | 92% | ***1*** | 2% | | | 56 | **32%** |
| VTH | ***3*** | 5% | ***38*** | 61% | ***34*** | 64% | ***75*** | **43%** |
| **Total** | **60** | **100%** | **62** | **100%** | **53** | **100%** | **175** | **100%** |

**Table A-17**

***Salmonella* Group B Phenotypes**

***(First Isolates)***

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | PT 6 | PT 7 | PT 8 | PT 9 | PT 10 | PT 11 | PT 12 | PT 13 | PT 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S | S | S | I | S | S | S | S | S | S |
| Amoxicillin/CA | S | R | R | R | R | R | S | S | R | R | R | I | S | S |
| Ampicillin | S | R | R | R | R | R | R | R | R | R | R | R | S | R |
| Cefazolin | S | R | R | R | R | R | R | R | R | R | R | R | S | S |
| Cefoxitin | S | R | R | R | R | R | S | S | R | R | R | S | S | S |
| Cefpodoxime | S | NT | R | NT | NT | NT | R | R | R | R | R | S | S | S |
| Ceftiofur | S | R | R | R | R | R | I | R | R | R | R | S | S | S |
| Cephalothin | S | R | R | R | R | R | R | R | R | R | R | R | S | S |
| Chloramphenicol | S | R | R | R | R | R | R | R | R | S | S | R | R | S |
| Enrofloxacin | S | S | S | R | S | S | S | S | S | S | S | S | S | S |
| Clindamycin | R | NT | R | NT | NT | NT | R | R | R | R | R | R | R | R |
| Erythromycin | R | R | NT | R | R | R | NT | NT | NT | NT | R | R | R | R |
| Gentamicin | S | R | S | S | S | R | R | R | S | R | R | R | R | S |
| Imipenem | S | S | S | I | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | S | NT | S | NT | NT | NT | S | S | S | S | S | S | S | S |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | R | R | NT | R | R | R | NT | NT | NT | NT | R | R | R | R |
| Penicillin | R | R | NT | R | R | R | NT | NT | NT | NT | R | R | R | R |
| Rifampin | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Sulphadimethoxime | S | R | NT | R | R | R | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | R | R | NT | R | R | R | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | S | R | R | R | R | R | R | R | R | R | R | R | S | S |
| Ticarcillin | S | R | I | R | I | R | R | R | R | R | I | R | S | R |
| Ticarcillin/CA | S | R | I | R | R | R | S | I | I | I | I | R | S | S |
| TMS | S | R | S | R | R | S | R | R | R | S | S | R | S | S |
| | | | | | | | | | | | | | | |
| **N** | 23 | 5 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | 10 | 5 | | 1 | 1 | 1 | | | | | | | | |
| 2006 | 10 | | 3 | | | | 1 | 1 | 1 | 1 | | | | |
| 2007 | 2 | | | | | | | | | | 1 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | |
| UN | 9 | 5 | | 1 | 1 | 1 | | | | | | | | |
| RVC | 8 | | 1 | | | | | | 1 | | | | 1 | |
| BVMTH | 6 | | 2 | | | | 1 | 1 | | 1 | 1 | | | 1 |
| VMR | | | | | | | | | | | | 1 | | |

**Table A-18**

***Salmonella* Group C1 Phenotypes**

***(First Isolates)***

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | PT 6 | PT 7 |
|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S | S | S |
| Amoxicillin/CA | S | R | R | S | R | R | S |
| Ampicillin | S | R | R | S | R | R | S |
| Cefazolin | S | R | R | S | R | R | S |
| Cefoxitin | S | R | R | S | R | R | S |
| Cefpodoxime | S | R | R | NT | R | R | S |
| Ceftiofur | S | R | R | S | R | R | S |
| Cephalothin | S | R | R | S | R | R | S |
| Chloramphenicol | S | R | R | S | R | R | S |
| Enrofloxacin | S | R | S | I | S | S | S |
| Clindamycin | R | NT | R | NT | NT | R | R |
| Erythromycin | R | R | NT | R | NT | NT | R |
| Gentamicin | S | S | S | S | S | R | S |
| Imipenem | S | S | S | S | S | S | S |
| Marbofloxacin | S | S | S | NT | S | S | S |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | R | R | NT | R | NT | NT | R |
| Penicillin | R | R | NT | R | NT | NT | R |
| Rifampin | R | R | R | R | R | R | R |
| Sulphadimethoxime | S | R | NT | S | NT | NT | NT |
| Spectinomycin | S | R | NT | R | NT | NT | NT |
| Tetracycline | S | R | R | S | R | R | R |
| Ticarcillin | S | I | R | S | R | R | S |
| Ticarcillin/CA | S | I | R | S | I | R | S |
| TMS | S | S | S | S | S | R | S |
| | | | | | | | |
| **N** | 14 | 2 | 2 | 1 | 1 | 1 | 1 |
| 2005 | 4 | 2 | 1 | 1 | 1 | | |
| 2006 | 3 | | 1 | | | 1 | |
| 2007 | 7 | | | | | | 1 |
| | | | | | | | |
| UN | 4 | 2 | 1 | 1 | | | |
| RVC | 2 | | | | | | 1 |
| BVMTH | 8 | | 1 | | 1 | 1 | |
| VMR | | | | | | | |

# Table A-19

## *Salmonella* Group C2 Phenotypes

*(First Isolates)*

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | PT 6 | PT 7 | PT 8 | PT 9 | PT 10 | PT 11 | PT 12 | PT 13 | PT 14 | PT 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Amoxicillin/CA | S | R | R | R | R | R | R | R | R | R | R | R | S | S | S |
| Ampicillin | S | R | R | R | R | R | R | R | R | R | R | I | R | S | S |
| Cefazolin | S | R | R | R | R | R | R | R | R | R | R | R | R | S | S |
| Cefoxitin | S | R | R | R | R | R | R | R | R | R | R | R | S | S | S |
| Cefpodoxime | S | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | R | S | I | S |
| Ceftiofur | S | R | R | R | R | R | R | R | R | R | R | R | S | S | S |
| Cephalothin | S | R | R | R | R | R | R | R | R | R | R | R | R | S | S |
| Chloramphenicol | S | R | R | R | R | R | R | R | R | R | R | R | S | S | S |
| Enrofloxacin | S | S | S | S | I | I | I | R | S | S | S | S | S | S | S |
| Clindamycin | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | R |
| Erythromycin | R | R | R | R | R | R | R | R | R | R | R | NT | NT | NT | NT |
| Gentamicin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Imipenem | S | S | S | S | S | S | I | I | I | S | S | S | S | S | S |
| Marbofloxacin | S | S | NT | NT | NT | NT | NT | NT | NT | NT | NT | S | S | S | S |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | R | R | R | R | R | R | R | R | R | R | R | NT | NT | NT | NT |
| Penicillin | R | R | R | R | R | R | R | R | R | R | R | NT | NT | NT | NT |
| Rifampin | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Sulphadimethoxime | S | R | R | R | R | R | R | R | R | R | R | NT | NT | NT | NT |
| Spectinomycin | S | R | R | R | R | R | R | R | R | I | I | NT | NT | NT | NT |
| Tetracycline | S | R | R | R | R | R | R | R | R | R | R | R | S | S | R |
| Ticarcillin | S | R | R | I | R | I | R | R | R | I | R | I | R | S | S |
| Ticarcillin/CA | S | R | I | R | R | R | R | R | R | R | R | I | S | S | S |
| TMS | S | S | S | S | R | S | R | R | R | S | S | S | S | S | S |
| | | | | | | | | | | | | | | | |
| **N** | 9 | 6 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | 3 | 6 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| 2006 | 4 | | | | | | | | | | | | | | 1 |
| 2007 | 2 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| UN | 3 | 6 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| RVC | 1 | | | | | | | | | | | | | | |
| BVMTH | 5 | | | | | | | | | | | | | | 1 |
| VMR | | | | | | | | | | | | | | | |

**Table A-20**
***Salmonella* species Phenotypes**
***(First Isolates)***

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | PT 6 | PT 7 | PT 8 | PT 9 | PT 10 | PT 11 | PT 12 | PT 13 | PT 14 | PT 15 | PT 16 | PT 17 | PT 18 | PT 19 | PT 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Amoxicillin/CA | S | R | S | R | R | R | R | S | R | S | R | I | R | R | S | S | S | R | R | R |
| Ampicillin | S | R | S | R | R | R | R | S | R | R | R | R | R | I | R | R | R | R | R | R |
| Cefazolin | S | R | S | R | R | R | R | S | R | R | R | R | R | R | R | R | R | R | R | R |
| Cefoxitin | S | R | S | R | R | R | R | S | R | S | R | S | R | I | S | S | S | R | S | R |
| Cefpodoxime | S | R | S | R | R | R | R | S | R | S | R | S | R | S | R | R | S | R | R | R |
| Ceftiofur | S | R | S | R | R | R | R | S | R | S | R | S | R | S | R | R | S | R | R | R |
| Cephalothin | S | R | S | R | R | R | R | S | R | R | R | R | R | R | R | R | R | R | R | S |
| Chloramphenicol | S | R | S | R | R | R | R | NM | R | S | R | R | R | S | R | R | S | R | NM | S |
| Enrofloxacin | S | I | S | S | S | I | S | S | S | I | S | S | S | R | S | S | S | S | I | S |
| Clindamycin | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Erythromycin | R | R | R | NT | NT | NT | NT | NT | NT | NT | NT | R | R | R | R | R | R | R | R | R |
| Gentamicin | S | S | S | S | R | S | R | S | R | S | R | R | S | R | R | R | S | S | S | S |
| Imipenem | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | R | R | R | NT | NT | NT | NT | NT | NT | NT | NT | R | R | R | R | R | R | R | R | R |
| Penicillin | R | R | R | NT | NT | NT | NT | NT | NT | NT | NT | R | R | R | R | R | R | R | R | R |
| Rifampin | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Sulphadimethoxime | S | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | S | R | R | R | R | R | R | S | R | S | R | R | R | R | S | R | S | R | S | R |
| Ticarcillin | S | R | S | I | I | R | R | S | R | R | R | R | I | S | R | R | R | R | I | S |
| Ticarcillin/CA | S | R | S | I | I | R | I | I | R | S | R | I | I | S | I | I | S | I | I | S |
| TMS | S | R | S | R | S | S | R | S | R | S | S | R | S | S | R | R | S | S | NM | S |
| | | | | | | | | | | | | | | | | | | | | |
| **N** | 45 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | 5 | | | | | | | | | | | | | | | | | | | |
| 2006 | 17 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | |
| 2007 | 23 | 1 | 1 | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | | | | | | | |
| UN | 4 | | | | | | | | | | | | | | | | | | | |
| RVC | 14 | 4 | 1 | 1 | | 1 | | 1 | | | 1 | | 1 | | | | 1 | | | |
| BVMTH | 27 | | 2 | 1 | 2 | | 1 | | 1 | 1 | | | | 1 | 1 | 1 | | 1 | 1 | 1 |
| VMR | | | | | | | | | | | | 1 | | | | | | | | |

**Table A-21**

***Salmonella* Antibiogram by Year**

**Percent Susceptible**

**BVMTH and CVHSR Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 100% | 97% | 100% |
| Amoxicillin/CA | 67% | 74% | 81% |
| Ampicillin | 67% | 66% | 72% |
| Cefazolin | 67% | 66% | 75% |
| Cefoxitin | 67% | 74% | 89% |
| Cefpodoxime | 67% | 68% | 83% |
| Ceftiofur | 67% | 68% | 83% |
| Cephalothin | 67% | 66% | 78% |
| Chloramphenicol | 50% | 71% | 86% |
| Enrofloxacin | 100% | 97% | 94% |
| Clindamycin | -- | 0% | 0% |
| Erythromycin | -- | -- | 0% |
| Gentamicin | 100% | 79% | 83% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | 100% | 100% | 97% |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | -- | -- | 0% |
| Penicillin | -- | -- | 0% |
| Rifampin | 0% | 0% | 0% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 67% | 58% | 81% |
| Ticarcillin | 67% | 66% | 78% |
| Ticarcillin/CA | 67% | 71% | 81% |
| TMS | 100% | 84% | 89% |
| **N** | **3** | **38** | **36** |
| ***BVMTH*** | ***3*** | ***38*** | ***34*** |
| ***CVHSR*** | | | ***2*** |

**Table A-22**
***Salmonella* Antibiogram by Year**
**Percent Susceptible**
**Regional Veterinary Community Specimens**
**(First Isolates)**

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 100% | 100% | 100% |
| Amoxicillin/CA | 100% | 61% | 88% |
| Ampicillin | 100% | 61% | 76% |
| Cefazolin | 100% | 61% | 76% |
| Cefoxitin | 100% | 61% | 88% |
| Cefpodoxime | 100% | 61% | 88% |
| Ceftiofur | 100% | 61% | 88% |
| Cephalothin | 100% | 61% | 76% |
| Chloramphenicol | 100% | 59% | 82% |
| Enrofloxacin | 100% | 83% | 94% |
| Clindamycin | -- | 0% | 0% |
| Erythromycin | -- | 0% | 0% |
| Gentamicin | 100% | 96% | 88% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | 100% | 100% | 100% |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | -- | 0% | 0% |
| Penicillin | -- | 0% | 0% |
| Rifampin | 0% | 0% | 0% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 100% | 61% | 76% |
| Ticarcillin | 100% | 61% | 76% |
| Ticarcillin/CA | 100% | 57% | -- |
| TMS | 100% | 78% | 94% |
| **N** | **2** | **23** | **17** |

**Table A-23**

***Staphylococcus aureus* Phenotypes**

***(First Isolates)***

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | PT 6 | PT 7 | PT 8 | PT 9 | PT 10 | PT 11 | PT 12 | PT 13 | PT 14 | PT 15 | PT16 | PT17 | PT18 | PT19 | PT20 | PT21 | PT22 | PT23 | PT24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | R | S | S | R | S | S | S | S | S | R | R | S | R | S | S | S | R | R | S | S | S | S | S | S |
| Amoxicillin/CA | R | S | S | R | S | S | S | S | S | R | R | S | S | R | S | S | S | R | S | R | S | S | S | S |
| Ampicillin | R | NI | NI | R | NI | R | NI | S | NI | R | R | R | NI | R | NI | NI | R | R | R | R | NI | R | NI | R |
| Cefazolin | R | S | S | R | S | S | S | S | S | R | R | S | S | R | S | S | S | R | S | R | S | S | S | S |
| Cefoxitin | R | S | S | R | S | S | S | S | S | R | R | S | S | R | S | S | I | R | S | R | S | S | S | S |
| Cefpodoxime | NT | S | S |  | S | S | I | NT |  | R | R | R | S | R | S | S | R | R | S | R | S | S | S | S |
| Ceftiofur | R | S | S | R | S | S | S | S | S | R | R | I | S | R | S | S | I | R | S | R | S | S | S | S |
| Cephalothin | R | S | S | R | S | S | S | S | S | R | R | S | S | R | S | S | S | R | S | R | S | S | S | S |
| Chloramphenicol | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | R | S | S | S | R | S |
| Enrofloxacin | S | S | S | S | S | S | S | S | S | S | S | S | S | R | R | S | S | S | S | S | I | S | S | S |
| Clindamycin | NT | S | NT | NT | R | NT | R | NT | NT | NT | NT | NT | S | R | S | S | R | R | R | NM | R | R | S | S |
| Erythromycin | R | S | S | R | R | S | R | S | S | S | S | R | S | R | S | S | R | R | R | I | R | R | S | S |
| Gentamicin | R | S | S | R | S | S | S | S | S | R | R | S | R | R | S | S | R | R | I | R | S | S | S | S |
| Imipenem | R | S | S | R | S | R | S | R | S | R | R | R | S | R | S | S | R | R | R | R | S | R | S | R |
| Marbofloxacin | NT | S | S |  | S | S | S | NT | NT | S | S | S | S | R | R | S | S | S | S | S | S | S | S | S |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | R | S | S | R | S | S | S | S | S | R | R | S | S | R | S | S | S | R | S | R | S | S | S | S |
| Penicillin | R | NI | NI | R | NI | R | NI | R | NI | R | R | R | NI | R | NI | NI | R | R | R | R | NI | R | NI | R |
| Rifampin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S |
| Sulphadimethoxime | R | NT | NT | R | NT | NT | NT | R | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | R | NT | NT | R | NT | NT | NT | R | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | S | S | S | S | S | S | S | S | S | R | R | S | S | S | R | R | S | R | S | S | S | S | S | S |
| Ticarcillin | R | NI | NI | R | NI | S | NI | S | NI | R | R | S | NI | R | NI | NI | I | R | S | R | NI | S | NI | S |
| Ticarcillin/CA | R | S | S | R | S | S | S | S | S | R | R | S | S | R | S | S | S | R | S | R | S | S | S | S |
| TMS | R | S | S | S | S | S | S | S | S | R | S | S | S | S | NM | S | R | R | S | S | S | S | S | S |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **N** | **11** | **11** | **5** | **4** | **4** | **3** | **2** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** |
| ***2005*** | ***2*** |  | ***5*** | ***1*** |  | ***3*** |  | ***1*** | ***1*** | ***1*** | ***1*** | ***1*** |  |  |  |  |  |  |  |  |  |  |  |  |
| ***2006*** | ***2*** | ***6*** |  | ***2*** |  |  | ***1*** |  |  |  |  |  | ***1*** | ***1*** | ***1*** | ***1*** | ***1*** | ***1*** |  |  |  |  |  |  |
| ***2007*** | ***7*** | ***5*** |  | ***1*** | ***4*** |  | ***1*** |  |  |  |  |  |  |  |  |  |  |  | ***1*** | ***1*** | ***1*** | ***1*** | ***1*** | ***1*** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ***UN*** | ***2*** |  | ***2*** | ***1*** |  | ***1*** |  | ***1*** | ***1*** | ***1*** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ***RVC*** |  | ***7*** | ***3*** | ***1*** | ***3*** | ***2*** |  |  |  |  | ***1*** | ***1*** | ***1*** |  | ***1*** |  |  |  | ***1*** | ***1*** |  | ***1*** | ***1*** |  |
| ***BVMTH*** | ***9*** | ***4*** |  | ***2*** | ***1*** |  | ***2*** |  |  |  |  |  |  | ***1*** |  | ***1*** | ***1*** | ***1*** |  |  | ***1*** |  |  | ***1*** |
| ***VMR*** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Table A-24**
***Staphylococcus aureus* Antibiogram by Year**
**Percent Susceptible**
**BVMTH Specimens**
***(First Isolates)***

| Antibiotic | 2006 | 2007 |
|---|---|---|
| Amikacin | 55% | 38% |
| Amoxicillin/CA | 55% | 38% |
| Ampicillin | 0% | 0% |
| Cefazolin | 55% | 38% |
| Cefoxitin | 45% | 38% |
| Cefpodoxime | 36% | 31% |
| Ceftiofur | 45% | 38% |
| Cephalothin | 55% | 38% |
| Chloramphenicol | 100% | 100% |
| Enrofloxacin | 91% | 92% |
| Clindamycin | 36% | 15% |
| Erythromycin | 36% | 15% |
| Gentamicin | 45% | 38% |
| Imipenem | 45% | 31% |
| Marbofloxacin | 91% | 100% |
| Orbifloxacin | -- | -- |
| Oxacillin | 55% | 38% |
| Penicillin | 0% | 0% |
| Rifampin | 91% | 100% |
| Sulphadimethoxime | -- | -- |
| Spectinomycin | -- | -- |
| Tetracycline | 82% | 100% |
| Ticarcillin | 0% | 11% |
| Ticarcillin/CA | 55% | 38% |
| TMS | 64% | 46% |
| **N** | **11** | **13** |
| ***BVMTH*** | ***11*** | ***13*** |
| ***CVHSR*** | | |

**Table A-25**

***Staphylococcus aureus* Antibiogram by year**

**Percent Susceptible**

**RVC Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 86% | 67% | 100% |
| Amoxicillin/CA | 86% | 83% | 91% |
| Ampicillin | 0% | 0% | 0% |
| Cefazolin | 86% | 83% | 91% |
| Cefoxitin | 86% | 83% | 91% |
| Cefpodoxime | 71% | 83% | 91% |
| Ceftiofur | 71% | 83% | 91% |
| Cephalothin | 86% | 83% | 91% |
| Chloramphenicol | 100% | 83% | 82% |
| Enrofloxacin | 100% | 83% | 100% |
| Clindamycin | -- | 83% | 50% |
| Erythromycin | 86% | 83% | 45% |
| Gentamicin | 86% | 67% | 82% |
| Imipenem | 43% | 83% | 73% |
| Marbofloxacin | 100% | 83% | 100% |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | 86% | 83% | 91% |
| Penicillin | 0% | 0% | 0% |
| Rifampin | 100% | 100% | 100% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 86% | 83% | 100% |
| Ticarcillin | 75% | 0% | 67% |
| Ticarcillin/CA | 86% | 83% | 91% |
| TMS | 100% | 100% | 100% |
| **N** | **7** | **6** | **11** |

**Table A-26**

***Pseudomonas aeruginosa* Phenotypes**

***(First Isolates)***

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | PT 6 | PT 7 | PT 8 | PT 9 | PT 10 | PT 11 | PT 12 | PT 13 | PT 14 | PT 15 | PT16 | PT17 | PT18 | PT19 | PT20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | I | S | S |
| Amoxicillin/CA | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Ampicillin | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Cefazolin | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Cefoxitin | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Cefpodoxime | R | R | NT | NT | NT | R | NT | R | NT | NT | NT | NT | R | R | R | R | R | R | R | R |
| Ceftiofur | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Cephalothin | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Chloramphenicol | I | I | R | R | R | S | I | R | R | R | R | S | R | R | R | S | S | R | I | I |
| Enrofloxacin | S | S | S | S | I | S | S | I | I | R | S | S | I | S | S | S | S | I | I | I |
| Clindamycin | NT | NT | NT | NT | NT | R | NT | NT | NT | NT | NT | NT | R | R | R | R | R | R | R | R |
| Erythromycin | NT | NT | R | R | R | NT | R | | R | R | R | R | NT | NT | NT | NT | R | R | R | R |
| Gentamicin | S | S | S | S | S | R | R | S | S | S | R | S | S | S | R | S | S | I | S | I |
| Imipenem | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | NI | NI | NT | NT | NT | NI | NT | NI | NT | NT | NT | NT | NI | NI | NI | NI | NI | NI | NI | NI |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | NT | NT | R | R | R | NT | R | NT | R | R | R | R | NT | NT | NT | NT | S | R | R | R |
| Penicillin | NT | NT | R | R | R | NT | R | NT | R | R | R | R | NT | NT | NT | NT | R | R | R | R |
| Rifampin | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Sulphadimethoxime | NT | NT | R | R | R | NT | R | NT | R | R | R | R | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | R | R | R | NT | R | NT | R | R | R | R | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Ticarcillin | S | S | S | S | S | S | S | R | S | R | S | S | R | R | R | R | R | R | S | R |
| Ticarcillin/CA | S | S | S | S | S | S | S | R | S | R | S | S | R | R | S | R | R | R | S | R |
| TMS | R | S | R | S | S | R | R | S | R | R | R | S | R | S | R | S | S | R | S | R |
| | | | | | | | | | | | | | | | | | | | | |
| N | 11 | 10 | 5 | 5 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | 2 | 2 | 2 | 1 | 3 | | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| 2006 | 5 | 4 | | 2 | | 1 | 1 | | | | | | 1 | 1 | 1 | 1 | | | | |
| 2007 | 4 | 4 | 3 | 2 | | 2 | | 1 | | | | | | | | | 1 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | | | | | | | |
| UN | 1 | 2 | 1 | 1 | 3 | | 1 | | 1 | 1 | 1 | 1 | | | | | | | | |
| RVC | 7 | 5 | 3 | 3 | | 3 | | 2 | | | | | 1 | | 1 | 1 | 1 | | | 1 |
| BVMTH | 3 | 2 | 1 | 1 | | | 1 | | | | | | | 1 | | | | 1 | 1 | |
| VMR | | 1 | | | | | | | | | | | | | | | | | | |

**Table A-27**
***Pseudomonas aeruginosa* Antibiogram by Year**
**Percent Susceptible**
**BVMTH and CVHSR Isolates**
***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 100% | 100% | 83% |
| Amoxicillin/CA | 0% | 0% | 0% |
| Ampicillin | 0% | 0% | 0% |
| Cefazolin | 0% | 0% | 0% |
| Cefoxitin | 0% | 0% | 0% |
| Cefpodoxime | 0% | 0% | 0% |
| Ceftiofur | 0% | 0% | 0% |
| Cephalothin | 0% | 0% | 0% |
| Chloramphenicol | 0% | 0% | 0% |
| Enrofloxacin | 100% | 100% | 67% |
| Clindamycin | -- | 0% | 0% |
| Erythromycin | -- | -- | 0% |
| Gentamicin | 100% | 80% | 83% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | -- | -- | -- |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | -- | -- | 0% |
| Penicillin | -- | -- | 0% |
| Rifampin | 0% | 0% | 0% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 0% | 0% | 0% |
| Ticarcillin | 100% | 80% | 83% |
| Ticarcillin/CA | 100% | 80% | 83% |
| TMS | 100% | 60% | 33% |
| **N** | **1** | **5** | **6** |
| ***BVMTH*** | | ***5*** | ***6*** |
| ***CVHSR*** | ***1*** | | |

**Table A-28**
***Pseudomonas aeruginosa* Antibiogram by Year**
**Percent Susceptible**
**RVC Isolates**
***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 100% | 100% | 100% |
| Amoxicillin/CA | 0% | 0% | 0% |
| Ampicillin | 0% | 0% | 0% |
| Cefazolin | 0% | 0% | 0% |
| Cefoxitin | 0% | 0% | 0% |
| Cefpodoxime | 0% | 0% | 0% |
| Ceftiofur | 0% | 0% | 0% |
| Cephalothin | 0% | 0% | 0% |
| Chloramphenicol | 0% | 17% | 23% |
| Enrofloxacin | 67% | 92% | 85% |
| Clindamycin | -- | 0% | 0% |
| Erythromycin | -- | -- | 0% |
| Gentamicin | 100% | 83% | 77% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | -- | -- | -- |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | -- | -- | 8% |
| Penicillin | -- | -- | 0% |
| Rifampin | 0% | 0% | 0% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 0% | 0% | 0% |
| Ticarcillin | 67% | 75% | 77% |
| Ticarcillin/CA | 67% | 83% | 77% |
| TMS | 33% | 42% | 46% |
| **N** | **3** | **12** | **13** |

**Table 29**

***Klebsiella pneumoniae* Phenotypes**

***(First Isolate)***

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | PT 6 | PT 7 | PT 8 | PT 9 | PT 10 | PT 11 | PT 12 | PT 13 | PT 14 | PT 15 | PT16 | PT17 | PT18 | PT19 | PT20 | PT21 | PT22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | I | S | S |
| Amoxicillin/CA | S | S | S | S | S | I | S | S | S | R | S | R | S | R | R | S | S | R | I | I | S | S |
| Ampicillin | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Cefazolin | S | S | S | R | S | S | S | S | S | I | S | R | S | S | R | R | S | S | S | S | R | S |
| Cefoxitin | S | S | S | S | S | S | S | S | S | S | S | R | S | R | R | S | S | S | S | S | S | S |
| Cefpodoxime | S | NT | S | S | S | NT | NT | S | S | S | S | R | S | S | R | R | S | S | S | S | R | S |
| Ceftiofur | S | S | S | S | S | S | S | S | S | S | S | R | S | S | I | R | S | S | S | S | R | S |
| Cephalothin | S | S | S | S | S | I | S | S | S | R | R | R | S | R | R | R | S | R | R | R | R | S |
| Chloramphenicol | S | S | S | S | S | S | R | R | R | R | R | R | S | S | R | S | S | R | S | S | R | R |
| Enrofloxacin | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | I | R | S | S | S | R | S |
| Clindamycin | R | NT | R | R | R | NT | NT | NT | NT | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Erythromycin | R | R | NT | NT | NT | R | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | R | R | R | R | R |
| Gentamicin | S | S | S | S | S | R | S | R | R | R | R | R | S | S | R | R | I | R | R | R | R | S |
| Imipenem | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | S | NT | S | S | S | NT | NT | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | R | R | NT | NT | NT | R | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | R | R | R | R | R |
| Penicillin | R | R | NT | NT | NT | R | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | R | R | R | R | R |
| Rifampin | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Sulphadimethoxime | NT | S | NT | NT | NT | R | S | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | I | NT | NT | NT | R | I | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | S | S | S | S | S | R | S | S | R | S | R | R | S | S | R | S | R | R | S | S | R | R |
| Ticarcillin | R | R | R | R | R | R | R | R | R | R | R | R | S | R | R | R | R | R | R | R | R | R |
| Ticarcillin/CA | S | S | S | S | S | I | S | S | S | R | S | R | S | S | I | S | S | R | R | R | S | S |
| TMS | S | S | R | R | R | R | S | S | R | S | R | R | S | S | R | S | R | R | NM | R | R | R |
| | | | | | | | | | | | | | | | | | | | | | | |
| N | 25 | 4 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | 2 | 4 | | | | 1 | 1 | 1 | 1 | | | | | | | | | | | | | |
| 2006 | 8 | | 1 | 1 | 1 | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | |
| 2007 | 15 | | 1 | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | | | | | | | | | |
| UN | 2 | 4 | | | | 1 | 1 | | | | | | | | | | | | | | | |
| RVC | 12 | | | | 1 | | | 1 | 1 | 1 | 1 | | 1 | 1 | | | 1 | | 1 | 1 | | |
| BVMTH | 9 | | 1 | 1 | | | | | | | | 1 | | | 1 | 1 | | 1 | | | 1 | 1 |
| VMR | 2 | | 1 | | | | | | | | | | | | | | | | | | | |

**Table 30**
***Klebsiella pneumoniae* Antibiogram by Year**
**Percent Susceptible**
**BVMYH and CVHSR Specimens**
***(First Isolates)***

| Antibiotic | 2006 | 2007 |
|---|---|---|
| Amikacin | 92% | 100% |
| Amoxicillin/CA | 75% | 100% |
| Ampicillin | 0% | 0% |
| Cefazolin | 67% | 88% |
| Cefoxitin | 83% | 100% |
| Cefpodoxime | 67% | 88% |
| Ceftiofur | 75% | 88% |
| Cephalothin | 58% | 88% |
| Chloramphenicol | 67% | 75% |
| Enrofloxacin | 92% | 88% |
| Clindamycin | 0% | 0% |
| Erythromycin | 0% | 0% |
| Gentamicin | 58% | 88% |
| Imipenem | 100% | 100% |
| Marbofloxacin | 100% | 100% |
| Orbifloxacin | -- | -- |
| Oxacillin | 0% | 0% |
| Penicillin | 0% | 0% |
| Rifampin | 0% | 0% |
| Sulphadimethoxime | -- | -- |
| Spectinomycin | -- | -- |
| Tetracycline | 67% | 75% |
| Ticarcillin | 0% | 0% |
| Ticarcillin/CA | 75% | 100% |
| TMS | 58% | 63% |
| **N** | **12** | **8** |
| *BVMTH* | *12* | *5* |
| *CVHSR* | | *3* |

**Table 31**
***Klebsiella pneumoniae* Antibiogram by Year**
**Percent Susceptible**
**RVC Specimens**
***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 100% | 100% | 92% |
| Amoxicillin/CA | 100% | 71% | 83% |
| Ampicillin | 0% | 0% | 0% |
| Cefazolin | 100% | 71% | 100% |
| Cefoxitin | 100% | 86% | 100% |
| Cefpodoxime | 100% | 86% | 100% |
| Ceftiofur | 100% | 100% | 100% |
| Cephalothin | 100% | 43% | 83% |
| Chloramphenicol | 33% | 57% | 100% |
| Enrofloxacin | 67% | 86% | 100% |
| Clindamycin | -- | 0% | 0% |
| Erythromycin | -- | -- | 0% |
| Gentamicin | 33% | 43% | 83% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | 100% | 100% | 100% |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | -- | -- | 0% |
| Penicillin | -- | -- | 0% |
| Rifampin | 0% | 0% | 0% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 67% | 57% | 100% |
| Ticarcillin | 0% | 14% | 0% |
| Ticarcillin/CA | 100% | 86% | 83% |
| TMS | 67% | 57% | 91% |
| **N** | **3** | **7** | **12** |

**Table A-32**

***Streptococcus beta* Phenotypes**

***(First Isolates)***

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | PT 6 | PT 7 | PT 8 | PT 9 | PT 10 | PT 11 | PT 12 | PT 13 | PT 14 | PT 15 | PT16 | PT17 | PT18 | PT19 | PT20 | PT21 | PT22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | I | I | R | I | S | S | S | I | S | R | I | I | S | S | R | S | S | I | I | I |
| Amoxicillin/CA | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Ampicillin | S | S | S | S | S | S | S | S | I | S | S | I | S | S | I | S | S | S | S | S | S | S |
| Cefazolin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Cefoxitin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Cefpodoxime | S | NT | NT | I | S | I | I | I | NT | NT | NT | NT | NT | NT | NT | S | I | S |  | I | S | S |
| Ceftiofur | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Cephalothin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Chloramphenicol | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | I | S | I | S | I |
| Enrofloxacin | S | S | I | S | S | S | I | S | R | I | S | I | I | R | I | S | S | S | I | I | S | S |
| Clindamycin | S | NT | NT | NT | NT | NT | S | S | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | S | I |
| Erythromycin | I | S | S | R | I | I | R | R | I | S | S | I | S | S | S | I | R | R | S | R | I | I |
| Gentamicin | S | S | S | S | R | S | S | S | S | S | S | I | S | S | S | S | R | S | S | I | S | S |
| Imipenem | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | S | NT | NT | S | S | S | S | S | NT | NT | NT | NT | NT | NT | NT | S | S | S | NT | S | S | S |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Penicillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Rifampin | S | S | S | S | S | S | S | S | NM | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Sulphadimethoxime | NT | S | R | NT | NT | NT | NT | NT | R | R | R | R | R | R | R | NT | NT | NT | R | NT | NT | NT |
| Spectinomycin | NT | S | R | NT | NT | NT | NT | NT | I | S | S | I | S | R | R | NT | NT | NT | I | NT | NT | NT |
| Tetracycline | S | S | S | S | R | S | S | S | R | R | R | S | S | R | S | R | R | R | S | R | S | R |
| Ticarcillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Ticarcillin/CA | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| TMS | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| N | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 |  | 2 | 2 | 1 | 1 | 1 |  |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |  |
| 2006 | 3 |  |  | 1 | 1 |  | 1 | 1 |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 1 |
| 2007 | 2 |  |  |  |  | 1 | 1 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| UN |  | 2 | 2 |  |  |  | 1 |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |  |  |
| RVC | 4 |  |  | 1 | 2 | 2 | 1 | 1 |  |  |  |  |  |  |  |  |  |  |  | 1 |  | 1 |
| BVMTH | 1 |  |  | 1 |  |  |  | 1 |  |  |  |  |  |  |  |  |  |  |  |  | 1 |  |
| VMR |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## Table A-32
### *Streptococcus beta* Phenotypes
*(First Isolates)*

| Antibiotic | PT23 | PT24 | PT25 | PT26 | PT27 | PT28 | PT29 | PT30 | PT31 | PT32 | PT33 | PT34 | PT35 | PT36 | PT37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | I | S | S | S | S | S | S | S | R | S | I | S | I | S | I |
| Amoxicillin/CA | S | S | S | S | S | I | S | S | I | S | S | S | I | S | S |
| Ampicillin | R | S | S | I | I | R | R | S | I | S | S | S | R | S | I |
| Cefazolin | S | S | S | S | I | R | S | S | S | S | S | S | R | S | S |
| Cefoxitin | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S |
| Cefpodoxime | S | S | S | S | I | R | I | I | I | I | S | S | R | S | S |
| Ceftiofur | R | S | S | S | R | R | R | S | S | S | S | S | R | S | S |
| Cephalothin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Chloramphenicol | I | S | S | S | I | I | I | I | S | S | S | S | R | S | S |
| Enrofloxacin | S | S | S | S | S | R | I | S | S | I | I | S | R | I | I |
| Clindamycin | R | S | NM | S | R | R | R | R | R | S | S | S | R | S | S |
| Erythromycin | R | I | I | R | R | R | I | R | R | I | I | R | R | I | I |
| Gentamicin | S | S | S | S | S | I | S | S | R | S | S | S | I | S | S |
| Imipenem | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | S | S | S | S | S | R | S | S | S | S | S | S | R | S | I |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Penicillin | S | S | S | I | S | S | S | S | S | S | S | S | S | S | S |
| Rifampin | S | S | S | S | S | R | S | S | S | S | S | S | S | S | S |
| Sulphadimethoxime | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | R | R | R | S | R | R | R | R | R | S | S | R | R | S | R |
| Ticarcillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Ticarcillin/CA | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| TMS | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| | | | | | | | | | | | | | | | |
| N | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | | | | | | | | | | | | | | | |
| 2006 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | |
| 2007 | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | | |
| UN | | | | | | | | | | | | | | | |
| RVC | 1 | 1 | 1 | 1 | | | | | | 1 | | 1 | 1 | 1 | 1 |
| BVMTH | | | | | 1 | 1 | 1 | 1 | | | 1 | | | | |
| VMR | | | | | | | | | 1 | | | | | | |

**Table A-33**
***Streptococcus beta* Antibiogram by Year**
**Percent Susceptible**
**BVMTH and CVHSR Specimens**
***(First Isolates)***

| Antibiotic | 2006 | 2007 |
|---|---|---|
| Amikacin | 71% | 33% |
| Amoxicillin/CA | 86% | 67% |
| Ampicillin | 57% | 67% |
| Cefazolin | 71% | 100% |
| Cefoxitin | 100% | 100% |
| Cefpodoxime | 14% | 67% |
| Ceftiofur | 57% | 100% |
| Cephalothin | 100% | 100% |
| Chloramphenicol | 43% | 100% |
| Enrofloxacin | 71% | 67% |
| Clindamycin | 43% | 67% |
| Erythromycin | 0% | 0% |
| Gentamicin | 86% | 67% |
| Imipenem | 100% | 100% |
| Marbofloxacin | 86% | 100% |
| Orbifloxacin | -- | -- |
| Oxacillin | 100% | 100% |
| Penicillin | 100% | 100% |
| Rifampin | 86% | 100% |
| Sulphadimethoxime | -- | -- |
| Spectinomycin | -- | -- |
| Tetracycline | 43% | 67% |
| Ticarcillin | 100% | 100% |
| Ticarcillin/CA | 100% | 100% |
| TMS | 100% | 100% |
| **N** | **7** | **3** |
| ***BVMTH*** | ***7*** | ***2*** |
| ***CVHSR*** | | ***1*** |

**Table A-34**

***Streptococcus beta A* ntibiogram by Year**

**Percent Susceptible**

**RVC Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 0% | 67% | 67% |
| Amoxicillin/CA | 100% | 100% | 89% |
| Ampicillin | 100% | 78% | 78% |
| Cefazolin | 100% | 100% | 89% |
| Cefoxitin | 100% | 100% | 89% |
| Cefpodoxime | 25% | 100% | 44% |
| Ceftiofur | 100% | 89% | 89% |
| Cephalothin | 100% | 100% | 100% |
| Chloramphenicol | 75% | 78% | 89% |
| Enrofloxacin | 75% | 100% | 44% |
| Clindamycin | -- | 75% | 89% |
| Erythromycin | 0% | 0% | 0% |
| Gentamicin | 50% | 89% | 89% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | 100% | 100% | 78% |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | 100% | 100% | 100% |
| Penicillin | 100% | 89% | 100% |
| Rifampin | 100% | 100% | 100% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 50% | 44% | 67% |
| Ticarcillin | 100% | 100% | 100% |
| Ticarcillin/CA | 100% | 100% | 100% |
| TMS | 100% | 100% | 100% |
| **N** | **4** | **9** | **9** |

**Table A-35**

***Streptococcus equi equi* Phenotypes**

***(First Isolates)***

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | PT 6 | PT 7 | PT 8 | PT 9 | PT 10 | PT 11 | PT 12 | PT 13 | PT 14 | PT 15 | PT 16 | PT 17 | PT 18 | PT 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | R | I | S | R | S | I | R | R | R | I | R | I | R | R | S | R | S | R | R |
| Amoxicillin/CA | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | S | I | I |
| Ampicillin | R | S | S | I | S | I | I | S | R | S | S | S | R | R | S | I | I | R | R |
| Cefazolin | S | S | S | S | S | S | R | S | R | S | S | S | R | R | S | S | S | R | R |
| Cefoxitin | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | S | R | R |
| Cefpodoxime | I | NT | NT | NT | NT | NT | NT | S | R | NT | NT | S | R | S | I | I | I | R | R |
| Ceftiofur | R | S | S | S | S | S | R | S | R | S | S | S | R | S | S | I | S | R | R |
| Cephalothin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | R |
| Chloramphenicol | I | S | S | S | S | S | S | I | R | S | S | S | I | I | S | I | S | I | R |
| Enrofloxacin | R | R | I | R | R | R | R | I | R | I | I | I | R | R | I | R | S | R | R |
| Clindamycin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | R | R |
| Erythromycin | R | S | S | I | S | R | R | I | R | R | I | I | R | I | I | R | R | R | R |
| Gentamicin | I | S | S | S | S | S | S | I | R | S | S | S | I | I | S | I | R | R | I |
| Imipenem | S | S | S | S | S | I | I | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | I | NT | NT | NT | NT | NT | NT | S | R | NT | NT | I | I | I | I | R | S | R | R |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | R |
| Penicillin | S | S | S | S | S | S | R | S | I | S | S | S | S | S | S | S | R | S | R |
| Rifampin | S | S | S | S | S | S | R | S | R | NM | S | S | S | R | S | S | R | R | R |
| Sulphadimethoxime | NT | R | R | R | S | R | R | NT | NT | R | R | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | I | S | I | I | I | I | NT | NT | S | I | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | R | S | S | S | S | S | S | R | R | R | S | S | R | R | S | R | R | R | R |
| Ticarcillin | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | S | S | R |
| Ticarcillin/CA | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | S | S | R |
| TMS | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | R |
| | | | | | | | | | | | | | | | | | | | |
| N | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| 2006 | | | | | | | | | | | | | | | | | | 1 | 1 |
| 2007 | 1 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| UN | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | | | | | | |
| RVC | 1 | | | | | | | | | | | 1 | | 1 | 1 | | 1 | 1 | 1 |
| BVMTH | | | | | | | | | | | | | | | | 1 | | | |
| VMR | | | | | | | | | | | | | | | | | | | |

**Table A-35**

***Streptococcus equi equi* Phenotypes**

***(First Isolates)***

| Antibiotic | PT 20 | PT21 | PT22 | PT23 | PT24 | PT25 | PT26 | PT27 | PT28 | PT29 | PT30 | PT31 | PT32 | PT33 | PT34 | PT35 | PT36 | PT37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | I | R | R | R | R | I | I | R | R | S | I | R | R | I | R | S | I | I |
| Amoxicillin/CA | S | S | S | S | S | S | S | S | I | S | S | S | S | S | R | S | S | S |
| Ampicillin | I | R | I | S | S | S | S | S | R | S | S | S | R | S | R | S | S | R |
| Cefazolin | S | S | S | S | S | S | S | S | R | S | S | S | R | S | R | S | S | S |
| Cefoxitin | S | S | S | S | S | S | S | S | R | S | S | S | R | S | R | S | S | S |
| Cefpodoxime | I | I | I | I | I | S | S | S | R | I | S | I | R | S | R | NM | S | S |
| Ceftiofur | R | R | S | R | S | S | S | S | R | S | S | S | R | S | R | I | S | I |
| Cephalothin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Chloramphenicol | I | I | I | I | I | S | I | I | R | S | S | I | I | S | R | S | I | I |
| Enrofloxacin | R | R | I | I | I | I | I | I | R | S | I | R | R | S | R | S | I | R |
| Clindamycin | R | R | R | R | S | S | NM | R | R | S | S | NM | R | S | R | S | R | R |
| Erythromycin | R | R | R | I | I | I | I | R | R | R | I | R | R | I | R | NM | I | R |
| Gentamicin | I | I | I | I | I | S | I | I | R | S | S | I | R | S | R | S | S | I |
| Imipenem | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | I | R | I | I | I | S | I | I | R | S | I | R | R | S | R | S | I | I |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | S | S | S | S | S | S | S | S | S | S | NM | S | S | S | R | S | S | S |
| Penicillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | R | I | S | S |
| Rifampin | S | S | S | S | S | S | S | S | R | S | S | S | R | S | R | S | S | S |
| Sulphadimethoxime | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | R | R | R | R | R | S | R | R | R | R | I | R | R | S | R | S | R | R |
| Ticarcillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S |
| Ticarcillin/CA | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| TMS | S | S | S | S | S | S | S | S | NM | S | S | S | S | S | S | S | S | S |
| | | | | | | | | | | | | | | | | | | |
| N | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | | | | | | | | | | | | | | | | | | |
| 2006 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | |
| 2007 | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | | | | | |
| UN | | | | | | | | | | | | | | | | | | |
| RVC | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | | 1 | | | | | 1 | |
| BVMTH | | | | | | | 1 | | | | 1 | | 1 | 1 | 1 | 1 | | 1 |
| VMR | | | | | | | | | | | | | | | | | | |

**Table A-36**
***Streptococcus equi equi* Antibiogram by Year**
**Percent Susceptible**
**BVMTH Specimens**
***(First Isolates)***

| Antibiotic | 2005-2007 |
|---|---|
| Amikacin | 13% |
| Amoxicillin/CA | 88% |
| Ampicillin | 50% |
| Cefazolin | 75% |
| Cefoxitin | 75% |
| Cefpodoxime | 57% |
| Ceftiofur | 38% |
| Cephalothin | 100% |
| Chloramphenicol | 38% |
| Enrofloxacin | 25% |
| Clindamycin | 50% |
| Erythromycin | 0% |
| Gentamicin | 38% |
| Imipenem | 100% |
| Marbofloxacin | 25% |
| Orbifloxacin | -- |
| Oxacillin | 86% |
| Penicillin | 75% |
| Rifampin | 75% |
| Sulphadimethoxime | -- |
| Spectinomycin | -- |
| Tetracycline | 25% |
| Ticarcillin | 88% |
| Ticarcillin/CA | 100% |
| TMS | 100% |
| **N** | **8** |
| ***BVMTH*** | ***8*** |
| ***CVHSR*** | |

**Table A-37**

***Streptococcus equi equi* Antibiogram by Year**

**Percent Susceptible**

**RVC Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 50% | 0% | 20% |
| Amoxicillin/CA | 100% | 75% | 80% |
| Ampicillin | 50% | 38% | 80% |
| Cefazolin | 75% | 75% | 80% |
| Cefoxitin | 100% | 75% | 80% |
| Cefpodoxime | 50% | 13% | 40% |
| Ceftiofur | 100% | 38% | 80% |
| Cephalothin | 100% | 88% | 100% |
| Chloramphenicol | 75% | 13% | 20% |
| Enrofloxacin | 25% | 0% | 20% |
| Clindamycin | -- | 25% | 25% |
| Erythromycin | 0% | 0% | 0% |
| Gentamicin | 50% | 13% | 40% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | 25% | 13% | 20% |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | 75% | 88% | 100% |
| Penicillin | 75% | 88% | 100% |
| Rifampin | 50% | 75% | 80% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 50% | 13% | 0% |
| Ticarcillin | 100% | 88% | 100% |
| Ticarcillin/CA | 100% | 88% | 100% |
| TMS | 75% | 88% | 100% |
| **N** | **4** | **8** | **5** |

**Table A-38**

***Streptococcus dysgalactiae equisimilis* Phenotypes**

***(First Isolates)***

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | PT 6 | PT 7 | PT 8 | PT 9 | PT 10 | PT 11 | PT 12 | PT 13 | PT 14 | PT 15 | PT16 | PT17 | PT18 | PT19 | PT20 | PT21 | PT22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | I | R | I | S | I | I | S | S | S | R | I | S | R | I | R | I | R | I | R | S |
| Amoxicillin/CA | S | S | S | S | S | S | S | S | S | S | S | S | S | S | I | S | I | S | R | S | S | S |
| Ampicillin | S | S | S | S | S | S | S | I | S | S | S | R | R | S | R | R | R | R | R | I | R | R |
| Cefazolin | S | S | S | S | S | S | S | S | S | S | S | R | S | S | R | R | R | R | R | S | R | R |
| Cefoxitin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | R | S | R | S | R | S |
| Cefpodoxime | S | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | R | S | S | R | I | R | I | R | I | R | R |
| Ceftiofur | S | S | S | S | S | S | S | S | S | S | S | R | R | S | R | R | R | R | R | R | R | R |
| Cephalothin | S | S | S | S | S | S | S | S | S | S | S | I | S | S | S | S | S | S | S | S | S | S |
| Chloramphenicol | S | S | S | S | S | S | S | S | S | S | S | I | I | I | I | I | R | I | I | I | I | I |
| Enrofloxacin | S | S | I | S | S | S | I | R | S | S | S | R | S | I | R | R | R | R | R | I | R | I |
| Clindamycin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | R | R | R | R | R | R | R | R | R |
| Erythromycin | I | S | S | R | R | S | S | I | S | S | S | R | R | R | R | R | R | I | R | R | R | R |
| Gentamicin | S | S | S | R | R | S | S | S | S | S | S | I | S | S | R | I | R | S | I | S | I | S |
| Imipenem | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | S | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | R | I | S | R | I | R | R | R | S | R | R |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Penicillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | I | S | S | S | S | S |
| Rifampin | S | S | S | R | S | S | S | S | S | S | S | R | S | S | R | S | R | S | R | S | R | I |
| Sulphadimethoxime | NT | S | R | R | S | S | R | R | R | R | S | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | S | I | S | S | S | S | I | S | S | S | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | S | S | S | S | S | R | R | S | R | S | R | R | R | R | R | R | R | R | R | R | R | R |
| Ticarcillin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | I | S | R | S | S | S |
| Ticarcillin/CA | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| TMS | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| | | | | | | | | | | | | | | | | | | | | | | |
| N | 10 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | |
| 2005 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | |
| 2006 | 3 | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2007 | 5 | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| UN | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | |
| RVC | 7 | | | | | | | | | | | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| BVMTH | 2 | | | | | | | | | | | | | | | | | | | | | |
| VMR | | | | | | | | | | | | | | | | 1 | | | | | | |

**Table A-38**

***Streptococcus dysgalactiae equisimilis* Phenotypes**

***(First Isolates)***

| Antibiotic | PT23 | PT24 | PT25 | PT26 | PT27 |
|---|---|---|---|---|---|
| Amikacin | I | R | I | S | S |
| Amoxicillin/CA | S | R | S | S | S |
| Ampicillin | I | R | S | S | S |
| Cefazolin | S | R | S | S | S |
| Cefoxitin | S | R | S | S | S |
| Cefpodoxime | I | R | S | S | S |
| Ceftiofur | I | R | S | S | S |
| Cephalothin | S | R | S | S | S |
| Chloramphenicol | I | R | S | S | S |
| Enrofloxacin | S | R | S | S | S |
| Clindamycin | R | R | S | S | S |
| Erythromycin | R | R | I | R | I |
| Gentamicin | S | R | S | S | S |
| Imipenem | S | S | S | S | S |
| Marbofloxacin | S | R | S | S | S |
| Orbifloxacin | NI | NI | NI | NI | NI |
| Oxacillin | S | R | S | S | S |
| Penicillin | S | R | S | S | S |
| Rifampin | S | R | S | S | S |
| Sulphadimethoxime | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | NT | NT |
| Tetracycline | R | R | S | S | R |
| Ticarcillin | S | R | S | S | S |
| Ticarcillin/CA | S | R | S | S | S |
| TMS | S | R | S | S | S |
| | | | | | |
| N | | | | | |
| 2005 | | | | | |
| 2006 | 1 | 1 | | | |
| 2007 | | | 1 | 1 | 1 |
| | | | | | |
| UN | | | | | |
| RVC | | | | | |
| BVMTH | 1 | 1 | 1 | | 1 |
| VMR | | | | 1 | |

**Table A-39**

***Streptococcus dysgalactiase equisimilis* Antibiogram by Year**

**BVMTH Specimens**

**(First Isolates)**

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | | 25% | 75% |
| Amoxicillin/CA | | 75% | 100% |
| Ampicillin | | 25% | 100% |
| Cefazolin | | 50% | 100% |
| Cefoxitin | | 75% | 100% |
| Cefpodoxime | | 25% | 100% |
| Ceftiofur | | 25% | 100% |
| Cephalothin | | 75% | 100% |
| Chloramphenicol | | 25% | 100% |
| Enrofloxacin | | 50% | 100% |
| Clindamycin | | 25% | 100% |
| Erythromycin | | 0% | 0% |
| Gentamicin | | 50% | 100% |
| Imipenem | | 100% | 100% |
| Marbofloxacin | | 50% | 100% |
| Orbifloxacin | | -- | -- |
| Oxacillin | | 75% | 100% |
| Penicillin | | 75% | 100% |
| Rifampin | | 75% | 100% |
| Sulphadimethoxime | | -- | -- |
| Spectinomycin | | -- | -- |
| Tetracycline | | 25% | 75% |
| Ticarcillin | | 75% | 100% |
| Ticarcillin/CA | | 75% | 100% |
| TMS | | 75% | 100% |
| **N** | | **4** | **4** |
| ***BVMTH*** | | ***3*** | ***3*** |
| ***CVHSR*** | | ***1*** | ***1*** |

**Table A-40**

***Streptococcus dysgalactiae equisimilis*** **Antibiogram by Year**

**RVC Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 33% | 40% | 100% |
| Amoxicillin/CA | 100% | 70% | 100% |
| Ampicillin | 33% | 30% | 100% |
| Cefazolin | 67% | 40% | 100% |
| Cefoxitin | 100% | 60% | 100% |
| Cefpodoxime | 67% | 30% | 100% |
| Ceftiofur | 33% | 30% | 100% |
| Cephalothin | 67% | 100% | 100% |
| Chloramphenicol | 33% | 20% | 100% |
| Enrofloxacin | 67% | 20% | 100% |
| Clindamycin | -- | 20% | 100% |
| Erythromycin | 0% | 0% | 0% |
| Gentamicin | 67% | 60% | 100% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | 33% | 40% | 100% |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | 100% | 100% | 100% |
| Penicillin | 100% | 90% | 100% |
| Rifampin | 67% | 50% | 100% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 33% | 20% | 100% |
| Ticarcillin | 100% | 80% | 100% |
| Ticarcillin/CA | 100% | 100% | 100% |
| TMS | 100% | 100% | 100% |
| **N** | **3** | **10** | **4** |

**Table A-41**

***Staphylococcus xylosus* Phenotypes**

***(First Isolates)***

| Antibiotic | PT1 | PT2 | PT3 | PT4 | PT5 | PT6 | PT7 | PT8 | PT9 | PT10 | PT11 | PT12 | PT13 | PT14 | PT15 | PT16 | PT17 | PT18 | PT19 | PT20 | PT21 | PT22 | PT23 | PT24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | S | S | S | S | S | I | NT |
| Amoxicillin/CA | S | R | S | R | R | S | S | S | S | R | S | S | R | R | S | S | R | S | S | S | R | R | S | NT |
| Ampicillin | S | R | S | R | R | S | S | S | S | R | S | S | R | R | S | R | R | S | S | S | R | R | S | NT |
| Cefazolin | S | R | S | R | R | S | S | S | S | R | S | S | R | R | S | S | R | S | S | S | S | R | S | NT |
| Cefoxitin | S | S | S | R | R | S | S | S | S | R | S | S | S | R | S | S | R | S | S | S | S | S | S | NT |
| Cefpodoxime | S | R | S | NT | NT | NT | NT | NT | S | R | I | S | R | R | S | R | R | S | S | S | R | R | S | NT |
| Ceftiofur | S | R | S | R | R | S | S | S | S | R | S | S | R | R | S | S | R | S | S | S | S | R | S | NT |
| Cephalothin | S | S | S | R | R | S | S | S | S | R | S | S | S | R | S | S | S | S | S | S | S | S | S | NT |
| Chloramphenicol | S | I | R | S | I | S | S | S | R | R | S | R | I | I | S | R | R | S | S | S | I | R | S | NT |
| Enrofloxacin | S | S | S | I | S | S | S | S | S | R | S | S | R | S | S | S | R | S | S | S | S | R | I | NT |
| Clindamycin | R | NT | S | NT | NT | NT | NT | NT | NT | R | R | R | R | R | I | R | R | R | R | S | R | R | S | NT |
| Erythromycin | R | R | S | R | R | S | R | R | R | R | R | R | R | R | R | I | R | I | R | S | I | R | S | NT |
| Gentamicin | S | S | S | R | R | S | S | S | S | R | S | S | S | R | S | S | S | S | S | S | S | S | S | NT |
| Imipenem | S | R | S | R | R | S | S | S | S | R | S | S | R | R | S | R | R | S | S | S | R | R | S | NT |
| Marbofloxacin | S | S | S | NT | NT | NT | NT | NT | S | R | S | S | R | S | S | S | R | S | S | S | R | R | I | NT |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NT |
| Oxacillin | S | S | S | R | R | S | S | S | S | R | S | S | S | R | S | S | S | S | S | S | S | S | S | NT |
| Penicillin | S | R | S | R | R | S | R | S | S | R | S | S | R | R | S | R | R | S | S | S | R | R | S | NT |
| Rifampin | S | S | S | S | S | S | S | S | S | R | S | S | S | R | S | S | S | S | S | S | S | S | S | NT |
| Sulphadimethoxime | NT | NT | NT | S | R | S | R | S | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | R | R | R | R | I | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | S | R | S | R | S | R | S | S | S | R | S | S | R | R | R | R | R | S | R | S | R | R | S | NT |
| Ticarcillin | S | S | S | R | R | S | S | S | S | R | S | S | S | R | S | S | S | S | S | S | S | S | S | NT |
| Ticarcillin/CA | S | S | S | R | R | S | S | S | S | R | S | S | S | R | S | S | S | S | S | S | S | S | S | NT |
| TMS | S | S | S | S | R | S | S | S | S | R | S | S | NM | S | S | S | R | S | S | S | S | S | S | NT |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| N | 8 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | | 2 | | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | |
| 2006 | 3 | | 2 | | | | | | | 1 | 1 | | | | | | | | | | | | | |
| 2007 | 5 | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| UN | | 2 | | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | |
| RVC | 4 | | 2 | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | | | 1 |
| BVMTH | 4 | | | | | | | | | | | | | | | | | | | 1 | | 1 | 1 | |
| VMR | | | | | | | | | | | | | | | | | | | | | | | | |

**Table A-42**

***Staphylococcus xylosus*** **Antibiogram by Year**

**Percent Susceptible**

**BVMTH Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | | 100% | 80% |
| Amoxicillin/CA | | 100% | 80% |
| Ampicillin | | 100% | 80% |
| Cefazolin | | 100% | 80% |
| Cefoxitin | | 100% | 100% |
| Cefpodoxime | | 100% | 80% |
| Ceftiofur | | 100% | 80% |
| Cephalothin | | 100% | 100% |
| Chloramphenicol | | 100% | 80% |
| Enrofloxacin | | 100% | 60% |
| Clindamycin | | 0% | 40% |
| Erythromycin | | 0% | 40% |
| Gentamicin | | 100% | 100% |
| Imipenem | | 100% | 80% |
| Marbofloxacin | | 100% | 60% |
| Orbifloxacin | | -- | -- |
| Oxacillin | | 100% | 100% |
| Penicillin | | 100% | 80% |
| Rifampin | | 100% | 100% |
| Sulphadimethoxime | | -- | -- |
| Spectinomycin | | -- | -- |
| Tetracycline | | 100% | 80% |
| Ticarcillin | | 100% | 100% |
| Ticarcillin/CA | | 100% | 100% |
| TMS | | 100% | 100% |
| **N** | **0** | **2** | **5** |
| *BVMTH* | | *2* | *5* |
| *CVHSR* | | | |

**Table A-43**
***Staphylococcus xylosus*** **Antibiogram by Year**
**Percent Susceptibility**
**RVC Specimens**
***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | | 80% | 100% |
| Amoxicillin/CA | | 80% | 67% |
| Ampicillin | | 80% | 58% |
| Cefazolin | | 80% | 75% |
| Cefoxitin | | 80% | 83% |
| Cefpodoxime | | 60% | 58% |
| Ceftiofur | | 80% | 75% |
| Cephalothin | | 80% | 92% |
| Chloramphenicol | | 40% | 50% |
| Enrofloxacin | | 80% | 83% |
| Clindamycin | | 40% | 0% |
| Erythromycin | | 40% | 0% |
| Gentamicin | | 80% | 92% |
| Imipenem | | 80% | 58% |
| Marbofloxacin | | 80% | 75% |
| Orbifloxacin | | -- | -- |
| Oxacillin | | 80% | 92% |
| Penicillin | | 80% | 58% |
| Rifampin | | 80% | 92% |
| Sulphadimethoxime | | -- | -- |
| Spectinomycin | | -- | -- |
| Tetracycline | | 80% | 42% |
| Ticarcillin | | 80% | 92% |
| Ticarcillin/CA | | 80% | 92% |
| TMS | | 80% | 91% |
| **N** | **0** | **4** | **13** |

**Table A-44**

***Staphylococcus species* Phenotypes**

***(First Isolates)***

| Antibiotic | PT1 | PT2 | PT3 | PT4 | PT5 | PT6 | PT7 | PT8 | PT9 | PT10 | PT11 | PT12 | PT13 | PT14 | PT15 | PT16 | PT17 | PT18 | PT19 | PT20 | PT21 | PT22 | PT23 | PT24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | S | R | NM |
| Amoxicillin/CA | S | S | S | R | R | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | R | S | S | NM |
| Ampicillin | S | S | S | R | R | S | S | S | R | S | R | R | R | R | R | R | R | R | R | S | R | R | R | NM |
| Cefazolin | S | S | S | R | S | S | S | S | S | S | R | S | S | R | S | R | R | S | S | S | R | S | S | NM |
| Cefoxitin | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | R | S | S | NM |
| Cefpodoxime | S | S | S | NT | NT | NT | NT | NT | I | I | R | S | S | R | S | R | R | I | S | I | R | S | R | NM |
| Ceftiofur | S | S | S | S | S | S | S | S | S | S | R | S | S | R | S | R | R | R | S | S | R | S | I | NM |
| Cephalothin | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | R | S | S | NM |
| Chloramphenicol | S | S | S | S | S | S | S | S | S | S | S | R | S | R | S | S | S | S | S | S | S | S | R | NM |
| Enrofloxacin | S | S | S | I | I | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | I | R | NM |
| Clindamycin | R | S | R | NT | NT | NT | NT | NT | NT | NT | NT | R | R | R | S | R | R | R | R | R | S | I | R | NM |
| Erythromycin | S | S | R | R | S | R | S | S | R | S | R | R | R | R | S | R | R | R | I | R | S | I | R | NM |
| Gentamicin | S | S | S | S | S | S | S | S | S | S | I | S | S | R | S | S | I | S | S | S | I | S | R | NM |
| Imipenem | S | S | S | I | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | R | S | S | NM |
| Marbofloxacin | S | S | S | NT | NT | NT | NT | NT | S | S | S | S | S | R | S | S | S | S | S | S | S | S | R | NM |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NM |
| Oxacillin | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | R | S | S | NM |
| Penicillin | S | S | S | R | R | S | S | R | R | S | S | R | R | R | R | S | R | S | S | R | R | R | R | NM |
| Rifampin | S | S | S | R | S | S | S | S | S | S | R | S | S | R | S | I | I | S | S | S | S | S | S | NM |
| Sulphadimethoxime | NT | NT | NT | S | S | S | S | S | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | R | R | I | R | I | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | I | S | S | S | S | S | S | NM |
| Ticarcillin | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | R | S | S | NM |
| Ticarcillin/CA | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | R | S | S | NM |
| TMS | S | S | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | S | S | NM |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| N | 4 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | 2 | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | |
| 2006 | | 3 | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | | | | | | | | |
| 2007 | 2 | | 3 | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| UN | 2 | | | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | 1 | | | | | | | | |
| RVC | 2 | 2 | 3 | | | | | | | | | 1 | 1 | 1 | 1 | | 1 | 1 | | 1 | | | 1 | |
| BVMTH | | 1 | | | | | | | | 1 | 1 | | | | | | | | 1 | | 1 | 1 | | 1 |
| VMR | | | | | | | | | | | | | | | | | | | | | | | | |

**Table A-45**

***Staphylococcus species* Antibiogram by Year**

**Percent Susceptible**

**BVMTH Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 100% | 100% | 100% |
| Amoxicillin/CA | 100% | 100% | 67% |
| Ampicillin | 50% | 100% | 0% |
| Cefazolin | 50% | 100% | 67% |
| Cefoxitin | 100% | 100% | 67% |
| Cefpodoxime | 0% | 100% | 67% |
| Ceftiofur | 50% | 100% | 67% |
| Cephalothin | 100% | 100% | 67% |
| Chloramphenicol | 100% | 100% | 100% |
| Enrofloxacin | 100% | 100% | 67% |
| Clindamycin | -- | 100% | 33% |
| Erythromycin | 50% | 100% | 33% |
| Gentamicin | 50% | 100% | 67% |
| Imipenem | 100% | 100% | 67% |
| Marbofloxacin | 100% | 100% | 100% |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | 100% | 100% | 67% |
| Penicillin | 100% | 100% | 33% |
| Rifampin | 50% | 100% | 100% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 100% | 100% | 100% |
| Ticarcillin | 100% | 100% | 67% |
| Ticarcillin/CA | 100% | 100% | 67% |
| TMS | 100% | 100% | 100% |
| **N** | **2** | **1** | **4** |
| *BVMTH* | *2* | *1* | *4* |
| *CVHSR* | | | |

**Table A-46**
***Staphylococcus species* Antibiogram by Year**
**Percent Susceptibility**
**RVC Specimens**
***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | | 83% | 89% |
| Amoxicillin/CA | | 83% | 100% |
| Ampicillin | | 33% | 67% |
| Cefazolin | | 83% | 89% |
| Cefoxitin | | 83% | 100% |
| Cefpodoxime | | 83% | 56% |
| Ceftiofur | | 83% | 67% |
| Cephalothin | | 83% | 100% |
| Chloramphenicol | | 67% | 89% |
| Enrofloxacin | | 83% | 89% |
| Clindamycin | | 50% | 0% |
| Erythromycin | | 50% | 22% |
| Gentamicin | | 83% | 78% |
| Imipenem | | 83% | 100% |
| Marbofloxacin | | 83% | 89% |
| Orbifloxacin | | -- | -- |
| Oxacillin | | 83% | 100% |
| Penicillin | | 33% | 67% |
| Rifampin | | 83% | 89% |
| Sulphadimethoxime | | -- | -- |
| Spectinomycin | | -- | -- |
| Tetracycline | | 83% | 89% |
| Ticarcillin | | 83% | 100% |
| Ticarcillin/CA | | 83% | 100% |
| TMS | | 83% | 100% |
| **N** | **0** | **6** | **9** |

**Table A-47**

***Enterococcus species* Phenotypes**

***(First Isolates)***

| Antibiotic | PT1 | PT2 | PT3 | PT4 | PT5 | PT6 | PT7 | PT8 | PT9 | PT10 | PT11 | PT12 | PT13 | PT14 | PT15 | PT16 | PT17 | PT18 | PT19 | PT20 | PT21 | PT22 | PT23 | PT24 | PT25 | PT26 | PT27 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | I | S | S | S | S | S | R | I | I | R | S | R | R | S | R | I | R | R | R | S | I | R | R | R | I | R |
| Amoxicillin/CA | S | S | S | S | S | S | S | S | S | S | S | R | S | S | S | S | S | S | S | R | I | S | S | S | I | S | S |
| Ampicillin | S | S | S | S | S | S | S | S | R | S | S | R | S | S | S | S | R | S | S | R | R | S | S | S | R | S | R |
| Cefazolin | S | R | S | S | S | R | S | R | R | S | R | R | R | R | S | S | R | S | R | R | R | S | R | R | R | I | R |
| Cefoxitin | S | S | R | S | S | R | R | R | R | S | I | R | R | I | S | R | R | R | R | R | R | I | R | S | R | I | R |
| Cefpodoxime | NT | NT | | I | S | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Ceftiofur | S | I | S | S | S | R | R | R | R | S | R | R | R | R | S | R | R | R | R | R | R | R | R | R | R | R | R |
| Cephalothin | S | S | S | S | S | R | S | R | R | R | S | R | R | I | S | I | R | I | R | R | R | S | I | S | R | S | S |
| Chloramphenicol | S | R | S | I | S | S | S | S | R | S | S | R | R | S | R | S | S | S | R | I | R | S | R | S | NM | R | I |
| Enrofloxacin | S | R | S | R | S | R | I | R | R | R | S | R | R | S | R | R | R | I | R | R | S | I | S | R | R | R | R |
| Clindamycin | NT | NT | NT | NT | NT | NT | NT | R | R | R | R | R | R | R | R | R | R | R | R | S | R | I | R | NM | R | R | R |
| Erythromycin | S | R | S | R | S | I | I | R | R | S | S | R | I | S | R | I | R | I | R | R | R | I | I | R | R | R | R |
| Gentamicin | S | R | S | S | S | S | S | R | R | R | I | R | R | R | S | R | I | S | R | R | S | S | R | R | R | R | R |
| Imipenem | S | I | S | S | S | I | S | I | I | R | S | R | I | S | S | S | R | S | R | R | S | S | S | S | R | I | R |
| Marbofloxacin | NT | NT | NT | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NM |
| Oxacillin | S | S | S | R | S | R | R | R | R | S | S | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Penicillin | S | S | S | R | S | R | S | R | R | S | S | S | R | S | S | S | S | S | R | R | R | S | S | S | R | S | S |
| Rifampin | S | R | R | R | S | S | I | R | R | S | S | R | R | S | R | S | R | R | I | R | R | I | S | R | R | S | R |
| Sulphadimethoxime | S | R | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | S | R | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | S | R | S | S | S | R | S | R | R | R | S | R | R | S | I | S | R | S | S | R | R | S | R | S | R | R | R |
| Ticarcillin | S | S | S | S | S | R | S | R | R | S | S | R | R | S | S | S | I | S | R | R | I | S | S | S | R | S | R |
| Ticarcillin/CA | S | S | I | S | S | R | S | R | R | R | S | R | R | S | S | S | I | S | R | R | I | S | S | S | R | S | R |
| TMS | S | S | S | R | S | S | S | R | S | S | S | R | R | S | S | S | S | S | R | R | R | S | R | R | R | S | NM |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | |
| 2006 | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | |
| 2007 | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| UN | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | |
| RVC | | | | | | | | 1 | 1 | 1 | | | | | 1 | | | | 1 | | 1 | 1 | | | | | |
| BVMTH | | | | | | 1 | 1 | | | | | | 1 | 1 | | 1 | 1 | 1 | | 1 | | | 1 | 1 | 1 | 1 | 1 |
| VMR | | | | | | | | | | | 1 | 1 | | | | | | | | | | | | | | | |

**Table A-48**

***Enterococcus species* Antibiogram by Year**

**Percent Susceptible**

**BVMTH Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 100% | 33% | 0% |
| Amoxicillin/CA | 100% | 67% | 80% |
| Ampicillin | 100% | 67% | 60% |
| Cefazolin | 50% | 0% | 20% |
| Cefoxitin | 0% | 0% | 10% |
| Cefpodoxime | 0% | 0% | 0% |
| Ceftiofur | 0% | 0% | 0% |
| Cephalothin | 50% | 33% | 30% |
| Chloramphenicol | 100% | 33% | 56% |
| Enrofloxacin | 0% | 33% | 20% |
| Clindamycin | -- | 0% | 11% |
| Erythromycin | 0% | 33% | 10% |
| Gentamicin | 100% | 0% | 10% |
| Imipenem | 50% | 33% | 50% |
| Marbofloxacin | -- | -- | -- |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | 0% | 33% | 0% |
| Penicillin | 50% | 67% | 80% |
| Rifampin | 50% | 33% | 40% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 50% | 33% | 40% |
| Ticarcillin | 50% | 33% | 60% |
| Ticarcillin/CA | 50% | 33% | 60% |
| TMS | 100% | 33% | 56% |
| **N** | **2** | **3** | **10** |
| *BVMTH* | *2* | *1* | *10* |
| *CVHSR* | | *2* | |

**Table A-49**

***Enterococcus species* Antibiogram by Year**

**Percent Susceptibility**

**RVC Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | | 0% | 50% |
| Amoxicillin/CA | | 100% | 75% |
| Ampicillin | | 67% | 75% |
| Cefazolin | | 33% | 50% |
| Cefoxitin | | 33% | 25% |
| Cefpodoxime | | 0% | 0% |
| Ceftiofur | | 33% | 25% |
| Cephalothin | | 0% | 50% |
| Chloramphenicol | | 67% | 25% |
| Enrofloxacin | | 0% | 25% |
| Clindamycin | | 0% | 0% |
| Erythromycin | | 33% | 0% |
| Gentamicin | | 0% | 75% |
| Imipenem | | 0% | 75% |
| Marbofloxacin | | -- | -- |
| Orbifloxacin | | -- | -- |
| Oxacillin | | 33% | 0% |
| Penicillin | | 33% | 50% |
| Rifampin | | 33% | 0% |
| Sulphadimethoxime | | -- | -- |
| Spectinomycin | | -- | -- |
| Tetracycline | | 0% | 50% |
| Ticarcillin | | 33% | 50% |
| Ticarcillin/CA | | 0% | 50% |
| TMS | | 67% | 50% |
| **N** | **0** | **3** | **4** |

**Table A-50**
***Actinobacillus equuli* Phenotypes**
***(First Isolates)***

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 |
|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S |
| Amoxicillin/CA | S | S | S | S | S |
| Ampicillin | S | S | S | S | S |
| Cefazolin | S | S | S | S | S |
| Cefoxitin | S | S | S | S | S |
| Cefpodoxime | S | | S | S | S |
| Ceftiofur | S | S | S | S | S |
| Cephalothin | S | S | S | S | S |
| Chloramphenicol | S | S | S | S | S |
| Enrofloxacin | S | S | S | S | S |
| Clindamycin | NT | NT | I | I | I |
| Erythromycin | NT | I | I | S | I |
| Gentamicin | S | S | S | S | S |
| Imipenem | S | S | S | S | S |
| Marbofloxacin | NI | NT | NI | NI | NI |
| Orbifloxacin | NI | NI | NI | NI | NI |
| Oxacillin | NT | S | S | S | NM |
| Penicillin | NT | R | R | R | R |
| Rifampin | S | S | S | S | S |
| Sulphadimethoxime | NT | S | NT | NT | NT |
| Spectinomycin | NT | R | NT | NT | NT |
| Tetracycline | S | S | I | S | S |
| Ticarcillin | S | S | S | S | S |
| Ticarcillin/CA | S | S | S | S | S |
| TMS | S | S | S | S | S |
| | | | | | |
| **N** | 9 | 4 | 2 | 2 | 1 |
| 2005 | 4 | 4 | 1 | | |
| 2006 | 3 | | | | 1 |
| 2007 | 2 | | 1 | 2 | |
| | | | | | |
| UN | | 4 | 1 | | |
| RVC | 3 | | | | |
| BVMTH | 5 | | 1 | 2 | 1 |
| VMR | 1 | | | | |

**Table A-51**

***Actinobacillus equuli*** **Antibiogram by Year**

**Percent Susceptible**

**BVMTH and CVHSR Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 100% | 100% | 100% |
| Amoxicillin/CA | 100% | 100% | 100% |
| Ampicillin | 100% | 100% | 100% |
| Cefazolin | 100% | 100% | 100% |
| Cefoxitin | 100% | 100% | 100% |
| Cefpodoxime | 100% | 100% | 100% |
| Ceftiofur | 100% | 100% | 100% |
| Cephalothin | 100% | 100% | 100% |
| Chloramphenicol | 100% | 100% | 100% |
| Enrofloxacin | 100% | 100% | 100% |
| Clindamycin | -- | 0% | 0% |
| Erythromycin | -- | 0% | 50% |
| Gentamicin | 100% | 100% | 100% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | -- | -- | -- |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | -- | -- | 100% |
| Penicillin | -- | 0% | 0% |
| Rifampin | 100% | 100% | 100% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 100% | 100% | 75% |
| Ticarcillin | 100% | 100% | 100% |
| Ticarcillin/CA | 100% | 100% | 100% |
| TMS | 100% | 100% | 100% |
| **N** | **3** | **3** | **4** |
| ***BVMTH*** | ***3*** | ***2*** | ***4*** |
| ***CVHSR*** | | ***1*** | |

**Table A-52**

***Actinobacillus equuli* Antibiogram by Year**

**Percent Susceptible**

**RVC Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 100% | 100% | 100% |
| Amoxicillin/CA | 100% | 100% | 100% |
| Ampicillin | 100% | 100% | 100% |
| Cefazolin | 100% | 100% | 100% |
| Cefoxitin | 100% | 100% | 100% |
| Cefpodoxime | 100% | 100% | 100% |
| Ceftiofur | 100% | 100% | 100% |
| Cephalothin | 100% | 100% | 100% |
| Chloramphenicol | 100% | 100% | 100% |
| Enrofloxacin | 100% | 100% | 100% |
| Clindamycin | -- | 0% | 0% |
| Erythromycin | -- | -- | 0% |
| Gentamicin | 100% | 100% | 100% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | -- | -- | -- |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | -- | -- | 100% |
| Penicillin | -- | -- | 0% |
| Rifampin | 100% | 100% | 100% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 100% | 100% | 100% |
| Ticarcillin | 100% | 100% | 100% |
| Ticarcillin/CA | 100% | 100% | 100% |
| TMS | 100% | 100% | 100% |
| **N** | **1** | **1** | **1** |

**Table A-53**
***Actinobacillus suis* Phenotypes**
***(First Isolates)***

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | PT 6 | PT7 |
|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S | S | S |
| Amoxicillin/CA | S | S | S | S | S | S | S |
| Ampicillin | S | S | S | S | S | S | S |
| Cefazolin | S | S | S | S | S | S | S |
| Cefoxitin | S | S | S | S | S | S | S |
| Cefpodoxime | S | S | S | | S | S | S |
| Ceftiofur | S | S | S | S | S | S | S |
| Cephalothin | S | S | S | S | S | S | S |
| Chloramphenicol | S | S | S | S | S | S | S |
| Enrofloxacin | S | S | S | S | S | S | S |
| Clindamycin | I | NT | R | NT | R | R | I |
| Erythromycin | NT | NT | NT | I | R | I | I |
| Gentamicin | S | S | S | S | S | S | S |
| Imipenem | S | S | S | S | S | S | S |
| Marbofloxacin | NI | NI | NI | NT | NI | NI | NI |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | NT | NT | NT | S | R | S | S |
| Penicillin | NT | NT | NT | R | R | R | R |
| Rifampin | S | S | S | S | S | S | S |
| Sulphadimethoxime | NT | NT | NT | S | NT | NT | NT |
| Spectinomycin | NT | NT | NT | R | NT | NT | NT |
| Tetracycline | S | S | S | S | S | S | S |
| Ticarcillin | S | S | S | S | S | S | S |
| Ticarcillin/CA | S | S | S | S | S | S | S |
| TMS | S | S | S | S | NM | S | S |
| | | | | | | | |
| **N** | **8** | **4** | **3** | **2** | **1** | **1** | **1** |
| ***2005*** | | ***4*** | | ***2*** | | | |
| ***2006*** | ***8*** | | ***3*** | | | | |
| ***2007*** | | | | | ***1*** | ***1*** | ***1*** |
| | | | | | | | |
| ***UN*** | | ***2*** | | ***2*** | | | |
| ***RVC*** | ***4*** | ***2*** | ***1*** | | | ***1*** | |
| ***BVMTH*** | ***4*** | | ***2*** | | ***1*** | | ***1*** |
| ***VMR*** | | | | | | | |

**Table A-54**

***Actinobacillus suis* Antibiogram by Year**

**Percent Susceptible**

**BVMTH and CVHSR Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | | 100% | 100% |
| Amoxicillin/CA | | 100% | 100% |
| Ampicillin | | 100% | 100% |
| Cefazolin | | 100% | 100% |
| Cefoxitin | | 100% | 100% |
| Cefpodoxime | | 100% | 100% |
| Ceftiofur | | 100% | 100% |
| Cephalothin | | 100% | 100% |
| Chloramphenicol | | 100% | 100% |
| Enrofloxacin | | 100% | 100% |
| Clindamycin | | 0% | 0% |
| Erythromycin | | -- | 0% |
| Gentamicin | | 100% | 100% |
| Imipenem | | 100% | 100% |
| Marbofloxacin | | -- | -- |
| Orbifloxacin | | -- | -- |
| Oxacillin | | -- | 50% |
| Penicillin | | -- | 0% |
| Rifampin | | 100% | 100% |
| Sulphadimethoxime | | -- | -- |
| Spectinomycin | | -- | -- |
| Tetracycline | | 100% | 100% |
| Ticarcillin | | 100% | 100% |
| Ticarcillin/CA | | 100% | 100% |
| TMS | | 100% | 100% |
| **N** | **0** | **6** | **2** |
| ***BVMTH*** | | ***6*** | ***2*** |
| ***CVHSR*** | | | |

**Table A-55**

***Actinobacillus suis* Antibiogram by Year**

**Percent Susceptible**

**RVC Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 100% | 100% | 100% |
| Amoxicillin/CA | 100% | 100% | 100% |
| Ampicillin | 100% | 100% | 100% |
| Cefazolin | 100% | 100% | 100% |
| Cefoxitin | 100% | 100% | 100% |
| Cefpodoxime | 100% | 100% | 100% |
| Ceftiofur | 100% | 100% | 100% |
| Cephalothin | 100% | 100% | 100% |
| Chloramphenicol | 100% | 100% | 100% |
| Enrofloxacin | 100% | 100% | 100% |
| Clindamycin | -- | 0% | 0% |
| Erythromycin | -- | -- | 0% |
| Gentamicin | 100% | 100% | 100% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | -- | -- | -- |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | -- | -- | 100% |
| Penicillin | -- | -- | 0% |
| Rifampin | 100% | 100% | 100% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 100% | 100% | 100% |
| Ticarcillin | 100% | 100% | 100% |
| Ticarcillin/CA | 100% | 100% | 100% |
| TMS | 100% | 100% | 100% |
| **N** | **2** | **5** | **1** |

**Table A-56**

***Actinobacillus species*** **Phenotypes**

***(First Isolates)***

| Antibiotic | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | PT 6 | PT 7 | PT 8 | PT 9 | PT 10 | PT 11 | PT 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S | S | S | R | S | S | S | S |
| Amoxicillin/CA | S | S | S | S | S | S | S | S | S | S | S | R |
| Ampicillin | S | S | S | S | S | S | S | R | S | S | R | R |
| Cefazolin | S | S | S | S | S | S | S | I | S | S | S | R |
| Cefoxitin | S | S | S | S | S | S | S | R | S | S | I | R |
| Cefpodoxime | S | S | S | S | S | NT | S | I | S | S | S | R |
| Ceftiofur | S | S | S | S | S | S | S | R | S | S | S | I |
| Cephalothin | S | S | S | S | S | S | S | R | S | S | S | S |
| Chloramphenicol | S | S | S | S | S | S | S | R | S | S | S | R |
| Enrofloxacin | S | S | S | S | S | S | S | S | S | S | S | S |
| Clindamycin | S | NT | S | R | I | NT | I | I | R | I | R | R |
| Erythromycin | S | NT | NT | NT | I | I | NT | NT | S | R | I | I |
| Gentamicin | S | S | S | S | S | S | S | R | S | S | S | S |
| Imipenem | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | NI | NI | NI | NI | NI | | NI | NI | NI | NI | NI | NI |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | S | NT | NT | NT | S | S | NT | NT | S | R | S | R |
| Penicillin | R | NT | NT | NT | R | R | NT | NT | R | R | R | R |
| Rifampin | S | S | S | S | S | S | S | S | S | S | NM | S |
| Sulphadimethoxime | NT | NT | NT | NT | NT | S | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | NT | NT | R | NT | NT | NT | NT | NT | NT |
| Tetracycline | S | S | S | S | S | S | S | S | S | S | S | R |
| Ticarcillin | S | S | S | S | S | S | S | I | S | S | S | R |
| Ticarcillin/CA | S | S | S | S | S | S | S | S | S | S | S | R |
| TMS | S | S | S | S | S | S | S | S | S | S | S | R |
| | | | | | | | | | | | | |
| **N** | **3** | **2** | **2** | **2** | **2** | **1** | **1** | **1** | **1** | **1** | **1** | **1** |
| ***2005*** | | ***2*** | | | | ***1*** | | | | | | |
| ***2006*** | | | ***2*** | ***2*** | | | ***1*** | ***1*** | | | | |
| ***2007*** | ***3*** | | | | ***2*** | | | | ***1*** | ***1*** | ***1*** | ***1*** |
| | | | | | | | | | | | | |
| ***UN*** | | ***1*** | | | | ***1*** | | | | | | |
| ***RVC*** | ***2*** | | ***1*** | ***1*** | ***1*** | | ***1*** | | | | ***1*** | |
| ***BVMTH*** | ***1*** | | | ***1*** | ***1*** | | | ***1*** | ***1*** | ***1*** | | ***1*** |
| ***VMR*** | | ***1*** | ***1*** | | | | | | | | | |

**Table A-57**

***Actinobacillus species*** **Antibiogram by Year**

**Percent Susceptible**

**BVMTH and CVHSR Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | 100% | 67% | 100% |
| Amoxicillin/CA | 100% | 100% | 80% |
| Ampicillin | 100% | 67% | 80% |
| Cefazolin | 100% | 67% | 80% |
| Cefoxitin | 100% | 67% | 80% |
| Cefpodoxime | 100% | 67% | 80% |
| Ceftiofur | 100% | 67% | 80% |
| Cephalothin | 100% | 67% | 100% |
| Chloramphenicol | 100% | 67% | 80% |
| Enrofloxacin | 100% | 100% | 100% |
| Clindamycin | -- | 33% | 20% |
| Erythromycin | -- | -- | 40% |
| Gentamicin | 100% | 67% | 100% |
| Imipenem | 100% | 100% | 100% |
| Marbofloxacin | -- | -- | -- |
| Orbifloxacin | -- | -- | -- |
| Oxacillin | -- | -- | 60% |
| Penicillin | -- | -- | 0% |
| Rifampin | 100% | 100% | 100% |
| Sulphadimethoxime | -- | -- | -- |
| Spectinomycin | -- | -- | -- |
| Tetracycline | 100% | 100% | 80% |
| Ticarcillin | 100% | 67% | 80% |
| Ticarcillin/CA | 100% | 100% | 80% |
| TMS | 100% | 100% | 80% |
| **N** | **1** | **3** | **5** |
| ***BVMTH*** | | ***2*** | ***5*** |
| ***CVHSR*** | ***1*** | ***1*** | |

**Table A-58**

***Actinobacillus species* Antibiogram by Year**

**Percent Susceptible**

**RVC Specimens**

***(First Isolates)***

| Antibiotic | 2005 | 2006 | 2007 |
|---|---|---|---|
| Amikacin | | 100% | 100% |
| Amoxicillin/CA | | 100% | 100% |
| Ampicillin | | 100% | 75% |
| Cefazolin | | 100% | 100% |
| Cefoxitin | | 100% | 75% |
| Cefpodoxime | | 100% | 100% |
| Ceftiofur | | 100% | 100% |
| Cephalothin | | 100% | 100% |
| Chloramphenicol | | 100% | 100% |
| Enrofloxacin | | 100% | 100% |
| Clindamycin | | 33% | 50% |
| Erythromycin | | -- | 50% |
| Gentamicin | | 100% | 100% |
| Imipenem | | 100% | 100% |
| Marbofloxacin | | -- | -- |
| Orbifloxacin | | -- | -- |
| Oxacillin | | -- | 100% |
| Penicillin | | -- | 0% |
| Rifampin | | 100% | 100% |
| Sulphadimethoxime | | -- | -- |
| Spectinomycin | | -- | -- |
| Tetracycline | | 100% | 100% |
| Ticarcillin | | 100% | 100% |
| Ticarcillin/CA | | 100% | 100% |
| TMS | | 100% | 100% |
| **N** | | **3** | **4** |

## Table A-59
## *Rhodococcus equi* Phenotypes
***(First Isolates)***

| Antibiotic | PT1 | PT2 | PT3 | PT4 | PT5 | PT6 | PT7 | PT8 | PT9 | PT10 | PT11 | PT12 | PT13 | PT14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amikacin | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Amoxicillin/CA | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Ampicillin | I | R | R | I | R | I | I | I | I | S | I | R | R | I |
| Cefazolin | I | R | R | S | R | S | I | S | R | S | S | R | R | R |
| Cefoxitin | S | R | S | S | S | S | S | S | S | S | S | S | S | S |
| Cefpodoxime | NT | R | I | NT | R | R | S | S | R | S | R | R | R | S |
| Ceftiofur | S | NT | NT | S | NT | NT | NT | NT | NT | NT | NT | I | S | S |
| Cephalothin | R | R | S | I | R | S | S | S | S | S | S | R | R | S |
| Chloramphenicol | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Enrofloxacin | R | I | S | R | I | S | S | S | S | S | S | S | I | S |
| Clindamycin | NT | NT | NT | NT | NT | NT | NT | NT | R | I | I | R | I | I |
| Erythromycin | S | R | I | S | I | I | S | I | R | S | S | I | I | S |
| Gentamicin | S | R | S | S | S | S | S | S | S | S | S | S | S | S |
| Imipenem | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NI | NI | NI |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | S | R | S | S | S | S | S | S | S | S | S | S | S | S |
| Penicillin | R | R | R | R | R | R | R | R | R | NI | R | R | R | R |
| Rifampin | S | R | R | S | S | S | S | S | S | S | S | S | S | S |
| Sulphadimethoxime | S | NT | NT | S | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | R | NT | NT | R | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | S | R | R | S | R | R | R | R | R | S | I | R | S | S |
| Ticarcillin | S | R | S | S | S | S | S | S | S | S | S | R | I | S |
| Ticarcillin/CA | S | S | S | S | S | S | S | S | S | S | S | R | I | S |
| TMS | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| | | | | | | | | | | | | | | |
| **N** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2005 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | |
| 2006 | | | | | | | | | 1 | 1 | 1 | | | |
| 2007 | | | | | | | | | | | | 1 | 1 | 1 |
| | | | | | | | | | | | | | | |
| UN | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | |
| RVC | | | | | | | | | 1 | 1 | | 1 | 1 | 1 |
| BVMTH | | | | | | | | | | | 1 | | | |
| VMR | | | | | | | | | | | | | | |

**Table A-60**
***Rhodococcus equi*** **Cumulative Antibiogram**
**Percent Susceptible**
**All Specimens**
***(First Isolates)***

| Antibiotic | 2005-2007 |
|---|---|
| Amikacin | 100% |
| Amoxicillin/CA | 100% |
| Ampicillin | 7% |
| Cefazolin | 36% |
| Cefoxitin | 93% |
| Cefpodoxime | 33% |
| Ceftiofur | 80% |
| Cephalothin | 57% |
| Chloramphenicol | 100% |
| Enrofloxacin | 64% |
| Clindamycin | 0% |
| Erythromycin | 43% |
| Gentamicin | 93% |
| Imipenem | 100% |
| Marbofloxacin | -- |
| Orbifloxacin | -- |
| Oxacillin | 93% |
| Penicillin | 0% |
| Rifampin | 86% |
| Sulphadimethoxime | 100% |
| Spectinomycin | 0% |
| Tetracycline | 36% |
| Ticarcillin | 79% |
| Ticarcillin/CA | 86% |
| TMS | 100% |
| **N** | **14** |
| ***Unknown*** | ***8*** |
| ***BVMTH*** | ***1*** |
| ***CVHSR*** | ***0*** |
| ***RVC*** | ***5*** |

**Table A-61**
**Comparative Antibiograms for Common Uterine Isolates**
***(First Isolates)***

| | **CVHSR/BVMTH** | **RVC** | **CVHSR/BVMTH** | **RVC** |
|---|---|---|---|---|
| | ***E. coli*** | ***E. coli*** | ***Strep. equi zoo.*** | ***Strep. equi zoo.*** |
| Amikacin | 100% | 91% | 40% | 59% |
| Amoxicillin/CA | 89% | 85% | 100% | 97% |
| Ampicillin | 56% | 66% | 100% | 89% |
| Cefazolin | 89% | 84% | 100% | 97% |
| Cefoxitin | 89% | 87% | 100% | 97% |
| Cefpodoxime | 89% | 85% | 40% | 78% |
| Ceftiofur | 89% | 87% | 100% | 92% |
| Cephalothin | 67% | 66% | 100% | 97% |
| Chloramphenicol | 100% | 79% | 90% | 86% |
| Enrofloxacin | 100% | 90% | 40% | 76% |
| Clindamycin | 0% | 0% | 78% | 83% |
| Erythromycin | 0% | 0% | 0% | 0% |
| Gentamicin | 78% | 71% | 60% | 89% |
| Imipenem | 100% | 100% | 100% | 100% |
| Marbofloxacin | 100% | 91% | 90% | 97% |
| Orbifloxacin | -- | -- | -- | -- |
| Oxacillin | 0% | 0% | 100% | 94% |
| Penicillin | 0% | 0% | 100% | 89% |
| Rifampin | 0% | 0% | 100% | 94% |
| Sulphadimethoxime | -- | -- | -- | -- |
| Spectinomycin | -- | -- | -- | -- |
| Tetracycline | 67% | 69% | 70% | 73% |
| Ticarcillin | 56% | 66% | 100% | 97% |
| Ticarcillin/CA | 78% | 84% | 100% | 97% |
| TMS | 100% | 72% | 100% | 100% |
| **N** | **9** | **68** | **10** | **37** |
| ***BVMTH*** | ***6*** | | | |
| ***CVHSR*** | ***3*** | | ***10*** | |
| ***RVC*** | | ***68*** | | ***37*** |

**Table A-62**
**Possible Hospital Acquired Infections in the BVMTH**

| | Year | LOHS | Problem | MRSA | *E. Faecalis* | *A. baumannii* | *S. marcescens* |
|---|---|---|---|---|---|---|---|
| Horse 1 | 2006 | 12 | Uterine Torsion Surgery | X | X | | |
| Horse 2 | 2006 | 30 | Draining Tract on Withers | X | | | |
| Horse 3 | 2006 | 22 | Colic Surgery | X | | | |
| Horse 4 | 2006 | 34 | Colic Surgery | X | X | | |
| Horse 5 | 2006 | 16 | Opthalmologic Surgery | X | | | |
| Horse 6 | 2006 | 52 | Sporothrix, Surgery | X | | | |
| Horse 7 | 2007 | 13 | Colic Surgery | X | | | |
| Horse 8 | 2007 | 45 | HIE, Bladder Surgery | X | | X | |
| Horse 9 | 2007 | 15 | Opthalmologic Surgery | X | | | |
| Horse 10 | 2007 | 86 | Pleuropneumonia, Thoracotomy | X | | X | X |
| Horse 11 | 2007 | 115 | Pleuropneumonia, Thoracotomy | X | X | X | X |
| Horse 12 | 2007 | 30 | Colic Surgery | X | | | |
| Horse 13 | 2007 | 91 | Orphan, Umbilical Resection | X | | | |
| Horse 14 | 2007 | 32 | Colic Surgery | X | X | | |
| Horse 15 | 2007 | 31 | Sepsis, Laryngeal Dysfunction | | | X | |
| Horse 16 | 2007 | 28 | Rhabdomyolysis, Renal Failure | | | X | |
| Horse 17 | 2007 | 9 | Opthalmology | | | X | |
| Horse 18 | 2007 | 22 | Thrombocytopenia | | | X | |
| Horse 19 | 2007 | 7 | Abscess | | | | X |
| Horse 20 | 2007 | OP | Hock Infection | | | | X |
| Horse 21 | 2006 | 92 | Abdominal Hernia Surgery | | X | | |
| Horse 22 | 2006 | 9 | Surgery | | X | | |
| Horse 23 | 2006 | 20 | Umbilical Resection | | X | | |

Table A-63
Oxacillin Resistant Staphylococcus aureus in the BVMTH Ordered by Date
(All Isolates)

| Patient | Horse 1 | Horse 2 | Horse 2 | Horse 3 | Horse 3 | Horse 4 | Horse 5 | Horse 6 | Horse 7 | Horse 8 | Horse 9 | Horse 10 | Horse 9 | Horse 11 | Horse 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specimen | uterus | tissue | tissue | other | other | incision | unspecified | incision | incision | catheter | eye | thorax | eye | thorax | incision |
| Date | 4/13/06 | 10/6/06 | 10/6/06 | 11/4/06 | 11/4/06 | 11/9/06 | 11/21/06 | 12/18/06 | 3/8/07 | 4/23/07 | 4/28/07 | 4/30/07 | 5/21/07 | 5/27/07 | 6/2/07 |
| Phenotype | PT1 | PT3 | PT3 | PT2 | PT3 | PT3 | PT4 | PT3 | PT3 | PT3 | PT3 | PT3 | PT4 | PT3 | PT3 |
| **Amikacin** | S | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Amoxicillin/CA** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Ampicillin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cefazolin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cefoxitin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cefpodoxime** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Ceftiofur** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cephalothin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Chloramphenicol** | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| **Enrofloxacin** | R | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| **Clindamycin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Erythromycin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Gentamicin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Imipenem** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Marbofloxacin** | R | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| **Orbifloxacin** | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| **Oxacillin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Penicillin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Rifampin** | S | S | S | R | S | S | S | S | S | S | S | S | S | S | S |
| **Sulphadimethoxime** | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| **Spectinomycin** | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| **Tetracycline** | S | S | S | R | S | S | S | S | S | S | S | S | S | S | S |
| **Ticarcillin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Ticarcillin/CA** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **TMS** | S | R | R | R | R | R | S | R | R | R | R | R | S | R | R |

Table A-63
Oxacillin Resistant Staphylococcus aureus in the BVMTH Ordered by Date
(All Isolates)

| Patient | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 13** | **Horse 14** | **Horse 12** | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 11** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specimen | TTW | TTW | TTW | abscess | incision | incision | fluid | fluid | thorax | thorax | fluid | fluid | TTW | TTW |
| Date | 6/2/07 | 6/2/07 | 6/2/07 | 6/15/07 | 6/16/07 | 6/23/07 | 6/28/07 | 6/29/07 | 7/18/07 | 7/18/07 | 10/20/07 | 10/20/07 | 12/3/07 | 12/3/07 |
| Phenotype | PT3 | PT3 | PT3 | PT3 | PT4 | PT3 | PT3 | PT3 | PT3 | PT3 | PT3 | PT3 | PT3 | PT5 |
| **Amikacin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Amoxicillin/CA** | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Ampicillin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cefazolin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cefoxitin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cefpodoxime** | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Ceftiofur** | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cephalothin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Chloramphenicol** | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| **Enrofloxacin** | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| **Clindamycin** | R | R | R | R | R | R | R | R | R | R | R | R | R | S |
| **Erythromycin** | R | R | R | R | R | R | R | R | R | R | R | R | R | S |
| **Gentamicin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Imipenem** | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Marbofloxacin** | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| **Orbifloxacin** | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| **Oxacillin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Penicillin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Rifampin** | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| **Sulphadimethoxime** | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| **Spectinomycin** | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| **Tetracycline** | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| **Ticarcillin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Ticarcillin/CA** | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **TMS** | R | R | R | R | S | R | R | R | R | R | R | R | R | R |

**Table A-64**

**Oxacillin Resistant *Staphylococcus aureus* in the BVMTH Ordered by Patient**

***(All Isolates)***

| Patient | **Horse 1** | **Horse 2** | **Horse 2** | **Horse 3** | **Horse 3** | **Horse 4** | **Horse 5** | **Horse 6** | **Horse 7** | **Horse 8** | **Horse 9** | **Horse 9** | **Horse 10** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specimen | uterus | tissue | tissue | other | other | incision | unspecified | incision | incision | catheter | eye | eye | thorax |
| Date | 4/13/06 | 10/6/06 | 10/6/06 | 11/4/06 | 11/4/06 | 11/9/06 | 11/21/06 | 12/18/06 | 3/8/07 | 4/23/07 | 4/28/07 | 5/21/07 | 4/30/07 |
| Phenotype | PT1 | PT3 | PT3 | PT2 | PT3 | PT3 | PT4 | PT3 | PT3 | PT3 | PT3 | PT4 | PT3 |
| **Amikacin** | S | R | R | R | R | R | R | R | R | R | R | R | R |
| **Amoxicillin/CA** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Ampicillin** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cefazolin** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cefoxitin** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cefpodoxime** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Ceftiofur** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cephalothin** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Chloramphenicol** | S | S | S | S | S | S | S | S | S | S | S | S | S |
| **Enrofloxacin** | R | S | S | S | S | S | S | S | S | S | S | S | S |
| **Clindamycin** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Erythromycin** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Gentamicin** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Imipenem** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Marbofloxacin** | R | S | S | S | S | S | S | S | S | S | S | S | S |
| **Orbifloxacin** | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| **Oxacillin** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Penicillin** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Rifampin** | S | S | S | R | S | S | S | S | S | S | S | S | S |
| **Sulphadimethoxime** | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| **Spectinomycin** | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| **Tetracycline** | S | S | S | R | S | S | S | S | S | S | S | S | S |
| **Ticarcillin** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Ticarcillin/CA** | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **TMS** | S | R | R | R | R | R | S | R | R | R | R | S | R |

**Table A-64**

**Oxacillin Resistant *Staphylococcus aureus* in the BVMTH Ordered by Patient**

***(All Isolates)***

| Patient | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 11** | **Horse 12** | **Horse 12** | **Horse 13** | **Horse 14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specimen | thorax | TTW | TTW | TTW | fluid | fluid | thorax | thorax | fluid | fluid | TTW | TTW | incision | incision | abscess | incision |
| Date | 5/27/07 | 6/2/07 | 6/2/07 | 6/2/07 | 6/28/07 | 6/29/07 | 7/18/07 | 7/18/07 | 10/20/07 | 10/20/07 | 12/3/07 | 12/3/07 | 6/2/07 | 6/23/07 | 6/15/07 | 6/16/07 |
| Phenotype | PT3 | PT3 | PT3 | PT3 | PT3 | PT3 | PT3 | PT3 | PT3 | PT3 | PT3 | PT5 | PT3 | PT3 | PT3 | PT4 |
| **Amikacin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Amoxicillin/CA** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Ampicillin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cefazolin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cefoxitin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cefpodoxime** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Ceftiofur** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Cephalothin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Chloramphenicol** | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| **Enrofloxacin** | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| **Clindamycin** | R | R | R | R | R | R | R | R | R | R | R | S | R | R | R | R |
| **Erythromycin** | R | R | R | R | R | R | R | R | R | R | R | S | R | R | R | R |
| **Gentamicin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Imipenem** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Marbofloxacin** | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| **Orbifloxacin** | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| **Oxacillin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Penicillin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Rifampin** | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| **Sulphadimethoxime** | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| **Spectinomycin** | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| **Tetracycline** | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| **Ticarcillin** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **Ticarcillin/CA** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| **TMS** | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | S |

**Table A-65**

***Enterococcus faecalis* Isolates from BVMTH Patients**

***(All Isolates)***

| Patient | Horse 22 | Horse 1 | Horse 23 | Horse 4 | Horse 21 | Horse 21 | Horse 21 | Horse 11 | Horse 14 | Horse 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| Specimen | Catheter | Uterus | Umbilicus | Incision | Incision | Incision | Incision | Catheter | Incision | Catheter |
| Date | 2/9/06 | 4/14/06 | 5/9/06 | 11/9/06 | 11/30/06 | 12/23/06 | 12/27/06 | 5/31/07 | 6/16/2007 | 7/7/2007 |
| Phenotype | PT1 | PT2 | PT3 | PT4 | PT4 | PT4 | PT4 | PT5 | PT6 | PT7 |
| Amikacin | R | R | R | R | R | R | R | R | R | R |
| Amoxicillin/CA | I | S | S | S | S | S | S | S | S | S |
| Ampicillin | R | S | S | S | S | S | S | S | S | S |
| Cefazolin | R | R | R | R | R | R | R | R | R | R |
| Cefoxitin | R | R | R | R | R | R | R | R | R | R |
| Cefpodoxime | R | R | R | R | R | R | R | R | R | R |
| Ceftiofur | R | R | R | R | R | R | R | I | R | R |
| Cephalothin | R | R | R | R | R | R | R | R | R | R |
| Chloramphenicol | I | S | S | R | R | R | R | R | S | R |
| Enrofloxacin | R | I | S | S | S | S | S | S | S | R |
| Clindamycin | R | R | R | R | R | R | R | R | R | R |
| Erythromycin | R | I | R | R | R | R | R | R | I | R |
| Gentamicin | R | I | R | R | R | R | R | R | I | R |
| Imipenem | R | S | S | S | S | S | S | S | S | S |
| Marbofloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | R | R | R | R | R | R | R | R | R | R |
| Penicillin | R | S | S | S | S | S | S | S | S | S |
| Rifampin | R | I | I | I | I | I | I | I | S | S |
| Sulphadimethoxime | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | R | S | R | R | R | R | R | R | S | R |
| Ticarcillin | R | I | I | I | I | I | I | I | I | I |
| Ticarcillin/CA | R | I | I | I | I | I | I | I | I | I |
| TMS | R | S | S | R | R | R | R | S | S | R |

**Table A-66**

***Acintetobacter baumannii* Isolates from BVMTH Patients**

***(All Isolates)***

| Patient | Horse 8 | Horse 10 | Horse 10 | Horse 11 | Horse 15 | Horse 16 | Horse 17 | Horse 18 |
|---|---|---|---|---|---|---|---|---|
| Specimen | Catheter | Thorax | Thorax | Catheter | Blood | Blood | Ear | Catheter |
| Date | 4/27/07 | 4/30/07 | 5/25/07 | 5/31/07 | 5/17/07 | 6/6/07 | 10/28/06 | 7/31/07 |
| Phenotype | PT1 | PT1 | PT2 | PT2 | PT3 | PT4 | PT5 | PT6 |
| Amikacin | S | S | S | S | S | S | S | S |
| Amoxicillin/CA | R | R | I | I | I | I | I | R |
| Ampicillin | R | R | R | R | I | I | R | R |
| Cefazolin | R | R | R | R | R | R | R | R |
| Cefoxitin | R | R | R | R | R | R | R | R |
| Cefpodoxime | R | R | R | R | R | R | S | R |
| Ceftiofur | R | R | R | R | R | R | R | R |
| Cephalothin | R | R | R | R | R | R | R | R |
| Chloramphenicol | R | R | R | R | R | R | I | R |
| Enrofloxacin | R | R | R | R | S | S | S | S |
| Clindamycin | R | R | R | R | R | R | R | R |
| Erythromycin | R | R | R | R | R | R | NT | R |
| Gentamicin | R | R | R | R | S | S | S | R |
| Imipenem | S | S | S | S | S | S | S | S |
| Marbofloxacin | NI | NI | NI | NI | NI | NI | NI | NI |
| Orbifloxacin | NI | NI | NI | NI | NI | NI | NI | NI |
| Oxacillin | R | R | R | R | R | R | NT | R |
| Penicillin | R | R | R | R | R | R | NT | R |
| Rifampin | R | R | R | R | R | I | R | R |
| Sulphadimethoxime | NT | NT | NT | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | NT | NT | NT | NT | NT |
| Tetracycline | R | R | R | R | S | S | S | R |
| Ticarcillin | I | I | I | I | S | I | S | R |
| Ticarcillin/CA | I | I | I | I | S | S | S | R |
| TMS | R | R | R | R | S | S | S | S |

**Table A-67**

***Serratia marcescens* Isolates from BVMTH Patients**

***(All Isolates)***

| Patient | Horse 10 | Horse 11 | Horse 11 | Horse 19 | Horse 20 |
|---|---|---|---|---|---|
| Specimen | Thorax | Catheter | Catheter | Abscess | Skin |
| Date | 4/30/07 | 7/5/07 | 7/5/07 | 4/30/07 | 8/13/07 |
| Phenotype | PT1 | PT2 | PT3 | PT4 | PT5 |
| Amikacin | R | I | S | R | R |
| Amoxicillin/CA | R | R | R | R | R |
| Ampicillin | R | R | R | R | R |
| Cefazolin | R | R | R | R | R |
| Cefoxitin | R | I | I | R | R |
| Cefpodoxime | S | R | R | I | S |
| Ceftiofur | S | R | R | S | I |
| Cephalothin | R | R | R | R | R |
| Chloramphenicol | R | R | R | R | R |
| Enrofloxacin | S | S | S | S | S |
| Clindamycin | R | R | R | R | R |
| Erythromycin | R | R | R | R | R |
| Gentamicin | R | R | R | R | R |
| Imipenem | S | S | S | S | S |
| Marbofloxacin | S | S | S | S | S |
| Orbifloxacin | NI | NI | NI | NI | NI |
| Oxacillin | R | R | R | R | R |
| Penicillin | R | R | R | R | R |
| Rifampin | R | R | R | R | R |
| Sulphadimethoxime | NT | NT | NT | NT | NT |
| Spectinomycin | NT | NT | NT | NT | NT |
| Tetracycline | R | R | R | R | I |
| Ticarcillin | R | R | R | R | R |
| Ticarcillin/CA | R | I | I | R | R |
| TMS | R | R | R | R | R |

## Table A-68
## Antibiogram for BVMTH and CVHSR Isolates - 2007
***(First Isolates)***

| | Amikacin | Amoxicillin/CA | Ampicillin | Cefazolin | Cefoxitin | Cefpodoxime | Ceftiofur | Cephalothin | Chloramphenicol | Enrofloxacin | Clindamycin | Erythromycin | Gentamicin | Imipenem | Marbofloxacin | Orbifloxacin | Oxacillin | Penicillin | Rifampin | Sulphadimethoxime | Spectinomycin | Tetracycline | Ticarcillin | Ticarcillin/CA | TMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***E. coli*** | 97% | 78% | 50% | 72% | 78% | 78% | 78% | 63% | 72% | 88% | 0% | 0% | 66% | 100% | 88% | -- | 0% | 0% | 0% | -- | -- | 53% | 59% | 81% | 59% |
| ***E. coli (foal)*** | 100% | 94% | 75% | 88% | 94% | 89% | 94% | 63% | 81% | 88% | 0% | 0% | 81% | 100% | 89% | -- | 0% | 0% | 0% | ### | 0% | 69% | 75% | 94% | 81% |
| ***S. equi zoo*** | 84% | 88% | 92% | 92% | 92% | 60% | 88% | 92% | 88% | 60% | 88% | 0% | 92% | 100% | 88% | -- | 96% | 92% | 92% | -- | -- | 72% | 100% | 100% | 100% |
| ***Salmonella*** | 100% | 81% | 72% | 75% | 89% | 83% | 83% | 78% | 86% | 94% | 0% | 0% | 83% | 100% | 97% | -- | 0% | 0% | 0% | -- | -- | 81% | 78% | 81% | 89% |
| ***S. aureus*** | 38% | 38% | 0% | 38% | 38% | 31% | 38% | 38% | 100% | 92% | 15% | 15% | 38% | 31% | 100% | -- | 38% | 0% | 100% | -- | -- | 100% | 11% | 38% | 46% |
| ***P. aeruginosa*** | 83% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 67% | 0% | 0% | 83% | 100% | -- | -- | 0% | 0% | 0% | -- | -- | 0% | 83% | 83% | 33% |
| ***K. pneumoniae*** | 100% | 100% | 0% | 88% | 100% | 88% | 88% | 88% | 75% | 88% | 0% | 0% | 88% | 100% | 100% | -- | 0% | 0% | 0% | -- | -- | 75% | 0% | 100% | 63% |
| ***Strep. beta*** | 33% | 67% | 67% | 100% | 100% | 67% | 100% | 100% | 100% | 67% | 67% | 0% | 67% | 100% | 100% | -- | 100% | 100% | 100% | -- | -- | 67% | 100% | 100% | 100% |
| ***S.equi equi*** | 13% | 88% | 50% | 75% | 75% | 57% | 38% | 100% | 38% | 25% | 50% | 0% | 38% | 100% | 25% | -- | 86% | 75% | 75% | -- | -- | 25% | 88% | 100% | 100% |
| ***Strep. dysgalactiae*** | 75% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 0% | 100% | 100% | 100% | -- | 100% | 100% | 100% | -- | -- | 75% | 100% | 100% | 100% |
| ***S. xylosus*** | 80% | 80% | 80% | 80% | 100% | 80% | 80% | 100% | 80% | 60% | 40% | 40% | 100% | 80% | 60% | -- | 100% | 80% | 100% | -- | -- | 80% | 100% | 100% | 100% |
| ***Staph. species*** | 100% | 67% | 0% | 67% | 67% | 67% | 67% | 67% | 100% | 67% | 33% | 33% | 67% | 67% | 100% | -- | 67% | 33% | 100% | -- | -- | 100% | 67% | 67% | 100% |
| ***Enterococcus species*** | 0% | 80% | 60% | 20% | 10% | 0% | 0% | 30% | 56% | 20% | 11% | 10% | 10% | 50% | -- | -- | 0% | 80% | 40% | -- | -- | 40% | 60% | 60% | 56% |
| ***Actinobacillus equuli*** | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 0% | 50% | 100% | 100% | -- | -- | 100% | 0% | 100% | -- | -- | 75% | 100% | 100% | 100% |
| ***Actinobacillus suis*** | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 0% | 0% | 100% | 100% | -- | -- | 50% | 0% | 100% | -- | -- | 100% | 100% | 100% | 100% |
| ***Actinobacillus species*** | 100% | 80% | 80% | 80% | 80% | 80% | 80% | 100% | 80% | 100% | 20% | 40% | 100% | 100% | -- | -- | 60% | 0% | 100% | -- | -- | 80% | 80% | 80% | 80% |

**Table A-69**
**Antibiogram for**
**RVC Isolates - 2007**
***(First Isolates)***

| | Amikacin | Amoxicillin/CA | Ampicillin | Cefazolin | Cefoxitin | Cefpodoxime | Ceftiofur | Cephalothin | Chloramphenicol | Enrofloxacin | Clindamycin | Erythromycin | Gentamicin | Imipenem | Marbofloxacin | Orbifloxacin | Oxacillin | Penicillin | Rifampin | Sulphadimethoxime | Spectinomycin | Tetracycline | Ticarcillin | Ticarcillin/CA | TMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***E. coli*** | 97% | 83% | 69% | 86% | 89% | 86% | 91% | 66% | 86% | 86% | 0% | 0% | 71% | 100% | 89% | -- | 0% | 0% | 0% | -- | -- | 66% | 69% | 83% | 71% |
| ***S. equi zoo*** | 59% | 100% | 83% | 100% | 100% | 79% | 90% | 100% | 93% | 76% | 75% | 0% | 93% | 100% | 100% | -- | 89% | 86% | 89% | -- | -- | 59% | 100% | 100% | 100% |
| ***Salmonella*** | 100% | 88% | 76% | 76% | 88% | 88% | 88% | 76% | 82% | 94% | 0% | 0% | 88% | 100% | 100% | -- | 0% | 0% | 0% | -- | -- | 76% | 76% | -- | 94% |
| ***S. aureus*** | 100% | 91% | 0% | 91% | 91% | 91% | 91% | 91% | 82% | 100% | 50% | 45% | 82% | 73% | 100% | -- | 91% | 0% | 100% | -- | -- | 100% | 67% | 91% | 100% |
| ***P. aeruginosa*** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 23% | 85% | 0% | 0% | 77% | 100% | -- | -- | 8% | 0% | 0% | -- | -- | 0% | 77% | 77% | 46% |
| ***K. pneumoniae*** | 92% | 83% | 0% | 100% | 100% | 100% | 100% | 83% | 100% | 100% | 0% | 0% | 83% | 100% | 100% | -- | 0% | 0% | 0% | -- | -- | 100% | 0% | 83% | 91% |
| ***Strep. beta*** | 67% | 89% | 78% | 89% | 89% | 44% | 89% | 100% | 89% | 44% | 89% | 0% | 89% | 100% | 78% | -- | 100% | 100% | 100% | -- | -- | 67% | 100% | 100% | 100% |
| ***S.equi equi*** | 20% | 80% | 80% | 80% | 80% | 40% | 80% | 100% | 20% | 20% | 25% | 0% | 40% | 100% | 20% | -- | 100% | 100% | 80% | -- | -- | 0% | 100% | 100% | 100% |
| ***Strep. dysgalactiae*** | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 0% | 100% | 100% | 100% | -- | 100% | 100% | 100% | -- | -- | 100% | 100% | 100% | 100% |
| ***S. xylosus*** | 100% | 67% | 58% | 75% | 83% | 58% | 75% | 92% | 50% | 83% | 0% | 0% | 92% | 58% | 75% | -- | 92% | 58% | 92% | -- | -- | 42% | 92% | 92% | 91% |
| ***Staph. species*** | 89% | 100% | 67% | 89% | 100% | 56% | 67% | 100% | 89% | 89% | 0% | 22% | 78% | 100% | 89% | -- | 100% | 67% | 89% | -- | -- | 89% | 100% | 100% | 100% |
| ***Enterococcus species*** | 50% | 75% | 75% | 50% | 25% | 0% | 25% | 50% | 25% | 25% | 0% | 0% | 75% | 75% | -- | -- | 0% | 50% | 0% | -- | -- | 50% | 50% | 50% | 50% |
| ***Actinobacillus equuli*** | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 0% | 0% | 100% | 100% | -- | -- | 100% | 0% | 100% | -- | -- | 100% | 100% | 100% | 100% |
| ***Actinobacillus suis*** | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 0% | 0% | 100% | 100% | -- | -- | 100% | 0% | 100% | -- | -- | 100% | 100% | 100% | 100% |
| ***Actinobacillus species*** | 100% | 100% | 75% | 100% | 75% | 100% | 100% | 100% | 100% | 100% | 50% | 50% | 100% | 100% | -- | -- | 100% | 0% | 100% | -- | -- | 100% | 100% | 100% | 100% |

**Table A-70**
**Multi-Drug Resistance by Organism**
***(First Isolates)***

| | N | Resistant to 0 Antibiotics | Resistant to 1 Antibiotic | Resistant to 2 to 4 Antibiotics | Resistant to 5 or More Antibiotics |
|---|---|---|---|---|---|
| ***E. coli*** | 245 | 0% | 31% | 18% | 50% |
| ***S. equi zoo*** | 205 | 42% | 30% | 21% | 7% |
| ***Salmonella Group B*** | 42 | 0% | 0% | 0% | 100% |
| ***Salmonella Group C1*** | 22 | 0% | 0% | 5% | 95% |
| ***Salmonella Group C2*** | 30 | 0% | 3% | 3% | 93% |
| ***Salmonella species*** | 71 | 0% | 0% | 1% | 99% |
| ***S. aureus*** | 57 | 28% | 4% | 28% | 40% |
| ***P. aeruginosa*** | 53 | 0% | 0% | 0% | 100% |
| ***K. pneumoniae*** | 50 | 0% | 0% | 2% | 98% |
| ***Strep. beta*** | 48 | 27% | 27% | 38% | 8% |
| ***S.equi equi*** | 38 | 16% | 5% | 39% | 39% |
| ***Strep. dysgalactiae*** | 37 | 35% | 16% | 24% | 24% |
| ***S. xylosus*** | 32 | 9% | 9% | 47% | 34% |
| ***Staph. species*** | 30 | 13% | 23% | 37% | 27% |
| ***Enterococcus species*** | 27 | 7% | 0% | 11% | 81% |
| ***Actinobacillus equuli*** | 18 | 50% | 28% | 22% | 0% |
| ***Actinobacillus species*** | 18 | 28% | 44% | 17% | 11% |
| ***Actinobacillus suis*** | 16 | 60% | 20% | 20% | 0% |
| ***Rhodococcus equi*** | 14 | 7% | 0% | 50% | 43% |

VITA

Margaret M. Brosnahan, DVM

Candidate for the Degree of

Master of Science

Thesis: BACTERIAL ISOLATES AND ANTIMICROBIAL SUSCEPTIBILITY PHENOTYPES OF EQUINE SPECIMENS SUBMITTED TO THE OKLAHOMA ANIMAL DISEASE AND DIAGNOSTIC LABORATORY 2005 – 2007

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Scope and Method of Study:

Antimicrobial resistance is a topic of pervasive importance in both human and veterinary medicine. Increasingly, the zoonotic transfer of pathogens such as multi-drug resistance strains of Salmonella, methicillin-resistant Staphylococcus aureus and vancomycin-resistant Enterococcus species is reported. The first step in responsible and effective use of antimicrobials in veterinary practice is to gain knowledge of the institutional and regional microbiologic environment. To this end, a large scale retrospective analysis was undertaken of all isolates from equine specimens submitted to the Oklahoma Animal Disease and Diagnostic Laboratory (OADDL) by the Boren Veterinary Medical Teaching Hospital, the College of Veterinary Health Sciences Ranch, and the regional veterinary community. Analysis was performed on pathogens identified, susceptibility phenotypes, and overall susceptibility patterns.

Findings and Conclusions:

The nature of bacterial isolates from equine specimens submitted to OADDL is similar to reported literature. Outbreaks of mutli-drug resistant pathogens, particularly Staphylococcus aureus, have occurred at the BVMTH. These findings are supportive of real-time surveillance of major equine pathogens.

ADVISER'S APPROVAL: Brenda C. Love