[Online Journal of Rural Research & Policy](https://newprairiepress.org/ojrrp)

Volume 5
Issue 7 *Special Issue: Rural Veterinary Practice*

Article 6

2010

Survey of Biosecurity Practices Utilized by Veterinarians Working with Farm Animal Species

David E. Anderson
Kansas State University

Recommended Citation
Anderson, David E. (2010) "Survey of Biosecurity Practices Utilized by Veterinarians Working with Farm Animal Species," *Online Journal of Rural Research & Policy*: Vol. 5: Iss. 7. https://doi.org/10.4148/ojrrp.v5i7.263

Survey of Biosecurity Practices Utilized by Veterinarians Working with Farm Animal Species

DAVID E. ANDERSON, DVM, MS, DACVS
College of Veterinary Medicine
Kansas State University

Recommended Citation Style:
Anderson, David E. "Survey of Biosecurity Practices Utilized by Veterinarians Working with Farm Animal Species." The Online Journal of Rural Research and Policy 5.7 (2010): 1-13.

Key words: Biosecurity, Veterinarian Practices, Farm Animal Species, Biocontainment, Agroterrorism

This is a peer- reviewed article.

Introduction

Biosecurity programs can be discussed from many perspectives. In many cases, biosecurity may be regulated state or federal programs with law enforcement – the goals of which are to protect the "national" livestock resources and protect consumer interests.[1] Alternatively, these programs may be producer level programs that are voluntarily established for protection of personal livestock investments. A core principle in the definition of "biosecurity" is the desire to prevent the introduction of disease.[2] When infectious disease is present on a farm or in a region, the term "biocontainment" may be used to describe programs aimed at confinement of the diseases to that farm or region such that it does not spread to other farms. Veterinarians are intimately involved in the maintenance of health and in the diagnosis and treatment of disease. When confronting an ongoing disease diagnosis and treatment situation, biocontainment can be readily implemented because the effects are apparent. However, when working to maintain a healthy herd, biosecurity practices may be more challenging to enforce because the threat is neither apparent nor seems eminent. An additional perspective on biosecurity relates to zoonotic diseases. Animal handlers and veterinarians are at risk for disease transmission from the animal to humans as part of their normal daily work habits.[3] This chronic and persistent exposure may lead to complacency regarding risk if the people involved have never knowingly suffered disease. Thus, biosecurity can be a challenging concept for farm managers and veterinarians to apply in field settings.

Veterinarians are challenged with different scenarios regarding their role in the treatment and prevention of disease. Veterinary practices having haul-in facilities with the option of hospitalization of livestock present different challenges as compared with veterinarians and vehicles traveling to farms for on-site procedures. Veterinary hospitals serve to concentrate sick or injured animals, pose risk of inter-species disease exposure, and present a greater burden on personnel to practice optimal hygiene and disinfection protocols.[4, 5] The veterinary hospital serves as the point source for interaction of multiple livestock operations. Veterinarians performing on-farm services have different challenges for biosecurity protocols because the vehicle, equipment, and practice personnel are the potential point sources of transmission of disease from one livestock operation to another. Veterinary practices that serve fewer, larger clients are less likely to act as a vehicle for transmission because they are less likely to visit more than one operation per day. Veterinarians that service many small sized farm clients may pose a greater risk because they are likely to visit multiple farms on a given day. Biosecurity programs conceptualized for ideal implementation are unlikely to translate directly into practice because of unforeseen obstacles, psychological barriers, or other confounding factors. Veterinarians represent a potential risk factor for client farms because the same individuals are responsible for contacting healthy, apparently healthy but diseased, and clinically diseased animals. The survey herein was undertaken in order to better understand how practicing veterinarians, in private practice settings, deal with the challenges of protecting their clients from the introduction or spread of disease. The purpose of this study was to document current biosecurity procedures used by practicing veterinarians under field conditions and determine which practices were most commonly or readily employed.

Materials and Methods:

An electronic survey was distributed using e-mail list severs of the American Association of Bovine Practitioners, American Association of Small Ruminant Practitioners, and a Llama Medicine Discussion Group. Practitioners were asked to provide details of biosecurity protocols they personally used when visiting client farms. Veterinarians were specifically asked not to discuss idealized protocols, and they were discouraged from projecting what they thought an optimal program would be, or to discuss any practice they were not actually performing. Instead, practitioners were asked to describe specifically what they actually do on a day-to-day basis for biosecurity and to make specific reference to practice type, state, country, use of coveralls/ aprons, boots, head covers, truck maintenance, separation of animals, facilities maintenance, needle use e.g. for vaccinations, instrument maintenance, and any other specific items. Only those surveys completed by private practitioners were included in the analysis.

Results

Completed surveys were returned by 53 private practitioners in different practices and not associated with corporate, government, or academic institutions. Demographic data was generated and practices stratified to include those who worked with cattle only (Bovine Practice; n-26) and those who worked with multiple species of farm animals (Mixed Large Animal Practices; n-27).

STUDY POPULATION

Of the 53 completed surveys, 26 were from practitioners who worked only with cattle (Bovine practices). These practices were located primarily in the USA and included the states of Idaho, New York, Utah, Ohio, Wisconsin, Pennsylvania, Michigan, Nebraska, Vermont, California, Washington, and Texas. International respondents included practitioners from Canada (Quebec, Ontario), Germany (Munich), Sweden (Skara), and Equador (Quito).

The remaining 27 completed surveys were from practitioners who worked with multiple farm animal species (Mixed large animal practices). These practitioners were primarily located in the United State and included the states of New York, Virginia, Connecticut, North Carolina, Oregon, Florida, Wisconsin, Illinois, Pennsylvania, Washington, Ohio, Georgia, and California. One respondent was located in Zurich, Switzerland.

PERSONAL BIOSECURITY PRACTICES

COVERALL USE

Of the 26 bovine practices, 14 (54%) changed coveralls between farms and sometimes between buildings on the same farm, and 12 (46%) changed coveralls "as needed" based on appearance of cleanliness. Of the 27 mixed large animal practices, 13 (48%) changed coveralls between every farm, 1 (4%) changed coveralls between all cattle client farms but only as needed based on cleanliness between small ruminant or camelid farms, and 13 (48%) changed coveralls on an as-needed basis based on appearance of cleanliness.

BOOTS USE

Boots were thoroughly cleaned and disinfected by 22 out of 26 (85%) bovine practices and were cleaned on an as needed basis for clean appearance between farms by 4 (15%). These habits were similar among mixed large animal practices where 22 out of 27 (81%) cleaned boots between every farm. Interestingly, 4 of those 22 (18%) practices indicated use of disposable boot covers, especially if a problem had previously been identified on that farm. Out of the 27 MLA practices, 5 (19%) cleaned boots on an as-needed basis and 2 of those 5 (40%) cleaned boots after every cattle call, but only cleaned as needed for small ruminant farms.

HEAD COVER

Four practices commented on the use of hats by their veterinarians. Of these 4, 2 were from bovine practices and 2 were mixed large animal practices. All 4 respondents indicated that the same hat was worn to all farms without cleaning unless obviously dirty.

EQUIPMENT BIOSECURITY PRACTICES

TRUCK MAINTENANCE

Of the 26 practices, 19 (73%) had no specific vehicle maintenance or scheduled cleaning program. Only 4 out of 26 (15%) bovine practices washed their practice vehicles regularly. Truck cleaning was performed on a daily basis in 1 practice and on a weekly basis in 3 practices. Vehicle use was restricted in 3 out of 26 (12%) practices in which the practitioners did not drive their vehicle in animal use areas. These vehicle biosecurity methods were similar among mixed large animal practices were 5 out of 27 (19%) did not allow the vehicle to be driven onto farms, 2 (7%) cleaned their truck weekly, and 20 (74%) had no specific truck maintenance plan or schedule cleaning program.

NEEDLE USE

The principle of "one needle per cow, one cow per needle" was reported by 8 (31%) out of 26 bovine practices. A single needle was used on multiple cattle by 9 (35%) bovine practices. The range of usage for needles varied from 1 needle per 4 head to 1 needle per 20 head. Among mixed large animal practices, 10 (37%) out of 27 used one needle per animal and 4 (15%) used one needle on multiple animals.

INSTRUMENT MAINTENANCE

Bovine practices reported that instruments and equipment were autoclaved between surgeries in 11 (42%) out of 26 practices and that these instruments were chemically sanitized in 6 (23%) practices before each use. Mixed large animal practices reported that 4 (15%) out of 27 indicated that instruments are autoclave sterilized and 8 (30%) chemically sanitized instruments before use.

CLIENT BIOSECURITY PRACTICES

SEPARATION OF ANIMALS

Isolation of new arrivals for various periods of time was performed regularly by 4 (15%) out of 26 bovine practices. This was performed by 2 (7%) out of 27 mixed large animal practitioners.

FACILITIES

Of the 26 bovine practices, 3 recommended use of boot washing and disinfection stations by farm personnel to minimize movement of manure and contaminants from one area of the farm to another. None of the 27 mixed large animal practices mentioned use of special practices by farm personnel.

GENERAL COMMENTS

Practioners were invited to make general comments regarding biosecurity practices in field settings. These comments are summarized in Table 1 (Bovine practices) and Table 2 (mixed large animal practices).

Discussion

This study showed a dearth of common biosecurity protocols among practicing veterinarians. This serves to emphasize that although idealized procedures allow targeting of specific practices and goals for control and prevention of contagious diseases, realities of practices applied in-the-field must be addressed. The respondents represent a wide range of geographic and educational backgrounds. However, this study revealed that some recommended biosecurity procedures are commonly used while others are rarely applied. The cleaning and disinfection of boots was the most commonly performed biosecurity procedure among both sets of practitioners with approximately 80% performing this between every farm. This finding implies that manure contamination is widely accepted as a significant risk for transmission of disease and has been applied in practice by boot washing and disinfection. Interestingly, cleaning or changing coveralls was only done by about 50% of practices and hats were not cleaned between farms. Mixed large animal practitioners mentioned that there was a lesser concern for biosecurity between small ruminant (including llamas and alpacas) farms than there was between cattle farms. The prior history of disease on the particular client's farm effected these choices. Surprisingly few practices reported a protocol for vehicle cleaning and disinfection.

Biosecurity and biocontainment are complex problems with multiple risk factors and confounding variables. This can be illustrated by a study on Campylobacter spp infection in broiler chicken flocks.[6] In that study, logistic regression was used to identify the most important risk factors for spread of the disease. The risk factors identified in the final model were absence of cement floors (4.15 odds ratio (OR)), presence of other animal species on the farm (7.52 OR), use of transportation cartons as feed plates (5.28 OR), disposal of manure on the farm (15.57 OR), lack of specific clothing requirements for farm workers (4.52 OR), and absence of cleaning and disinfection of the broiler house and surroundings (6.86 OR). These data illustrate the role that on-farm, inter-farm, and inter-species mingling can have on the propagation of diseases within the target species. In the study reported herein, needles were found to be a risk factor or transmission of disease. Many practices reported using a single needle for up to 20 head of cattle. Common use of needles has been shown to be a means of transmission of *Anaplasma marginale* in cattle.[7]

Data mining is an interesting and powerful tool to conduct a disease risk investigation. Compromise of biosecurity in cattle herds residing in Wales was explored using this technique in a recent study.[8] In that study, logistic regression, classification trees, and factor analysis were used to classify cattle herds into risk of disease presence as a surveillance tool. This may be applied either for endemic diseases or in times of emergence of new diseases. In that study, infectious diseases were used to assess farm risk and the category of "high risk holdings" was determined to be large, open cattle farms with frequent movement of livestock onto the farm and in proximity to large number of livestock. This study helps to identify risk in times when eminent disease outbreaks are not apparent. The beliefs and practices used by producers may have a profound influence on practicing veterinarians as demonstrated in the general comments (Table 1 and Table 2). This may help explain some of the findings reported herein.

The proximity of farms is likely associated with risk for breach of biosecurity with respect to disease transmission. A study focused on determination of the mode of indirect contact as compared with direct contact among cattle demonstrated this concern.[9] Hierarchial cluster analysis and network analysis were used to assess the data relative to the connectedness of cattle and farm operations. The data suggested that farm level contacts with companies and contractors may increase disease risk because these entities perform little to no biosecurity prevention practices. Not surprisingly, adjacent farms are most likely to share equipment and have inter-farm human and livestock traffic. Thus, increasing density and contiguous land among farms represent a significant risk of breech in biosecurity.

These factors were further explored in a study that was conducted to examine the application of biosecurity practices on livestock farms in Sweden.[10] The purpose of that research was to identify common biosecurity practices used in various livestock operations and by animal transporters and veterinarians. Not surprisingly, biosecurity practices varied widely. The size of the farm and species of livestock being raised were significant confounding variables effecting the biosecurity practices utilized. One of the most common breeches of biosecurity were that 50% of farms purchasing animals introduced them directly to the farm without a quarantine period. Visitors to the farms were asked to wear protective clothing on fewer than 40% of the farms. In our study, isolation protocols for new animals arriving at the farm were infrequently done. The most stringent biosecurity was practiced by swine farms as compared with cattle, small ruminants or mixed livestock farms. Hobby farms reported less stringent biosecurity as compared with large commercial livestock operations. Interestingly, farmers reported that among visitors to the farm, the greatest biosecurity efforts were undertaken by veterinarians and artificial insemination technicians. The lowest standards were demonstrated by animal transporters, salesmen, and repairmen. A common theme from the farm owners was the perception that the risk of introduction of disease was low. The authors speculated that this impression was linked to a poor understanding of the means of transmission of various diseases. The authors concluded that farmer education could substantially improve acceptance and enforcement of biosecurity practices.

Participation in livestock shows, exhibitions, and fairs remains popular. These activities represent a potential risk for exposure to infectious and contagious diseases from a large number of farms in a short period of time with close proximity and frequent episodes of direct contact. In a survey of biosecurity practices among farms attending California exhibitions, data revealed that 7% of participants took no biosecurity action prior to arrival at the show.[11] Further, 10% of participants indicated that they performed no biosecurity protocol for their own animals returning to the farm of origin. Although these numbers may appear small at first, these participants are responsible for a significant risk of exposure to other livestock because 97% of animals being exhibited returned to the farm of origin after the fair/show. Of the participants who reported that they practiced biosecurity when returning home from exhibitions, only 36% of these practiced quarantine of the exhibited animals. These data are particularly concerning when considering the fact that 6% of all participants came from states other than California. The study of California State Fair participants identified several core values of biosecurity that farmers and ranchers considered important for their personal livestock. The most common protocols used before the show included individual animal inspection (76%) and vaccination of animals (62%). Interestingly, protocols that were infrequently used were disinfection of truck and trailer (36%) and disinfection of boots and equipment (19%). Thus, contaminants from the farm of origin may be brought to the fair grounds. During the exhibition, the most commonly practiced protocols were avoidance of shared equipment (61%) and preventing physical contact with other animals (50%). Infrequently used protocols included use of hand sanitizers (38%), preventing visitors from touching animals (37%), disinfecting pens prior to use (23%), and disinfecting boots and equipment (9%). Thus, contaminants at the fairgrounds may be easily moved amongst various exhibited livestock. The practice most commonly done after the fair was to wash clothes and tools used at the show (67%). Infrequently used practices included disinfection of equipment (40%), disinfection of the truck and trailer (37%), quarantine of show animals (26%), and disinfection of boots and shoes (14%). Thus, exposure of the home farm from contaminant exposure at the fairgrounds is possible. These studies serve to highlight a seemingly low perception of, concern for, or awareness of the need for biosecurity by animal owners and managers. In this instance, the fact that farms were moving their own livestock may diminish their expectation for the risk of disease exposure or the likelihood of bringing disease to their own farm. Veterinarians can play a role in increasing awareness of or urgency for biosecurity. Epidemiolgic tools such as disease modeling can be used to estimate risk.[12] Specific biosecurity plans may be able to be tailored to livestock operations be prioritizing disease concerns and implementing specific strategies to mitigate those risks.

Biosecurity is increasingly discussed in concert with security, agroterrorism, and terrorism. Farm managers and veterinarians can play a vital role in the protection of the agricultural commodity industries and the public by preventing the purposeful introduction of contagious diseases or the intentional contamination of milk and meat products before they enter the consumer marketplace.[13] Producers have shown a receptiveness to security training and implementation of measures aimed at prevention of agroterrorism.[14] An example of how easily a large number of farms could be effected by the contamination of a point source has been illustrated by an event where a contaminant in feed occurred at a feed mixing mill.[15] This contaminant resulted in the exposure of over 1000 animals, illness in over 500 animals, and the death of nearly 150 animals. Although this error occurred because of a mistake, the contamination could easily have been malicious.

One significant but often overlooked concern in biosecurity as it relates to infectious and contagious diseases is the need to conserve genetically valuable livestock. When highly contagious diseases, such as FMD, arise, the individual value of livestock can not undermine the goal of biocontainment of the outbreak and eradication of the disease. Seed stock farms and ranches must consider the potential loss when designing a biosecurity plan that will maximize the likelihood for prevention of the introduction of disease. The biosecurity plan must consider every facet of daily farm operation: people, vehicles, equipment, food sources, manure and waste management, carcass disposal, wildlife, etc.[16] Whenever possible, genetics should be preserved through artificial means such as semen and embryo freezing, somatic cell storage for potential cloning, and off sight depositories.

Biosecurity is increasingly important to include in daily routines for farm management as well as veterinary practice. Veterinarians bear the burden of responsibility for the protection of their clients' farm and ranches from the introduction of diseases to their premise because of their professional activities. These clients depend on livestock for their livelihood and future and the veterinarian must be mindful of the impact resulting from compromised biosecurity. Veterinarians should consider developing a practice biosecurity plan using the principles of Hazard Analysis and Critical Control Point.[17] These include a hazard analysis, identification of the control points, determining critical limits for the control points, establishing monitoring programs, determining corrective action in response to breech of control points, establishing a verification method, and designing effective record-keeping practices. Epidemiologic tools can be used to demonstrate to clients the potential risk of farm exposure for various diseases.[18] These tools can also be used to develop plans to mitigate risks in the event of a disease outbreak. Veterinary colleges, state and federal officials and veterinary offices, diagnostic laboratories, and extension services all can be valuable resources in developing biosecurity plans, rapid diagnostic assessment of new diseases, and establishing risk.

Veterinary Teaching Hospitals are perceived to have optimal or ideal biosecurity programs and practices. Veterinarians may recall activities they were exposed to as students in the professional curriculum and use these as a benchmarks from which they develop their own personal or practice biosecurity standards. This may not achieve the desired outcome. In a survey of veterinary teaching hospitals, 82% reported a nosocomial infection within the previous 5 years, 58% had restricted admission to the hospital as a result of disease outbreak at the hospital, and 50% reported occurrence of zoonotic infections.[19] Surprisingly only 42% of teaching hospitals required biosecurity training of employees. Despite these facts, 40% of the teaching hospitals self-reported that they considered their infection control efforts to be in the top 10% of teaching hospitals. Disease outbreaks result in dramatic changes in biosecurity awareness, compliance, and monitoring to prevent additional outbreaks. The effectiveness of designing, implementing, training, and monitoring have been shown to be useful in developing habitual use of biosecurity principles.[20] These studies emphasizes the need for objective criterion based evaluations of biosecurity protocols so that personal bias does not adversely alter the effectiveness of the program. Surveillance is a key feature of objective criteria from which to identify lapses in biosecurity. Veterinary medical teaching hospitals have a large number of specialists in a large diversity of fields. These highly trained individuals may perceive that they have superior habits and protocols compared to general practices. The published studies of teaching hospitals suggest that this is not necessarily the case.[21, 22]

The results of the study reported herein highlight some of the biosecurity practices that are common and identifies some protocols that have not been accepted under daily field practice conditions. Further, this study suggests that there are different standards among practitioners when comparing biosecurity practices for bovine, small ruminant, and swine farms. Further research is warranted to improve biosecurity standards of practice and explore species bias.

Table 1. General comments made by some of the 26 bovine only practices regarding biosecurity practices in field settings. [back]

- Rectal sleeves are changed between pens
- Try not to leave windows down and spread flies
- Calving use disposable garbage bag-like aprons, but no gloves
- Use sterile plastic OB sleeves plus surgery gloves after a good scrub changed between animals
- OB suits/aprons are washed in the washing machine with soap and hung to dry between all uses
- Hands get washed 50% of the time
- Work with the most susceptible populations first, then move to the sick animals
- In swine industry, change completely between farms
- I let the individual client set the pace for this. If the client continues to buy cows from dealers, dispersal auctions despite my warnings, I do not bother to put clean coverall on for his farm. In fact some of these type clients tell me not to do anything that will increase their call charge just for biosecurity reasons!
- Use the clients' supplies as much as possible
- Use disposable gloves for many procedures

Table 2. General comments made by some of the 27 mixed large animal practices regarding biosecurity practices in field settings. [back]

- Use the clients' supplies as much as possible
- Avoid going to a Caseous Lymphadenitis (CL) farm and a non CL farm on the same day
- Always use gloves
- Work with the most susceptible populations first, then move to the sick animals
- Wash hands
- Wear a glove on non palpating hand
- Use as much disposable equipment (gloves, boots, ultrasound, etc) as possible
- Eye ball health check of every animal every day
- Shear healthy sheep first then shear sick or sheep with known abscesses last

End Notes: Anderson, David E. "Survey of Biosecurity Practices Utilized by Veterinarians Working with Farm Animal Species." *Online Journal of Rural Research & Policy* (5.7, 2010).

1. Hueston WD, Taylor JD. Protecting US cattle: the role of national biosecurity programs. Vet Clin Food Anim 2002;18:177-196. [back]

2. Dargatz DA, Garry FB, Traub-Dargatz JL. An introduction to biosecurity of cattle operations. Vet Clin Food Anim 2002;18:1-5. [back]

3. Elchos B, Scheftel J. Discussion of the Compendium of Veterinary Standard Precautions: preventing zoonotic disease transmission in veterinary personnel. Zoonoses Public Health 2008;55:526-528. [back]

4. Benedict KM, Morley PS, Van Metre DC. Characteristics of biosecurity and infection control programs at veterinary teaching hospitals. J AM Vet med Assoc 2008;233:767-773. [back]

5. Morley PS. Surveillance for nosocomial infections in veterinary hospitals. Vet Clin Equine 2004;20:561-576. [back]

6. Cardinale E, Tall F, Guèyeb EF, Cisse M, Salvat G. Risk factors for *Campylobacter* spp. infection in Senegalese broiler-chicken flocks. Preventive Veterinary Medicine 64 (2004) 15–25. [back]

7. Reinbold JB, Coetzee JF, Hollis L, et al. Comparison of transmission of Anaplasma marginale infection using needle-free and standard needle injection. Proceedings of the 40th Annual Convention of the American Association of Bovine Practitioners. September 20-22, 2007, Vancouver, Canada: 262. [back]

8. Ortiz-Pelaez A, Pfeiffer DU. Use of data mining techniques to investigate disease risk classification as a proxy for compromised biosecurity of cattle herds in Wales. *BMC Veterinary Research* 2008, 4:24 (http://www.biomedcentral.com/1746-6148/4/24). [back]

9. Brennan ML, Kemp R, Christley RM. Direct and indirect contacts between cattle farms in north-west England. Preventive Veterinary Medicine 84 (2008) 242–260. [back]

10. Noremark M, Frossling J, Lewerin SS. Application of Routines that Contribute to On-farm Biosecurity as Reported by Swedish Livestock Farmers. Transbound Emerg Dis. 2010 May 24. http://www3.interscience.wiley.com/journal/123466892/abstract?CRETRY=1&SRETRY=0] [back]

11. Thunes C, Carpenter TE. Biosecurity practices and travel history of individuals exhibiting livestock at the 2005 California State Fair. J Am Vet Med Assoc 2007:231:581-585. [back]

12. Smith DR. Epidemiological tools for biosecurity and biocontainment. Vet Clin Food Anim 200218:157-176. [back]

13. Kelly AM. Veterinary medicine in the 21st century: the challenge of biosecurity. ILAR Journal 2005;46:62-64. [back]

14. Moore DA, Payne M. An evaluation of dairy producer emergency preparedness and farm security education. J Dairy Sci 2007;90:2052-2057. [back]

15. Kosal M, Anderson DE. An unaddressed issue of agricultural terrorism: a case study on feed security. Journal of Animal Science, 2004;82(11):3394-3400. [back]

16. Wrathall AE, Simmons HA, Bowles DJ, Jones S. Biosecurity strategies for conserving valuable livestock genetic resources. Reprod, Fertil, Develop 2004;16:103-112. [back]

17. Morley PS. Biosecurity of veterinary practices. Vet Clin Food Anim 2002; 18:133-155. [back]

18. Smith DR. Epidemiological tools for biosecurity and biocontainment. Vet Clin Food Anim 200218:157-176. [back]

19. Morley PS. Surveillance for nosocomial infections in veterinary hospitals. Vet Clin Equine 2004; 20:561-576. [back]

20. Smith BP, House JK, Magdesian KG, et al. Principles of an infectious disease control program for preventing nosocomial gastrointestinal and respiratory tract diseases in large animal veterinary hospitals. J AM vet med Assoc 2004; 225:1186-1195. [back]

21. Morley PS. Surveillance for nosocomial infections in veterinary hospitals. Vet Clin Equine 2004; 20:561-576. [back]

22. Smith BP, House JK, Magdesian KG, et al. Principles of an infectious disease control program for preventing nosocomial gastrointestinal and respiratory tract diseases in large animal veterinary hospitals. J AM vet med Assoc 2004; 225:1186-1195. [back]

Author Information

David E. Anderson (back to top)

David E Anderson, DVM, MS, DACVS, Professor, Head of Agricultural Practices, College of Veterinary Medicine, Kansas State University. Dr. Anderson was raised in North Carolina in the small farming town of Oak Ridge. He earned both a BS degree in Animal Science and a DVM from North Carolina State University. He then completed an intensive rotating internship in large animal medicine and surgery at the University of Georgia and a Residency in Food Animal Medicine, Surgery, and Reproduction at Kansas State University. Dr. Anderson became a board certified specialist in surgery (Diplomate ACVS) in 1995. While at Kansas State University, he earned a MS degree in Clinical Sciences focusing on bovine surgery bone physiology and fracture repair. Dr. Anderson became Head of Food Animal Medicine and Surgery at Ohio State University where he developed techniques in minimally invasive surgery of ruminants and founded the International Camelid Institute. The ICI is an information repository and continuing education center with participants from 17 countries around the globe. Currently, Dr. Anderson is Head of Agricultural Practices at Kansas State University in the Department of Clinical Sciences in the College of Veterinary Medicine. He continues development of novel surgical treatments of injuries that limit welfare and productive use of livestock. His research focus is in surgery of food animals with special emphasis on pain and welfare. In 2009, Dr. Anderson founded the International Academy of Farm Animal Surgery to provide a method for international exchange of information among veterinarians. The IAFAS has over 300 participants in 19 different countries.