suggested a need for increased personnel at the tracks to get perfect movement tracking, but suggested there was some value in having even an imperfect tracking system in racehorses. The study also pointed to the fact that the technology for scanners and software needs to be adjusted to make tracking less cumbersome and therefore more useful. Individuals that participated in the study still had to do a great deal of paperwork and data entry; a system with the ability to automatically upload the information would be more ideal. The same issues with a need for additional labor to sort through paperwork are faced in Louisiana with their equine infectious anemia program. Louisiana hires a student worker to keep track of horses when they are Coggins tested and their individual identifications are recorded in the state database.

10.5 Equine Industry Benefits

Benefits of a National Animal Identification System in the equine species are more numerous but much harder to quantify than adoption costs. Generally speaking, most industry members we visited with recognize potential benefits to equine identification, and feel that the industry should be proactive in creating a system. A large segment of the equine industry exists for pleasure and not business creating an array of benefits of animal ID across ownership incentives and animal uses. Major categories of benefits are discussed below.

10.5.1 Premises Registration

The first step of getting equine premises across the nation identified has already proven to be beneficial in some circumstances that have occurred. Wisconsin animal health officials were able to use their premises registration database to send out mailings with West Nile Virus education during the season when outbreaks commonly occur. Currently, animal health officials sometimes go so far as driving door to door to contact individuals in an area about animal disease outbreaks in the equine species; the ability to identify premises allow for better and faster establishment of quarantine regions and find other possibly

infected animals. An article from early 2008 stated that so far, over 430,000 premises have registered voluntarily with NAIS (Cordes, Hammerschmidt, 2008). The Jockey Club requires anyone who wants to purchase microchips from them to first have a premises identification number. However, one problem that the equine industry noted with the premises identification system is that it is currently a point location (such as an address) and not an area, so an individual farm can have multiple premises ID numbers if they chose to sign up every address in their area. It would also be extremely valuable to identify premises by type – which are farms, arenas, racetracks, stables, parks, trail riding areas, or other equine event locations – to help with density estimates and event studies.

10.5.2 An Official, Complete, Ideal Trace-Back System

In equine industry meetings, having an official, complete, ideal trace-back system was the most noted benefit of having an equine identification system. Simply having the ability to identify and trace horses contains many benefits within itself, particularly in disease containment, tracking, and possibly eradication. Currently, there is little to no ability to locate and quarantine horses in a given area surrounding a disease outbreak short of driving door-to-door. The ESWG notes that in being a responsible member of the livestock industry, some sort of identification system would aid the equine industry in working with other livestock groups to quickly trace diseases and prevent outbreaks. Premises identification as well as a trace-back system could make this more feasible. Reductions in commerce could also occur, which is discussed further below.

Disease outbreaks in recent years, in Florida, New Mexico, and numerous other states and locations, have indicated the possible benefits of more quickly being able to identify and trace horses when an outbreak occurs. Some individuals stated the number one priority in disease control in horses would be to track down a-symptomatic carrier horses. Numerous diseases in the horse world, including EHV and EIA, can be carried in and shed from a horse for years, sickening other equids without the host ever showing signs. If all horses in an outbreak could trace back to contact

with a horse showing no signs, at least that horse could be tested to see if it was a carrier animal. See the section "Equine Diseases of Concern" for more information on these cases.

Some members of the equine industry feel that disease tracking is already done to a high degree through CVIs, EIA testing, and other measures of tracking, but feel that the ability to track international horses in shows and races could prevent foreign animal diseases from entering the US. The Jockey Club stated that in any given year, less than five races are cancelled due to disease outbreaks, but race cancellations do occasionally occur. The Penn State study on veterinarians asked some additional questions about the National Animal Identification system, such as if they felt that NAIS would help stop the spread of foreign animal diseases, to which 55% reported yes and 45% responded no. Of the veterinarians in the survey, 76% reported that they had experienced a contagious disease outbreak, indicating that these outbreaks do occur on a regular basis.

Industry members generally feel that equine identification may help minimize the effects of disease outbreaks. Disease eradication could also save the industry a great deal of money – for example, with over 2 million EIA tests performed annually at a cost of over $25/test; EIA testing alone costs over $50 million dollars on an annual basis. If EIA could somehow be eradicated from the US over time, eliminating the need for testing, the industry could save this money.

10.5.3 Maintaining Equine Commerce and Movements

A proper trace-back system that could identify where a sick animal had been and which horses it had or had not been in contact with could assist the equine community in decreasing the level of quarantines and assist equine commerce with less interruptions and shorter durations. Recent outbreaks in the equine community and other livestock communities have prevented state to state or international commerce from occurring due to a lack of confidence in the state or nation's ability to track and contain the diseases. If a national system were in place, it may be possible to quarantine only the affected horses and allow other horses within the state or area to continue to move as needed. In addition, as

noted in the section "State of the Horse Industry," live equine exports constitute an annual value of over $460 million. An animal identification system that was in sync with other systems in the world could expedite the process of getting US horses into and out of other countries and bringing foreign horses into the US. If for any reason the US had a disease outbreak that prevented all equine exports from occurring, this could cost the industry millions of dollars.

10.5.4 Monitoring and Prevention of Loss or Theft

Though horse theft is not as common now as in the past due to better identification systems, horse theft does occur in rare instances. When the horse slaughter market was stronger, some members of the equine industry stated that horse theft seemed more common. Horses also occasionally get loose and get lost by breaking out of pastures or getting away on trail rides, and being able to positively identify these horses when they were found would be beneficial. Individuals that do not travel and compete with their horses regularly have less direct incentive to adopt NAIS. However, NAIS gives individuals the opportunity to positively identify their horses, for the lifetime of the animal, and many industry professionals feel that if the idea was properly presented, even backyard horse owners would be accepting. A lack of education is to blame for much of the anxiety over the NAIS in the equine species. USEF has even stated that they may be willing to provide microchips to their members at a reduced cost or free with the registration of the horse and membership, simply as a service to their members and the industry.

10.5.5 Disaster Relief and Recovery

In recent years, hurricanes Andrew, Katrina, and now Ike have shown the equine industry the value of having an animal identification system, or the problems that are caused by the lack of one in the case of Andrew. Hurricane Andrew was evidence to the horse industry of how bad it can be when horses are not identified. It took many weeks for owners to find their horses, if they ever did. On the other hand, hurricane Katrina was evidence of how beneficial unique identification can be. Due to the 1994 EIA testing law requiring unique identification, horses were almost all

identified and their owners were able to be found and contacted in a timely manner during the relief efforts. Virtually all horses were returned to their rightful owners following Katrina, which was not the case with many other livestock species in this and other disasters. Hurricane Ike in Texas has ongoing rescue efforts. A state park has become the staging area to collect all the misplaced livestock. Having a horse with unique, individual identification will make it much easier for the rescuers to find and contact owners, and for owners to find their horse if they go to the staging area to look for them. In addition to hurricanes, the same situations have occurred in the California and Colorado wildfires, where horses are pooled together in rescue facilities to get them out of the path of the fire, and then owners have to come to those facilities and attempt to pick their horse out of possibly hundreds of horses. In many cases horses look similar making visual identification problematic.

Severe blizzards in Colorado and Wyoming have also at times isolated horse herds miles from home with no access to food, and hay drops have saved the lives of these animals. Having premises with horses identified could aid in knowing where to look for stranded livestock to drop hay for these relief efforts. The Penn State veterinary survey asked questions about disaster planning in veterinarians' offices; 80% of respondents did not have a plan of action for emergency situations. Some respondents stated that in severe weather zones they do try to provide information to their clients and that they do consider disaster planning to be an important issue.

10.5.6 Organization of Production Records

Breeding operations can utilize microchip identification for tracking embryo recipient mares, to keep track of which mare is having which donor's foal. Some organizations require that recipient mares be identified by microchip prior to implanting an embryo. In addition, when mares go to the breeding shed, especially in the thoroughbred industry, proper identification is essential to ensure they are bred to the right stallion. Occasionally, mares are bred by the wrong stallion, resulting in the DNA not matching when the foal is born and registered with The Jockey Club. Many breeding farms currently use halters or collars on all

mares with the name of the horse on it, but these can break, become lost, and occasionally get switched. In addition, some staff on thoroughbred breeding farms cannot speak English, and therefore cannot read the halter tags. Having the ability to scan a number prior to breeding would almost eliminate the potential for mares being switched and allow for easier tracking of production records on the mares and stallions.

10.5.7 Show Check-In & Management

Having individual animal identification at horse shows could aid in the check in process, improving the speed of health checks and verifying that every animal entering the show grounds has an up to date Coggins test and health certificate. Having microchips and possibly electronic CVIs and Coggins tests would allow for faster check in than is currently possible with hard copies of paperwork. At rodeos electronic ID could provide verification that the correct cowboy is riding the correct bucking horses. Though rare, occasionally the wrong animal is brought into the chutes to be ridden. Show organizations could scan horses entering the gate to verify that the correct horse is entering the show ring, because on rare occasions the wrong horse is shown. The value to major show organizations is at the management level for shows: the ability to increase the speed of check-in, verify that the correct individuals are riding the correct horses, track points on the horses and riders during the show season, and assist in speeding up the numerous other small tasks that go into organizing major equine events. It may also help shows to prevent disease at their events and track affected horses if an outbreak were to occur.

10.5.8 "Smart Cards"

The benefits of using Smart Cards are closely related to show management and check in. Smart Cards, or Integrated Circuitry Cards, are credit card sized devices that have the ability to incorporate any desired information on the equine, such as the dates of EIA tests, CVIs, and brand inspections that are commonly required for equids to move interstate or be exhibited at large events. These cards are also capable of

allowing an individual to check in a horse for their classes, stalls, and other management issues at a horse show. They can be connected to private databases for farm management or professional organizations such as breed associations or show offices. Utilization of electronic health papers has to be approved by the states; over half of the states in the US have already approved this system. Using electronic paperwork for health papers could also guarantee that the correct horse has the correct health papers and reduce the amount of physical paperwork for the organizations requiring the documents as well as owners and veterinarians.

10.5.9 Racetrack Management and Racehorse Check In

There are numerous benefits of microchips that are specific to the racehorse world. The current system used to individually identify racehorses is a tattoo inside the lip of the horse with an individual code. When horses are checked in and out of the racetracks (if they keep track of this), checked in for races, or checked in for various other procedures such as veterinary examinations or breeding, quite often the lip tattoo is used to verify horse identity. This requires “flipping” the horse’s lip to read the tattoo. Though most thoroughbreds get used to their mouths being handled, some object to this procedure, especially right before a race when the horses are amped up and ready to run. Occasionally, during the pre-race checks, horses even flip over in the paddock and can hurt themselves or their handlers. Each track employs a professional horse identifier that checks horses pre-race, though in some cases the grooms are the ones who actually flip the lips.

Tattoos have the issue of sometimes fading or getting smeared. Microchips would allow for a major simplification of this check-in process. If microchips were implemented on a mandatory basis, this form of identification has the potential to replace lip tattoos in the check-in process, avoiding the potential for spreading disease by touching the lips of multiple horses to check tattoos, avoiding wasting gloves to guard against the spread of disease, speeding up the process with the quick scan of a wand as opposed to physically having to touch the horse, and

avoiding the potential for the horse objecting to its lip being flipped and hurting itself or its handlers in the process.

Microchips would provide definitive verification that the correct animal is being raced, and cannot be smeared or fade like lip tattoos sometimes do. In addition, horses could be identified when coming on and off the track to verify that the correct horses are working out at their scheduled work out times, and horses could be scanned in and out of the gates to verify their identities and aid in tracking, if a tracking system was implemented. Overall, it would be better for the horse handlers and horses alike. Thoroughbred industry owners would likely be sold on the idea if it would simplify their shipping in and out of racetracks and identity verification in the paddock or saddling enclosure. Occasionally, horses are purposely misidentified when leaving or entering the track. Trainers occasionally bring horses onto the track that are not racing on that track for training purposes, when only horses racing there are supposed to be on the track. Also, some high profile racehorses have been hauled off the track for veterinary procedures and been disguised as a "pony" horse or another racehorse to prevent the public from finding out the horse may have a health problem. The use of microchips could aid in increasing and simplifying security in the entire racehorse industry.

10.5.10 Management of Registries and Other Organizations

Numerous equine industry breed organization members mentioned that horse identification system could help their organization keep better track of their horses. There are more than 200 recognized breeds of horses worldwide, and there are at least 125 breed organizations in the United States according to the American Horse Council in 2007, and some horses are registered in multiple organizations. An example of this is that the AQHA is the primary Quarter Horse registry in the world, but there are several different registries for Foundation Quarter Horses, International Quarter Horse registries, and color registries that any breed of horse can be registered in if they are the right color. This, in addition to the mixing of breeds of horses in boarding stables and often at shows, and with the added issues of horses shifting from owner to owner

without registration being transferred or the papers being lost, makes registration papers only partially useful as a tracking device if not directly tied to some physical form of identification on the horse.

The address of the owner is often not where a horse lives. If a horse lives at a boarding stable, the address on registration papers will be the owner's address, not the stable where the horse is located. Microchipping the horse and having some form of movement tracking would aid in all of these struggles faced by breed registrations, by providing a permanent source of information attached to the horse for its lifetime. There are numerous examples of where breed registries have stated NAIS would help when USEF has a problem with horses changing hands and being reregistered under a different name by the new owners, allowing horses that were competing at more advanced levels to come back to lower levels under a new name (and therefore, win at those lower levels). This is not a major problem for the high level horses, but at the lower level shows the problem does occasionally exist. Having a microchip in the horse that is a permanent, tamper proof device identifying the horse, would prevent these issues from happening.

USEF would also like to offer their members the service of looking up a horse's show records via the microchip number in the instance that they are looking to buy the horse to verify that statements the seller makes about the animal are true. They feel that providing microchips to their members, which they have mentioned they are willing to do for free with registrations, may increase registration numbers in their organization. For these reasons, the fact that horses change names, owners, and move around a great deal in their organization, USEF supports NAIS. Having this system could aid the PRCA in verification of ownership and inventory numbers of stock contractors, because they have regulations that require contractors to own a certain number of animals to be recognized by the PRCA.

In the Thoroughbred industry, some breeders already microchip horses when they hit the ground, prior even to pulling a DNA sample for The Jockey Club. This provides permanent identification of the foal from birth, and prevents switching foals or other misidentifications from occurring before paperwork reaches The Jockey Club. Anywhere from 2-

4 foals annually are misidentified or have a DNA discrepancy. Microchips also prevent foals from being switched after the identification has occurred, to avoid issues such as a cheaper foal being switched for a more expensive foal after the expensive foal has died. The Jockey Club would have the ability to identify and manage a horse from the moment it hits the ground throughout its life, including finding out which horses end up at rescue facilities after their race careers.

The English studbook made microchipping mandatory, and numerous other nations are requiring microchips for registration or tracking purposes. Because of this, The Jockey Club felt that selling microchips to their clients would be worthwhile to assist Thoroughbred owners who desire to race or breed internationally. Other groups besides breed organizations feel that microchipping would aid in the management of their organization. Sales organizations feel that it would aid them in numerous ways. For one, it would prevent the need to flip lips at the sales, avoiding the spread of diseases or possible injuries to horses or handlers. Certain veterinary procedures, such as conformation altering procedures, are not allowed to be performed on horses by some sales organizations. Many high end Thoroughbred sales allow prospective buyers to look up veterinary records on the sale horses, and microchips could guarantee that no procedures are hidden from these records. Finally, it would provide permanent and definite identification of the sale horse, so that the right horse was sold in the ring and hauled out by the correct buyer. Additionally, some small show and rodeo circuits could utilize the microchip numbers to keep track of the horses, their owners, and their show records in a quicker electronic form, allowing tracking to be more feasible even at these lower level shows.

10.5.11 Identification for Veterinary Records

One of the veterinarians' biggest time constraints in doing a CVI is taking the time to write out and draw out the markings and color of the horses. Veterinarians do numerous CVIs annually, it is one of the most common calls they receive on horses, and therefore simplifying or speeding up this process in any way could save a great deal of time and money. Using microchips as definite identification and avoiding the time it takes to

write and draw out markings or other information would improve the speed and efficiency of EIA tests, CVIs, pre-purchase examinations, and could create a quicker, more organized system with these documents for disease trace back situations. Another benefit to veterinarians is for their own office organization and to identify the horse on health papers and records such as radiographs. When an individual wants to buy a horse internationally, it is important that the correct documents on the horse are received for the buyer's veterinarian's review, so that mistakes are not made when high dollar international purchases occur. Some veterinarians in the European Union put microchip numbers on horse records for management and sales purposes.

10.5.12 Biothermal Chips

If proven accurate, the biothermal chips could eliminate the need for taking temperatures on horses rectally, which can be a dangerous procedure with some horses. It could also lower the need for cross ties, which some veterinarians consider dangerous to the horse; because one individual would be able to read the horse's temperature in its neck rather than having to have it tied and go to the rear end of the animal. It would allow boarding stables, breeding farms, racehorse training stables, or show agencies to monitor horse health every day if desired. It can possibly allow these operations to catch infections before clinical signs are visually apparent helping to avoid transmission of possible disease outbreaks. In a quarantine situation, these chips could also provide a faster method to check temperatures with a lower risk of spreading infections to horses that are not yet affected.

10.5.13 Assist in Research Efforts on the Horse Industry

Several industry members throughout the research process pointed out the fact that statistics on the equine industry are difficult to obtain and accuracy is questionable at times. Having a complete horse identification and tracking system would allow for more accurate and complete census information to be obtained at a lower cost. One statistician stated that it would take an estimated $7 million dollars just to start a full equine census program (Hill, 2008). Having more accurate information on the

horse industry would allow for more accurate economic, epidemiological, or other types of studies. Horse densities could aid greatly in knowledge of disease spread and quarantine regions. Veterinarians could also do better marketing and better preventative medicine programs with accurate census data. This information has a value of its own, though it is hard to quantify.

10.5.14 Horse Slaughter

Currently, horses have a direct effect on the food chain, as many are exported to Canada and Mexico for slaughter. Identification that is compliant with slaughter regulations could theoretically assist in ensuring that horses which have been treated with drugs not approved for use in horses for human consumption do not enter the food chain.

10.5.15 Help with Unwanted Horse Problem

It is possible that ownership trace-back could prevent irresponsible horse owners from turning their horses loose or dumping them off on other individuals at auction yards or into empty pastures, which has been occurring recently, by providing a method of positive ownership identification. This way, irresponsible horse owners would have to face the consequences of improperly abandoning their animals. Some organizations are looking to microchip horses simply for the reason of dealing with the unwanted horse issue. However, some problems exist with this idea, because it would be the responsibility of the horse owner to get the horse microchipped and reported into a database somewhere, and they may just not report this information or transfers of ownership to avoid these consequences if they are irresponsible in the first place.

10.6 Equine Diseases of Concern

There are numerous diseases in equid species that are of concern to the horse industry and to other livestock industries. In the US Animal Health Report for 2006, eight “animal health events” were reported, five of which involved horses but affected multiple species of animals, while three of those were equine-specific disease outbreaks (USDA 2007k). As

evidenced by this, horses and other equine play an important role in the health status of the livestock sector, and attention to this segment of the industry could help alleviate economic losses and eradicate zoonotic diseases affecting multiple species. These diseases are those that would have a devastating effect on the equine population and in many cases can spread rapidly across species boundaries into the food animal chain, and into humans. The US equine industry has been reasonably safe for many years – in fact, it is difficult to find case studies on major outbreaks of any disease, though they do occur. Some are documented on a state-by-state level, or the show or racing circuits that are affected know about them, but other than that the information is not tracked nor made publicly available, making cost estimates of these outbreaks difficult, if not impossible, to measure. From multiple sources, the following is a list of diseases of concern to the equine species, including both zoonotic and equine-specific diseases. Some are obvious as problems, while others are less known or not currently in the US, but could still have a drastic economic impact if not monitored, or if an outbreak occurred that was not immediately caught and traced:

10.6.1 Anthrax

This disease can affect cattle, sheep, goats, horses, camels, antelopes, other herbivores, and humans. In 2006, Minnesota had an outbreak that killed 91 total animals, including some horses. It is also an OIE-reportable (World Animal Health Organization) equine disease.

10.6.2 Borna Disease (BD)

A neurological disease primarily found in horses and sheep, but also in other warm-blooded animals, including cats, dogs, primates, and cattle. Horses have an 60-95% according to USDA-APHIS (USDA 2002a). Surviving animals may be permanently neurologically impaired.

10.6.3 Brucellosis

Infrequently occurs in horses and humans, more commonly in other livestock species. Horses generally acquire this disease through contact with infected cattle or swine. Many of the wild bison and elk herds in

Yellowstone National Park and other areas are carriers of the bacteria that cause this disease. Brucellosis causes fistulous withers and in some cases abortions or death in horses. Brucellosis is a reportable disease in the US.

10.6.4 Contagious Equine Metritis

Contagious Equine Metritis is a disease that is mentioned in the 2006 US Animal Health Report (USDA, 2007k). Though it is not a zoonotic disease, it can have a devastating impact on a breeding farm or industry, as it is passed through semen by A.I., as well as direct breeding, or contaminated tools, and causes temporary infertility in mares. In most horses, there are no symptoms except for the mare becoming infertile (and therefore, unbreedable, losing a breeding season, which is vital in the equine industry due to the 11 month gestations and small windows for breeding and foaling in some segments, such as racing where older foals are better). Only two horses were reported to have this disease in 2006 – both Lippizzaner stallions imported from Germany into Wisconsin (USDA, 2007k). However, in 1978 and 1979, major outbreaks occurred in Kentucky and Missouri, devastating the breeding industry in those states and prompting efforts to eradicate the disease from the US. This disease is reportable to the OIE (World Animal Health Organization).

10.6.5 Equine Herpes Virus

Equine Herpes Virus (aka Equine Rhinopneumonitis) recently has been under close watch by USDA-APHIS. There have been numerous outbreaks of this disease recorded over the years. It also has some emerging disease concerns: in the 2006 Animal Health Report, Equine Herpesvirus Type 1 (EHV-1) is strongly emphasized due to changes in symptoms, because it is becoming a neurological disease with an increased morbidity/mortality rate and may constitute and emerging disease. This disease is deadly to horses and can cause significant losses to occur. Nearly every horse in the world is exposed to EHV-1 by the time they are two years old, it has long been a cause of respiratory illness and abortion, and in some cases horses that are exposed become latent carriers, never getting sick but never getting rid of the virus and

constantly spreading it to other horses. In 2006, there were 12 outbreaks of the neurological form of this disease in nine different states, and numbers of these cases have been increasing and affecting larger facilities. Even vaccinated horses have contracted the disease, and some have died, apparently due to the mutated strain being too strong and too fast acting for the vaccine to work. Increased horse movement may be to blame for this disease occurring more often in recent years. In late 2006, Florida had an outbreak of EHV-1 which prevented movement of horses on Calder racecourse, including two barns where horses were not allowed to leave at all and the prevention of any horses moving into the track's stables during the quarantine period. At least four horses died in this outbreak. Industry members stated that several racetracks have been shut down or quarantined in recent years due to EHV outbreaks. Maryland also recently experienced an EHV outbreak which affected the horse racing industry. This disease is reportable to the OIE.

10.6.6 Equine Infectious Anemia

Equine Infectious Anemia (EIA) is a disease that is still of concern in many states and easily spreads through biting flies and mosquitoes and is often deadly (or the horse must be quarantined for the rest of its life as a carrier or euthanized, depending on state laws). It certainly would be much less costly from a testing standpoint and a cost of equine lives standpoint if this disease was eradicated. As recently as June 2008, three horses in South-Central Indiana were euthanized after testing positive for EIA. Many state laws require the Coggins test, or another official test, for EIA to be conducted before horses are moved. This may also be an opportunity to implement individual horse ID and tracking by requiring horses to be microchipped at the time of their Coggins test. EIA testing has also increased over the years, with over two million EIA tests performed in 2005, creating a possible route to both track these animals and help eradicate a disease that has plagued the horse industry for a number of years. This is up from 1999 tests of 1.6 million to 2.1 million in 2005.

The Equine 2005 Report contains information about Equine Infectious Anemia knowledge and testing, which has been suggested as a method of

implementation for NAIS in horses. Slightly less than half (45.6%) of operations overall were knowledgeable of this disease, while 9.8% were unaware of EIA. Larger operations (>20 horses) tended to be more knowledgeable, while small operations (5-9 horses) tended have less knowledge. Overall, 37.6% of equids were tested for EIA in the 12 months of this study and 76.9% of the operations had at least one equid tested; with very high percentages being tested in the south (over 50%) while the west (at 14.7%) had the lowest testing numbers. Show/competition horses, race horses, and lessons/school horses were much more likely to be tested than breeding, farm/ranch, or recreational horses. The average cost of an EIA test across all regions was $27.33 per test including all costs associated with conducting the test, such as transportation, drawing the blood, and the laboratory and paperwork, with larger operations having only slightly lower costs. Reasons for EIA testing were primarily for show/event requirements, interstate movement, and personal knowledge. Familiarity with EIA increased from 1998 to 2005, with only 9.8% of operators indicating they were unaware of EIA in 2005 compared to 16.7% in 1998. The cost of a Coggins test (test for EIA) had increased 19.1% over these years, from $22.95 to $27.33. EIA is a OIE-reportable disease.

10.6.7 Equine Influenza

Equine Influenza is an OIE-reportable disease. It is transmitted by aerosol, and causes the horse to be lethargic, have a cough, depressed appetite, and a fever, and can lose a competing horse such as racehorses a great deal of time in their training and ability to race, but is rarely deadly. A recent outbreak in Australia crippled the entire Australian equine industry, especially for racing and breeding, and costs are estimated to be in the billions of dollars. This is an example of the extreme damage that an equine outbreak can do to an economy of the industry and the long term devastating effects it can have if not caught in time. Unfortunately, no scholarly research articles were found on this outbreak, but numerous popular press articles contained information on this and other equine influenza outbreaks, and gave cost estimates to the industry for such events.

The Australian outbreak appears to be due to improper handling at quarantine facilities of horses entering the country, which had been a concern of the Australian horse industry for a number of years prior to this outbreak. Equine influenza had never previously appeared in Australia, and was greatly feared by the racing industry. Previous outbreaks of equine influenza have affected many nations.

In 1986 and 2003, South Africa experienced major outbreaks of equine influenza, and reported in 2004 that they blamed problems with their quarantine stations for the 2003 outbreak. In 1986, races were cancelled for three months in South Africa due to equine influenza. In 2003, racing stopped in nearly all South African racing regions when an estimated 1,000 racehorses were affected by the equine flu, in an outbreak blamed on horses imported from the US. Estimated losses were R120 million in net betting turnover and R10 million in attributable profits. Japan suffered a 2007 outbreak when 29 horses were diagnosed with the equine flu. Three race meets were cancelled, the first Japanese cancellations for 30 years, and several major races and racehorses were affected. The cost was estimated at A$48 million in lost turnover. The United States experienced an outbreak in greyhound racing dogs in Florida, where eight dogs were killed by a respiratory disease later identified as a strain of equine influenza. This event led to an outbreak of the disease in racing and pet dogs, and represents an event where an equine disease has unexpectedly mutated and crossed species boundaries. Great Britain experienced a 2003 outbreak which did not cancel any race meets but was considered the worst outbreak of equine influenza in more than a decade in Newmarket's racing community. Even with all horses vaccinated against equine influenza, Hong Kong suffered an outbreak in 1992 that affected 75% of horses stabled at the Royal Hong Kong Jockey Club, and caused seven race meets over 32 days to be cancelled. Ireland also experienced an outbreak in 2006 from July to December.

The Australian Equine Influenza Outbreak occurred in August of 2007, and the effects were still being felt through the end of October with race cancellations. The outbreak spread from international horses to recreational horses at Sydney's Centennial Park. All racing across the country was cancelled, and a 72-hour ban was placed on movement of all

racehorses. Several major races, including the Sydney Turf Club's A$1 million Golden Rose race and the Melbourne Cup, were delayed or cancelled due to the outbreak. This outbreak affected everyone from breeders and trainers of racehorses to the stock market, due to the effects on bookmaker companies and race track stocks (Wainwright, Moore, 2007).

The horse racing industry in Australia was reported to be an A$8 billion dollar industry with 74,000 jobs in Victoria alone, and it simply came to a halt due to the disease outbreak. No final number on the horses that tested positive for the virus was available, but an August 27th estimate reported 47 horses positive at that time, and another report stated that 200 hacks at a park near the quarantine area were showing signs. Racehorse owners were not allowed to move their horses, in many cases not even allowed to exercise their racehorses. Pony clubs and other shows and events were voluntarily cancelled in many cases. The cost of the delayed breeding season is also extremely important, because the age of racing horses is important in how well they perform on the track, and entire crops of foals could be lost or of reduced quality due to effects on the breeding season. Job losses have occurred, and trainers have lost time with their horses because of their inability to work out and to race. One source estimated the economic loss from a three-month cancellation of events in Victoria would be more than A$57.5 million dollars (Eddy, et al., 2007). This same source stated that the Victorian Government could lose up to A$3 million per week in revenues from betting on horse races. Another source reported that the cost of a three-day halt on wagering in Victoria and New South Wales would be A$70 million, and that all bets for that time period would have to be refunded (Eddy, et al., 2007). In addition, because the equine flu is an emerging disease in Australia, a vaccination program should be started in racehorses, which for the first year at three doses of vaccine per horse would cost A$5.4 million, excluding veterinary administration charges. In 2001, the cost of a response to an outbreak in Victoria was estimated by another organization as A$775,840 with a limited outbreak (using three infected premises as an example) and A$3,740,540 if all race horses in training in the area were vaccinated (Eddy, et al., 2007). Though all of these costs are only estimates, and it is hard to quantify the economic

loss of horses that lost training days or missed a breeding cycle, it is easy to see from this example that a major disease outbreak has a significant cost.

10.6.8 Equine Piroplasmosis

Equine Piroplasmosis (EP) is a disease APHIS is working to eradicate, and was believed to be eradicated in 1988 until a recent 2008 outbreak. It has only been found in the US in one state, Florida, and is a parasitic disease believed to be spread by tropical ticks. It was first noticed in "backyard" horses (not horses that moved around much). It causes anemia, jaundice, fever, and weight loss, and death in up to 20% of affected horses. In a paper written prior to the current outbreak, it is mentioned that eradicating this disease from south Florida in 1988 took 25 years and $12 million dollars. As of September 10, 2008, 20 horses have tested positive (Ryder, 2008b). Five have been "removed" from the area via euthanasia or been moved to a research laboratory, 15 are still in Florida on five different premises. As of September 12, 2008, some of the quarantines were being lifted while leads on horses that had been in contact with the positive horses were still being followed. All imported horses must be tested for this disease. EP is a OIE-reportable disease.

10.6.9 Equine Viral Arteritis

Equine Viral Arteritis (EVA) is listed as an infectious disease of concern in the 2006 Animal Health Report due to a recent outbreak. EVA can be spread both through the respiratory system and breeding practices, and causes both flu-like symptoms and abortions (in some cases, "abortion storms") in pregnant mares. Stallions can carry the disease in glands for many years and are a significant source of infection. The costs to the industry are lost breeding, unhealthy animals and the veterinary costs associated with treatment, and the loss of use of stallions and loss of broodmares for a season or sometimes more. This is a serious disease and one that is costly to the industry.

In 2006, a farm in New Mexico suffered up to 50% losses from mares aborting due to EVA, and two of its stallions were found to test positive from their semen. One of the breeding stallions and any mares that had

visited the property were traced back to 18 states – six states, Kansas, Montana, New Mexico, Oklahoma, Utah, and Alabama, had horses that showed recent EVA infection, and four more states had horses showing suggestions of recent EVA infection, but not definite proof (California, Colorado, Idaho, Texas) (USDA, 2007k).

In New Mexico, a total of 23 premises housing 1,081 horses were either voluntarily or officially quarantined, and the last of these was lifted from quarantine on December 5, 2006. Utah also experienced 21 premises and 591 horses being put under quarantine, with an additional six premises and 350 horses being temporarily quarantined before testing clean, and the last of these quarantines was lifted on November 26 of 2006 (Timoney, et al., 2007). This outbreak showed the need for a national system, or at least common programs among the states, to find and control this economically harmful disease. It also pointed out the fact that embryo transfer and A.I., as well as the common practice of pasturing numerous mares together on breeding farms, allowed the disease to spread readily and rampantly by both respiratory and reproductive routes. EVA is a OIE-reportable disease.

10.6.10 Encephalomyelidities

Encephalomyelidities (West Nile, Eastern Equine Encephalitis, Western Equine Encephalitis) are all are currently in the US. Not spread from horses to humans, but humans and horses can both get these diseases. Horses serve as a kind of watch animal for these diseases – when horses in the area start coming down with them, humans often follow. West Nile recently emerged in the US; the other two have been around for many years. All three can be deadly to the equine species and are OIE (World Animal Health Organization) reportable diseases.

The West Nile Virus outbreak in 2002 affected 15,257 reported horses in 43 states. A study was done on the specific impacts of this outbreak to the North Dakota equine industry (Ndiva Mongoh, et al., 2008). They used estimates of a 15 year useful life of a horse, a $2,000 average value for a horse, maintenance costs of $339 per month, and the monthly cost of purchasing a horse at $13.72 per horse. Disease recovery time varied from one day to three weeks and from three weeks to six months for a

horse to fully recover to its normal usefulness, with an average of four months until total recovery. The cost of West Nile Virus treatment ranged from $190 to $380 per month for horses that stayed on their feet, and $3,000 to $6,000 per month for downer horses. Some isolated cases outside of North Dakota were reported to cost up to $100,000 for treatment.

A study prior to this one estimated the costs of the WNV outbreaks in Nebraska and Colorado at $2.75 million (USDA, 2003), and another study estimated the 2003 economic loss due to fatalities in the state of Texas at $7.46 million (Galvan, et al., 2004). In the case of the North Dakota outbreak, 569 horses were affected with a 22% mortality rate. The total cost to North Dakota was $1.9 million, with $1.5 million dollars incurred by horse owners, and a $400,000 expense to the state of North Dakota for monitoring, control, and surveillance of the disease. The costs incurred by horse owners included $781,203 due to medical costs, with $4,803 for vaccinating 152 horses and $524,400 for the treatment costs of 345 horses, and $802,790 due to the inability to use animals. The cost of the 126 horses that died was estimated to be $252,000. They also stated that these cost estimates are most likely conservative.

10.6.11 Glanders

Glanders affects horses, mules, and donkeys, though it is not currently in the US. It can be spread from horses to humans, and was used in biological warfare in WWI. All imported horses must be tested for this disease. Glanders is an OIE-reportable disease.

10.6.12 Hendra Virus Disease

Hendra Virus Disease is a new emerging disease which is seen in humans and horses. It has only been documented in Australia so far, and has a high mortality rate.

10.6.13 Japanese Encephalitis

Japanese Encephalitis (JE) has been documented in humans, swine (which are amplifiers), and horses. Horses and humans are considered dead-end

hosts, but horse-to-horse transmission is possible. JE is an OIE-reportable disease.

10.6.14 Leptospirosis

Leptospirosis affects humans, many domestic and wildlife species, cattle, pigs, horses, dogs, rodents, wildlife species. It usually spreads from fecal/urine contaminated water. Using a disease tracking database to discover spots of major outbreaks of this disease could prevent some individuals or livestock from getting infected. Leptospirosis is an OIE-reportable disease.

10.6.15 Rabies

Rabies is a well known disease that affects horses, humans, and many other mammals. It may be possible to use an animal tracking database with this disease to indicate regions of major outbreaks and send out recommendations for updating vaccinations in horses for this particular vaccine, which in most states is only available from a veterinarian and not always administered for that reason. Rabies is an OIE-reportable disease.

10.6.16 Screwworm

Screwworm was originally eradicated from the US in 1966, and restrictions exist on horses coming in to the US from countries where it is known to exist. Screwworms can affect humans, horses, and other livestock, and feed on the flesh of these animals usually after hatching from their eggs laid by flies near open wounds. Screwworm is an OIE-reportable disease.

10.6.17 Strangles

Although neither APHIS-VS nor ESWG mentions this disease as a recognized disease of concern, Strangles (aka Equine Distemper, aka Streptococcus equi) is common and can be costly to the horse industry, and has been written up in the American Quarter Horse Magazine recently. Internal or “Bastard” Strangles (where the infection spreads to

lymph nodes other than those in the head and neck) is often deadly, and can occur in a low percentage of cases, though there is no definite estimate on the percentage rate of occurrence. If treated, horses are generally recover, but if left untreated horses can die, mainly from secondary infections such as pneumonia. Even though the mortality rate is low and it is not zoonotic, it can have major economic ramifications due to its highly contagious nature and long recovery periods. It can also occasionally leave permanent scaring, limiting some horses time in the show ring for certain disciplines. Strangles is mentioned in one of the AHC press releases as having recently negatively affected horse owners and the equine industry, and in some cases caused restrictions on the movement of horses (AHC, 2005b). An industry source also mentioned an outbreak on the backside of Churchill Downs a couple years ago which occurred because of a two-year-old that was on the track against regulations (horses stabled on the track are only supposed to be racing there, and the horse was there for training purposes only).

10.6.18 Tetanus

Horses and humans are most susceptible of all animal species to tetanus. It is a bacterial disease which causes toxins affecting the nerves that control muscles. The bacteria are common in the soil and environment, and horses are commonly affected due to the environments they live in and how common injuries to horses are.

10.6.19 Venezuelan Equine Encephalomyelitis

Venezuelan Equine Encephalomyelitis (VEE) is fatal to horses and humans, and horses do play a role in transmission to humans. The last US outbreak was in 1971. South American countries still have this disease, and outbreaks are also occasionally seen in Mexico. Highly infectious, and considered a biosecurity threat. VEE is an OIE-reportable disease.

10.6.20 Vesicular Stomatitis

Vesicular Stomatitis (VS) affects cattle, sheep, swine, horses, humans, and presents similar symptoms as FMD in ruminants. The 2006 US Animal Health Report states that only one state (Wyoming) had a VS outbreak in 2006, affecting 17 horses. The previous year, however, there was an outbreak affecting nine states and 584 horses. The PRCA stated that two rodeos in the last six years have been cancelled due to VS outbreaks. VS is an OIE-reportable disease.

10.6.21 Other Diseases

Other equine diseases listed as OIE-reportable (World Animal Health Organization) in the United States are: African Horse Sickness (Never Occurred), Dourine (hasn't occurred since 1934), and Surra (never occurred). Many of these diseases are transmissible between horses and other livestock species, and in some cases even to humans. For many of the other diseases, horses are a dead-end host. However, for diseases such as JE and WNV, horses often act as sentinels of the disease: when it is seen in horses, human cases often follow, even though horses are not the vector through which they are spread. In some cases, such as with West Nile, prevention methods can be instituted at that time such as mosquito control to prevent further horse and human cases from developing. A few of the other diseases on this list, such as Tetanus and Strangles, are specific to the equine species. The value that a national animal identification system would bring with species-specific diseases is to find out more about prevalence and spread, and learn more about prevention as well. Some equine-specific diseases are extremely costly to the industry, and even if they do not affect the food sector or human health, they do have an economic cost and therefore prevention and tracking would be beneficial.

10.7 Industry Concerns and Recommendations

SEVERAL CONCERNS WERE SHARED with our research team during interviews with horse industry stakeholders that are important to mention, but that do not fit directly into the benefit and cost analysis of the system. NAIS may or may not have any effect on these industry concerns, but numerous individuals and organizations mentioned these issues as important considerations. The equine industry is a unique, diverse industry that is challenging to define and develop an NAIS benefit-cost analysis for. This section summarizes issues of concern with design and adoption of NAIS in the equine sector that were revealed from the research conducted for this study.

10.7.1 Horses are Already Identified

Numerous organizations question the value an additional form of identification would have for horses that are already registered and tracked using CVIs and EIA tests. They want to know what the specific benefits are for microchipping a horse that they feel is already identified by other methods. Utilizing the existing breed registries will be an important part of NAIS, as they know a lot about where their major show and race horses are and what disease problems exist. AQHA even has a horseback riding program that keeps track to some extent of horses and individuals on private trail rides, where people report the location and trail they rode on and the hours they rode to get rewards for hours in the saddle. In the thoroughbred racing industry, saying they need to both tattoo and microchip would cost extra money to the breeder to perform both procedures to identify the horse, and would not be well accepted. Thoroughbred breeders also have a concern with the confidentiality of microchipping and the database records. They do realize there is a problem with papers not always being sold with horses, but recommend that no one buys a horse without papers. The concerns about costs to breeders for identifying their horses are related to the need to make sure people do not have to register their horse in multiple places; they need to have one registry to send paperwork to and get into the NAIS system. This suggests the involvement of breed associations for record keeping.

Additionally, several industry members suggested that microchipping still needs to be only one part of the permanent identification of a horse. Counterfeit chips exist, and therefore photographs, written descriptions, tattoos, brands, and other forms of identification will still be necessary for positive identification of horses.

10.7.2 Problems with Current Identification and Registration

Numerous documents in the equine industry indicate that many horses are already individually identified, making NAIS implementation easier. However, even though a horse is registered with an association does not mean the horse's information is current, or even that the ownership information is correct. The horse may also be at a different address than listed on the registration, as the papers may state the location of the owner, not the horse if it is boarded or in training. Registration is currently left up to the owners to transfer, and many horses are sold without papers, or the seller charges an additional fee to the buyer to get the papers. Even when a horse is sold with the transfer forms, many buyers do not bother to send in transfer forms because of transfer fees registries charge for this service. Off-the-track thoroughbreds are also a major issue, because they are often sold without papers, and since their papers are not linked to ownership, their location is often lost in the system. Because of the fact that registration papers have no direct physical link with the animal, they are simply a pedigree, drawings of markings, and in some registries a photograph, it is easy for papers to be lost or never transferred and for the identity of a horse to be lost.

Some registries keep DNA information on their horses, but that is a process which takes time and would not be capable of meeting 48 hour trace-back goals. That procedure also must be performed by a lab, and most owners do not send in a DNA sample just to see if it matches some record in a registry. Part of the reason the estimates for horse population numbers range so drastically may be because horses registered with one registry under one name may also be in a different registry under a different name due to papers being lost during the lifetime of the animals. Recreational horses especially are not well

tracked and often get lost in current systems. One suggestion has already been mentioned – to enact a pedigreed livestock law similar to Canada to require papers to be transferred with a change of ownership. Another option could be to require EIA testing at changes of ownership, and have the veterinarian or another official record the microchip number under a different premise ID, so that even if breed registration papers are not immediately transferred, at least local animal health officials can find out where the horse is located. In this way, the horse's microchip number could be linked to the correct premises, and the horse could be tracked even if not registered. However, the options for dealing with these issues would all depend on how the database for the equine industry is organized.

10.7.3 Education Needs and Information Concerns

There are concerns with education and current information available about NAIS in the equine world. There is a lot of misinformation and or misunderstanding regarding the intentions of the system, some of which are raised by concerns about confidentiality of movement tracking. Most major equine organizations recognize many concerns are not founded, but misunderstanding can contribute to resistance in NAIS adoption. Breed registries and other equine organizations are concerned about what the USDA expects from the equine industry in an NAIS system. Costs and difficulty in implementing the system will depend on what the exact parameters of the system end up being.

The Penn State survey of veterinarians assimilated some excellent data on veterinarian's knowledge of NAIS. Many equine owners receive the majority of their healthcare information from veterinarians, so educating veterinarians would be a start to educating all equine owners (Dreschel, et al., 2008). The study found that only 21% of veterinarians felt they were very familiar with NAIS, while 17% stated that they were not at all familiar. Forty-one percent of veterinarians stated they were concerned about finding an improved identification method for equids. Some equine groups recommended that starting an education program with breeders would be the best way to implement NAIS, as if horses were microchipped from birth, eventually the whole population would be

microchipped. The breeders will also be the ones to bear this cost over time; after all older horses are microchipped, they are the ones adding new horses to the population. According to the AHC 2007 Horse Industry Directory, there are 31 educational organizations involved in the equine industry. Youth organizations such as the National 4-H Council and the National FFA Organization would be a great place to start educating groups on microchipping and tracking their horses, and encouraging the youth involved in these programs to have their parents or boarding stables get premise identification numbers.

Numerous survey results have exhibited the need for further education programs on equine healthcare, especially on the smaller premises in the industry. The NAHMS Equine surveys found that 41.7% of operations had not heard of NAIS prior to the survey and only 14.4% considered themselves knowledgeable about the topic. Large operations tended to be more knowledgeable about NAIS than small operations. Operations that were more knowledgeable about NAIS tended to use microchips more often, and operations that at least recognized the term EIA (Equine Infectious Anemia) were 2.8 times more likely to have some level of NAIS knowledge. Vaccination practices are also an area where education could be useful. The use of some level of vaccination on a given premises were approximately the same between 1998 and 2005, with the notable difference being the West Nile Virus vaccine being approved and used in approximately 60% of equine populations. Overall, about 75% of operations vaccinated at some level in both 1998 and 2005. However, 29% of operations that stated they did not vaccinate any equids on their property also transported animals by trailer off of the premises, indicating that unprotected horses are leaving their properties and possibly interacting with other horses or areas where horses have been.

For traveling and interacting with other equids, 60.6% of operations that had horses that left the premises and returned after direct contact with outside animals never isolated or quarantined these animals upon return, and only 10.6% routinely isolated these equids. Operations required a non-resident equine coming on to their premises to have an EIA test 42.1% of the time, and 18.0% required a CVI form. Of the 21.5% of operations that added new horses to their operation in the last 12 months, excluding newborn foals, 58.6% always required an EIA test for

horses being added to their property, and 27.4% required a CVI. Only 63.0% of operations where the horses left the premises sometime within the last five years have ever been asked to present health papers (EIA test results or CVI). Most of these cases were at a show/event or at a sale. Premises in the southern region were asked more often (70.7% of the time) than the north, east, or west. The western region had the lowest percentage of operations being asked to present health papers, at 47.5% of operations that traveled in the last five years, but had the highest numbers for interstate and international movement, suggesting the state laws about papers being checked on livestock traveling between these western states have not been well enforced.

10.7.4 The Issue of Recreational Horses

Some equine stakeholders feel the industry should not be separated in two different priority levels (horses that require CVI/EIA tests and horses that do not) because: 1) the different levels are the same species and diseases can easily be transmitted between them; 2) horses that are not often moved and not highly valued tend to have lower health care standards, be vaccinated less, and are more vulnerable to exposure or to be a non-expressing disease carrier; and 3) horses from the different levels interact regularly. There is not complete separation and segregation between recreational horses and show horses. A lot of premiere show horses are shown in small schooling shows as practice, where recreational horses are also shown by their owners. The different classes of horses also interact at playdays, gymkhanas, trail rides, or boarding stables. Recreational horses may not travel as much as business competition horses, but there is frequent direct and indirect contact. Also, as noted in the case study on EVA, shipped semen and other breeding horses and issues in the breeding industry can and has carried diseases across state lines, whether physical horses are moved or not.

Evidence of the lower healthcare standards on smaller operations is provided by statistics in the NAHMS Equine 2005 studies. On average, 75.9% of operations administered some form of vaccinations in the last 12 months, but large operations (20+ equids) were more likely (87.2%) to administer at least one vaccination to their horses as compared to small

operations(5-9 equids), at 73.6%. Veterinarians were the source of the vaccinations 76.0% of the time, and a higher percentage of small operations used a veterinarian as a source for the vaccinations as opposed to the large operations. This could provide a route for these smaller operations to get microchips inserted by the veterinarian. A higher percentage of large operations also required CVIs, EIA tests, or other health records for new horses coming on to their premises than did small operations, and large operations quarantined new horses more often.

Farm/ranch and personal use horse operations are much less likely to have any kind of written or computerized health records on their animals than boarding/training or breeding farms (USDA, 2006e). Small farms were also less likely than large farms to keep health records of any kind. In regards to quarantining or isolating equids returning to the farm after traveling off-premises and interacting with other equids, large operations quarantined a greater percentage of the time than did small operations. Residences with horses for personal use and farm/ranch operations were less likely than breeding or boarding/training operations to routinely isolate horses upon returning to the operation.

10.7.5 Movement Tracking

Throughout the industry, many stakeholders do not favor complete movement tracking of horses for various reasons. One group stated that where a steer could move 3-4 times in a lifetime, a horse would move 3-4 times in a day. Many horses move frequently to shows, events, other farms, sales, or even trail rides – all of these movements would be difficult and costly to track at a high degree of accuracy. Some members of the industry also comment that due to health care regulations in the equine world such as EIA tests and CVIs, equine diseases are already well traced and horses carrying diseases are found in many cases simply by talking to owners and finding the horses they have been in contact with. “Herd records” in the business plan, requiring the owners to keep accurate records of where the horse has been, and when, is currently the only way to track a specific horse’s movements. However, even if owners did this, they have no system to report the information to, and the

current level of record keeping evidenced by the NAHMS report would not indicate that owners are prepared to keep records of their horses' movements (USDA, 2006e; USDA, 2006f). The NAHMS report only discussed health records, but it stated that the use of computerized methods and the veterinarian keeping records have both increased, while 23.5% of operations still have no written or recorded health records. There is also an issue with horses that stay at home being comingled with the horses that are traveling regularly, so it is difficult to limit the horses that need to be traced to only the animals that are moving regularly.

10.7.6 What to do with Positive Horses

Some horse owners have major concerns about what will happen to their horses in the case of a disease outbreak. Several equine diseases, including EHV and EIA, can cause some horses to be carriers and spread disease to other equids while never showing signs themselves. These diseases are difficult to cure and often the horse must be placed in permanent quarantine or euthanized. Many smaller horse owners fear that their horse may be euthanized in the event of a disease outbreak, and would rather hide their horses from a disease tracking system than to risk losing them.

10.7.7 Decreasing Attendance at Events

Two of the major equine organizations expressed concerns that the movement tracking would increase the cost to horse owners, which would in turn increase the cost of their events (especially with movement tracking) and therefore increase entry fees or ticket prices, which may decrease public attendance at events. In addition, with movement tracking, they were concerned that if reporting was too difficult, numerous exhibitors would not participate or only show close to home rather than out of their states or regions. If the NAIS system simplifies the check in process or management at shows or rodeos, these concerns may be eliminated.

10.7.8 European Union and Other Nations Requiring Microchips

The European Union has adapted a program to give every equine a Unique Equine Life Number (UELN) which is a 15 character code, the first three digits representing the country, the second three representing the breed of the horse, and the final nine being random numbers to identify the individual horse. At least 12 European nations, as well as Australia, New Zealand, and many of the South American nations already have microchipping regulations in the equine species. Many of these regulations are specific to the racehorse industry or horse movement, but some nations require all horses to be microchipped, and others require certain breeds to be microchipped to be allowed into registries or studbooks.

In the US, many of the equids in Louisiana are already microchipped due to their EIA testing program requirements. Great Britain microchips race horses at three months when DNA and hair samples are taken by the veterinarian. This is a similar process to what The Jockey Club requires in the United States for Thoroughbred foals. Some equine industry individuals suggested that the tracking of international horses was particularly important, and that all horses going through US quarantine should be chipped, but expressed concerns that placing a requirement on other nations to do something the US does not do would not be well received. In addition, the recent discussion of adding reining as an Olympic equestrian sport could increase the number of Quarter Horse or Stock-Type horses exported from the United States, and cause a greater need for US horses to meet the identification requirements of foreign nations.

10.7.9 Desire to make It Mandatory

Some members of the equine industry suggested that some in the equine industry are just waiting around to see what happens. They suggest that someone needs to make a National Equine ID program mandatory, with a timeline to allow the industry to adjust and learn the best way to go about implementing a system by trying it out. Currently, owners are not sure where to report their microchip numbers to, microchip scanners are

not used regularly at events, and therefore the owners currently chipping their horses are not enjoying many of the potential benefits. They stated that the only way to get an effective level of participation in an equine NAIS would be to make it mandatory. Certain things need to occur to make the system more effective, such as extending the read range on scanners and getting veterinarians to use microchip identification in their practices, and they feel it is likely these things will occur if more horses were microchipped. The equine industry has been talking about and meeting to discuss the idea of NAIS for years, discussing the possible benefits including health records, tracking horses, day-to-day farm operations, and disaster recovery, but what it comes down to is they just feel they need to implement the system and find out where horses are, then the benefits will come with time.

10.7.10 Making sure USDA does not put regulations on the Industry they cannot handle

The equine industry initially felt that horses were an afterthought to be included in the NAIS, and then horses that moved a lot became a high priority in the plan. They are concerned about the USDA making regulations that the horse industry cannot conform to, and want to make sure they are involved in the planning and implementation of any system. That way, the horse industry will be able to develop a system that fits well into the current structure of the industry and hopefully meets the goals set out by the USDA.

10.7.11 Are horses pets or livestock?

The question of horses being a “pet” or a “livestock” animal is one that continuously raises issues in the equine world. Many individuals treat their horses as pets, but they are a part of the livestock industry in some locations. Parts of the equine industry do behave more like the pet industry, and recognizing this fact is important to learning how to implement an identification system in the equine species.

10.7.12 Certainty that the horse and chip are properly matched in the system

Horse registries are concerned about when and how to microchip horses to be certain that the correct microchip number is reported with the horse that receives that microchip. The Thoroughbred industry usually has veterinarians out for a neonatal exam and to do a hair pull for a DNA test, which are two possible times to identify horses. Taking the human error out of reporting microchip numbers will be important in being certain that the system works properly.

10.7.13 Enforcing current laws

Many members of the equine industry pointed out that enforcing current regulations on the equine industry is a major issue, and that any additional system would have to be enforced at a stricter level. The punishment for breaking a regulation and the level of enforcement both must be strict enough to encourage individuals to actually follow the rules. Enforcing the laws we already have was a major concern for members of the industry, though it is possible that a tracking system could assist in the level of enforcement. In addition, to use CVIs and EIA tests for tracking purposes, it is important that veterinarians turn these documents in to the state office on a timely basis, which is not currently the case. Education could help fix this particular issue. Numerous industry members felt that current CVI and EIA testing regulations required for traveling interstate and intrastate are not enforced at a reasonable level. Producer opinion suggests that numerous events and locations that claim to have regulations on EIA tests at events and places where equids comingle do not enforce these regulations. The Business Plan recommends standardizing disease programs, and in the equine species this could mean getting states to standardize and enforce EIA testing regulations. Working on the assumption that we are currently able to track horses using CVI and EIA testing requirements as the state level is good, if these current regulations are enforced. If they are not, this will not be a useful or effective form of disease tracking, because if even one sick horse is missed, the disease could slip through the quarantine region and spread. If a horse needs an EIA test for traveling purposes, a good recommendation on the national level would be to

have a program similar to the state of Louisiana's, requiring a horse to have a permanent form of identification, preferably a microchip, before the test will be performed.

10.7.14 Cost concerns in certain equine industry segments

Industry members commented that the cost of an NAIS system probably will not have much of an effect on the high end of the horse industry. For high dollar race horses and show horses, getting the horse microchipped and scanned at shows would constitute such a small percentage of the horse's value and the annual costs that it would not affect them very much. However, it will affect the smaller racehorse trainers or show horse owners who are either just entering the business or struggling to keep going, and will also affect recreational horse owners who do not normally spend great amounts of money on their horses and just occasionally haul to parks, trail rides, rodeos, or small shows. However, these are also the horses that the USDA is less concerned about identifying initially, so it is possible that by the time they need to microchip their animals the system will be working well and the benefits will outweigh their costs.

10.7.15 Create disease spread models and costs for disease outbreaks

One recommendation is that disease spread models be created and studied to better predict costs associated with potential equine disease outbreaks and benefits identification and movement tracking systems could have in disease eradication and prevention.

10.7.16 Unreliable information

Throughout this project, statements and statistics have been quoted that do not necessarily match industry and producer opinion. The number of equids with no unique form of identification, as listed in the NAHMS studies, may be much higher than indicated by this study because, based on producer opinion, many of the horses left out of the NAHMS study

(horses located on premises with four or less horses) would be in the recreational industry were registration is not always important or necessary. Horse movement numbers, when compared from 1998 to 2005, indicated that horse movement had decreased rather than increased. Industry members are perplexed by this result, when the numbers of events and organizations, including recreational events, are increasing annually. In addition, the 2006 Animal Health Report sites increases in horse movement to possibly explain the spread of equine diseases such as EHV-1.

10.8 Industry Opinion on NAIS

Both the Penn State study and the Colorado Smart Card study asked survey questions on people's attitudes towards an NAIS system in the equine species. The Colorado study found that 85% of participants agreed or strongly agreed with having an animal identification system for the equine species, while 15% were neutral and none disagreed. The majority of participants, 98%, also felt that the project was worthwhile, and 100% wanted to see national acceptance of the equine passport as proof of the EIA test, CVI, and brand inspection. Of the animal healthcare providers in the Penn State study, only 47% were in favor of NAIS, while 4% were opposed and the rest were neutral or unsure. Fifty-six percent of respondents felt that NAIS would be useful in stopping a contagious disease while the rest disagree with this statement. Industry opinion obviously differs greatly on NAIS, and further education could also assist in helping people understand and accept such as system.

10.9 Benefit-Cost Analysis for NAIS for Equine

10.9.1 Costs

The costs of NAIS adoption in equine are quantified for Premises Registration, Animal Identification, and Animal Tracking. Because of lack of data in the equine species, some estimates used here are based on quantities obtained through studies on other species of livestock, and others are producer estimates.

The cost for Premises Registration is shown in table 10.6. The number of premises where equids are housed as quoted in the NAIS Business Plan, is 570,000. In addition to this, the ESWG listed some premises that would not be included in this number as they would not permanently house horses. Estimates for the numbers of these additional facilities, including almost 4,000 State and National Parks (where trail riding areas may exist) and 3,077 counties in the United States (estimate of number of county or state fair/event grounds), constituted adding an additional 9,975 premises (1.75% of the equine premises). So the number of equine premises needed to register is 579,975 if there was 100% adoption of premises registration. Using the net present value of annualized premises registration cost of $4.64 (see Section 4 of this report), this means that the total cost to the industry of 100% premises registration is $2.9 million.

Table 10.6. Cost of Premises Registration in Equine Industry

	Number	$/premises	Industry cost
Equine operations	570,000	$4.64	$2,643,999
Other premises*	9,975	$4.64	$46,270
Total	579,975		$2,690,269

* Includes locations where horses will be comingled and estimated to be 1.75% of equine operations.

Costs for Animal Identification are exhibited in table 10.7. The total costs are based on a total number of equids in the United States being, as listed in the Business Plan, 5.8 million head (USDA, 2008g). This number is then adjusted up by 0.44% to account for the failure rates of microchips obtained in various studies. We assumed that the equine population is staying constant over time and that the average lifespan of a horse is 20 years (the low end of the range of lifespan indicated by the ESWG in their recommendations). The ESWG mentioned in their recommendations that one of the things that make horses unique is that they have the longest life expectancy of any livestock species, and stated a range of 20-35 years.

For replacement horse annual cost of NAIS, the cost of the microchip is an average of five prices obtained for the Destron-Fearing regular and biotherm microchips from distributors to veterinarians ($10, $12, $15, $16, and $20), and this average cost was charged to 100% of replacement horses. A veterinary charge for inserting the chip was based on the veterinary survey results for cost of the microchip and insertion, minus the cost of the chip as this is included separately, and this cost was also charged to 100% of replacement horses. The cost of veterinary travel assumes that 35.6% of the 570,000 premises, or 202,920 locations, where equines are housed would have a foal during the year, as reported in the Equine 2005 survey results.

The estimated annual number of foals, 290,000, was divided by 202,920 premises to get an estimate of 1.4 foals microchipped per veterinarian visit. However, this cost would only apply if the veterinarian was coming out for no other reason than to microchip the foal. The majority of horse owners having foals will have a veterinarian out to check the foal for neonatal exams or first vaccinations within the first year, so we did not charge a travel cost for new foals being microchipped annually. Finally, a cost of $4.15 was charged for the time and materials the owner would spend recording the data on the horse and reporting this data to a government database. Producer estimates indicated that filling out the paperwork on an equine would take an average of 15 minutes, at a cost of $14.60/hour (see Section 4 for wage rate assumptions). In addition, we assumed a $0.50 charge for materials such as postage, printing, or copying as may be necessary for government or equine owner records.

For horses that are currently in the equine population and would initially need to be microchipped, we included an annual interest cost of 7.75%. The NAHMS Equine 2005 survey reported that approximately 1.5% of equids are already microchipped and we assumed they therefore are also recorded in a database. The ESWG Microchip Paper reported an estimate of 600,000 horses already being microchipped, or approximately 10% of the horse population estimate we are using. However, we chose to assume the NAHMS Equine 2005 study was correct for this estimate. Therefore, the percentage of the equine population the microchip, veterinary charge, and recording/reporting data charges are applied to have been reduced to 98.5% with 100% adoption. Based on information included in the NAHMS Equine 2005 survey, such as the percentage of horses vaccinated by veterinarians and the percentage of horses tested for EIA, as well as producer estimates, we also assumed that 30% of horses currently would not see a veterinarian on an annual basis. Therefore, an interest charge on veterinary travel is applied to 30% of the current equine population.

If an equine owner needs a horse microchipped, it is likely that they will add this procedure to another routine veterinary call to mitigate travel costs. We also assume that if a horse is being hauled to the veterinarian to get microchipped, it is probably being hauled in for additional reasons, and therefore we are not charging travel or an office call fee to any percentage of these horses. Once again, the veterinary travel charge assumes that multiple horses are microchipped on each trip, and to obtain an average number of horses microchipped per trip, we assumed that all horses on a given premises would be microchipped in one trip if the veterinarian was coming out for that explicit purpose. Therefore, we took the estimated 5.8 million horses in the United States divided by the estimated 570,000 premises these animals are located on, to come up with an average number of horses per premises of 10.2 head. The veterinary travel charge was then divided by this number of horses.

Using the assumptions and data noted above, we obtain an annual cost of microchipping horses, veterinary charges for insertion, veterinary travel charges, and recording/ reporting data. The sum of all these annual costs comes to a total of $34.5 million for 100% Animal

Identification phase of implementing NAIS in the equine species (table 10.7).

The final phase of the Business Plan for NAIS, Animal Tracking, is by far the hardest to quantify for the equine species. The Business Plan suggests that events, such as shows, races, sales, or other exhibitions, where horses are comingled with equids from different premises, should be a priority in a tracking system (USDA, 2008g). They identify show horses through the USEF Horses Identification Program, and racehorses are identified through The Jockey Club, the United States Trotting Association, and the American Quarter Horse Association. Additional exhibitions or events where horses from across the state or from out of state comingle could include AQHA shows, PRCA and NHSRA rodeos, and numerous other events. The AHC identified 66 Show and Sport Equine Organizations, all or any of which may host their own state, regional or national shows. In addition, some educational organizations such as 4-H host horse shows, as well. The Equine 2005 Event Survey suggested that an average of 151.0 equids would be at an event on a typical day, and that 270.9 equids would attend the event over the entire course of the event. Local lessons, shows, and jackpot roping, where only a small number of local equids are expected to attend, were excluded from this study.

Table 10.7. Estimated Annual Cost of Identifying Horses Individually with Microchips

	Actual Number	Number to Chip**
Replacement horses*	290,000	291,276
Horses in current inventory	5,800,000	5,825,520

	Replacement horse, $/head	Percent applies to	Current inventory horse, $/head	Percent applies to**	Total industry cost
Microchip	$14.60	100.0%	$1.13	98.5%	$10,745,332
Vet charge	$27.40	100.0%	$2.12	98.5%	$20,165,897
Vet travel	$29.36	0.0%	$0.32	30.0%	$558,522
Recording/reporting data	$4.15	100.0%	$0.32	98.5%	$3,054,324
Total	$75.51		$3.90		$34,524,074

*Based on an average horse life of 20.0 years and assuming a constant inventory.

**Assuming that .44% of horses must be re-chipped due to microchip failure.

***The 98.5% accounts for the 1.5% horses that are already chipped, 30.0% is based on an estimate that 70.0% of horses will be chipped by a veterinarian at the same time they are being tested/treated for some other reason.

To illustrate the horse numbers that attend events held by large show organizations, we obtained some event information from equine organizations. From AQHA and USEF, we were able to obtain an approximate number of annual shows and also other equine event numbers from AQHA, which included an average number of horses attending these events. In 2007, AQHA held 2,449 shows with an average of 351 entries per show, and 554 special events with 63 entries per event. USEF estimated they hold 2,500 shows annually with 150 entries per show. Estimates were obtained on the number of PRCA and NHSRA rodeos, of 650 and 1,200 rodeos annually, respectively. In the NAHMS Equine 2005 Event survey, Western Events/Fairs/Rodeos had an average number of equids attending over the entire course of the event of 608.3 head. Unfortunately, this number also has a standard deviation of 262.2, indicating a high level of variability across these types of events.

As it is impossible at this time to quantify the number of equine events per organization and obtain an actual number of equine events, number of equines per event, and movement numbers, we chose to go a different route to quantify the tracking charges. The NAHMS Equine 2005 survey recorded information about the number of operations that transported equids off the premises by vehicle and later returned with them, which was a total of 58.4% of operations. Of these, 94.8% transported the equids within the state (53.1% for 1-9 trips, 37.7% for 10-99 trips, and 4.0% for 100 or more trips). Premises that hauled horses to adjacent states constituted 34.3% of operations (26.8% for 1-9 trips, 7.2% for 10-99 trips, and 0.3% for 100+ trips), 11.9% of operations transported within the US but beyond adjacent states (with 10.9% for 1-9 trips, 0.9% for 10-99 trips, and 0.1% for 100+ trips), and 1.1% transported equids out of the US (1.0% for 1-9 trips and 0.1% for 10-99 trips). These numbers indicate that 332,880 operations (58.4% × 570,000) transported equids off the premises and returned on an annual basis.

If we make the assumption that an individual reporting between one and nine trips is hauling the median amount of times, meaning 5 hauls, and that between 10 and ninety-nine trips is the median number of 54.5 hauls, and that horses hauled more than 100 times would be hauled 125 times, then we can come up with a total number of times horses were hauled by vehicle off premises and returned on an annual basis.

Therefore, 91.8% of the operations that hauled horses off premises by vehicle hauled 5 times, 45.9% hauled 54.5 times, and 4.4% hauled 125 times. This equates to ((332,880 × 0.918) × 5 = 1,527,919.2 hauls + (332,880 × 0.459) × 54.5 = 8,327,159.64 hauls + (332,880 × 0.044) × 125=1,830,840 hauls = 11,685,919 total hauls. The number of horses hauled on each of these trips would vary, but if we estimate two horses per haul, and estimate that for each haul, the horse would be scanned twice (once at the destination and once upon return to the original location), we can get a total number of scans for the equine industry, not including horses that left the property and did not return because of sale, of 46,743,675 necessary scans.

We can estimate the total horses sold using USDA Census data, and assume that when horses are sold they also move to a new property. Whether they are sold privately or through a public venue such as an auction, we will assume they are scanned twice during this process, once into the auction yard or when leaving their former residence, and once upon arriving at their new residence. The USDA 2002 Census reported a total of 487,808 equids sold. Therefore, if we estimate two scans per sale, we can estimate 975,616 scans due to horses moving because of change of ownership and therefore changing premises. Adding this quantity to the scans necessary for equine movement on and off premises, we get a total number of annual scans of 47.7 million.

The cost of the reader was quantified by taking the prices of Destron-Fearing readers ($350 and $360) which do not have the ability to store data, and an estimated cost of $885 for an Allflex wand reader, which is able to store information, and averaging them. The reasoning behind this is that the readers which have storage capabilities in the other livestock sectors tend to be much higher priced than the Destron-Fearing reader, and some reports, such as the California Racehorse movement study, have reported using Allflex readers with storage capability greatly simplified the movement tracking process. However, horses also tend to be handled in smaller numbers most of the time, so for small farms, breeding operations, veterinarians, anyone using the biothermal chip in horses, or show check in (checking horses one at a time), a reader without storage capability would be perfectly reasonable and less costly. Therefore, we assumed that 50% of the operations requiring readers

would purchase the Destron-Fearing reader, and 50% would purchase the Allflex, or some other more expensive reader with storage capabilities. This average reader cost of $620 was then allocated over an estimated three year lifespan, as was used for the other livestock industries, with interest applied. It is possible that in some segments of the equine industry, where the readers are not shipped around and always are kept in protective cases, that the readers will last much longer than this, as is evidenced by the reports from veterinarians of readers lasting more than 10 years. However, as we have no definite estimate of reader longevity for the specific types of scanners used in the equine industry, the three year estimate of the other livestock species seems to be a reasonable assumption. Based on these parameters, the total annual cost per reader is $239.50.

We estimated that 108,870 readers would be required in the equine industry. Each of the 9,975 estimated additional premises would require at least one reader, and additionally large farms (as defined by the NAHMS Equine 2005 Study as those with 20+ horses) would probably desire a reader to keep track of horses traveling on and off of their premises. Large operations were more likely to have horses travel on and off of their premises, according to the Equine 2005 study, as 77.0% of large operations transported equids off the premises and back by vehicle as opposed to 66.3% of medium operations and 53.1% of small operations. Large operations represented 7.8% of all operations with over five horses on the premises as of July 1, 2005. Since we do not have an estimate for the number of operations with less than 5 horses, we will use this 7.8% to get an approximate number of large premises that may choose to purchase a reader. Therefore, the number of large premises requiring readers would be approximately 0.078 × 570,000 = 44,460. We realize that this may not be the best estimation method for the number of readers required by the equine industry. It is likely that the premises themselves will not purchase the readers, but instead the organizations hosting the shows, races, and events. However, we have no way of quantifying the number of shows and events held annually by each of the breed, show/sport, or educational organizations in the equine world. For future research efforts, focusing on quantifying the number of equine

events held nationwide by all of the equine organizations may provide better estimates for scanning and tracking expenses.

Using the data we currently have, with approximately 9,975 premises where equids comingle, and 44,460 large equine farms where readers may be desirable for management purposes, we estimate a total number of 54,435 premises requiring readers. Using a requirement of two scanners per premises, to allow for the need for multiple scanners at one moment in time, we come up with a total requirement of 108,870 readers in the equine industry. If we take the total number of reads required by the industry, of 47,719,291, divided by this number of readers, we get an average number of reads per scanner of 438 annually. The annual cost per reader was divided by the average number of reads per scanner to get the cost per scan for an individual horse, which was $0.546 (table 10.8).

Table 10.8. Estimated Cost Per Scan in Equine.

Description		
Reader Cost/Scan		$0.55
Annual Reader Cost	$239.50	
Average Reader Cost	$620.00	
Estimated Lifespan (yrs)	3	
Interest Rate	7.75%	
Annual Scans/Reader	438.31	
Database Charge		$0.09
Labor		$0.18
Avg time, seconds	60	
Cost, $/hour	$9.80	
Workmen's comp, %	10.00%	
Annual Cost Per Read/Scan		$0.81

Next, we estimated the amount of time it takes to scan a horse and get a positive identity by checking the information. Based on producer estimates, considering the fact that some horses will be more skittish than others, we will use a number of 60 seconds, or one minute, per scan on a horse. This is applied to a labor cost of $9.80 per hour and a workmen's compensation percentage of 10.0% (for explanation, see Section 4 on labor costs), to get a labor cost per scan of approximately $0.180. This cost was added to the database charge per scan of $0.085 per scan (see Section 4 for explanation of database costs) and the charge for the reader per scan of $0.546 to get a total annual cost per scan of $0.811, which is reported in table 10.8. Based on an estimate of 47.7 million scans required by the industry, the total annual cost to the equine industry for 100% equine movement tracking is estimated at $38.7 million (table 10.9).

Table 10.9. Estimated Horse Movements and Scanning Cost.

Number of operations	570,000
Percent of operations that transported equids off the premises and later return by vehicle	58.4%
Number of operations that transported equids off the premises and later returned by vehicle	332,880

Number of trips per year	Percent of operations	Median trips	Total trips	Total scans*	Industry cost
1-9	91.8%	5	1,527,919	6,111,677	$4,954,237
10-99	45.9%	54.5	8,327,160	33,308,639	$27,000,593
100+	4.4%	125	1,830,840	7,323,360	$5,936,450
Total			11,685,919	46,743,675	$37,891,280
Annual equine sales			Head	Total scans**	Industry cost
Total			487,808	975,616	$790,852
TOTAL				47,719,291	$38,682,132

* Total scans is based on 2.0 horses per trip and 2.0 scans per horse per trip.

** Total scans is based on 2.0 scans per horse sold.

Based on the stated assumptions and parameters, our estimated total cost to the equine industry to implement NAIS in the equine species is $75.9 million, as shown in table 10.10. Animal tracking is found to be the greatest expense to the equine industry on an annual basis, however, the cost of the individual animal identification with microchips is only slightly less.

Table 10.10. Total Annual Cost of NAIS Adoption to the Equine Industry.*

Premises Registration	$2,690,269
Animal Identification	$34,524,074
Animal Tracking	$38,682,132
Total	$75,896,475

*Assuming 100% Compliance based on the stated parameters

10.9.2 Benefits

Benefits of NAIS adoption in equine are much more difficult to quantify than costs, but we can view benefits to the equine industry in terms of what the system could save under certain scenarios. Though potential benefits are numerous, they are difficult to quantify. One way to look at it is to take the estimated value of a horse as $2,733, based on the USDA Census for equids sold as described in the introduction of this section, and divide the cost of NAIS in the equine species by this amount. This would constitute the loss of approximately 27,946 equine lives; therefore, if having an NAIS system could save this number of horses from a disease outbreak in a given year, the system would be paid for. This number seems high, but only constitutes 0.48% of the current equine population.

According to the NAHMS report, 1.8% of equids greater than 30 days of age die annually (USDA, 2006e; USDA 2006f). Of this 1.8%, 0.8% die from Strangles, 2.2% from other respiratory issues (which could include infectious diseases), and 3.2% from neurological disorders including WNV and EPM. Unknown causes of death also constituted 6.6% of equine deaths. Taken together, Strangles, other respiratory deaths, and neurological deaths constitute 0.1116% of the entire equine population,

and unknown causes constitute 0.1188% of the equine population. Thus, if animal ID and tracking helped to eradicate some of these diseases, the value in animals saved annually would pay for nearly one-fourth of NAIS adoption costs for horse owners.

Benefits of NAIS associated with animal disease surveillance and control and disaster assistance are also important. Labor costs will certainly be saved in some of these situations, in theory USDA or state animal health officials would no longer have to drive door-to-door in the case of a disease outbreak to check for other equids to test for illness. In disaster recoveries, the cost of labor and feed to take care of horses while searching for owners, could be reduced if horses were simply scanned and owners identified from database records. In addition, veterinarians could save time and hassle by having a microchip identification number for the equine on all of the veterinary records, including health and EIA test certificates, as opposed to drawing out and describing color and markings. Though this saved time may add up to only minutes per exam, over the course of a year with over 2 million EIA tests and likely a similar or greater amount of CVIs performed, it would save a great deal of labor expense. If EIA testing requirements were perfected and every horse tested, the disease could be eradicated from the United States. If this scenario were to happen, pending repeal of the laws requiring EIA testing, US horse owners could save over $50 million per year in from EIA testing expenses. Based on the NAHMS Equine 2005 Survey, the total cost of EIA testing in 2005 was approximately $57,464,741 (2,102,625 tests at an average of $27.33 per test). This value would constitute approximately 75% of the cost of NAIS in the equine species.

Research could also be aided by an equine NAIS. One statistician stated approximate estimates of $7 million dollars simply to start a full equine census. Many in the horse industry feel would be valuable for research and marketing purposes, and others feel full census data could aid in disease tracking, control, and prevention through increased knowledge of equine population densities and disease spread rates. At least partial census data could be obtained by an animal identification system in horses. Additionally, prevention in the loss of equine commerce is of value, though once again precise values cannot be applied at this time. However, if live equine exports constitute approximately $460 million

annually (as estimated in 2005), any effect on the ability to import or export equids could have a great financial impact of the industry. Due to the fact that these horses may still be moved or sold within the United States, we cannot conclude that a total ban on exports would cost the equine industry this full amount, but the cost of NAIS only constitutes approximately 17% of this total value of exports. Therefore, it is easy to see that keeping horse movement open internationally is important, and though state numbers are not available, equine commerce between states is also valuable.

Taking a brief look at overseas disease outbreaks that have occurred, the 2003 influenza outbreak in South Africa cost that nation R130 million, which (using September 2008 exchange rates) equates to approximately $15.8 million US dollars. Japan's 2007 outbreak, costing them $48 million Australian dollars equates to approximately $37.9 million US dollars using September 2008 exchange rates. Australia, which has an $8 billion dollar horse racing industry, approximated its losses during the 2007 equine influenza outbreak as between $57.5 and $70 million Australian dollars, a range of $45.4-$55.3 million US dollars. These estimates all include the loss from betting revenue and direct costs due to losses of breeding, equine movement, cancelled race events, and equine healthcare expenses. Considering that the United State's horse racing industry is worth an estimated $26.1 billion dollars, according to the AHC survey, outbreaks of a disease similar to what has happened in other countries could have a much greater financial impact on the US industry. Equine influenza already exists in the United States, and major outbreaks usually do not occur due to regular vaccinations, but other diseases could have the same far reaching affects.

The only US economic study on equine disease outbreaks discovered in the research for this project was the study on the North Dakota WNV outbreak (Ndiva Mongoh, et al., 2008). The outbreak cost the state of North Dakota approximately $1.9 million in one year, and it was written in the conclusions that this was likely an underestimate of actual economic impacts. In addition, the North Dakota study mentioned other studies which had concluded losses of $2.75 million in Colorado/Nebraska in a given year and losses from equid deaths in the state of Texas as $7.46 million in one year. The expenses for disease

treatments on a monthly basis ranged from $190-$380 if the horse remained on its feet to $3,000-$6,000 for downer horses. In addition, $802,790 was estimated to be the cost for the simple loss of use of the animal for a number of months for the equine to fully recover. The cost of these single-state outbreaks alone being prevented would cover or nearly cover the expense of premises registration for the equine industry. Though hard to quantify, it can be seen that having some sort of prevention and quarantine system for equine disease outbreaks, which would aid in maintaining commerce and preventing further loss of equine use or life, could provide enormous benefits to the equine industry.

One of the industry concerns is enforcement of current laws, and the implementation of NAIS is one way to help enforce laws, including the animal neglect and abandonment regulations, which may assist in preventing irresponsible horse owners from simply dumping or leaving their animals. These owners could be identified through the horse's microchip number. Even if they did not report ownership of the animal, the previous owner could report who the animal was sold to (or the auction it was sold through) and the abandoning owner could be traced and charged.

The specific benefits of premises registration, theft, disaster relief, and the added ability to manage large farms, shows, or exhibitions are difficult to enumerate and these are private benefits that are not a direct part of NAIS adoption. Nonetheless, these benefits are important for adoption as they are what encourage private individuals to adopt. We can assume that there will be some benefit in all these categories. Shows, farms, and exhibitions may save on labor and materials charges if records could be made electronic rather than on paper. However, these are all theoretical costs that are not possible to quantify at this time. The value of solving the problem of "unwanted horses" is also difficult to quantify. Additionally, though no values were assigned, the prevention of injury to racehorses or handlers when being checked in to the racetrack or for designated race or warm-ups constitutes a value for human injury, labor time, and possible loss of use of the animal if it was injured by flipping over in the paddock. Veterinarians and large farms could also save a great deal of time and labor if the biothermal chip was

perfected and other methods of reading temperatures on horses were no longer required.

10.10 Conclusions

THE EQUINE INDUSTRY, which that has an estimated $102 billion dollar impact on the US economy annually with $39 billion of that in direct impacts according to the AHC survey, is a complex industry which is difficult to define and analyze. A precise estimate for the number of horses in the United States or the number of premises they reside on is difficult to obtain, and the information surrounding implementation of a national identification system in the equine industry is constantly growing with changes in technology and ongoing studies. Using the best available current information, this analysis suggests a total cost to the industry of $76.1 million for 100% industry compliance on all levels – premises ID, animal ID, and movement tracking. This amount constitutes a small percentage, 0.075%, of the industry's total economic impacts to the United States and approximately 0.20% of the industries direct economic impacts. The benefits of NAIS adoption are more difficult to enumerate, but given limited disease outbreak information and other data we were able to collect, at least a portion of the cost of NAIS in the equine species would be offset by benefits to the industry. At this time, we cannot definitively conclude from our analysis and available data whether benefits of full NAIS adoption in equine exceed costs of adoption. More research is needed to fully quantify benefits of NAIS adoption that we have omitted in the equine industry. If diseases such as EIA could be eradicated through improved surveillance and testing, or if equine export markets were not able to avoid major lengthy disruption during a possible disease outbreak, such accomplishments would make benefits of NAIS adoption quickly exceed costs.

11. Minor Species

11.1 Bison

11.1.1 Size of Industry

According to the National Bison Association, there are approximately 250,000 bison currently in the United States, including those on public lands. The 2002 Census of Agriculture counted approximately 232,000 bison on about 4,000 farms. Of these bison, 30% are located in South Dakota and North Dakota and 37% are in Montana, Nebraska, Oklahoma, Wyoming, Minnesota, and Colorado.

11.1.2 Diseases of Bison

On public lands bison comingle with each other as well as with deer and elk. Bison are naturally hardy animals and are not susceptible to many of the diseases that plague wild animals and other livestock. For example, deer and elk suffer from Chronic Wasting Disease (CWD) yet there have been no incidents of this disease among bison. However, bison are vulnerable to diseases that have been introduced from Europe. Malignant catarrhal fever or MCF, is one important infectious disease affecting bison. Sheep carry and transmit MCF but do not succumb to it. The disease is spread through nasal secretions and when bison share the same pasture, feed, or water as sheep, they often contract the disease.

Another disease introduced from Europe to which bison are susceptible is brucellosis. The management of brucellosis in Yellowstone National Park has been a controversial topic for decades. While there have been no documented cases of brucellosis being transmitted from bison to cattle, if such a transmission would occur, the impact on the livestock economy of Montana could be substantial. Controversy surrounds park manager techniques to control the number of bison leaving Yellowstone National Park. These techniques include public hunting, hazing bison back into the park, capture, testing for brucellosis exposure, and shipping bison to slaughter (Cheville, McCullough, Paulson, 1989).

11.1.3 Identification Systems Place

Due to the smaller size of the industry in general and processing facilities specifically, the bison industry has the ability to track animals more easily than does the beef industry.

The North American Bison Registry is maintained by National Bison Association (NBA). However, the membership in the registry is small so its usefulness as an identification system is limited. Another identification system used by some bison producers is a source-verified program. The NBA currently offers the National Bison's Source Verification Program as a tool to promote a natural product that can be traced to the ranch of origin. This program is similar to what is required for bison identification under the National Animal Identification System (Carter, 2008). Currently, approximately 23,000 animals are involved in this program, representing close to 10% of the total number of bison in the United States.

11.1.4 Priority of Bison

The bison industry has far less impact on the United States livestock industry as a whole than do other species examined in more detail in this project. In 2002, the number of bison represented 0.2% of total cattle in the United States. Because of the relatively small size of the industry and the nature of bison production, comingling, and thus chance of disease spread, among bison is less than that among cattle. However, near public lands containing bison herds, concerns of disease spread across species remains an important issue. Unlike cattle, bison are wild animals and so they are moved around the country infrequently. In addition, the industry already uses a source-verified program that provides traceability, so the structure for a more wide-spread animal identification system is already in place. Because of the relatively small size of the bison industry, we do not estimate specific benefits and costs of NAIS adoption by the industry in this report. Costs of registering premises in the bison industry would be similar to those of other species. We expect costs of adopting individual animal ID for those who are not already involved in programs similar to the NAIS requirements would be similar

to those for beef cattle (assuming the operation has facilities to work the bison).

11.2 Camelids

11.2.1 The Camelid Industry

The US alpaca industry has been growing rapidly over the past twenty years. The animals were first imported into the United States from South America in 1984 and their numbers in 2006 exceeded 86,000 head. The four top alpaca farming states are Ohio, Washington, Oregon and California (Baird, 2008). The long term goal of the alpaca industry in the US is to develop a domestic textiles industry. However, there are not currently enough alpacas in the US to support an industry, so the majority of those in the alpaca industry are breeders (Anderson, 2008). Live animal shows are an important part of the alpaca industry.

The US Llama population in 2006 exceeded 157,000. Llamas are farmed in similar areas as alpacas. The top llama farming states are Oregon, California, Texas and Washington (Baird, 2008). While some llamas are shown, much of the industry is a companion animal industry. Most of the shows that alpacas and llamas attend are sponsored by the Alpaca Owners and Breeders Association (AOBA) or the Alpaca and Llama Show Association (ALSA).

11.2.2 Diseases of camelids

Camelids are susceptible to certain viruses and parasites, however, the viruses they carry do not cross species lines. Mange and parasites are likely the biggest problems for camelids currently. Mange is species specific while camelids share internal parasites with other ruminants such as cattle, sheep and goats. In general, Brucellosis, Blue Tongue, and Foot and Mouth Disease do not survive well in camelids. The industry monitors for Tuberculosis and Brucellosis, but there has never been a positive test for these in camelids. Likewise, a test exists for Bluetongue, but it is not a clinical entity in camelids. (Anderson, 2008)

11.2.3 Identification Systems in Place

In July 2005, the AOBA began requiring all animals at AOBA-sponsored shows to be microchipped. It is estimated that approximately 85-90% of the US alpaca population is registered through the Alpaca Registry. When an alpaca is registered, it is DNA fingerprinted and microchipped. A smaller percentage of llamas are registered than alpacas because fewer are shown. Approximately 55-65% of llamas are registered (Anderson, 2008).

11.2.4 Priority of Camelids

Both the size and the nature of the camelid industry in the United States make it less of an identification priority than cattle, swine, sheep and poultry. In 2006 there were an estimated 243,000 llamas and alpacas in the United States. This is approximately 4% of the number of sheep in the United States in 2006 and 0.2% of the number of cattle. While the industry is relatively small and highly identified, much breeding movement occurs in the alpaca industry because no AI or embryo transfer is allowed. Therefore alpacas cross state lines frequently, making identification potentially an important issue. The alpaca industry is similar in nature to the equine industry in many ways, just much smaller in overall size. Due to the small size of the camelid industry and the fact that alpacas are predominantly registered, DNA fingerprinted, and have microchips, the industry has already largely adopted NAIS types of animal ID systems. Thus, we do not estimate specific benefits and costs of NAIS adoption by the industry in this report.

11.3 Cervids

11.3.1 The Cervid Industry

Although settlers in the United States farmed elk as early as the 1800's, the practice became popular in the United States in the 1960's. Both elk and white-tailed deer are native to North America. Velvet, a common ingredient in Chinese medicine, is the main product obtained from elk.

Most velvet produced in the United States is sold to China or used by Asian populations residing in the United States. Elk meat is consumed to a limited extent in the United States. Minnesota has a meat cooperative that sells 80,000 pounds of elk meat per year to upscale Orlando markets (Zebarth, 2008). Elk meat is also consumed at mountain resorts. The most common species of cervid raised in North America is white-tailed deer. Most people own these animals to hunt or raise them for breeding stock.

11.3.2 Size of Industry

In 2002 in the United States there were approximately 286,900 captive deer and 97,900 captive elk in a total of about 7,200 facilities (USDA 2002b). A majority of the deer population (52%) was in Texas. Wisconsin and Michigan, the second and third most populated states, each housed 8%. The elk population was more dispersed with the highest percent of animals in any one state being 17% in Minnesota. Wisconsin was the second most populated state with 13% of captive elk and Colorado and Texas follow with 10% and 6%, respectively.

11.3.3 Diseases

Cervids are susceptible to many of the same diseases as cattle. Perhaps the most troubling disease for the captive cervid industry has been CWD, a form of BSE. Cases of CWD have been found in white tail deer, mule deer, elk, and moose. CWD was first discovered in 1978 in Colorado wildlife research animals. It was not discovered in farmed animals until 1996 in Canada and 1997 in South Dakota. The most recent case in the US farmed industry was a whitetail deer in Minnesota. Wyoming has the highest incidences of CWD in the free-ranging population. Population reduction has been tried as a means of disease control, but the tactic has not been very successful (i.e. concentration of the cervid population does not seem to affect percentage of animals infected with CWD).

11.3.4 Identification Systems in Place

Producers need a license and a permit from the state to raise cervids. This is commonly controlled by each state's Department of Agriculture. Farmed cervids are classified as livestock according to APHIS regulation, so producers are subject to livestock regulations with additional fencing requirements. One purpose of cervid identification is to keep the captive population separate from the wild population.

In 2006, APHIS completed a Chronic Wasting Disease Herd Certification Program in coordination with the states and the farmed cervid industry. If states have programs in place that match the requirements for the national program, producers can enroll in the state programs. Otherwise they can enroll directly in the national program. Premises registration is required by the program and every animal is required to have two forms of permanent identification. The regulations of this program meet the requirements of the National Animal Identification System (Zebarth, 2008).

11.3.5 Priority of Cervids

In hopes of controlling CWD, APHIS and the captive cervid industry have been proactive in creating programs and methods to monitor the disease among cervids. The CWD Herd Certification Program is in place and much of the industry complies with its requirements. As such, the industry is highly regulated and far ahead of others in its level of identification and traceability. Thus, we do not explicitly complete a benefit and cost analysis of NAIS adoption for the cervid industry.

11.4 Goats

11.4.1 The Goat Industry

Several factors have contributed to the recent growth of the goat industry in the United States. The meat sector of the goat industry has seen marked growth while the angora and dairy sectors have declined.

The phasing out of the government wool program in 1995 caused a rapid decrease in mohair production. Since goat meat is a staple in many Hispanic and Muslim cultures, as ethnic populations in the US have grown, the demand for goat meat for consumption has increased (Faris, 2008).

The number of goats in the United States in January 2008 was approximately three million head according to NASS. Of these, 42% were located in Texas. The second most populous state was California with 4.4% of the goat population (134,000 goats). The meat goat population was 2.5 million head, approximately 83% of the total US goat population. The geographic distribution of the meat goat population is similar to the total goat distribution. Texas is home to approximately 44% (1 million) of meat goats in the US. Tennessee is a distant second with 4.7% of the meat goat population. (USDA, 2002b).

The number of Angora goats in the US as of January 2008 was 210,000, down 10% from the previous year. A majority of these goats are located in Texas (71%). Arizona comes in a distance second with 8% of the Angora goat population. The US had 305,000 dairy goats as of January 2008, a slight increase from January 2007. About 11% of these are in Wisconsin while California and Texas are home to 10% and 8%, respectively (USDA, 2002b).

While the goat industry is relatively small (sheep inventory as of January 2008 is over twice as large as goat inventory), meat goat numbers in the United States are growing.

11.4.2 Diseases and Identification Systems

As the goat industry grows, the knowledge of diseases that affect goats is also growing. Parasites are more of a health concern for goats than are diseases. Internal parasites can be managed by maintaining a low stocking density in pastures. As more animals graze on the same pasture, parasite problems increase because animals are grazing closer to the ground and the amount of fecal matter on the pasture increases. Diseases that affect the goat industry include caprine arthritis-

encephalitis (CAE), footrot, caseous lymphadenitis (CL), soremouth, and scrapie. Of these diseases, CAE is the most serious.

Although scrapie rarely affects goats, many goat producers are enrolled in the National Scrapie Eradication Program (NSEP). According to APHIS, as of December 2007, 52% of the goat herds are registered in the program (USDA, 2007e). The NSEP has been successful in tracking animal across the United States.

11.4.3 Priority of Goats

APHIS assigned goats a medium priority designation in their Business Plan to Advance Animal Disease Traceability. Several characteristics of goats and the goat industry make the species less of a priority for this research project. First, the small size of the industry, relative to the major species industries, lessens its importance with regard to the livestock industry as a whole. The number of goats in the US as of January 2008 was less than half the number of sheep. Next, the industry's participation in the NSEP coupled with the low incidences of the disease found in goats provide a relatively high level of traceability for the risk of disease spread associated with the species. Finally, the geographical concentration of the industry allows a possible disease outbreak to be more easily managed. However, as previously mentioned, the industry appears to be becoming less geographically concentrated than in the past. Costs of adopting NAIS for goat producers would likely be similar to those of the sheep industry.

12. Other Benefits Of NAIS Adoption

Premises registration, animal identification, and animal movement tracking offer a number of benefits to industry stakeholders, government health professionals, food safety regulators, and consumers. The types of benefits that accrue range from enhanced animal health surveillance to improving consumer demand because of food product credence attributes associated with food and animal traceability. The economic impact of several of the benefits discussed here are estimated directly or indirectly and presented in previous sections of this report. The benefits estimated in our report are those that are directly affected by NAIS adoption. However, the economic values of numerous benefits noted here are not estimated in this study because they are benefits that NAIS adoption would enable or make more efficient, but are *not* directly a part of the confidential NAIS premises registration or animal ID system. As a result, we know that our current benefit-cost analysis understates potential benefits of NAIS adoption. In addition to the summary that follows, see Smith et al. (2005) for an excellent discussion of several benefits of traceability.

12.1. Enhancing Animal Health Surveillance and Disease Eradication

One of the most important direct benefits of premises registration, animal ID, and animal movement tracking is the impact on animal health. To conduct appropriate, statistically sound, animal health surveillance requires knowing where animals are located, their densities, and animal movements. Developing sampling procedures of animals to determine statistically valid measures of the extent of diseases in populations require knowing where animals are located.

A number of state and national animal identification programs have been used in the United States in attempts to eradicate a variety of animal diseases. Examples include the national brucellosis eradication program,

with roots back to 1934 (Bradt, 1959), in which vaccinated heifers are identified with an official tattoo in the ear. Ironically, this program has been so successful at eradicating the disease that vaccinations have greatly declined over time going from 45% of heifers being vaccinated in 1995 to only 20% by 2003 (Wiemers, 2003). The result is far fewer cattle having a brucellosis animal ID for any type of traceability in the event of a health crisis. The swine pseudorabies (PRV) eradication plan was successful in getting all states designated as free from the disease. However, large populations of feral swine in certain regions of the country raise concerns regarding PRV reintroduction. Thus, the new targeted surveillance program integrates with swine premises registration data to develop "a robust database to allow targeted sampling based on associated risks" (Korslund, 2008, p. 2). The National Scrapie Eradication Program started in 2001 identifies animals using an ear tag that are over 18 months of age entering the sheep breeding herd indentifying each animal by flock of origin and each having a unique herd management number.

Animal disease management and eradication programs provide an immediate benefit from integration with NAIS. Standardization of premises identification systems; uniformity in a nationally recognized animal, lot, or flock identification numbering system; and standardized methods and devices for livestock ID utilization (Wiemers, 2003) all speak to the ability on a national level to rapidly identify premises, trace animals, and respond with appropriate actions in the event of an animal disease outbreak. Preparedness before an outbreak is essential in reducing the economic impact.

12.2 Reducing Economic Impact of Disease Outbreaks

THE TYPE OF ANIMAL IDENTIFICATION and traceability system in place in an industry can significantly impact the duration, spread, and economic consequences of a foreign animal disease (Saatkamp et al., 1995 and 1997). Disney et al. (2001) analyzed the economic impacts of improved animal identification systems for cattle and swine using a

hypothetical foot-and-mouth disease (FMD) outbreak in the United States. Improved animal identification systems in cattle could provide economic benefits with average benefit-cost ratios for cattle ranging from 1.24 to 3.15 depending upon the time planning horizon and the traceability situation. However, economic benefits (in terms of reduced economic consequences of an FMD outbreak) were not justified in swine with improved animal identification systems and most benefit-cost ratios were less than one. Zhao, Wahl, and Marsh (2006) investigated the economic consequences of an FMD outbreak in the US with increased levels of animal traceability and surveillance. They concluded that total consumer and producer combined surplus losses from an FMD outbreak would decline from $266.3 billion to $50.3 billion with a depopulation rate that went from 30% to 60% of latent infectious herds, which the authors attributed to increased animal traceability.

12.3. Regionalization and Compartmentalization to Re-establish Market Access

In management of any animal disease outbreak one critical issue regarding the economic impact of the outbreak is the ability to contain the disease and restore market access for at least part of the industry as soon as possible. This brings to the forefront the concept of regionalization (or zoning) in which a subpopulation, based on geographic region, can be demonstrated as an isolated area free of disease incidence enabling the region to have international market access. Paarlberg et al. (2007) examine the economic impact of regionalization in the United States of a highly pathogenic avian influenza outbreak. They concluded that such an outbreak in the United States would have substantial economic impacts with about a $718 million reduction in returns to capital and management in the poultry meat production sector with no regionalization over a 4-year time horizon. With regionalization, poultry meat producer losses would reduce to around $500 million because regionalization dampens export market losses.

Compartmentalization is further refined relative to zoning and involves isolating one or more establishments with common biosecurity

management measures “that provide distinct disease risk separation from animals or birds at higher risk for the disease(s) in question” (Scott et al., 2006, p. 875). The World Organization for Animal Health (Office international des epizooties – OIE) officially recognizes regionalization and compartmentalization animal disease management procedures as conditions that may enable resumed international market access in unaffected areas following a disease discovery. Animal ID, movement tracking, inflow, and outflow documentation are essential in demonstrating such an auditable biosecurity management system is present.

12.4. Reducing Producer Costs Associated with Animal Disease Testing

Animal disease testing is part of on-going animal disease surveillance and eradication programs. Having individual animal identification can significantly reduce the costs to both the producer and the state veterinarians of testing a herd for a particular animal disease. In Michigan for example between January 1, 2000 and June 1, 2006 over 18,000 herds and 1,191,063 animals (average tested herd size of approximately 66 head) have been tested for bovine tuberculosis (Michigan Department of Agriculture, 2006). Michigan, currently the only state with a mandatory individual animal identification program in operation, provides a specific example of the producer cost savings that may be realized by having individual animal identification and associated electronic technologies available to increase testing efficiency. Discussions with Dr. Tom Flynn and Dr. Dan Robb (both experienced veterinarians in Michigan) suggest that use of MIM (a software technology that leverages electronic animal identification in animal disease testing) leads to quicker TB testing of cow herds. In particular, Robb suggests that creation of herd testing for 25, 50, and 100 head herds may be conducted 0, 1, and 2.5 hours quicker, respectively, by utilizing MIM software on animals with RFID animal identification. These reduced times of testing herds of more than 25 head correspond to

reduced periods of on-farm production interruption and hence reduced lost value of production for participating farmers.

12.5. Enhancing Animal Welfare in Response to Natural Disasters

During natural disasters there are times when having premises registration and/or animal identification can greatly assist officials in identifying and assisting animals in distress or finding owners for displaced animals. A recent example of premises registration improving animal health surveillance occurred in southeast Colorado during the December 2006 blizzards. Colorado Department of Agriculture used premises registration information to check on the welfare of ranchers and their livestock which substantially accelerated the rate and expanded the scope, of issue assessment and assistance needs (Colorado Department of Agriculture, 2007). Following hurricane Katrina in New Orleans, 163 horses and mules were returned to their owners, mostly identified with microchips or lip tattoos in 2005 (New Orleans City Business, 2005).

12.6 Facilitating Meeting Country-of-Origin Labeling Requirements

With country-of-origin labeling of meat being enacted in September 2008, retailers are required to label fresh beef, pork, lamb, chicken, and goat, as well as other products, according to its country of origin. All retailers and suppliers are required to maintain origin information for one year for covered products that they sell. Under this law, producers must maintain records that can link animals sold to production records documenting animal origin. If animals are comingled from multiple sources of origin, for example, cattle stockers and feedlots, they will need to be able to link the animals in a pen to their origins. If animal sorting and co-mingling from multiple sources occurs, the burden of maintaining origin records could be reduced with individual animal ID.

In particular, animals having NAIS compliant forms of ID (e.g., "840" tags) can use this to verify origin. Thus, NAIS compliant individual animal identification eliminates the need for maintaining multiple affidavits for lots of animals comingled from a variety of sources.

12.7 Reducing Information Asymmetry by Increasing Transparency in Supply Chain

An important implication of animal traceability is that it can reduce information asymmetry leading to greater transparency in the vertical supply chain. Animal identification is a direct link to where an animal originated and with movement tracking provides an efficient way to identify sources of and quickly solve animal production problems that affect overall value of animals throughout production and processing. For example, Resende-Filho and Buhr (2008) demonstrate that even with low levels of animal traceability (39%), a beef packer can induce a cattle feeder to adopt quality control practices to reduce incidence of injection-site lesions in fed cattle. Animal tracing would provide similar incentives to reduce information asymmetry related to up to date vaccination programs, feeding regimens that might lead to meat residues, or tracking other animal treatments such as growth promoting implant programs.

12.8 Reducing Risk of Unfounded Responsibility in Liability Claims

Traceability systems create incentives for firms to do things that increase food safety because such systems increase the possibility of legal action upon responsible parties. As such, traceability enables parties in the vertical supply chain to more easily document that they are not responsible for harm associated with a food safety event (Pouliot and Sumner, 2008).

12.9 IMPROVING EFFICIENCY OF VALUE ADDED AND CERTIFIED PROGRAMS

THE USDA AGRICULTURAL MARKETING SERVICE (AMS) has several voluntary marketing programs such as USDA Process Verified, Quality Systems Assessment, and Non-Hormone Treated Cattle that require animal identification and traceability. The AMS has integrated their auditing of these certification programs to enable NAIS to meet the animal identification requirements.

NAIS can also be used to help verify requirements for USDA Export Verification programs to be eligible for products to be exported to specific countries such as Japan or EU. Global certification programs, such as International Standardization Organization (ISO) guidelines, are another growing source of food safety and hygiene systems entailing traceability (Meuwissen et al., 2003).

Some industry stakeholders told us they were concerned that NAIS adoption could reduce premiums associated with source and age verification programs. This is possible, if NAIS animal ID makes such voluntary AMS programs easier and cheaper to comply with. However, if industry adoption of NAIS animal ID and tracing increases domestic and/or export demand in ways described in Section 9, then the industry would still garner significant net benefits from adoption. However, some individuals could be made worse off, or certainly benefit less, from NAIS adoption than the average firm.

12.10 SOCIAL BENEFITS OF ANIMAL TRACING

SOCIAL VALUE OF TRACEABILITY in general is very well presented by Golan et al. (2004b, pages 37-38):

Social benefits may also include the avoided costs to firms that produce safe products but lose sales because of safety problems in the industry. A firm's traceability system not only helps minimize potential damages for the individual firm, it also helps minimize damages to the whole industry

and to upstream and downstream industries as well. For example, a series of widespread ground meat recalls has the potential to hurt the reputation and sales of the entire meat industry, including downstream industries such as fast food restaurants and upstream suppliers such as ranchers. The benefits to the industry of a traceability system pinpointing the source of the bad meat and minimizing recall (and bad publicity) could therefore be much larger than the benefits to the individual firm.

Though their example refers specifically to a meat traceability issue, similar arguments certainly apply to animal traceability.

12.11. Enhancing Global Competitiveness

In case studies of poultry, beef, pork, lamb, and fish firms employing traceability located in France, Holland, Germany, Norway, and Scotland, Buhr (2003) states, "When case participants were asked why they adopted traceability, the first response in every case was, "Consumers demanded to know where their food came from and how it was produced" (p. 14). Following the BSE events in the United States in December 2003, the vast majority of the beef export market was completely closed. Five years later, only about 75% of beef export market volume movement prior to the BSE event has been regained. Murphy et al. (2008) in review of animal identification systems in North America argue that animal identification systems are becoming "prerequisites to international trade" (p. 284).

Liddell and Bailey (2001) argue that the United States pork industry lags behind major world producers of United Kingdom, Denmark, Japan, and Australia in animal traceability. Meisinger et al. (2008) also demonstrate how much more advanced the EU, UK, Denmark, New Zealand, and Australia are relative to US in swine and pork traceability. Bass et al. (2008) discuss how major lamb producing countries of Australia and EU have advanced mandatory sheep traceability systems beyond the voluntary system present in the United States. Tonsor and Schroeder (2006) present similar arguments comparing the United States and Australian beef tracing systems. Souza-Monteiro and Caswell (2004)

present evidence that EU, Japan, Australia, Brazil, Argentina, and Canada lead the United States in beef traceability systems. Table 12.1, taken from Bowling et al. (2008), illustrates how many of the major cattle producing countries have animal ID and traceability systems that are mandatory. Bailey (2007) demonstrates the US has a weaker beef traceability system than Uruguay, Argentina, EU, and Australia. He concludes that consumer concerns about credence attributes provided through animal ID and traceability could become more important threatening the ability of the United States industry to compete effectively. Meat and Livestock Australia (2008) consider cattle ID in their country as an insurance policy in the event of a trade disruption.

Table 12.1. Comparison of Cattle Population and Identification and Traceability Systems.

Country	Cattle Population (1,000 hd) [1]	Premises ID[2]	Individual Cattle ID[2]	Group / Lot Cattle ID[2]	Electronic Cattle ID[2]	Record Animal Movement[2]	Retire Animal Number[2]
Australia	28,560	M	M	V	M	M	M
Botswana	3,100	V	M	NA	M	M	V
Brazil	207,157	M	V	M	V	M	V
Canada	14,830	V	M	NA	M	V	M
European Union	90,355	M	M	V	V	M	M
Japan	4,391	M	M	V	V	M	M
Mexico	28,648	V	V	V	V	V	V
Namibia	2,384	M	M	V	V	M	M
New Zealand*	9,652	V	V	V	V	V	V
South Korea*	2,484	M	M	V	V	M	M
Uruguay	11,956	M	M	V	M	M	M
United States*	96,702	V	V	V	V	V	V
World	1,383,157						

[1]All numbers are for cattle populations in 2006 as reported by the Food and Agriculture Organization of the United Nations (FAOSTAT, 2008).

[2] M = Mandatory, V = Voluntary, NA = Not Allowed

* Indicates a voluntary program. The requirements listed are for those who choose to participate

Source: Bowling et al. (2008). Reproduced with permission from Editor-in-Chief, *Professional Animal Scientist*.

13. Information Gleaned from Industry Meetings and Lessons Learned

During the course of our discussions with industry stakeholders, in addition to information and data that were used directly in our benefit-cost analysis, several related sentiments were revealed. Here we summarize some of these sentiments. This particular section of our report, unlike most of the rest of our analysis, is not meant to represent a scientific survey response and does not therefore have associated robust statistical properties in terms of whose opinions it does or does not represent. However, our discussions were broad in terms of industry organizations and representatives that we visited and thus represent views expressed by a significant segment of industry (see appendix A3 for list of organizations we visited). The information we share here is a synthesis of comments and does not represent any single entity or person.

13.1 Cost of animal ID is just a cost of doing business

In our industry discussions we often heard sentiments reflecting that animal ID and tracing are part of a well-functioning and efficient vertical food production and marketing chain. This sentiment was reflected in reference to numerous aspects of what animal ID and movement tracing brings to animal health management, crisis management, adding credence attributes to food labels, enhancing trade, and various other potential benefits. Making NAIS practices a part of business reflects the idea that many in industry perceive a need and are moving forward with evaluating how to adopt systems most efficiently.

13.2 Mandate, tell us the rules, and we'll adjust

The sentiment relating to mandating animal ID was especially voiced by market participants who recognize economies of scale associated with fixed investment in ID scanning and recording equipment. A voluntary ID system, with moderate or low levels of adoption, is costly for firms that must make facility modifications and procure information technology equipment in order to offer animal ID and recording services. If mandated, the investment must be made by all firms and will be fully utilized in each establishment. If left voluntary, establishments must figure out whether to make investments necessary to adopt NAIS practices in the presence of uncertainty about their ability to fully utilize the equipment. This makes adoption of such equipment a strategic decision that can either make a firm more or less competitive with other firms in the industry. The "tell us the rules" segment of this statement was a reflection of developing guidelines over time in NAIS including what some perceived as a change in direction from what some believed appeared to be a system that was headed toward being made mandatory to a voluntary system.

13.3 Not mandating will result in low animal movement tracking

A concern that was similar to the sentiment of "mandate and we will adjust," was that without mandating, producers will be slower to adopt and fewer will adopt ID and tracing technology. Again, the concern was that slow and small adoption rates, makes it difficult, especially for smaller firms in industry, to know what direction to head in terms of adding or not adding animal ID and recording services.

13.4 Stakeholders do not largely support a NAIS national data bank

NUMEROUS ORGANIZATIONS TOLD US that an NAIS national data bank was not preferred. Instead industry organizations often times told us their preference was for the individual industry to maintain their own data bank(s) while allowing USDA access on an as needed basis. This sentiment was at times motivated by a group that might be capturing more information than that specified by NAIS and using it for other purposes making dumping parts of the data to another data bank simply an added cost without perceived additional value or because the industry preferred to keep the data internal. This preference was revealed across numerous species and industry sectors.

13.5 But, not having a coordinated national data base is problematic

DESPITE PREFERENCES FOR MAINTAINING animal ID and movement records internal within an industry, many that we visited with admitted that having multiple individual data banks, may make coordination and communication across data banks problematic. The feeling was that the lack of a centralized data base will either slow or curtail successful tracing. Centralized data banks in Australia and Canada, where animal ID systems are mandatory and more mature, were often noted examples of how such systems have been designed.

13.6 Do not know animal density or location making surveillance hard

BENEFITS OF ANIMAL ID resulting from improved animal surveillance were presented in Section 12. Our research team heard from several in a variety of settings that not knowing the locations,

densities, or movements of animals makes disease surveillance much more difficult.

13.7 LARGER FIRMS NEED COMMON TECHNOLOGY

HAVING ID AND ANIMAL MOVEMENT recording occur at the speed of commerce is a very important dimension of acceptability and adoption of ID systems. Furthermore, larger firms that have large numbers of animals flow through their operations, indicate common technology that will operate effectively at the speed of commerce is essential for efficient ID and movement tracking. This suggests that if a technology neutral position remains for NAIS adoption, the resulting adoption will be more expensive and have a lower rate of adoption than if specific technology specifications were defined at points in time. In contrast, smaller operations often have preference for a variety of animal ID and recording systems that may not be compatible with recording large numbers of animal movements rapidly. Thus, we heard conflicting opinions as to the value of "technology neutral" systems such as are currently being suggested in the NAIS plans.

13.8 DO NOT ADD REDUNDANCIES TO CURRENT PRACTICES

WE HEARD SEVERAL TIMES from several organizations across species that an animal ID and movement tracking system, whether group/lot or individual animal, needs to complement, not add redundancy and added layers of work to current industry practices. The reality of whether and how this can be accomplished is well beyond the scope of our project, but it was revealed often enough to merit noting.

13.9 NAIS ENABLES US TO REGIONALIZE AND PERHAPS COMPARTMENTALIZE ISSUES

ANOTHER FREQUENTLY MENTIONED comment by stakeholders was the opportunity for NAIS to regionalize and compartmentalize animal health issues to more quickly and more fully re-establish market access in the wake of an animal disease or food safety event. Again, this was discussed more fully in Section 12, but it is well recognized by stakeholders as something NAIS should be designed to enhance.

13.10 BREEDING HERDS ARE BIGGEST CHALLENGE AND NEED FOR NAIS

SEVERAL STAKEHOLDERS REVEALED the greatest need and the greatest challenge for NAIS adoption is in the animal breeding herd. Focusing effort on this segment of each species appears well justified.

13.11 NEGATIVE EXTERNALITY ON NON-ADOPTERS, SOCIAL VALUE EXCEEDS PRIVATE

WHILE WE OFTEN HEARD sentiments about supporting mandated NAIS by many stakeholders we also often heard concerns that related to non-adopters gaining at the expense of adopters of the technology. From an animal health management perspective someone who does not adopt the technology gains from those who do by the overall animal herd health being improved. Thus, individual producers that believe others will adopt have less incentive themselves to adopt. In economics this is referred to as a 'free rider' problem meaning that adopters essentially subsidize non-adopters. Industry ID management systems such as compartmentalization (discussed in Section 12) can negate much of the 'free rider' problem. There is some sentiment that there might a significant public value of animal ID that justify public support for such

programs as adoption rates might be lower than desired without such support.

13.12 First breach of confidentiality will be disaster

The issue of confidentiality of data and information collected in NAIS has long been a concern voiced by some industry participants (Bailey and Slade, 2004). Stakeholders told us that a breach of such confidentiality would be a disaster for development of NAIS. This concern was not unexpected, but speaks volumes to industry demand for confidentiality of NAIS data.

13.13 Technology needs to be error free

Operating at the speed of commerce and error free are commonly stated characteristics of an NAIS system that industry participants indicate will greatly affect adoption rates. Tonsor and Schroeder (2006) discussed how components of the Australian animal ID system required troubleshooting and solving problems as they occur. This is true of NAIS as well. However, the United States livestock industries operate with considerably more animal movement than many other countries resulting in lower tolerance for technology problems and reading errors by US industry participants. Bottom line, the technology needs to be as error free as possible. Related to this, many participants reiterated the need for one system, at least within a species, such that they did not have to work with and/or support multiple technologies.

13.14 Packers will benefit but do not pay the costs

Several industry participants voiced concern that with full animal ID and tracing adoption growers incur the major costs, but packers gain the major benefits. Our results indicate that indeed growers

incur the largest share of NAIS adoption costs, especially in the beef sector (Section 4). However, as our economic analysis shows (Section 9), growers as well as packers gain if modest domestic beef demand and/or export demand enhancements occur from NAIS full animal ID and tracing adoption.

13.15 NAIS IS A GOOD THING FOR GLOBAL INDUSTRY

THE FEELING THAT NAIS IS NEEDED to ensure consumer confidence in our products was a widely, though not unanimously, held sentiment among stakeholders of all species and sectors.

14. Limitations

As with any such benefit-cost analysis of this scale and scope, the limitations of this study are too large in number to fully illuminate. However, several limitations of this project deserve elaboration.

14.1 Lack of data necessary for precise estimation

Estimating benefits and costs of adoption of NAIS is much like doing so for any new technology; many of the benefits and costs have to be estimated based on projections and assumptions made having less than ideal data. For example, our study relies on surveys of industry adoption rates of numerous management practices such as computer use and animal ID and other management practices that are often dated, subject to weaknesses of the survey methods used to collect primary data, and may not be representative of the entire industry. Furthermore, often data from different sources do not match up well and often data in the form needed simply do not exist. We tried to address this chronic shortcoming by using the most current and reliable published data available, supplementing public data with industry expert opinion, and where feasible and important to outcomes, performing sensitivity analyses.

Our study team's way of dealing with data uncertainty or unavailability in direct cost estimation was to generally err on the upper end of cost estimate range. As such, the NAIS adoption cost estimates in this study are more likely biased upward than being understated. As a result of data challenges present, it is difficult to assign precise statistical confidence levels to our overall estimates. Instead, our estimates represent a culmination of the best information we could collect given a large number of constraints using the most appropriate methods available to complete the analysis.

14.2 Benefit-cost estimates are based on current technology and prices

The analysis of benefits and costs of adoption of NAIS hinges heavily on current technology available to ID animals and record their movements. Over time the technology is improving and will continue to become cheaper as it is more fully adopted around the world and as additional refinements are made. Furthermore, the full benefits of NAIS have not been fully discovered as is typical of such new technology developments. There are likely benefits from such adoption that industry has not yet realized. For example, an improved animal identification and information system might enhance a beef cow/calf producer's ability to manage his cowherd (e.g., culling and genetic selection decisions) and thus lower costs of production. While benefits such as this will undoubtedly exist, they tend to be operation specific and are hard to predict and thus they have not been included in our analysis. As such, our benefit-cost analysis, even though completed with appropriate discounting and net present value analysis and annualizing methods, uses current values for benefit and cost parameterization. Likely these understate future benefits and overstate future costs.

14.3 Costs are *probable* and benefits are *potential*

One issue apparent from the start of this project was that quantifying direct costs of adopting animal ID systems was markedly different from determining benefits. Quantifying direct costs of adopting NAIS, though very involved and requiring many assumptions, judgments, and estimates is an exercise in evaluating highly probable outcomes. That is, costs of adoption reflect well-defined actions and investments that need to be made by industry participants if they elect to adopt NAIS practices.

In sharp contrast, most of the benefits of NAIS adoption are potential benefits that have some largely unknown probability of occurrence and/or are conditional on how industry participants elect to utilize NAIS

ID and tracing technology. Typically the probability of events that provide apparent benefits of having a widely adopted NAIS, is not known with any reasonable degree of certainty. For example, no one has a reliable estimate of any particular highly contagious foreign animal disease outbreak in the United States where having NAIS might greatly reduce costs of disease management and eradication. Even if we had an estimate of the probability of a disease outbreak, the epidemiology of disease spread is uncertain and can at best be simulated numerous times to obtain a distribution of possible outcomes. Furthermore, potential diseases and their probability of occurrence are dynamic. There are no reliable estimates of the type or frequency of natural disasters that might occur where having NAIS would substantially reduce adverse impacts. How market access will be affected by having a traceability system present and having regionalization and compartmentalization in the event of an industry crisis is subject to global trade policies and political relationships that often times, at best, lag scientific knowledge. In other words, while few would question the benefits of having NAIS in the event of a major disease outbreak, what is often debated is the probability of a major disease outbreak occurring.

Because of the challenge with estimating direct benefits, our study relied heavily upon scenario analyses that are not predictions, but reflect *what if* assessments using our best judgment to design relevant scenarios to help provide useful information for decision making. Anytime scenarios are relied upon, there are always going to be preferences for more and different scenarios to be presented. We selected what we felt were the most useful scenarios for making sound industry and public policy decisions. Certainly, more scenarios can be considered than what we present.

We also included a section in the report on other potential benefits (Section 12) specifically to highlight that many benefits of NAIS adoption are not explicitly estimated in our study. For example, our overall benefit-cost estimation ignores most private firm direct benefits NAIS adoption may provide including improved supply chain coordination, enhancing value-added opportunities, and enabling more intensive production management. As a result, overall benefit estimates

associated with NAIS adoption quantified in our analysis are undoubtedly underestimated.

14.4 Synergism and substitution of NAIS adoption is largely ignored

NAIS adoption by one species affects benefits and costs of adoption in other species. For example, having individual animal ID and animal traceability in cattle, has a direct positive impact on the swine industry in the event of a contagious disease outbreak that crosses species. Such cross-species affects can have substantial economic impact when it comes to things such as market access. One way we address part of this species cross-over is through our equilibrium displacement model where beef, pork, poultry, and lamb markets are directly linked to, and affect, each other. However, our study does not fully address cross-species impacts with respect to disease management and eradication that could increase or reduce the net benefit of NAIS adoption in one species or another.

14.5 Lack pet and hobby data

Throughout our benefit-cost analysis the focus was on NAIS adoption in commercial agriculture with much less emphasis on individuals who have animals as pets or raise them for hobbies. We relied upon USDA NASS and Census data for the number of livestock operations by species when estimating costs and thus we do not account for livestock owners that do not meet the official classification of an operation. For example, we do not have specific data on club calves, sheep, or pigs; animals raised by youth for competition or show events; backyard poultry flocks; and many other small non-farm livestock or poultry caretakers. Though we do not have detailed data, the number of animals included in these segments is a very small proportion of the total industry, so excluding these animals is not a major omission in animal numbers. Some pet or hobby animals have very little cross-premises

movement during their lifetimes, so premises registration might be sufficient to have information about animal locations for these operations. Thus, the omission of operations and animals of this type likely is not a critical issue impacting the benefit-cost analysis. However, animals that are involved in county and state fairs and other livestock shows, could have considerable animal movement and co-mingling. Largely omitting such animals (except in equine where we attempted to capture more of these) and individuals from our analysis is a weakness of our study. If reliable data existed on such individuals, we expect our overall industry costs of NAIS adoption would increase very little by their inclusion (because the animal numbers are very small relative to the population). However, benefits of having animal movement tracking for these animals might be a bit larger and a more important omission because of the amount of movement and co-mingling involved with some of these animals.

14.6 WE ASSUME THE REST OF THE WORLD IS STATIC

OUR BENEFIT-COST ANALYSIS IS SPECIFIC TO the United States. Our equilibrium displacement modeling exercise includes import and export equations, however, the model assumes nothing else in the rest of the world changes as we change NAIS adoption rates and run various scenarios. This is not realistic, but on the other hand, neither are any other assumptions of what specific global adjustments might occur outside of our model under various scenarios. This is simply the reality of any economic model. When we make an exogenous supply and/or demand shock and evaluate the outcome, we assume *ceteris paribus* (all else constant). Indeed, all else is never constant.

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16. Appendices

Appendix A3: Industry Association Representative Meetings

1. American Association of Meat Processors
2. National Renderers Association
3. Darling International
4. Seaboard Farms
5. Superior Lamb
6. Southwest Meat Association
7. Smithfield Beef
8. National Milk Producers Federation
9. National Livestock Producers Association
10. Livestock Marketing Association
11. Michigan Department of Agriculture
12. United Producers Inc. (Auction Network in Michigan)
13. Michigan cow/calf, feedlot, and dairy producers
14. National Meat Association
15. American Sheep Industry Association
16. American Meat Institute
17. National Cattlemen's Beef Association
18. United States Meat Export Federation
19. Meat and Livestock Australia
20. Canadian Cattle Identification Agency
21. APHIS Risk Analysis Team members
22. Pro Rodeo Cowboys Association
23. Meat and Livestock Australia
24. National Pork Board
25. National Pork Producers Association
26. Colorado State University Veterinary Hospital
27. American Horse Council
28. Destron Fearing
29. R-CALF U.S.A.
30. American Quarter Horse Association
31. National Bison Association

32. American Boer Goat Association
33. North American Elk Breeders Association
34. The Jockey Club
35. United States Equestrian Federation
36. Thoroughbred Owners and Breeders Association
37. Kentucky Department of Agriculture
38. American Association of Equine Practitioners
39. Penn State University – Animal & Dairy Science Department
40. National Horseman's Benevolent and Protective Association
41. Kentucky Thoroughbred Association
42. Broseco Ranch
43. Agri Beef Company
44. APHIS
    a. Center for Emerging Issues
    b. National Surveillance Unit
    c. National Animal Health Monitoring System
45. Office of the Chief Information Officer
46. Policy and Program Development
47. National Center for Animal Health Programs
48. National Chicken Council
49. American Boer Goat Association
50. Kansas State University—Animal Sciences & Industry Department
51. Kansas State University—Clinical Sciences Department
52. California Department of Food and Agriculture
53. University of California-Davis, NAIS cost and benefit research team
54. Center for Animal Disease Modeling and Surveillance (CADMS), Univ. of California-Davis

Appendix A4: Bovine Cost Appendices

Appendix A4.1: Beef Cow/Calf Operations

Table A4.1.1 Number of Beef Cow/Calf Operations and Inventory and Production Levels by Size of Operation.

	Size of Operation, number of head						
	1-49	50-99	100-499	500-999	1000-1999	2000-4999	5,000+
Number of operations	585,050	94,490	72,855	4,180	980	290	55
Percent of operations currently tagging	35.1%	54.3%	61.0%	61.4%	61.4%	61.4%	61.4%
Average herd size, head	15.7	65.2	175.9	633.9	1,182.90	2,512.60	7,828.50
Bulls in herd, head (500+ lbs)	0.6	2.6	7	25.1	46.8	99.3	309.4
Calving rate, %	95.6%	95.6%	95.6%	95.6%	95.6%	95.6%	95.6%
Calving rate adjusted for twinning, %	94.3%	94.3%	94.3%	94.3%	94.3%	94.3%	94.3%
Calf death loss before 24 hours, %	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%
Calf death loss after 24 hours, %	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%
Replacements retained, %	15.1%	15.1%	15.1%	15.1%	15.1%	15.1%	15.1%
Replacement animals, head	2.4	9.8	26.6	95.7	178.6	379.3	1,181.80
Cow death (disappearance) loss, %	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%
Cull rate, %	11.0%	11.0%	11.0%	11.0%	11.0%	11.0%	11.0%
Cows culled, head	1.7	7.2	19.4	69.7	130.1	276.4	861.1
Bulls culled, head	0.2	0.6	1.7	6.3	11.7	24.8	77.4
Total animals sold, head	13.4	55.9	150.7	543.1	1,013.50	2,152.70	6,707.30
Calves born and alive at 24 hours, head	14.6	60.6	163.5	589.2	1,099.50	2,335.40	7,276.50
Calves dead after 24 hours, head	0.7	2.7	7.3	26.4	49.2	104.6	325.9
Total calves available for sale, head	13.9	57.9	156.2	562.8	1,050.2	2,230.8	6,950.5

Table A4.1.2 Tags and Tag Applicators per Cow/calf Operation by Size of Operation that Currently Tags Cattle.

	Size of Operation, number of head						
	1-49	50-99	100-499	500-999	1000-1999	2000-4999	5,000+
Number of calves to retag, head	0.3	1.4	3.9	14.1	26.3	55.8	173.8
Total cows and bulls tagged, head	0.4	1.7	4.6	16.5	30.7	65.3	203.4
Total tags purchased	15.3	63.7	172	619.7	1,156.50	2,456.50	7,653.70
Tag loss rate, %	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
RFID button tag cost, $/tag	$2.50	$2.30	$2.20	$2.00	$2.00	$2.00	$2.00
Total RFID tag cost, $/operation	$41	$155	$400	$1,312	$2,447	$5,199	$16,197
RFID tag applicator cost, $/unit	$11.83	$11.83	$11.83	$11.83	$11.83	$11.83	$11.83
Number of tag applicators	1	1	2	4	5	6	7
Years of RFID tag applicator	4	4	4	4	4	4	4
Annual cost of tag applicator, $/operation	$4	$4	$7	$14	$18	$21	$25

Table A4.1.3 Tags and Tag Applicators Required per Cow/calf Operation by Size of Operation Currently Not Tagging Cattle.

	Size of Operation, number of head						
	1-49	100-499	500-999	1000-1999	2000-4999	5,000+	5,000+
Number of calves to retag, head	0	0	0	0	0	0	0
Total cows and bulls tagged, head	0	0	0	0	0	0	0
Total tags purchased	13.4	55.9	150.7	543.1	1,013.50	2,152.70	6,707.30
Tag loss rate, %	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
RFID button tag cost, $/tag	$2.50	$2.30	$2.20	$2.00	$2.00	$2.00	$2.00
Total RFID tag cost, $/operation	$36	$136	$351	$1,149	$2,145	$4,556	$14,194
RFID tag applicator cost, $/unit	$11.83	$11.83	$11.83	$11.83	$11.83	$11.83	$11.83
Number of tag applicators	0	0	0	0	0	0	0
Years of RFID tag applicator	4	4	4	4	4	4	4
Annual cost of tag applicator, $/operation	$0	$0	$0	$0	$0	$0	$0

Table A4.1.4 Tagging-Related (Working) Costs per Cow/Calf Operation by Size of Operation that Currently Tags Cattle.

	Size of Operation, number of head						
	1-49	50-99	100-499	500-999	1000-1999	2000-4999	5,000+
RFID Tag Labor Cost							
Labor rate, $/hour	$9.80	$9.80	$9.80	$9.80	$9.80	$9.80	$9.80
Time to tag 2X / animal, seconds	30	30	30	30	30	30	30
Cost of tagging animal 2X, $/head	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08
Cost of tagging, $/operation	$1	$5	$14	$51	$95	$202	$629
Labor and Chute Costs							
Setup time for retag, hours	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Hours required to re-tag / sort	0.26	0.31	0.41	0.81	1.29	2.47	7.17
Number of employees	1	3	4	5	6	6	6
Labor cost to retag, $/operation	$3	$10	$17	$42	$81	$154	$446
Chute charge, $/head	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00
Total chute cost, $/operation	$1	$3	$9	$32	$60	$128	$399
Cattle Shrink Costs							
Average calf weight, lbs/head	524	524	524	524	524	524	524
Shrink, lbs/head	2	2	2	2	2	2	2
Average calf price, $/lb	$1.21	$1.21	$1.21	$1.21	$1.21	$1.21	$1.21
Percent of price to assign to shrink	25%	25%	25%	25%	25%	25%	25%
Average cow weight, lbs/head	1,274	1,274	1,274	1,274	1,274	1,274	1,274
Shrink, lbs/head	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Average cow price, $/lb	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48
Percent of price to assign to shrink	25%	25%	25%	25%	25%	25%	25%
Total shrink costs, $/operation	$1	$6	$15	$54	$100	$213	$663
Miscellaneous Costs							
Human injury, $/operation	$0	$1	$2	$6	$12	$23	$70
Animal injury, $/operation	$0	$1	$1	$5	$9	$19	$60
Total Working Costs, $/operation	$7	$25	$58	$190	$357	$739	$2,268

Table A4.1.5 Tagging-Related (Working) Costs per Cow/Calf Operation by Size of Operation Currently Not Tagging Cattle.

	Size of Operation, number of head						
	1-49	100-499	500-999	1000-1999	2000-4999	5,000+	5,000+
RFID Tag Labor Cost							
Labor rate, $/hour	$9.80	$9.80	$9.80	$9.80	$9.80	$9.80	$9.80
Time to tag 2X / animal, seconds	0	0	0	0	0	0	0
Cost of tagging animal 2X, $/head	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Cost of tagging, $/operation	$0	$0	$0	$0	$0	$0	$0
Labor and Chute Costs							
Setup time for retag, hours	0	0	0	0	0	0	0
Hours required to re-tag / sort	0	0	0	0	0	0	0
Number of employees	0	0	0	0	0	0	0
Labor cost to retag, $/operation	$0	$0	$0	$0	$0	$0	$0
Chute charge, $/head	$2.54	$2.54	$2.54	$2.54	$2.54	$2.54	$2.54
Total chute cost, $/operation	$34	$142	$384	$1,382	$2,578	$5,477	$17,065
Cattle Shrink Costs							
Average calf weight, lbs/head	524	524	524	524	524	524	524
Shrink, lbs/head	2.62	2.62	2.62	2.62	2.62	2.62	2.62
Average calf price, $/lb	$1.21	$1.21	$1.21	$1.21	$1.21	$1.21	$1.21
Percent of price to assign to shrink	25%	25%	25%	25%	25%	25%	25%
Average cow weight, lbs/head	1,274	1,274	1,274	1,274	1,274	1,274	1,274
Shrink, lbs/head	2.75	2.75	2.75	2.75	2.75	2.75	2.75
Average cow price, $/lb	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48
Percent of price to assign to shrink	25%	25%	25%	25%	25%	25%	25%
Total shrink costs, $/operation	$10	$41	$109	$394	$735	$1,561	$4,863
Miscellaneous Costs							
Human injury, $/operation	$0	$0	$0	$0	$0	$0	$0
Animal injury, $/operation	$2	$9	$24	$86	$161	$343	$1,068
Total Working Costs, $/operation	$46	$192	$517	$1,862	$3,475	$7,381	$22,996

Table A4.1.6 Costs Associated with Reading Tags per Cow/Calf Operation by Size of Operation.

	Size of Operation, number of head						
	1-49	50-99	100-499	500-999	1000-1999	2000-4999	5,000+
Animals Bought and Number of Reads							
Average cattle bought	6	18	44	135	135	135	135
Animals sold through auction, %	69.60%	69.60%	69.60%	69.60%	69.60%	69.60%	69.60%
Non-auction cattle bought, head	1.8	5.5	13.3	41.2	41.2	41.2	41.2
Misread percentage	2.80%	2.80%	2.80%	2.80%	2.80%	2.80%	2.80%
Total reads of electronic tags	1.8	5.7	13.6	42.3	42.3	42.3	42.3
RFID System is:	Outsourced	Outsourced	Outsourced	Outsourced	Outsourced	Outsourced	Outsourced
RFID capital cost per read	$4.35	$1.96	$1.62	$1.14	$1.14	$1.14	$1.14
Labor/chute costs per read	$1.38	$0.47	$0.22	$0.17	$0.17	$0.17	$0.17
Shrink/injury cost per read	$0.22	$0.08	$0.04	$0.02	$0.02	$0.02	$0.02
Total RFID cost, $/read	$5.95	$2.51	$1.88	$1.33	$1.33	$1.33	$1.33
Total RFID cost, $/operation	$11	$14	$26	$56	$56	$56	$56

APPENDIX A4.2: DAIRY OPERATIONS

Table A4.2.1 Number of Dairy Operations and Inventory and Production Levels by Size of Operation.

	Size of Operation, number of head						
	1-49	50-99	100-199	200-499	500-999	1,000-1,999	2000+
Number of operations	33,435	20,980	9,325	4,555	1,700	920	595
Percent of operations currently tagging	86.50%	86.50%	86.50%	86.50%	86.50%	86.50%	86.50%
Average herd size, head	20.3	67.2	131.6	299.6	673.4	1,323.90	3,555.50
Bulls in herd, 500+ 17, Dairy 9	0.2	0.7	1.4	3.2	7.3	14.3	38.3
Calves per cow, %	92.50%	92.50%	90.10%	90.10%	86.30%	86.30%	86.30%
Calving rate adjusted for twinning, %	89.50%	89.50%	87.20%	87.20%	83.50%	83.50%	83.50%
Calf death loss before 48 hours, %	6.50%	6.50%	6.50%	6.50%	6.50%	6.50%	6.50%
Calf death loss after 48 hours, %	8.30%	8.30%	9.20%	9.20%	6.50%	6.50%	6.50%
Replacements retained, %	44.80%	44.80%	44.80%	44.80%	44.80%	44.80%	44.80%
Replacement animals, head	9.1	30.1	59	134.3	301.8	593.4	1,593.70
Cow death (disappearance) loss, %	4.80%	4.80%	5.80%	5.80%	6.10%	6.10%	6.10%
Cull rate, %	24.10%	24.10%	23.70%	23.70%	23.40%	23.40%	23.40%
Cows culled, head	4.9	16.2	31.2	71	157.6	309.8	832
Bulls culled, head	0.1	0.2	0.4	0.8	1.8	3.6	9.6
Total animals sold, head	11.8	39.2	72.5	165.1	363.1	714	1,917.40
Calves born and at 48 hours, head	18.1	60.2	114.8	261.2	562.3	1,105.50	2,968.80
Calves dead after 48 hours, head	1.6	5.3	11.3	25.7	39.1	76.9	206.4
Total calves available for sale, head	16	53	100	227.6	505.6	994	2,669.50

Table A4.2.2 Tags and Tag Applicators per Dairy Operation by Size of Operation that Currently Tags Cattle.

	Size of Operation, number of head						
	1-49	50-99	100-199	200-499	500-999	1,000-1,999	2000+
Number of calves to retag, head	0.4	1.3	2.5	5.7	12.6	24.9	66.7
Number of cows and bulls to retag, head	0.5	1.7	3.3	7.6	17	33.5	89.8
Total tags purchased	19.1	63.2	120.6	274.5	591.9	1,163.80	3,125.40
Tag loss rate, %	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
RFID button tag cost, $/tag	$2.50	$2.30	$2.20	$2.10	$2.00	$2.00	$2.00
Total RFID tag cost, $/operation	$51	$157	$286	$621	$1,276	$2,508	$6,735
RFID tag applicator cost, $/unit	$11.83	$11.83	$11.83	$11.83	$11.83	$11.83	$11.83
Number of tag applicators	1	1	2	3	4	5	6
Years of RFID tag applicator	4	4	4	4	4	4	4
Annual cost of tag applicator, $/operation	$4	$4	$7	$11	$14	$18	$21

Table A4.2.3 Tags and Tag Applicators Required per Dairy Operation by Size of Operation Currently Not Tagging Cattle.

	Size of Operation, number of head						
	1-49	50-99	100-199	200-499	500-999	1,000-1,999	2000+
Number of calves to retag, head	0	0	0	0	0	0	0
Number of cows and bulls to retag, head	0	0	0	0	0	0	0
Total tags purchased	11.8	39.2	72.5	165.1	363.1	714	1,917.40
Tag loss rate, %	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
RFID button tag cost, $/tag	$2.50	$2.40	$2.30	$2.20	$2.10	$2.00	$2.00
Total RFID tag cost, $/operation	$32	$101	$180	$391	$822	$1,539	$4,132
RFID tag applicator cost, $/unit	$11.83	$11.83	$11.83	$11.83	$11.83	$11.83	$11.83
Number of tag applicators	0	0	0	0	0	0	0
Years of RFID tag applicator	4	4	4	4	4	4	4
Annual cost of tag applicator, $/operation	$0	$0	$0	$0	$0	$0	$0

Table A4.2.4 Tagging-Related (Working) Costs per Dairy Operation by Size of Operation that Currently Tags Cattle.

	Size of Operation, number of head						
	1-49	50-99	100-199	200-499	500-999	1,000-1,999	2000+
RFID Tag Labor Cost							
Labor rate, $/hour	$9.80	$9.80	$9.80	$9.80	$9.80	$9.80	$9.80
Time to tag 2X / animal, seconds	30	30	30	30	30	30	30
Cost of tagging animal 2X, $/head	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08
Cost of tagging, $/operation	$2	$5	$10	$23	$49	$97	$261
Labor and Chute Costs							
Setup time for retag, hours	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Hours required to re-tag / sort	0.27	0.31	0.36	0.49	0.79	1.32	3.12
Number of employees	1	1	1	1	1	1	1
Labor cost to retag, $/operation	$3	$3	$4	$5	$8	$14	$33
Chute charge, $/head	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00
Total chute cost, $/operation	$1	$3	$6	$13	$30	$58	$157
Cattle Shrink Costs							
Average calf weight, lbs/head	524	524	524	524	524	524	524
Shrink, lbs/head	0	0	0	0	0	0	0
Average calf price, $/lb	$1.21	$1.21	$1.21	$1.21	$1.21	$1.21	$1.21
Percent of price to assign to shrink	25%	25%	25%	25%	25%	25%	25%
Average cow weight, lbs/head	1,274	1,274	1,274	1,274	1,274	1,274	1,274
Shrink, lbs/head	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Average cow price, $/lb	$0.45	$0.45	$0.45	$0.45	$0.45	$0.45	$0.45
Percent of price to assign to shrink	25%	25%	25%	25%	25%	25%	25%
Total shrink costs, $/operation	$0	$0	$1	$2	$5	$9	$25
Miscellaneous Costs							
Human injury, $/operation	$0	$1	$1	$2	$4	$7	$19
Animal injury, $/operation	$0	$0	$1	$2	$5	$9	$25
Total Working Costs, $/operation	$6	$13	$22	$48	$101	$195	$520

Table A4.2.5 Tagging-Related (Working) Costs per Dairy Operation by Size of Operation Currently Not Tagging Cattle.

	Size of Operation, number of head						
	1-49	50-99	100-199	200-499	500-999	1,000-1,999	2000+
RFID Tag Labor Cost							
Labor rate, $/hour	$9.80	$9.80	$9.80	$9.80	$9.80	$9.80	$9.80
Time to tag 2X / animal, seconds	0	0	0	0	0	0	0
Cost of tagging animal 2X, $/head	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Cost of tagging, $/operation	$0	$0	$0	$0	$0	$0	$0
Labor and Chute Costs							
Setup time for retag, hours	0	0	0	0	0	0	0
Hours required to re-tag / sort	0	0	0	0	0	0	0
Number of employees	0	0	0	0	0	0	0
Labor cost to retag, $/operation	$0	$0	$0	$0	$0	$0	$0
Chute charge, $/head	$2.54	$2.54	$2.54	$2.54	$2.54	$2.54	$2.54
Total chute cost, $/operation	$30	$100	$185	$420	$924	$1,817	$4,878
Cattle Shrink Costs							
Average calf weight, lbs/head	524	524	524	524	524	524	524
Shrink, lbs/head	0	0	0	0	0	0	0
Average calf price, $/lb	$1.21	$1.21	$1.21	$1.21	$1.21	$1.21	$1.21
Percent of price to assign to shrink	25%	25%	25%	25%	25%	25%	25%
Average cow weight, lbs/head	1,274	1,274	1,274	1,274	1,274	1,274	1,274
Shrink, lbs/head	2.75	2.75	2.75	2.75	2.75	2.75	2.75
Average cow price, $/lb	$0.45	$0.45	$0.45	$0.45	$0.45	$0.45	$0.45
Percent of price to assign to shrink	25%	25%	25%	25%	25%	25%	25%
Total shrink costs, $/operation	$2	$5	$10	$22	$49	$97	$260
Miscellaneous Costs							
Human injury, $/operation	$0	$0	$0	$0	$0	$0	$0
Animal injury, $/operation	$2	$6	$12	$26	$58	$114	$305
Total Working Costs, $/operation	$34	$111	$206	$469	$1,031	$2,027	$5,444

Table A4.2.6 Costs Associated with Reading Tags per Dairy Operation by Size of Operation.

	Size of Operation, number of head						
	1-49	50-99	100-199	200-499	500-999	1,000-1,999	2000+
Animals Bought and Number of Reads							
Average cattle bought	3	10	19	44	134	264	710
Animals sold through auction, %	69.60%	69.60%	69.60%	69.60%	69.60%	69.60%	69.60%
Non-auction cattle bought, head	0.9	2.9	5.9	13.4	40.9	80.3	215.7
Misread percentage	2.80%	2.80%	2.80%	2.80%	2.80%	2.80%	2.80%
Total reads of electronic tags	23.8	78.9	154.7	352.2	802.9	1,578.60	4,239.50
RFID System is:	Outsourced	Outsourced	Outsourced	Outsourced	Owned	Owned	Owned
RFID capital cost per read	$1.26	$0.96	$0.90	$0.88	$0.64	$0.33	$0.13
Labor/chute costs per read	$0.26	$0.20	$0.14	$0.13	$0.12	$0.12	$0.12
Shrink/injury cost per read	$0.04	$0.03	$0.02	$0.02	$0.02	$0.02	$0.02
Total RFID cost, $/read	$1.57	$1.18	$1.05	$1.03	$0.78	$0.46	$0.26
Total RFID cost, $/operation	$37	$93	$163	$362	$622	$732	$1,106

APPENDIX A4.3: BACKGROUNDING OPERATIONS

Table A4.3.1 Number of Backgrounding Operations and Inventory and Production Levels by Size of Operation.

	Operation Size Category						
	1	2	3	4	5	6	7
Number of operations	21,438	11,334	6,333	4,333	3,329	2,316	1,787
Average animals purchased, head	30.5	103.7	345.3	496.4	722	1,452.60	2,963.30
Death loss, %	1.30%	1.30%	1.30%	1.30%	1.30%	1.30%	1.30%
Total calves available for sale, head	30.2	102.3	340.8	490	712.6	1,433.70	2,924.80

Table A4.3.2 Tags and Tag Applicators Required per Backgrounding Operation by Size of Operation

	Operation Size Category						
	1	2	3	4	5	6	7
Average animals purchased, head	30.5	103.7	345.3	496.4	722	1,452.60	2,963.30
Tag loss rate, %	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Number of calves to retag, head	0.8	2.6	8.5	12.2	17.8	35.8	73.1
Total tags purchased	0.8	2.6	8.5	12.2	17.8	35.8	73.1
RFID button tag cost, $/tag	$2.50	$2.50	$2.50	$2.50	$2.50	$2.40	$2.30
Total RFID tag cost, $/operation	$5	$13	$28	$38	$55	$98	$184
RFID tag applicator cost, $/unit	$11.83	$11.83	$11.83	$11.83	$11.83	$11.83	$11.83
Number of tag applicators	1	2	2	2	3	3	3
Years of RFID tag applicator	4	4	4	4	4	4	4
Annual cost of tag applicator, $/operation	$3	$6	$6	$6	$9	$9	$9

Table A4.3.3 Tagging-Related (Working) Costs per Backgrounding Operation by Size of Operation.

	Operation Size Category						
	1	2	3	4	5	6	7
RFID Tag Labor Cost							
Labor rate, $/hour	$9.80	$9.80	$9.80	$9.80	$9.80	$9.80	$9.80
Labor and Chute Costs							
Setup time for retag, hours	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Hours required to re-tag / sort	0.26	0.3	0.41	0.47	0.58	0.91	1.59
Number of employees	2	2	2	3	3	3	4
Labor cost to retag, $/operation	$5	$6	$8	$14	$17	$27	$62
Chute charge, $/head	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00
Total chute cost, $/operation	$1	$3	$9	$12	$18	$36	$73
Cattle Shrink Costs							
Average calf weight, lbs/head	700	700	700	700	700	700	700
Shrink, lbs/head	2.75	2.75	2.75	2.75	2.75	2.75	2.75
Average calf price, $/lb	$1.09	$1.09	$1.09	$1.09	$1.09	$1.09	$1.09
Percent of price to assign to shrink	25%	25%	25%	25%	25%	25%	25%
Total shrink costs, $/operation	$1	$2	$6	$9	$13	$27	$55
Miscellaneous Costs							
Human injury, $/operation	$0	$0	$1	$1	$1	$2	$4
Animal injury, $/operation	$0	$0	$1	$2	$3	$6	$12
Total Working Costs, $/operation	$7	$11	$25	$38	$52	$97	$206

Table A4.2.4 Costs Associated with Reading Tags per Backgrounding Operation by Size of Operation.

	Operation Size Category						
	1	2	3	4	5	6	7
Animals Bought and Number of Reads							
Average cattle bought	30.5	103.7	345.3	496.4	722	1,452.60	2,963.30
Animals sold through auction, %	69.60%	69.60%	69.60%	69.60%	69.60%	69.60%	69.60%
Non-auction cattle bought, head	9.3	31.5	105	150.9	219.5	441.6	900.8
Misread percentage	2.80%	2.80%	2.80%	2.80%	2.80%	2.80%	2.80%
Total reads of electronic tags	10.7	36.4	121.4	174.5	253.8	510.6	1,041.50
RFID System is:	Outsourced	Outsourced	Outsourced	Outsourced	Outsourced	Outsourced	Owned
RFID capital cost per read	$1.61	$1.13	$0.99	$0.97	$0.95	$0.93	$0.84
Labor/chute costs per read	$0.22	$0.23	$0.25	$0.24	$0.29	$0.28	$0.29
Shrink/injury cost per read	$0.24	$0.23	$0.22	$0.22	$0.22	$0.22	$0.22
Total RFID cost, $/read	$2.07	$1.59	$1.47	$1.43	$1.46	$1.44	$1.35
Total RFID cost, $/operation	$22	$58	$178	$249	$371	$736	$1,407

Table A4.3.1 Number of Feedlot Operations and Inventory and Production Levels by Size of Operation.

	Size of Operation, feedlot capacity (head)								
	1-999	1000-1999	2000-3999	4000-7999	8000-15999	16000-23999	24000-31999	32000-49999	50000+
Number of operations	85,000	809	564	343	182	78	55	71	58
Fed cattle marketings, head	43.5	964.2	2,473.40	5,755.10	13,928.60	27,769.20	42,345.50	61,633.80	118,982.80
Disappearance, %	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Estimated placements, head	44.9	994	2,549.90	5,933.10	14,359.40	28,628.10	43,655.10	63,540.00	122,662.60
Death loss, %	1.30%	1.30%	1.30%	1.30%	1.30%	1.30%	1.30%	1.30%	1.30%
Total fed cattle marketed, head	44.3	981.1	2,516.80	5,856.00	14,172.70	28,255.90	43,087.60	62,714.00	121,068.00

Table A4.3.2 Tags and Tag Applicators Required per Feedlot Operation by Size of Operation.

	Size of Operation, feedlot capacity (head)								
	1-999	1000-1999	2000-3999	4000-7999	8000-15999	16000-23999	24000-31999	32000-49999	50000+
Estimated placements, head	44.9	994	2,549.90	5,933.10	14,359.40	28,628.10	43,655.10	63,540.00	122,662.60
Tag loss rate, %	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Number of calves to retag, head	1.1	24.5	62.9	146.4	354.3	706.4	1,077.20	1,567.80	3,026.70
Total tags purchased	1.1	24.5	62.9	146.4	354.3	706.4	1,077.20	1,567.80	3,026.70
RFID button tag cost, $/tag	$2.50	$2.50	$2.30	$2.20	$2.10	$2.00	$2.00	$2.00	$2.00
Total RFID tag cost, $/operation	$6	$73	$165	$349	$788	$1,482	$2,253	$3,272	$6,303
RFID tag applicator cost, $/unit	$11.83	$11.83	$11.83	$11.83	$11.83	$11.83	$11.83	$11.83	$11.83
Number of tag applicators	1	3	5	5	5	5	5	5	5
Years of RFID tag applicator	4	4	4	4	4	4	4	4	4
Annual cost of tag applicator, $/operation	$3	$9	$15	$15	$15	$15	$15	$15	$15

Table A4.3.3 Tagging-Related (Working) Costs per Feedlot Operation by Size of Operation.

	Size of Operation, feedlot capacity (head)								
	1-999	1000-1999	2000-3999	4000-7999	8000-15999	16000-23999	24000-31999	32000-49999	50000+
RFID Tag Labor Cost									
Labor rate, $/hour	$9.80	$9.80	$9.80	$9.80	$9.80	$9.80	$9.80	$9.80	$9.80
Labor and Chute Costs									
Setup time for retag, hours	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Hours required to re-tag / sort	0.27	0.7	1.4	2.93	6.75	13.2	20	28.99	55.74
Number of employees	3	3	4	5	6	6	6	6	6
Labor cost to retag, $/operation	$8	$21	$55	$144	$397	$776	$1,176	$1,705	$3,277
Chute charge, $/head	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00
Total chute cost, $/operation	$1	$25	$63	$146	$354	$706	$1,077	$1,568	$3,027
Cattle Shrink Costs									
Average calf weight, lbs/head	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
Shrink, lbs/head	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25
Average calf price, $/lb	$0.95	$0.95	$0.95	$0.95	$0.95	$0.95	$0.95	$0.95	$0.95
Percent of price to assign to shrink	25%	25%	25%	25%	25%	25%	25%	25%	25%
Total shrink costs, $/operation	$1	$19	$49	$113	$275	$547	$835	$1,215	$2,345
Miscellaneous Costs									
Human injury, $/operation	$1	$1	$4	$10	$26	$52	$78	$113	$218
Animal injury, $/operation	$0	$4	$10	$23	$56	$112	$172	$250	$482
Total Working Costs, $/operation	$11	$69	$180	$436	$1,108	$2,194	$3,338	$4,851	$9,349

Table A4.3.4 Costs Associated with Reading Tags per Feedlot Operation by Size of Operation.

	Size of Operation, feedlot capacity (head)								
	1-999	1000-1999	2000-3999	4000-7999	8000-15999	16000-23999	24000-31999	32000-49999	50000+
Animals Bought and Number of Reads									
Average cattle bought	44.9	994	2,549.9	5,933.1	14,359.4	28,628.1	43,655.1	63,540.0	122,662.6
Animals sold through auction, %	69.60%	69.60%	69.60%	69.60%	69.60%	69.60%	69.60%	69.60%	69.60%
Non-auction cattle bought, head	13.6	302.2	775.2	1,803.7	4,365.2	8,702.9	13,271.2	19,316.2	37,289.4
Misread percentage	2.80%	2.80%	2.80%	2.80%	2.80%	2.80%	2.80%	2.80%	2.80%
Total reads of electronic tags	15.8	349.4	896.2	2,085.3	4,678.0	9,326.5	14,222.0	20,700.1	39,961.1
RFID System is:	Outsourced	Outsourced	Outsourced	Owned	Owned	Owned	Owned	Owned	Owned
RFID capital cost per read	$1.44	$0.95	$0.93	$0.46	$0.45	$0.27	$0.20	$0.17	$0.12
Labor/chute costs per read	$0.31	$0.35	$0.34	$0.34	$0.31	$0.31	$0.31	$0.30	$0.30
Shrink/injury cost per read	$0.26	$0.24	$0.24	$0.24	$0.15	$0.15	$0.15	$0.15	$0.15
Total RFID cost, $/read	$2.00	$1.53	$1.51	$1.04	$0.91	$0.73	$0.66	$0.62	$0.58
Total RFID cost, $/operation	$32	$534	$1,352	$2,163	$4,264	$6,764	$9,396	$12,880	$23,237

Appendices A8: Government Costs

Appendix A8.1: List of Individuals Contacted/Interviewed

List of Individuals Contacted/Interviewed:

Federal Government Personnel:

- Diana Darnell – USDA-APHIS (based in Milo, MI)
- Dr. Tom Flynn – DVM, USDA-APHIS
- Dr. Neil Hammerschmidt – USDA-APHIS
- Dr. Tom Kasari – USDA-APHIS
- Dr. David Morris – USDA-APHIS
- Randy Munger – DVM, USDA-APHIS (based in Fort Collins, CO)
- Dr. John Wiemers – USDA-APHIS

Individual State Contacts:

- Dr. Paul Anderson – Minnesota Board of Animal Health
- Matthew Ankney – Interagency Bovine TB Eradication Coordinator, Michigan Department of Agriculture
- Roberta Bailey – Accountant, Michigan Department of Agriculture
- Delores Clausen – Animal ID Coordinator, Iowa Department of Agriculture and Land Stewardship Animal Industry
- Linda Cope – Animal ID Integration Analyst, Idaho State Department of Agriculture
- Kenny Edgar – Animal ID Coordinator, Texas Animal Health Commission
- Dr. Charlie Hatcher – Animal ID Coordinator, Tennessee Department of Agriculture
- Dr. Dave Fly – New Mexico State Veterinarian, New Mexico Livestock Board
- Charles Gann – Animal ID Coordinator, Arkansas Livestock & Poultry Commission
- John Heller – Former Animal ID Coordinator, Colorado Department of Agriculture
- Kevin Kirk – Special Assistant to the Division Director, Michigan Department of Agriculture
- Brad Klaassen – Animal ID Coordinator, Oklahoma Department of Agriculture, Food, and Forestry
- Paul McGraw – DVM, Assistant State Veterinarian, Wisconsin Department of Agriculture, Trade, and Consumer Protection
- Doug Metcalf – Chief of Staff, Indiana Board of Animal Health

- Penny Page – Animal ID Coordinator, North Carolina Department of Agriculture
- Ted Radintz – Animal Health Response Outreach Coordinator, Minnesota Department of Agriculture
- Brian Rickard – Animal ID Coordinator, Kansas Animal Health Department
- Dr. Dan Robb – DVM, Michigan Department of Agriculture
- Ray Scheierl – State of Minnesota
- Victor Velez – California Department of Food and Agriculture

Appendix A8.2: Survey of Select Animal ID Coordinators

The following email message was sent on August 29th to animal ID coordinators/leaders in fourteen states (included in Appendix 8.1).

I have one more request for your IMMEDIATE attention to kindly make of you as I wrap up the national NAIS benefit/cost assessment.

Attached is a short, 8 question survey that I would like you to complete. I am using this as a follow-up to diverse discussions I have had over the past few months. This will help me get answers to some standardized questions and hence improve our analysis.

As in our phone discussions, I will not report individual results, or provide direct citations on comments; rather I will present summary statistics of the entire set of responses I receive. Please also provide any comments/background that you feel might be useful in interpreting your responses. Moreover, if you have specific values for each multiple-choice question, please provide them as well.

While I don't typically do this, I would like for you to respond to this by next Tuesday (September 2nd) if at all possible as I am required to submit my report by next Thursday. Accordingly, please complete it and return to me electronically I don't believe the survey will take much of your time.

Thanks again for your assistance and enjoy your weekend, Glynn

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Glynn T. Tonsor
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317-B Agriculture Hall
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Fax: 517-432-1800

The survey document contained the following set of questions:

PREMISES REGISTRATION QUESTIONS:

1. *How many new applications for NAIS premises registration can your office typically process in one hour?*
   a. *Please choose one of the following ranges that best encompasses your professional assessment:*
      i. *0-20*
      ii. *21-40*
      iii. *41-60*
      iv. *61-80*
      v. *81-100*
      vi. *101-120*
      vii. *Over 120*

2. *What is the frequency of premises registration applications that contain some sort of error or omission requiring follow-up investigations?*

   For hard-copy applications

   i. *0%-5% frequency*
   ii. *6%-10% frequency*
   iii. *11-15% frequency*
   iv. *16-20% frequency*
   v. *Over 20 %*

For internet-based applications

i. *0%-5% frequency*
ii. *6%-10% frequency*
iii. *11-15% frequency*
iv. *16-20% frequency*
v. *Over 20 %*

3. *What do you believe is the cost (including all costs of efforts related to soliciting new applications, processing applications, addressing application errors/omissions, etc.) of currently establishing new premises in your state?*
   a. *Please choose one of the following ranges:*
      i. *$0/premise - $15/premise*
      ii. *$16/premise - $30/premise*

iii. *$31/premise - $45/premise*
iv. *$46/premise - $60/premise*
v. *$61/premise - $75/premise*
vi. *$76/premise - $90/premise*
vii. *Over $90/premise*

4. *Assume tomorrow you were provided the necessary funds, with the intent of enhancing premises registration rates in your state, to conduct an extensive mass mailing effort to all known individuals within your state that have not yet registered their premises (but are suspected to have premises that ideally would be registered with NAIS). What do you believe would be overall response?*

a. *0-10% of those contacted would register their premises*
b. *11-20% of those contacted would register their premises*
c. *21-30% of those contacted would register their premises*
d. *31-40% of those contacted would register their premises*
e. *Over 40% of those contacted would register their premises*

BUDGET QUESTIONS:

5. *Approximately what portion of the funds received in the USDA cooperative agreements your state has received to date were used primarily for registration activities?*

a. *Please choose one of the following ranges:*
   i. *0-20%*
   ii. *21%-40%*
   iii. *41%-60%*
   iv. *61%-80%*
   v. *81%-100%*

6. *Looking forward over the next three years, what portion of your state's NAIS related activities do you expect to be focused on premises registration?*

a. *Please choose one of the following ranges:*
   i. *0-20%*
   ii. *21%-40%*
   iii. *41%-60%*
   iv. *61%-80%*
   v. *81%-100%*

USE OF NAIS INFORMATION:

7. *If tomorrow a livestock disease was identified in your state, to what extent would you use information available to you through your state's current participation in the national NAIS system?*
   a. *Please choose the most appropriate response:*
      i. *Not at all, I would not use NAIS information*
      ii. *I would use NAIS information, but less than other in-state resources*
      iii. *I would use NAIS information more than other in-state resources*
      iv. *I would rely almost exclusively on NAIS information*

8. *Continuing with the prior question, if a livestock disease was identified in your state, how long do you believe it would currently take to notify all livestock producers operating within the following distances of the outbreak?*
   a. *WITHIN 15 miles:*
      i. *less than 1 hour*
      ii. *1-5 hours*
      iii. *6-12 hours*
      iv. *13-24 hours*
      v. *25-48 hours*
      vi. *49-96 hours*
      vii. *5-7 days*
      viii. *Over 1 week*

   b. *WITHIN 30 miles:*
      i. *less than 1 hour*
      ii. *1-5 hours*
      iii. *6-12 hours*
      iv. *13-24 hours*
      v. *25-48 hours*
      vi. *49-96 hours*
      vii. *5-7 days*
      viii. *Over 1 week*

Thanks again for your assistance in making this project more complete,

Glynn Tonsor

Appendices A9: Modeling Market Effects of Animal Identification

Appendix A9.1: Stochastic Equilibrium displacement models

Elasticity-based computable equilibria (equilibrium displacement models) or partial equilibria models are commonly used when assessing the effects and/or the costs of potential changes in economic policy or structure. Elasticity-based computable equilibria models are attractive in that they are obtained by simple manipulation or row operations of differential approximations to economic models and are accurate to the degree that the underlying system can be linearly approximated (Davis and Espinoza, 1998; Brester, Marsh, and Atwood, 2004).

In economic modeling, the system's actual parameters are usually unknown and must be estimated or assumed. Most studies use some combination of assumed, previously published, and/or statistically estimated shares and elasticities. In all cases, it should be recognized that uncertainty exists with respect to the model's actual parameters and, as a result, with respect to the policy effects derived using estimated parameters. Davis and Espinoza (1998) illustrate the importance of examining the sensitivity of changes in prices and quantities (as well as producer and consumer surplus) relative to variations in selected elasticity estimates. Also, as a practical matter, the amount of uncertainty with respect to model parameters may vary across parameters. For example, if a number of researchers and statistical methodologies have obtained similar estimates for a given elasticity, the degree of uncertainty with respect to the given elasticity will be less than for a parameter for which published estimates have varied widely across researchers and methodologies.

An additional complication in policy models is that subsets of the model's economic parameters are likely to be correlated, non-normally distributed, and possibly intractable. For example, elasticities of supply in a vertically structured model might be positively correlated and restricted to be positive, while own-demand elasticities might be positively

correlated and restricted to be negative (Davis and Espinoza, 1998). Brester, Marsh, and Atwood (2004) use Monte Carlo simulations of an equilibrium displacement model in which elasticities among vertical demand and supply sectors are correlated.

As indicated below, if independent marginal distributions of a model's parameters can be approximated, Monte Carlo simulation techniques can be used to introduce correlation between marginal pseudo-samples from possibly widely divergent statistical families of distributions. However, in such cases, the common methods for generating correlated multivariate normal random variates are inappropriate if applied directly to the marginal pseudo-samples themselves.

We use a variant of the Iman-Conover (1982) process for generating correlated random variables. The Iman-Conover process is attractive in that marginal distributions can be simulated independently from most continuous distributions. Each of the independently generated marginal samples is then merely reordered to obtain a rank correlation similar to the desired correlation structure. The Iman-Conover process is straightforward and easy to implement in most common spreadsheets and statistical packages. The following examples were developed in "R"—a free public source statistical modeling software package.

We first demonstrate why traditional procedures for generating correlated multivariate normal random variates are inappropriate for a general set of marginal distributions. We then demonstrate the use of Iman-Conover procedures for introducing correlation while preserving all marginal pseudo-samples.

A9.1.1 Generating Multivariate Normal Pseudo-Samples

The most commonly used procedures for generating correlated multivariate normal samples exploit the fact that linear combinations of normal random variates are themselves normally distributed. Assume that an n by k multivariate normal "sample" Z_C with covariance matrix Σ is desired. A common procedure to generate such a sample matrix is to initially populate an n by k matrix Z_1 with randomly and independently generated normal (0,1) random variates. If the random variates in Z_1 are independently generated, the expected covariance matrix of Z_1 is a k by k

identity matrix I_1. However, for finite samples the realized sample covariance matrix is computable as

$$\hat{\Sigma}_{Z_1} = Z_1' \left[\frac{1}{n-1} \left(I_n - \frac{1}{n} \underline{1}_n \underline{1}_n \right) \right] Z_1' \hat{C} Z_1 \qquad \text{(A9.1)}$$

and may not equal I_k. In the above expression, $\underline{1}_n$ is an n by 1 vector with each element equal to 1, and $\hat{C}$ is the sample covariance operator. Procedures similar to those presented in Greene (2003) can be used to easily demonstrate that $Y' \hat{C} Y$ is the sample covariance matrix of any corresponding sample matrix Y.

Before proceeding, we apply an Iman-Conover "whitening" process by factoring $\hat{\Sigma}_{Z_1} = U' U$ using a Cholesky or similar factorization algorithm. If Z_1 was generated randomly, the matrix U will be nonsingular and a "whitened" sample matrix Z_W can be constructed as $Z_W = Z_1 U^{-1}$. Because the columns of Z_W are linear combinations of the columns of Z_1, the n by k sample Z_W will be multivariate normal with sample covariance matrix:

$$\hat{\Sigma}_{Z,W} = Z_W' \hat{C} Z_W = \left(U^{-1}\right)' Z_1' \hat{C} Z_1 U^{-1} = \left(U^{-1}\right)' \hat{\Sigma}_{Z_1} U^{-1} = \left(U'\right)^{-1} U' U U^{-1} = I_k. \qquad \text{(A9.2)}$$

Obtaining a multivariate normal sample Z_C with sample covariance matrix Σ is accomplished by factoring $\Sigma = V' V$ and generating $Z_C = Z_W V$, which has sample covariance matrix:

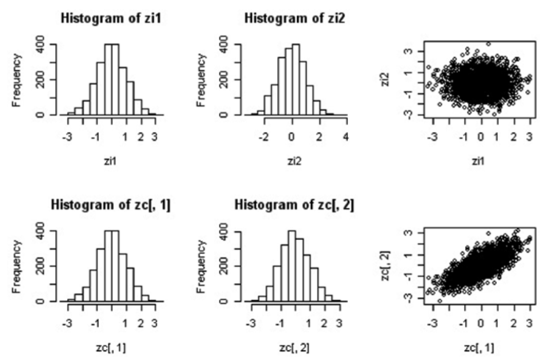
$$\hat{\Sigma}_{Z_C} = Z_C' \hat{C} Z_C = V' Z_W' \hat{C} Z_W V = V' \hat{\Sigma}_{Z_W} = V'V = \Sigma. \qquad \text{(A9.3)}$$

Because each column of Z_C is generated as linear combinations of the columns of Z_W, the columns in Z_C are distributed multivariate normal while having a sample covariance equal to the desired covariance matrix Σ. The panels in figure A9.1 plot the results of applying the above process with 2,000 observations on two normal variates with a target correlation of 0.7. The top three panels are histograms and a joint scatter plot of the two independently generated normal (0,1) variates. The bottom three panels in Figure A9.1 present histograms and a joint scatter plot of the two marginals after the above transformations were applied. The resulting correlation between the two marginals is 0.7.

In the following discussion we return to the multivariate normal matrix Z_C because it is integral to the variant of the Iman-Conover procedure that

we use. In the next section, we demonstrate why the above process for generating correlated random variables (taking linear combinations of independently generated marginals) is not appropriate when working with nonadditively regenerative marginal distributions.

Figure A9.1. Plots of Normally Random Variates Before and After Transformation



A.9.1.2 Linear Combinations of Nonregenerative Distributions

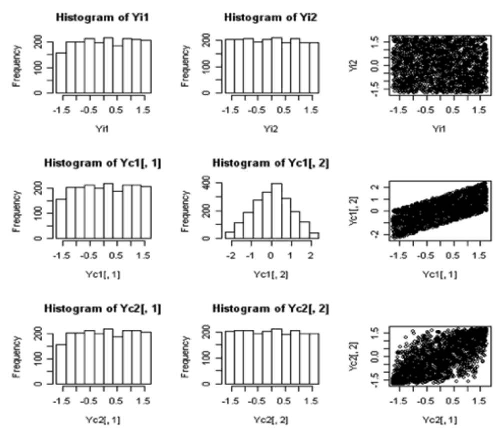
The top three panels in Figure A9.2 present histograms and a joint scatter plot from a 2,000 by 2 bivariate pseudo-sample Y_1 generated as two independent *uniform* $-\sqrt{3}, \sqrt{3}$ distributions with mean 0 and variance 1. The histograms and scatter plot of the marginal distributions indicate that the pseudo-samples appear to be uniformly and independently distributed over the $-\sqrt{3}, \sqrt{3}$ interval.

Assume that a correlated bivariate uniform distribution is desired with correlation 0.7. Because the uniform distribution is not additively regenerative, generating correlated variates using the Cholesky decomposition weighted-average procedure destroys the original marginal distributions. The middle three panels in Figure A9.2 demonstrate this result. With a bivariate distribution, the Cholesky decomposition transformation leaves the first marginal unchanged. However, the second variate is reconstructed as a linear combination of

both the original marginal samples. The second histogram in the middle set of panels clearly shows that the resulting variate is not uniformly distributed although the correlation between the two transformed random variates is 0.7. The scatter plot of the joint observations is presented in the third panel of Figure A9.2.

The results of applying the Iman-Conover process to the uniform marginal samples are presented in the third panel of plots in Figure A9.2.[17]

Figure A-2. Results of Generating Correlated Uniform Random Variates



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[17] As we indicate above, the Iman-Conover process can easily be implemented in Excel or other programming environments. Following is R code that can be used to compute the reordered correlated pseudo-sample. The user calls the function with the Y_I and SIGMA matrices. The function returns the correlated Y_C sample matrix.

```
ImanConover=function(yi,sigma) {
yc=yi
ydim=dim(yi)          # record the dimension of the Y_I matrix
zi=matrix(rnorm(ydim[1]*ydim[2]),ydim[1],ydim[2])   # populate the normal(0,1) Z_I matrix
zc=(zi %*% (solve(chol(cov(zi)))) %*% (chol(sigma))  # create the correlated Z_C matrix
for (j in 1:ncols) {
 ys=sort(yi[,j])
 yc[,j]=ys[rank(zc[,j])]              # create the correlated Y_C matrix
 }
yc
   }
```

Because the Iman-Conover process merely involves reordering the original marginal pseudo-sample, the process has clearly not affected the histograms of the marginal distributions. The Pearson correlation of the transformed variates for this example is about 0.695. The third plot in panel three is a scatter plot of the joint distribution after the reordering process.

The Iman-Conover process can easily be used to generate correlated random variables over a wide range of possible functional forms for the marginal distributions in an economic policy simulation model.

APPENDIX A9.2: CONSUMER/PRODUCER SURPLUS CHANGES UNDER VARIOUS LEVELS OF ANIMAL ID SYSTEM ADOPTION AND DEMAND CHANGES

Table A9.2.1. Producer and Consumer Surplus Changes from 30% Adoption of a Full Animal Identification/Tracing Program.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	-9.91	-0.12	-134.03	-112.66	-0.038%
Wholesale Beef	-35.51	-0.62	-210.97	-178.39	-0.107%
Slaughter Cattle	-139.42	-1.73	-489.86	-423.79	-0.214%
Feeder Cattle	-143.55	-3.39	-478.26	-417.24	-0.264%
Total Beef Producer Surplus	-332.15	-5.84	-1,304.29	-1,115.00	-0.243%
Retail Pork	14.59	-0.05	36.65	33.06	0.028%
Wholesale Pork	3.28	-0.23	6.26	5.98	0.010%
Slaughter Hog	1.52	-0.47	-1.51	-0.47	-0.001%
Total Pork Producer Surplus	19.49	-0.75	41.00	38.63	0.016%
Retail Domestic Lamb	1.19	-0.01	1.18	1.25	0.032%
Wholesale Lamb	0.17	-0.01	-0.80	-0.56	-0.034%
Slaughter Lamb	-0.42	-0.06	-3.00	-2.40	-0.153%
Feeder Lamb	-2.67	-0.08	-9.80	-8.49	-0.485%
Total Lamb Producer Surplus	-1.73	-0.16	-12.25	-10.12	-0.112%
Retail Poultry	41.95	0.01	92.28	83.63	0.045%
Wholesale Poultry	30.18	-0.01	71.04	64.47	0.037%
Total Poultry Producer Surplus	72.05	0.00	161.94	146.66	0.041%
Total Meat Producer Surplus	-243.94	-6.80	-1,109.90	-947.86	-0.119%
Consumer Surplus					
Retail Beef	-136.70	-0.55	-409.41	-360.75	-0.112%
Retail Pork	3.33	-0.23	9.90	8.87	0.004%
Retail Domestic Lamb	-2.86	-0.02	-9.27	-8.13	-0.175%
Retail Imported Lamb	3.80	0.02	10.83	9.61	0.107%
Retail Poultry	-0.46	0.04	18.61	15.49	0.004%
Total Meat Consumer Surplus	-129.46	-0.76	-378.70	-336.18	-0.027%

Table A9.2.2. Producer and Consumer Surplus Changes from 50% Adoption of a Full Animal Identification/Tracing Program.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	-19.00	-0.21	-242.15	-205.58	-0.069%
Wholesale Beef	-64.02	-1.09	-383.90	-326.55	-0.196%
Slaughter Cattle	-245.81	-3.04	-858.36	-745.70	-0.376%
Feeder Cattle	-253.96	-5.97	-843.38	-736.59	-0.466%
Total Beef Producer Surplus	-588.54	-10.28	-2,303.37	-1,967.53	-0.428%
Retail Pork	25.44	-0.08	63.81	57.33	0.048%
Wholesale Pork	5.71	-0.39	11.10	10.54	0.017%
Slaughter Hog	2.69	-0.80	-2.31	-0.53	-0.001%
Total Pork Producer Surplus	33.92	-1.27	72.10	67.63	0.028%
Retail Domestic Lamb	1.98	-0.01	2.01	2.10	0.053%
Wholesale Lamb	0.29	-0.02	-1.34	-0.93	-0.057%
Slaughter Lamb	-0.70	-0.09	-5.00	-4.01	-0.256%
Feeder Lamb	-4.45	-0.14	-16.31	-14.05	-0.809%
Total Lamb Producer Surplus	-2.85	-0.26	-20.40	-16.84	-0.187%
Retail Poultry	73.02	0.01	159.98	145.24	0.079%
Wholesale Poultry	52.30	-0.02	123.58	112.07	0.064%
Total Poultry Producer Surplus	125.39	-0.01	282.19	256.42	0.071%
Total Meat Producer Surplus	-434.81	-11.92	-1,968.97	-1,677.80	-0.212%
Consumer Surplus					
Retail Beef	-240.60	-0.97	-717.43	-636.20	-0.197%
Retail Pork	5.89	-0.39	17.47	15.79	0.008%
Retail Domestic Lamb	-4.76	-0.03	-15.42	-13.55	-0.292%
Retail Imported Lamb	6.36	0.03	18.12	16.13	0.180%
Retail Poultry	-1.10	0.07	31.55	26.15	0.006%
Total Meat Consumer Surplus	-227.89	-1.33	-658.96	-586.86	-0.048%

Table A9.2.3. Producer and Consumer Surplus Changes from 70% Adoption of a Full Animal Identification/Tracing Program.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	-35.39	-0.34	-408.54	-346.87	-0.117%
Wholesale Beef	-105.18	-1.71	-630.50	-534.45	-0.326%
Slaughter Cattle	-396.21	-4.77	-1,373.30	-1,181.33	-0.603%
Feeder Cattle	-398.55	-9.70	-1,308.38	-1,159.81	-0.733%
Total Beef Producer Surplus	-940.97	-16.47	-3,702.95	-3,149.67	-0.691%
Retail Pork	39.44	-0.12	99.31	89.22	0.075%
Wholesale Pork	9.01	-0.56	18.33	17.21	0.028%
Slaughter Hog	4.34	-1.16	-1.87	0.57	0.001%
Total Pork Producer Surplus	53.18	-1.84	115.28	107.89	0.044%
Retail Domestic Lamb	2.83	-0.01	2.93	3.09	0.077%
Wholesale Lamb	0.41	-0.03	-1.86	-1.30	-0.080%
Slaughter Lamb	-0.97	-0.13	-7.00	-5.62	-0.357%
Feeder Lamb	-6.22	-0.20	-22.84	-19.68	-1.136%
Total Lamb Producer Surplus	-3.96	-0.37	-28.50	-23.41	-0.261%
Retail Poultry	112.90	0.02	245.51	223.17	0.121%
Wholesale Poultry	80.87	-0.03	190.52	174.04	0.098%
Total Poultry Producer Surplus	194.69	-0.01	438.73	398.11	0.110%
Total Meat Producer Surplus	-706.45	-18.81	-3,157.19	-2,704.56	-0.342%
Consumer Surplus					
Retail Beef	-384.34	-1.52	-1,146.63	-1,015.54	-0.313%
Retail Pork	9.72	-0.56	28.88	26.24	0.013%
Retail Domestic Lamb	-6.67	-0.05	-21.56	-18.96	-0.411%
Retail Imported Lamb	8.98	0.04	25.73	22.80	0.255%
Retail Poultry	-1.62	0.10	48.67	41.06	0.010%
Total Meat Consumer Surplus	-365.15	-2.04	-1,056.77	-936.05	-0.076%

Table A9.2.4. Producer and Consumer Surplus Changes from 50% Adoption of a Premises Registration Program.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	2.22	0.01	6.28	5.61	0.002%
Wholesale Beef	0.29	0.00	1.12	0.97	0.001%
Slaughter Cattle	-0.40	0.00	-0.28	-0.24	0.000%
Feeder Cattle	-0.40	-0.03	-0.40	-0.34	0.000%
Total Beef Producer Surplus	1.58	-0.03	6.17	5.39	0.001%
Retail Pork	0.71	0.00	1.61	1.47	0.001%
Wholesale Pork	0.15	-0.02	0.17	0.18	0.000%
Slaughter Hog	0.05	-0.03	-0.28	-0.19	0.000%
Total Pork Producer Surplus	0.92	-0.05	1.45	1.41	0.001%
Retail Domestic Lamb	0.18	0.00	0.14	0.16	0.004%
Wholesale Lamb	0.03	0.00	-0.17	-0.12	-0.007%
Slaughter Lamb	-0.10	-0.01	-0.61	-0.50	-0.032%
Feeder Lamb	-0.46	-0.01	-1.72	-1.49	-0.085%
Total Lamb Producer Surplus	-0.34	-0.03	-2.35	-1.93	-0.021%
Retail Poultry	2.10	0.00	4.49	4.06	0.002%
Wholesale Poultry	1.55	0.00	3.38	3.08	0.002%
Total Poultry Producer Surplus	3.70	0.00	7.90	7.19	0.002%
Total Meat Producer Surplus	5.55	-0.11	12.97	11.91	0.001%
Consumer Surplus					
Retail Beef	-1.34	0.01	-1.91	-1.82	-0.001%
Retail Pork	0.10	-0.02	0.19	0.18	0.000%
Retail Domestic Lamb	-0.51	-0.01	-1.71	-1.50	-0.032%
Retail Imported Lamb	0.62	0.00	1.86	1.64	0.018%
Retail Poultry	-0.08	0.00	0.68	0.56	0.000%
Total Meat Consumer Surplus	-1.15	0.00	-0.83	-0.87	0.000%

Table A9.2.5. Producer and Consumer Surplus Changes from 50% Adoption of a Bookend Animal Identification Program.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	-19.99	-0.18	-205.37	-172.81	-0.058%
Wholesale Beef	-52.22	-0.84	-301.62	-252.85	-0.152%
Slaughter Cattle	-195.84	-2.24	-678.74	-590.99	-0.297%
Feeder Cattle	-186.17	-5.00	-622.94	-545.99	-0.345%
Total Beef Producer Surplus	-458.30	-8.24	-1,785.11	-1,525.54	-0.334%
Retail Pork	19.86	-0.01	51.79	46.35	0.039%
Wholesale Pork	4.97	-0.09	13.32	12.04	0.019%
Slaughter Hog	3.16	-0.18	6.58	6.21	0.010%
Total Pork Producer Surplus	27.78	-0.28	72.07	65.44	0.027%
Retail Domestic Lamb	1.21	-0.01	1.31	1.37	0.034%
Wholesale Lamb	0.18	-0.01	-0.75	-0.54	-0.033%
Slaughter Lamb	-0.41	-0.05	-2.90	-2.34	-0.149%
Feeder Lamb	-2.56	-0.08	-9.44	-8.11	-0.465%
Total Lamb Producer Surplus	-1.59	-0.15	-11.66	-9.63	-0.107%
Retail Poultry	64.22	0.01	126.70	115.24	0.063%
Wholesale Poultry	35.84	0.01	86.62	78.42	0.044%
Total Poultry Producer Surplus	100.56	0.02	213.67	193.17	0.054%
Total Meat Producer Surplus	-335.18	-8.67	-1,512.80	-1,286.46	-0.164%
Consumer Surplus					
Retail Beef	-190.12	-0.76	-563.57	-499.46	-0.154%
Retail Pork	7.01	-0.07	23.46	20.52	0.010%
Retail Domestic Lamb	-2.76	-0.02	-8.97	-7.90	-0.169%
Retail Imported Lamb	3.81	0.02	10.81	9.56	0.107%
Retail Poultry	2.68	0.06	32.94	27.77	0.007%
Total Meat Consumer Surplus	-174.73	-0.77	-500.73	-443.70	-0.036%

Table A9.2.6. Producer and Consumer Surplus Changes from 50% Adoption of a Full Animal Identification/Tracing Program.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	-19.00	-0.21	-242.15	-205.58	-0.069%
Wholesale Beef	-64.02	-1.09	-383.90	-326.55	-0.196%
Slaughter Cattle	-245.81	-3.04	-858.36	-745.70	-0.376%
Feeder Cattle	-253.96	-5.97	-843.38	-736.59	-0.466%
Total Beef Producer Surplus	-588.54	-10.28	-2,303.37	-1,967.53	-0.428%
Retail Pork	25.44	-0.08	63.81	57.33	0.048%
Wholesale Pork	5.71	-0.39	11.10	10.54	0.017%
Slaughter Hog	2.69	-0.80	-2.31	-0.53	-0.001%
Total Pork Producer Surplus	33.92	-1.27	72.10	67.63	0.028%
Retail Domestic Lamb	1.98	-0.01	2.01	2.10	0.053%
Wholesale Lamb	0.29	-0.02	-1.34	-0.93	-0.057%
Slaughter Lamb	-0.70	-0.09	-5.00	-4.01	-0.256%
Feeder Lamb	-4.45	-0.14	-16.31	-14.05	-0.809%
Total Lamb Producer Surplus	-2.85	-0.26	-20.40	-16.84	-0.187%
Retail Poultry	73.02	0.01	159.98	145.24	0.079%
Wholesale Poultry	52.30	-0.02	123.58	112.07	0.064%
Total Poultry Producer Surplus	125.39	-0.01	282.19	256.42	0.071%
Total Meat Producer Surplus	-434.81	-11.92	-1,968.97	-1,677.80	-0.212%
Consumer Surplus					
Retail Beef	-240.60	-0.97	-717.43	-636.20	-0.197%
Retail Pork	5.89	-0.39	17.47	15.79	0.008%
Retail Domestic Lamb	-4.76	-0.03	-15.42	-13.55	-0.292%
Retail Imported Lamb	6.36	0.03	18.12	16.13	0.180%
Retail Poultry	-1.10	0.07	31.55	26.15	0.006%
Total Meat Consumer Surplus	-227.89	-1.33	-658.96	-586.86	-0.048%

Table A9.2.7. Producer and Consumer Surplus Changes from 30% Adoption of a Full Animal Identification/Tracing Program with a 7.92% Export Beef Demand Increase.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	-30.20	2.93	-1.52	-17.31	-0.006%
Wholesale Beef	-68.74	12.24	30.92	0.03	0.000%
Slaughter Cattle	5.06	63.78	1,351.71	1,036.81	0.521%
Feeder Cattle	-45.69	39.45	734.71	549.05	0.348%
Total Beef Producer Surplus	-138.21	118.54	2,086.42	1,549.37	0.334%
Retail Pork	23.34	-0.34	34.11	32.91	0.027%
Wholesale Pork	5.80	-0.41	3.06	4.23	0.007%
Slaughter Hog	3.24	-0.58	-3.32	-1.45	-0.002%
Total Pork Producer Surplus	32.65	-1.34	34.33	35.80	0.015%
Retail Domestic Lamb	1.29	-0.01	1.20	1.26	0.032%
Wholesale Lamb	0.19	-0.01	-0.77	-0.54	-0.033%
Slaughter Lamb	-0.41	-0.06	-3.02	-2.43	-0.155%
Feeder Lamb	-2.67	-0.09	-9.87	-8.49	-0.486%
Total Lamb Producer Surplus	-1.62	-0.16	-12.29	-10.05	-0.112%
Retail Poultry	63.97	-0.09	99.25	92.60	0.051%
Wholesale Poultry	46.19	-0.12	74.36	69.73	0.040%
Total Poultry Producer Surplus	109.26	-0.21	175.31	164.63	0.046%
Total Meat Producer Surplus	3.81	116.86	2,324.13	1,759.07	0.220%
Consumer Surplus					
Retail Beef	-235.72	11.45	-287.45	-295.96	-0.089%
Retail Pork	6.99	-0.78	0.91	2.81	0.001%
Retail Domestic Lamb	-2.88	-0.02	-9.29	-8.15	-0.176%
Retail Imported Lamb	4.02	0.01	10.86	9.69	0.109%
Retail Poultry	0.73	-0.61	2.60	3.80	0.001%
Total Meat Consumer Surplus	-225.47	10.01	-274.69	-285.83	-0.023%

Table A9.2.8. Producer and Consumer Surplus Changes from 50% Adoption of a Full Animal Identification/Tracing Program with a 14.14% Export Beef Demand Increase.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	-56.41	5.23	-10.36	-38.50	-0.012%
Wholesale Beef	-123.58	21.88	54.32	0.12	0.001%
Slaughter Cattle	11.83	114.15	2,433.58	1,859.36	0.931%
Feeder Cattle	-79.52	70.62	1,325.44	990.92	0.626%
Total Beef Producer Surplus	-245.90	212.12	3,762.88	2,811.65	0.598%
Retail Pork	41.02	-0.60	59.08	57.48	0.047%
Wholesale Pork	10.24	-0.71	5.36	7.50	0.012%
Slaughter Hog	5.79	-1.00	-5.54	-2.32	-0.004%
Total Pork Producer Surplus	57.41	-2.33	60.85	62.75	0.025%
Retail Domestic Lamb	2.17	-0.01	2.02	2.13	0.053%
Wholesale Lamb	0.31	-0.02	-1.29	-0.92	-0.056%
Slaughter Lamb	-0.69	-0.09	-5.04	-4.07	-0.259%
Feeder Lamb	-4.45	-0.14	-16.43	-14.17	-0.811%
Total Lamb Producer Surplus	-2.68	-0.27	-20.47	-16.74	-0.186%
Retail Poultry	112.46	-0.17	173.48	161.91	0.088%
Wholesale Poultry	80.92	-0.21	129.64	122.19	0.070%
Total Poultry Producer Surplus	192.30	-0.39	307.75	287.38	0.081%
Total Meat Producer Surplus	4.87	209.20	4,185.69	3,151.34	0.395%
Consumer Surplus					
Retail Beef	-417.47	20.45	-503.34	-518.74	-0.157%
Retail Pork	12.45	-1.38	1.78	5.17	0.002%
Retail Domestic Lamb	-4.80	-0.04	-15.49	-13.59	-0.294%
Retail Imported Lamb	6.77	0.01	18.29	16.22	0.182%
Retail Poultry	1.04	-1.09	3.07	5.67	0.001%
Total Meat Consumer Surplus	-399.53	17.90	-483.51	-502.26	-0.040%

Table A9.2.9. Producer and Consumer Surplus Changes from 70% Adoption of a Full Animal Identification/Tracing Program with a 22.95% Export Beef Demand Increase.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	-97.64	8.49	-38.12	-77.89	-0.025%
Wholesale Beef	-203.37	35.60	85.73	0.00	0.003%
Slaughter Cattle	20.52	185.95	3,981.41	3,050.59	1.516%
Feeder Cattle	-118.11	114.85	2,199.96	1,653.58	1.035%
Total Beef Producer Surplus	-391.73	345.35	6,157.61	4,605.85	0.974%
Retail Pork	64.97	-0.96	93.07	90.04	0.074%
Wholesale Pork	16.35	-1.08	8.91	12.33	0.019%
Slaughter Hog	9.32	-1.49	-6.98	-2.37	-0.004%
Total Pork Producer Surplus	91.06	-3.53	97.66	100.29	0.041%
Retail Domestic Lamb	3.12	-0.02	2.93	3.07	0.077%
Wholesale Lamb	0.44	-0.03	-1.81	-1.29	-0.078%
Slaughter Lamb	-0.97	-0.13	-7.06	-5.71	-0.362%
Feeder Lamb	-6.22	-0.20	-22.97	-19.84	-1.140%
Total Lamb Producer Surplus	-3.66	-0.38	-28.47	-23.32	-0.260%
Retail Poultry	176.85	-0.27	269.25	253.43	0.138%
Wholesale Poultry	127.59	-0.34	201.14	190.73	0.108%
Total Poultry Producer Surplus	303.22	-0.63	474.72	450.05	0.125%
Total Meat Producer Surplus	0.13	340.96	6,839.39	5,137.32	0.645%
Consumer Surplus					
Retail Beef	-672.63	33.23	-797.74	-828.12	-0.251%
Retail Pork	20.49	-2.16	4.10	9.36	0.005%
Retail Domestic Lamb	-6.75	-0.06	-21.77	-19.06	-0.413%
Retail Imported Lamb	9.71	0.02	26.04	23.21	0.258%
Retail Poultry	1.74	-1.78	2.59	7.03	0.002%
Total Meat Consumer Surplus	-640.86	29.16	-769.58	-800.44	-0.063%

Table A9.2.10. Producer and Consumer Surplus Changes from 90% Adoption of a Full Animal Identification/Tracing Program with a 34.13% Export Beef Demand Increase.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	-152.99	12.64	-63.64	-119.91	-0.040%
Wholesale Beef	-304.27	53.05	137.92	0.10	0.005%
Slaughter Cattle	52.38	277.81	6,008.17	4,620.69	2.267%
Feeder Cattle	-156.02	171.75	3,343.75	2,548.64	1.576%
Total Beef Producer Surplus	-550.50	515.97	9,356.81	6,972.44	1.491%
Retail Pork	93.73	-1.41	132.20	129.03	0.105%
Wholesale Pork	23.79	-1.52	13.07	18.23	0.029%
Slaughter Hog	13.78	-2.03	-8.09	-2.03	-0.003%
Total Pork Producer Surplus	132.09	-4.96	140.17	146.62	0.059%
Retail Domestic Lamb	4.28	-0.02	4.01	4.19	0.105%
Wholesale Lamb	0.59	-0.04	-2.45	-1.73	-0.106%
Slaughter Lamb	-1.30	-0.18	-9.54	-7.70	-0.489%
Feeder Lamb	-8.38	-0.27	-30.98	-26.75	-1.542%
Total Lamb Producer Surplus	-4.86	-0.51	-38.35	-31.43	-0.350%
Retail Poultry	254.64	-0.41	384.13	362.24	0.197%
Wholesale Poultry	183.07	-0.50	286.19	270.96	0.154%
Total Poultry Producer Surplus	437.48	-0.93	671.78	644.10	0.178%
Total Meat Producer Surplus	16.98	509.76	10,371.26	7,771.57	0.973%
Consumer Surplus					
Retail Beef	-978.47	49.47	-1,115.11	-1,179.58	-0.359%
Retail Pork	30.41	-3.11	7.55	14.68	0.007%
Retail Domestic Lamb	-9.12	-0.08	-29.34	-25.72	-0.558%
Retail Imported Lamb	13.22	0.02	35.39	31.56	0.350%
Retail Poultry	2.70	-2.66	1.23	7.55	0.002%
Total Meat Consumer Surplus	-931.59	43.51	-1,081.19	-1,110.45	-0.089%

Table A9.2.11. Producer and Consumer Surplus Changes from 30% Adoption of a Full Animal Identification/Tracing Program with a 0.24% Domestic Beef Demand Increase.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	159.83	42.03	1,087.40	879.42	0.296%
Wholesale Beef	6.44	32.41	429.18	321.71	0.194%
Slaughter Cattle	-88.76	35.17	279.12	173.08	0.087%
Feeder Cattle	-110.18	20.40	43.21	0.25	0.000%
Total Beef Producer Surplus	-26.33	130.56	1,826.45	1,351.20	0.290%
Retail Pork	26.11	0.02	64.67	58.29	0.049%
Wholesale Pork	6.57	-0.18	14.46	13.44	0.021%
Slaughter Hog	3.76	-0.44	3.90	4.45	0.007%
Total Pork Producer Surplus	36.81	-0.61	84.14	76.84	0.031%
Retail Domestic Lamb	1.31	-0.01	1.44	1.46	0.037%
Wholesale Lamb	0.19	-0.01	-0.74	-0.52	-0.032%
Slaughter Lamb	-0.42	-0.06	-2.97	-2.40	-0.153%
Feeder Lamb	-2.67	-0.08	-9.79	-8.48	-0.484%
Total Lamb Producer Surplus	-1.60	-0.16	-11.98	-9.84	-0.110%
Retail Poultry	70.77	0.03	148.47	135.65	0.074%
Wholesale Poultry	51.17	0.02	115.56	105.71	0.060%
Total Poultry Producer Surplus	122.46	0.05	265.21	241.69	0.067%
Total Meat Producer Surplus	130.96	130.02	2,171.18	1,665.84	0.208%
Consumer Surplus					
Retail Beef	-18.30	165.56	1,226.25	889.04	0.275%
Retail Pork	8.25	-0.10	23.05	21.01	0.010%
Retail Domestic Lamb	-2.88	-0.02	-9.23	-8.13	-0.175%
Retail Imported Lamb	4.04	0.02	11.24	10.02	0.113%
Retail Poultry	1.17	0.21	35.25	29.46	0.007%
Total Meat Consumer Surplus	-5.66	165.65	1,305.55	945.88	0.078%

Table A9.2.12. Producer and Consumer Surplus Changes from 50% Adoption of a Full Animal Identification/Tracing Program with a 0.43% Domestic Beef Demand Increase.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	279.48	74.19	1,911.99	1,541.71	0.519%
Wholesale Beef	10.54	57.22	753.83	563.08	0.340%
Slaughter Cattle	-156.52	62.09	495.30	305.53	0.153%
Feeder Cattle	-194.86	36.00	82.52	0.28	0.000%
Total Beef Producer Surplus	-49.65	230.48	3,214.25	2,380.94	0.509%
Retail Pork	45.77	0.05	113.69	102.36	0.085%
Wholesale Pork	11.48	-0.31	25.50	23.71	0.038%
Slaughter Hog	6.63	-0.75	7.18	8.07	0.013%
Total Pork Producer Surplus	64.71	-1.03	148.21	135.51	0.055%
Retail Domestic Lamb	2.21	-0.01	2.45	2.48	0.062%
Wholesale Lamb	0.31	-0.02	-1.24	-0.88	-0.053%
Slaughter Lamb	-0.69	-0.09	-4.97	-4.01	-0.255%
Feeder Lamb	-4.44	-0.14	-16.30	-14.12	-0.808%
Total Lamb Producer Surplus	-2.64	-0.26	-19.88	-16.36	-0.182%
Retail Poultry	123.63	0.06	259.81	237.56	0.129%
Wholesale Poultry	89.45	0.03	202.34	184.93	0.106%
Total Poultry Producer Surplus	214.64	0.09	464.69	422.48	0.118%
Total Meat Producer Surplus	227.14	229.58	3,823.71	2,931.10	0.366%
Consumer Surplus					
Retail Beef	-32.68	292.21	2,165.64	1,567.45	0.484%
Retail Pork	14.53	-0.16	41.07	37.15	0.018%
Retail Domestic Lamb	-4.81	-0.03	-15.40	-13.56	-0.292%
Retail Imported Lamb	6.78	0.03	18.96	16.88	0.189%
Retail Poultry	1.79	0.37	60.76	50.75	0.012%
Total Meat Consumer Surplus	-11.36	292.37	2,300.85	1,667.26	0.137%

Table A9.2.13. Producer and Consumer Surplus Changes from 70% Adoption of a Full Animal Identification/Tracing Program with a 0.67% Domestic Beef Demand Increase.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	435.74	117.62	3,002.55	2,425.91	0.813%
Wholesale Beef	12.95	90.76	1,174.01	869.84	0.525%
Slaughter Cattle	-254.26	98.50	774.75	467.24	0.239%
Feeder Cattle	-306.89	56.79	139.24	2.93	0.002%
Total Beef Producer Surplus	-95.12	365.27	5,079.13	3,722.43	0.797%
Retail Pork	72.03	0.09	178.92	161.23	0.134%
Wholesale Pork	18.12	-0.44	41.22	38.24	0.061%
Slaughter Hog	10.54	-1.09	13.13	14.33	0.023%
Total Pork Producer Surplus	102.34	-1.46	237.68	216.00	0.087%
Retail Domestic Lamb	3.16	-0.01	3.62	3.63	0.091%
Wholesale Lamb	0.44	-0.03	-1.74	-1.21	-0.073%
Slaughter Lamb	-0.96	-0.13	-6.94	-5.61	-0.357%
Feeder Lamb	-6.21	-0.20	-22.89	-19.73	-1.136%
Total Lamb Producer Surplus	-3.60	-0.37	-27.59	-22.75	-0.253%
Retail Poultry	193.79	0.09	407.94	371.49	0.202%
Wholesale Poultry	139.65	0.05	317.04	288.96	0.165%
Total Poultry Producer Surplus	335.59	0.14	729.25	660.50	0.183%
Total Meat Producer Surplus	339.25	364.07	6,015.21	4,590.61	0.574%
Consumer Surplus					
Retail Beef	-58.00	463.28	3,412.97	2,466.01	0.758%
Retail Pork	23.35	-0.20	66.80	60.30	0.029%
Retail Domestic Lamb	-6.75	-0.05	-21.58	-19.01	-0.411%
Retail Imported Lamb	9.72	0.04	27.26	24.20	0.269%
Retail Poultry	2.81	0.57	95.13	79.52	0.019%
Total Meat Consumer Surplus	-26.98	463.55	3,628.72	2,618.28	0.216%

Table A9.2.14. Producer and Consumer Surplus Changes from 90% Adoption of a Full Animal Identification/Tracing Program with a 0.96% Domestic Beef Demand Increase.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	616.55	167.83	4,250.25	3,429.40	1.148%
Wholesale Beef	15.95	129.52	1,661.31	1,235.50	0.746%
Slaughter Cattle	-369.21	140.54	1,102.82	667.72	0.335%
Feeder Cattle	-440.14	80.88	197.89	0.06	0.000%
Total Beef Producer Surplus	-150.22	521.09	7,226.74	5,284.86	1.126%
Retail Pork	102.79	0.15	255.37	229.25	0.191%
Wholesale Pork	25.92	-0.57	60.01	55.54	0.088%
Slaughter Hog	15.14	-1.44	20.56	21.72	0.035%
Total Pork Producer Surplus	146.34	-1.90	343.24	312.25	0.125%
Retail Domestic Lamb	4.32	-0.02	4.99	4.98	0.125%
Wholesale Lamb	0.59	-0.04	-2.38	-1.64	-0.100%
Slaughter Lamb	-1.30	-0.18	-9.37	-7.56	-0.482%
Feeder Lamb	-8.37	-0.27	-30.83	-26.58	-1.537%
Total Lamb Producer Surplus	-4.80	-0.50	-37.10	-30.46	-0.340%
Retail Poultry	275.25	0.13	577.44	526.37	0.287%
Wholesale Poultry	197.59	0.07	450.60	410.42	0.234%
Total Poultry Producer Surplus	475.87	0.20	1,034.46	938.56	0.259%
Total Meat Producer Surplus	469.28	519.52	8,564.25	6,516.81	0.811%
Consumer Surplus					
Retail Beef	-86.04	661.04	4,863.54	3,504.80	1.074%
Retail Pork	33.96	-0.22	97.99	88.16	0.042%
Retail Domestic Lamb	-9.12	-0.06	-29.12	-25.61	-0.556%
Retail Imported Lamb	13.25	0.05	37.00	32.88	0.365%
Retail Poultry	4.08	0.81	135.43	113.67	0.027%
Total Meat Consumer Surplus	-40.43	661.44	5,160.86	3,732.09	0.308%

Table A9.2.15. Producer and Consumer Surplus Changes in the Absence of an Animal Identification/Tracing Program and a 10% Permanent Loss of Beef Export Markets.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	81.15	5.65	149.22	127.93	0.044%
Wholesale Beef	137.13	17.23	206.45	178.55	0.109%
Slaughter Cattle	-224.97	-49.52	-2,143.71	-1,741.23	-0.886%
Feeder Cattle	-107.97	-53.86	-1,517.87	-1,191.51	-0.757%
Total Beef Producer Surplus	-110.71	-80.59	-3,222.91	-2,561.19	-0.560%
Retail Pork	-8.96	0.20	-4.57	-5.96	-0.005%
Wholesale Pork	-3.06	0.13	-0.41	-1.13	-0.002%
Slaughter Hog	-1.91	0.13	0.52	-0.14	0.000%
Total Pork Producer Surplus	-14.25	0.47	-4.76	-7.40	-0.003%
Retail Domestic Lamb	-0.13	0.00	-0.10	-0.11	-0.003%
Wholesale Lamb	-0.01	0.00	0.00	-0.01	0.000%
Slaughter Lamb	-0.01	0.00	0.01	0.00	0.000%
Feeder Lamb	0.00	0.00	0.02	0.01	0.001%
Total Lamb Producer Surplus	-0.16	0.00	-0.08	-0.10	-0.001%
Retail Poultry	-33.70	0.08	-34.14	-33.36	-0.018%
Wholesale Poultry	-18.85	0.13	-13.56	-15.10	-0.008%
Total Poultry Producer Surplus	-52.98	0.22	-49.66	-49.82	-0.014%
Total Meat Producer Surplus	-182.00	-79.93	-3,290.08	-2,645.07	-0.336%
Consumer Surplus					
Retail Beef	127.74	-15.13	-95.66	-31.46	-0.010%
Retail Pork	-4.16	0.68	5.79	3.07	0.001%
Retail Domestic Lamb	0.03	0.00	0.09	0.07	0.002%
Retail Imported Lamb	-0.24	0.01	-0.13	-0.16	-0.002%
Retail Poultry	-1.31	0.82	16.69	11.54	0.003%
Total Meat Consumer Surplus	644.49	1,406.45	13,798.58	10,410.01	0.839%

Table A9.2.16. Producer and Consumer Surplus Changes in the Absence of an Animal Identification/Tracing Program and a 25% Permanent Loss of Beef Export Markets.

Surplus Measure	Short Run	Long Run	Cumulative	Cumulative Present Value	Cumulative Percent Of Total
	million dollars				
Producer Surplus					
Retail Beef	202.60	14.12	361.48	312.37	0.107%
Wholesale Beef	342.05	42.93	496.71	435.20	0.269%
Slaughter Cattle	-562.08	-123.66	-5,350.27	-4,344.00	-2.239%
Feeder Cattle	-269.85	-134.15	-3,710.58	-2,954.39	-1.895%
Total Beef Producer Surplus	-277.28	-200.91	-8,045.22	-6,391.45	-1.407%
Retail Pork	-22.41	0.49	-11.42	-14.89	-0.013%
Wholesale Pork	-7.65	0.31	-1.03	-2.83	-0.004%
Slaughter Hog	-4.77	0.33	1.29	-0.36	-0.001%
Total Pork Producer Surplus	-35.63	1.17	-11.88	-18.37	-0.008%
Retail Domestic Lamb	-0.33	0.00	-0.25	-0.27	-0.007%
Wholesale Lamb	-0.04	0.00	-0.01	-0.02	-0.001%
Slaughter Lamb	-0.01	0.00	0.02	0.01	0.001%
Feeder Lamb	-0.01	0.00	0.04	0.02	0.001%
Total Lamb Producer Surplus	-0.40	0.01	-0.20	-0.25	-0.003%
Retail Poultry	-84.24	0.19	-85.26	-83.36	-0.046%
Wholesale Poultry	-47.13	0.34	-33.90	-37.74	-0.021%
Total Poultry Producer Surplus	-132.45	0.55	-124.14	-124.43	-0.035%
Total Meat Producer Surplus	-455.09	-199.20	-8,212.58	-6,601.83	-0.843%
Consumer Surplus					
Retail Beef	319.68	-37.82	-229.16	-74.61	-0.023%
Retail Pork	-10.40	1.70	14.46	7.68	0.004%
Retail Domestic Lamb	0.08	0.01	0.22	0.18	0.004%
Retail Imported Lamb	-0.61	0.02	-0.32	-0.40	-0.004%
Retail Poultry	-3.29	2.05	41.73	28.84	0.007%
Total Meat Consumer Surplus	302.99	-34.02	-172.92	-44.58	-0.004%

Questions

Response from John Clifford, D.V.M., Deputy Administrator for Veterinary Services and Chief Veterinarian, Animal and Plant Health Inspection Service, U.S. Department of Agriculture

Questions Submitted by Hon. Walt Minnick a Representative in Congress from Idaho

Question 1. Dr. Clifford, you testified that there are challenges associated with protecting producers' privacy in the development and implementation of a national identification system. What authority does the Department of Agriculture have to protect this sensitive information and how can we safeguard this information from being subject to the Freedom of Information Act if the program is mandated?

Answer. USDA takes National Animal Identification System (NAIS) privacy issues very seriously. In developing NAIS standards, we intentionally limited the type and quantity of information collected and maintained by the Federal government. This is the most effective step we can take in order to help protect producer privacy.

USDA generally treats producer information as confidential. The Freedom of Information Act (FOIA) does, however, compel us to release information that is not subject to a FOIA exemption. To date, USDA has applied FOIA exemptions to withhold NAIS producer information when requested, and will continue to apply appropriate exemptions to protect personal information and confidential business information provided by NAIS participants, consistent with law and the Administration's recently announced policies regarding FOIA.

Question 2. If the NAIS were made mandatory, would backyard poultry flocks and every single animal be required to participate?

Answer. To be successful, NAIS must include animals moving in commerce because of their potential to spread disease. If NAIS were made mandatory, we would not require__but certainly encourage__producers keeping backyard poultry flocks and other animals not moving in commerce to participate. At a minimum, we would strongly encourage these producers to register their premises, since animal disease does not discriminate on the basis of herd or flock operation size or whether a producer sells animals commercially or raises them for personal use. With premises registration information, we can proactively contact these producers early on in a disease situation, so that they can take steps to protect their animals.

The three bovine spongiform encephalopathy (BSE) tracebacks in the United States are important examples of why we need a high participation rate of animals in commerce. In tracing back these three cows, we ran into a number of dead ends and in multiple cases, we just could not trace back an animal to its herd of origin, which is key in properly investigating BSE cases. Having these premises and animals identified would have benefitted the government and producers tremendously, allowing a more swift and targeted response and use of resources.

Question 3. With respect to premises registration, beef cattle premises have shown to be the most difficult to register, while the dairy cattle, poultry, swine, sheep, and goat markets have had a much greater participation in the registration effort. What do you think accounts for this disparity?

Answer. Various groups within the beef cattle industry have voiced a number of concerns with NAIS that we believe contribute to their low participation rate, currently estimated at 25%. One of the greatest concerns we have heard is with the costs associated with a mandatory NAIS. Over 90 percent of the industry costs for such a system would be associated with the cattle sector. This is largely due to the individual animal identification required, whereas swine, sheep, goats, and poultry can often be sufficiently traced using premises and group lot identification. Additionally, cattle typically move more times during their lifespan than other livestock species.

Concerns have also been raised about the use of producer information. Some have concerns that their information will be released and used to their detriment, such as for liability purposes related to food safety tracebacks, as we move forward with this critical program.

We believe strongly that we must work collaboratively with industry to address their concerns and move forward with an effective NAIS__whether it be a mandatory or voluntary system. In fact, on April 15, 2009, the Secretary held a roundtable with stakeholders representing the full spectrum of views on NAIS. This meeting kicked off a larger listening tour to gather feedback on concerns and, more importantly, to identify potential solutions to help USDA and the U.S. livestock sector move forward with the program.

Question 4. What studies have been done demonstrating that NAIS will reduce the occurrence or scope of animal disease outbreaks?

Answer. I would first like to clarify that the purpose of NAIS is not to reduce the occurrence of an animal disease outbreak, but rather, to reduce the scope of disease

spread by increasing traceability and thereby allowing for a swifter and more precise response. Several studies have looked at foreign animal disease outbreaks and their resulting effects, and have found that a quicker response equates to a significant decrease in negative effects from an outbreak. I will briefly discuss a few of these studies.

In a study that examined the impacts of a hypothetical foot-and-mouth disease outbreak in California, researchers found that a shorter traceback time is key to reducing the scope of a disease, as indicated by the study's finding that in its simulation, "a one-week delay in starting depopulation could increase the proportion of infected premises from 18% to more than 90%." [1] An additional study cited "prompt identification and elimination of affected herds" as a major factor influencing eradication of an outbreak of foot-and-mouth disease. [2] A more recent study that examined the value of traceability in a hypothetical foot-and-mouth disease outbreak in Kansas found that "as the level of surveillance and ability to trace cattle increases, the number of animals that have to be destroyed and related costs decrease." [3]

These studies highlight the need for enhanced traceability, which can be achieved through increased participation in NAIS. The more quickly we can identify what animals and operations may be affected, the faster we will be able to find exposed animals and take the necessary steps to contain the disease. Conversely, the longer the process takes, the more a contagious disease can spread, potentially increasing the number of herds and animals involved. And, in the case of diseases like BSE that are not contagious, the longer it takes to provide definitive information about the extent of the disease, the longer we will see decreased consumer confidence and negative trade impacts. This would lead to more cost for producers, longer commerce interruptions with added cost to consumers, and more disruptions to communities and industries connected to livestock production.

We also see significant opportunities to reduce the scope of domestic disease within our animal health programs. For example, of the 199 positive cases of bovine tuberculosis identified in the United States between late 2003 and early 2008, over 84 percent of the animals did not have official USDA individual identification. As a result, USDA and state investigative teams spent substantially more time and money conducting tracebacks, including an expanded scope of an investigation to identify suspect and exposed animals. Additionally, the average time spent conducting a traceback involving 27 recent bovine tuberculosis investigations was 199 days. This is simply not acceptable.

We can see the potential value added by enhancing traceability when we compare recent tuberculosis tracebacks of U.S. versus Canadian cows. Since 2006, we have completed 44 investigations of bovine tuberculosis positive animals. The average length of time to complete these investigations was 186 days. However, the average investigation time for two cattle that originated in Canada, which has a mandatory animal identification system, was only 19.5 days. Canada's unique numbering standard, tied to a unique premises identification, is consistent with our proposed standards for advancing traceability in the United States. Incorporation of these standards into livestock commerce will provide USDA with the readily-accessible, accurate information required to expedite disease control efforts.

Question 5. What analysis has been conducted of current tracking capabilities? For example, what is the average tracking time for individual animals? For cases that have taken longer than average, what reason(s) have been identified for the slower response?

Answer. USDA examines animal disease surveillance data, animal health program data, and actual animal disease investigations to analyze our current traceback capabilities. Current traceability in the poultry, swine, and sheep industries is high. However, we have consistently found that in the beef cattle industry, tracebacks take longer, cannot always be completed, and result in longer delays and greater costs to producers because of the industry's low traceability level. Traceback time varies depending on each unique situation, and is greatly affected by the availability of records, which can vary widely. Additionally, as disease risk lessens, fewer people participate in USDA's existing eradication programs. This means that fewer animals

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[1] Ekboir, J.M., L.S. Jarvis and J.E. Bervejillo. 2003. Potential Impact of FMD Outbreak in California, in Sumner, D. (ed.), Exotic Pests and Diseases: Economics, Science and Policy, Iowa State University Press.

[2] Ekboir, Javier. (1999). *The Potential Impact of Foot and Mouth Disease in California: The Role and Contribution of Animal Health Surveillance and Monitoring Services.* Davis, Calif.: Agricultural Issues Center.

[3] Pendell, D.L. and Schroeder, T.C. (2007). Value of Animal Traceability Systems in Managing a Foot-And-Mouth Disease Outbreak in Southwest Kansas. Kansas State University Agricultural Experiment Station and Cooperative Extension Service.

are identified and can be traced if there is a disease event. Below are some examples:

Bovine Spongiform Encephalopathy (BSE) 09

Surveillance data from July 2007 through January 2009 indicated that of 72,869 primarily adult cattle, only 39% (28,558) were identified with an official USDA metal ear tag. Official USDA animal identification tags are individually unique nationally and provide the opportunity to also associate a point of first tagging, allowing for a faster traceback.

Bovine Brucellosis 09

USDA official brucellosis calfhood vaccination requires the attachment of a USDA official animal identification tag, which provides a primary means of identifying cattle for traceability purposes. Program data for calendar year 2008 indicates that slightly more than 3.7 million heifer calves were vaccinated, out of over 20 million heifers that were eligible (based on USDA National Agricultural Statistics Service data). Therefore, only 18.5% of eligible heifers for brucellosis vaccination were identified with nationally unique, USDA official animal identification.

Question 6. What analysis has been done to determine the specific data that would be important during a disease outbreak, and the potential for error or delay due to excessively large databases?

Answer. USDA determined what data is needed during a disease outbreak based on widely agreed upon veterinary epidemiological principles, the agency's experience responding to animal diseases, and stakeholder input. It is generally understood within veterinary epidemiology that it is vital to have data that would identify an animal's origin and movements. [4] Examination of USDA's previous experience in responding to animal disease events, including review of epidemiological investigation reports, supports that assertion. Our analysis defined what is needed to identify, contain, and eradicate livestock disease. This includes (1) the animal's identity, (2) where it originated, (3) what other farms it was on, (4) what other animals it had contact with, (5) what other farms are in the vicinity of the affected farms, and (6) the timeframe in which those contacts took place.

The NAIS Information Technology (IT) systems were built specifically to provide this vital information to animal health officials quickly and easily when a disease event arises. They were also designed to be able to function effectively in the event of a major outbreak. The systems have a full back-up site, are tested regularly to ensure performance level, and are updated as enhancements become available.

The problem USDA faced at the outset of development of NAIS was not that of an excessively large database, but rather that there were multiple disparate systems, coupled with traceback data that was contained on paper records stored in file cabinets at numerous locations across the country. USDA has effectively used a number of large databases for a variety of its programs and thus has experience in developing and maintaining them successfully. USDA is confident that the IT system built to support NAIS, while encompassing large databases, is being carefully managed to provide available and secure traceability information when needed.

Question 7. What analysis has been done of the unintended consequences of NAIS? For example, what plans have been developed to address non-compliance and the risks posed by animals that are being kept illegally?

Answer. NAIS is currently a voluntary program; therefore, non-compliance is not an issue. However, in order for the program to be successful, participation must exceed the critical mass level of participation estimated by USDA to be 70 percent of the animals in a specific species/sector identified and traceable to their premises of origin. If we did not exceed this threshold, we would not be able to significantly improve traceability.

In a mandatory system, USDA would likely develop a gradual enforcement scheme and detect non-compliance as animals moved in commerce. In each instance, we would assess the risk of that movement involving animals that were not officially identified, work to communicate the importance of complying with the regulations to those responsible for the movement, and, when necessary, assess penalties commensurate with the risk.

Questions Submitted by Hon. K. Michael Conaway a Representative in Congress from Texas

Question 1. What is the basis for the design of NAIS? Specifically, why does USDA repeatedly state that 48-hour traceback is "optimal" and that the program needs to include every animal? Both claims run contrary to sound epidemiology and

[4] Toma, et al., (1999). "Dictionary of Veterinary Epidemiology," Iowa State University Press.

risk analysis. Diseases have incubation times from a few hours to a few years__one approach does not fit all. And risk analysis would dictate that we focus our resources on high risk facilities (which typically mean high density).

Answer. A working group of epidemiologists, producers, market operators, harvest facility operators and other stakeholders determined that a 48-hour time frame would satisfy all sectors of the livestock production chain. Yes, incubation time and infectivity vary among diseases; however, we must have a system capable of handling the worst case scenario. This worst case scenario is a foot-and-mouth disease outbreak, which has an incubation time of 24–36 hours. To develop the 48-hour goal, we coupled this with the likelihood that 100% of the needed data would not be available electronically and would require some manual tracing.

It is important to remember that 48 hours is the goal, developed by experts in this field, to obtain all traceback information__but not to complete all disease tracebacks. For example, it takes 72 hours just to complete a screening test for bovine tuberculosis. But, it is essential to locate potentially exposed animals to help keep the disease from spreading should confirmatory results come back positive.

From my perspective, I agree that high density, intensively managed livestock populations pose a greater risk for disease amplification; however, animal disease can strike operations of all sizes and we must be prepared for that risk. USDA does not believe that every animal should be included in NAIS__the key is that NAIS must include all animals *moving in commerce* because of their potential to spread disease. And beyond that, additional premises registration and identification of lower priority operations and animals only serve to make the system stronger.

Question 2. What are the costs of NAIS? In the cost-benefit analysis for COOL, USDA included the following: labor, training, modification of existing record-keeping, software programming, computer hardware, impacts on operations' efficiency, and more. Yet, when asked about NAIS, USDA makes it sound like it's nothing more than the cost of the tag.

Answer. NAIS costs include program management by veterinarians, information specialists, statisticians and others; outreach; animal identification (identification devices and labor, applicators, etc.); data collection (market readers, slaughter readers, field readers, data collection labor); and the development and maintenance of the information system itself. Once NAIS is implemented, there will still be ongoing costs. The system is comprised of components that will have to be rebuilt, replaced, or updated over time (e.g., as the livestock population turns over, new ID tags will need to be purchased; as new technologies become available, computers, applicators, and readers will need to be replaced; etc.). Data from the Kansas State University benefit-cost analysis released by USDA on April 29, 2009, show that annual estimated costs for implementing NAIS today throughout the livestock (food animal) industries could range from roughly $143 million for a bookend approach with 90 percent participation, to $228 million for full pre-harvest traceability with 100 percent participation, with other options falling in between.

Because over 90 percent of the industry costs for a fully implemented system would be associated with the cattle industry, I would like to briefly discuss their costs. As the program currently stands, for most U. S. cattle operations, the cost to identify animals with NAIS-compliant tags/devices is a choice of alternatives and price comparisons with tags that are already being used, and most often, not the imposed implementation of a totally new system of tagging. Data show that in the U. S. cattle industry, 79.1 percent of all beef cows and 97.4 percent of all dairy cows are identified individually with some form of animal identification [5]. NAIS-compliant, USDA official animal identification tags are available as traditional visual tags as well as RFID tags/devices. They are very similar to the existing tags being used by the producers, where often only the numbering system is different. Actual costs depend upon the producer's choice of which tag works best for their operation. Overall, the costs for NAIS roughly translate into less than one-half percent of the retail value of U.S. beef products.

Question 3. There are serious ethical concerns in how NAIS has been developed. The USDA's working groups were initially drawn from the working groups established by the National Institute for Animal Agriculture (NIAA). The NIAA is an industry trade organization, and the members of the working groups included many companies who stood to profit directly from the implementation of NAIS, such as tag manufacturers and database management companies. Even some of the non-profit organizations__such as Farm Bureau and Jockey Club__have subsidiaries or

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[5] based upon USDA APHIS National Animal Health Monitoring System (NAHMS) data (Beef 2007–08 and Dairy 2007 studies).

ties to companies that manage databases. These conflicts of interest have never been addressed.

Answer. I do not believe that we took ethical missteps in the development and implementation of the NAIS. The National Animal Identification Development Team was initiated by USDA at the request of the United States Animal Health Association, an organization of state and federal animal health officials, producers, and livestock industry organizations. The steering Committee and working groups were selected under the direction of USDA, not NIAA. The participants are experts on these issues, and it was essential that we develop the program using their expertise.

Nearly 400 individuals representing over 200 stakeholder organizations helped develop the initial plan, which was called the United States Animal Identification Plan (USAIP). There was a concerted effort to include large and small producers, livestock markets, harvest facilities, renderers, academia, producer organizations, breed organizations, state and Federal animal health agencies, tribal organizations, technology providers (tags, readers, integrators), data service providers, transportation (trucking industry), and grower alliances, cooperatives, and other organizations not necessarily affiliated with a national organization.

Inclusion of companies and organizations directly involved in the animal identification or data collection business was not seen to be a conflict of interest. Their expertise was valuable, but certainly not the only source of information.

The USAIP was only one set of recommendations that the agency considered in developing the National Animal Identification System (NAIS). Public input from listening sessions across the country was also considered. The numerous comments received from email and website postings were as well. And Secretary Vilsack has emphasized his desire to seek additional input as we continue with NAIS implementation.

Question Submitted by Hon. David Scott a Representative in Congress from Georgia

Question 1. The GAO reported in July 2007 that the Department had major areas that would hinder USDA's ability to implement NAIS effectively, what has the USDA done to cover these issues:

A. USDA has not prioritized the implementation of NAIS by species or other criteria. Instead, the agency is implementing NAIS for numerous species simultaneously, causing federal, state, industry resources to be allocated widely, rather than being focused on the species of greatest concern.

B. USDA has not developed a plan to integrate NAIS with preexisting USDA and state animal ID requirements. As a result, producers are generally discouraged from investing in new ID devices for NAIS.

C. USDA has not clearly defined a time frame for rapid trace back possibly slowing response and causing greater economic losses.

D. USDA does not require potentially critical information to be recorded, such as species or age in the NAIS databases.

Answer. USDA appreciates the review conducted by GAO and has addressed all recommendations. I will outline progress on each of the four issues you specifically mentioned below.

A. APHIS has prioritized the implementation of NAIS by species and other criteria. USDA's *A Business Plan to Advance Animal Disease Traceability* specifically addresses prioritization of NAIS implementation by species. NAIS should be implemented in a way that addresses the unique attributes of different species/industry sector and the way animals are raised and processed. In addition, we need to consider that animal diseases are not always species-specific. For example, foot-and-mouth disease (FMD) was first diagnosed in swine in the United Kingdom outbreak in 2001 but soon affected cattle and sheep. Therefore, APHIS recognizes that NAIS must be inclusive for all livestock and poultry while prioritizing efforts that will address the species with the greatest void in traceability.

Species were grouped into two tiers, and within each tier, ranked as low, medium, or high priority. The level of priority reflects the emphasis each species and each sector will be given in implementing the strategies and actions of the business plan. The specific prioritization of species can be found on pages 14–25 of the business plan, which is available at: *http://animalid.aphis.usda.gov/nais/naislibrary/documents/plans__reports/TraceabilityBusinessPlan%20Ver%201.0%20Sept%202008.pdf.*

B. USDA has taken a number of steps to integrate NAIS with preexisting USDA and State animal identification requirements and encourage the use of new identification devices through ongoing actions defined in the business plan on pages 26–27. For example, the National Poultry Improvement Plan (NPIP) supplements NAIS with locations of poultry breeder flocks, resulting in traceability estimated at more than 95 percent. Additionally, an estimated 95 percent of sheep flocks can be traced

back to the flock of origin due to the identification provided by USDA's scrapie eradication surveillance program.

APHIS issued regulations to establish the premises identification number (PIN) as a standard for identifying locations that manage and/or hold livestock, with a final rule on July 18, 2007 (72 FR 39301–39307). The regulations also established the animal identification number (AIN) as an official numbering system for all disease program activities (bovine tuberculosis, brucellosis, scrapie, etc.) to uniquely identify locations across all disease programs. Additionally, APHIS published an interim rule on September 18, 2008, which reserves the 840 number for U.S.-born animals (73 FR 54059–54063).

A. On December 22, 2008, we issued Veterinary Services (VS) Memorandum No. 575.19 to explain our policy for the use of the PIN in the administration of animal disease program activities. Specifically, the use of the PIN format is being established as the standard for all disease programs to ensure the locations are uniquely identified across all disease programs.

On January 13, 2009, we published a proposed rule (74 FR 1634–1643) to make the 840 number the only version of the AIN, establish the NAIS seven-character PIN as the sole standard, and have a standardized PIN for all premises that use USDA official animal identification.

USDA and states are incorporating electronic data capture and reporting into existing animal health programs and information systems. This effort in mobile information management for field collection of animal identification data, whether chuteside with producers or at surveillance points such as harvest facilities or livestock markets, is expanding. Examples include the electronic bovine tuberculosis testing system, electronic brucellosis system for vaccination and testing, and the electronic scrapie tracing system.

C. The September 2008 traceability business plan provides timelines with performance measure objectives to advance tracing capabilities for each species. Tables outlining these timelines are found on pages 59–60 of the business plan.

D. With regard to requiring potentially critical information to be recorded, such as species or age, in the NAIS databases, APHIS has discussed this issue extensively with stakeholders through the species working groups and in collaboration with industry. Participants identified the minimum data elements that must be obtained to conduct a traceback investigation. APHIS incorporated these data elements into NAIS through the requirements of the animal tracking databases.

Other data elements, such as species, date of birth, and gender, are often contained in information systems maintained by service providers in animal agriculture and may be provided when necessary. Requiring additional information for an animal record to be considered a "qualifying" record, however, must be closely evaluated so as not to exclude otherwise valuable information.

Through development of animal tracking databases, APHIS has established a process to ensure that any consideration of expanding data elements is done in collaboration with the species working groups and through the recommendation of the NAIS Subcommittee. Experience with the animal tracking databases as they come on line with the Animal Trace Processing System will allow APHIS to document the availability of necessary information.

APHIS is studying the information available through the animal tracking databases to determine if additional required fields are necessary or if the data maintained in the systems are adequate without requiring additional data elements. Additionally, such findings and potential recommendations will be discussed with the species working groups. If changes are warranted, APHIS will revise the NAIS program standards and repost them in July 2009.

Question Submitted by Hon. Frank Kratovil, Jr. a Representative in Congress from Maryland

Question 1. Is it fair to say that you bring to the table substantial insight into the cost and benefit of this system? If so, can it be an effective system if it is not mandatory?

Answer Yes, I do believe that I have substantial insight due to decades of experience in protecting animal health and think it is important to examine the costs of our animal health programs and compare those to the potential benefits. The NAIS system can only be effective with strong participation that exceeds the critical mass level estimated by USDA to be 70 percent of the animals in a specific species/sector identified and traceable to their premises of origin. If we do not exceed this threshold, we will not be able to significantly improve traceability. In other words, this important system simply won't work. It is essential that we have an effective NAIS__whether it is voluntary or mandatory__in order to more quickly and precisely respond to animal disease outbreaks.

To examine the costs and benefits of various forms of a National Animal Identification System, we sought the help of outside experts. A team from Kansas State University, Montana State University, Colorado State University, and Michigan State University carried out this analysis. The analysis studies the benefits and costs of all components of NAIS across all industry/species sectors. The analysis sought to determine the overall distribution of the system's benefits and costs among producers of various-sized herds, marketing firms, processors, consumers, and state and federal government agencies. USDA provided the analysis to the Committee on April 29, 2009.

I recognize that cost is a significant concern for everyone with an interest in the NAIS. We know accountability is essential to assure the American public that the Federal government is making the best and most efficient choices when it comes to their tax dollars. We understand that NAIS implementation is not cheap; data from the Kansas State University cost-benefit analysis show that annual estimated costs for implementing NAIS today throughout the livestock (food animal) industries could range from roughly $143 million for a bookend approach with 90 percent participation, to $228 million for full pre-harvest traceability with 100 percent participation, with other options falling in between. But we must compare this with the estimated billions of dollars in losses we would suffer from an FMD outbreak. And, although significant, the costs for implementing NAIS in the cattle sector roughly translate into less than one-half percent of the retail value of U.S. beef products.

We are committed to being transparent and providing information about the benefits and costs of NAIS. On April 15, 2009, the Secretary held a roundtable with stakeholders representing the full spectrum of views on NAIS. This meeting kicked off a larger listening tour to gather feedback on concerns—including producer costs—and, more importantly, to identify potential solutions to help USDA and the U.S. livestock sector move forward with the program. We look forward to a productive discussion on these issues.