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# Bovine Tuberculosis

Bovine Tuberculosis is a bacterial infection caused by a gram-positive bacterium which has a wide host range and can infect deer, badger, hogs, bison, and even humans.<sup>1</sup> Inhalation of infected droplets expelled from the lungs of an infected animal is the usual route of infection, although ingestion, particularly via contaminated milk, also occurs.<sup>2</sup> Tuberculosis is characterized by inflammation, most often of the respiratory system. Signs include difficulty in breathing, coughing, and loss of appetite.<sup>3</sup> The principal sign of tuberculosis commonly is emaciation in spite of good nutrition and care. Tuberculosis is spread through aerosol transmission as well as ingestion of contaminated food products.<sup>4</sup> Tuberculosis is endemic throughout the world.

Bovine Tuberculosis is insidious on many levels, not the least of which is its ability to infect the human population through several vectors including, proximity to infected animals, consuming meat products and by-products, and ingestion of tainted milk. In the early 1900's it is estimated that roughly 148,000 U.S. citizens lost their lives to tuberculosis. Of these tuberculosis related deaths, it is further estimated that nearly ten percent of them had contracted the bovine form of the disease.<sup>5</sup> In 1917, the United States began an unprecedented campaign to eradicate bovine tuberculosis from the U.S. cattle herd. Between 1917 and 1940, approximately 3.8 million cattle were destroyed as a result of testing positive for tuberculosis and by 1941, every county in the United States was officially accredited free of tuberculosis (reaction rate below 0.5 percent).<sup>6</sup>

Data were gathered from both the USDA's Yearbook publications and the proceedings of the annual meetings of the United States Livestock Sanitary Association (USLSA) and its successor the United States Animal Health Association (USAHA) which allowed uslp to determine that tuberculosis has occurred every year since tracking began in the United States. Every state in the Union has historically suffered from outbreaks of tuberculosis. While tuberculosis has not been completely eradicated in the United States, currently, the states of Arizona, California, Colorado, Michigan, Minnesota, New Mexico, and Oklahoma have each experienced at least one tuberculosis event in the four years 2005 through 2008,<sup>7 8 9 10</sup> the occurrences of tuberculosis in

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<sup>1</sup> "What is Bovine Tuberculosis?" Department for Environmental Food and Rural Affairs (Defra), last modified August 21, 2008, accessed September 3, 2010, <http://www.defra.gov.uk/foodfarm/farmanimal/diseases/atoz/tb/abouttb/index.htm>

<sup>2</sup> *Merck Veterinary Manual, 9<sup>th</sup> Edition*, ed. C. Kahn (Whitehouse Station, NJ: Merck & Co., 2008), accessed April, 2010, <http://www.merckvetmanual.com/mvm/index.jsp>.

<sup>3</sup> "What is Bovine Tuberculosis?" Department for Environmental Food and Rural Affairs (Defra), last modified August 21, 2008, accessed September 3, 2010, <http://www.defra.gov.uk/foodfarm/farmanimal/diseases/atoz/tb/abouttb/index.htm>

<sup>4</sup> "Bovine Tuberculosis," United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), August, 2002; accessed August 31, 2010, [http://www.aphis.usda.gov/publications/animal\\_health/content/printable\\_version/fs\\_ahbtb.pdf](http://www.aphis.usda.gov/publications/animal_health/content/printable_version/fs_ahbtb.pdf); "What is Bovine Tuberculosis?" Department for Environmental Food and Rural Affairs (Defra), last modified August 21, 2008, accessed September 3, 2010, <http://www.defra.gov.uk/foodfarm/farmanimal/diseases/atoz/tb/abouttb/index.htm>

<sup>5</sup> Alan L. Olmstead and Paul W. Rhode, "An Impossible Undertaking: The Eradication of Bovine Tuberculosis in the United States," *Journal of Economic History* 64 (2004), 734-772; accessed May, 2010, [http://www.unc.edu/~prhode/Impossible\\_Undertaking.pdf](http://www.unc.edu/~prhode/Impossible_Undertaking.pdf).

<sup>6</sup> *Ibid*

<sup>7</sup> "2008 U.S. Animal Health Report," United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), accessed April, 2010, [http://www.aphis.usda.gov/animal\\_health/animal\\_health\\_report/downloads/AHR\\_08/2008\\_US\\_Animal\\_Health\\_Report.pdf](http://www.aphis.usda.gov/animal_health/animal_health_report/downloads/AHR_08/2008_US_Animal_Health_Report.pdf).

the U.S. herd have been reduced dramatically since the outset of the eradication efforts. The data from the proceedings of the annual meetings of the USLSA/USAHA included the number of “reactor animals.” Data were also discovered in the Cooperative State-Federal Bovine Tuberculosis Eradication Program Statistical Tables of Fiscal Year 1984 publication which coincided very closely with the USLSA reactor animal numbers. Both currently and historically, the U.S. destroys all animals testing positive for the tuberculosis disease. These test positive animals are referred to in the veterinary industry as “reactor animals.” Unless an agreement between the producer and APHIS results in a depopulation order, those animals not testing positive for the tuberculosis disease in an affected herd are not destroyed and remain under quarantine until the quarantine is lifted or until they test positive and are destroyed, whichever comes first.

It is estimated by the USDA that at the onset of the eradication effort in 1917, the annual cost of tuberculosis to the livestock sector was at least \$40 million. The benefits associated with the eradication campaign were, in 2004, estimated to have saved the U.S. taxpayer and producers \$98.7 million per year over the period 1918 to 1962.<sup>11</sup>

In the United States, a federal and statewide eradication program has resulted in many states being given “bovine tuberculosis-free” status.<sup>12</sup> These programs use routine testing and record-keeping to trace infected animals back to their originating herd to control as well as prevent the spread of tuberculosis. Worldwide, the three principal approaches to the control of tuberculosis are: test and slaughter, test and segregation, and chemotherapy [*unique cases, i.e. elephants*]. The test and slaughter policy is the only one assured of eradicating tuberculosis and relies on the reactors to the tuberculin test (which isn’t always reliable).<sup>13</sup> [*Clarification added*] Another approach is the depopulation of the affected herd.

Please see the following figure illustrating the number of cattle historically destroyed or slaughtered due to tuberculosis in the United States.

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<sup>8</sup> “2007 U.S. Animal Health Report,” United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), accessed September 1, 2010, [http://www.aphis.usda.gov/publications/animal\\_health/content/printable\\_version/ahr2007.pdf](http://www.aphis.usda.gov/publications/animal_health/content/printable_version/ahr2007.pdf).

<sup>9</sup> “2006 U.S. Animal Health Report,” United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), accessed April, 2010, [http://www.aphis.usda.gov/publications/animal\\_health/content/printable\\_version/06\\_AHReport\\_508.pdf](http://www.aphis.usda.gov/publications/animal_health/content/printable_version/06_AHReport_508.pdf).

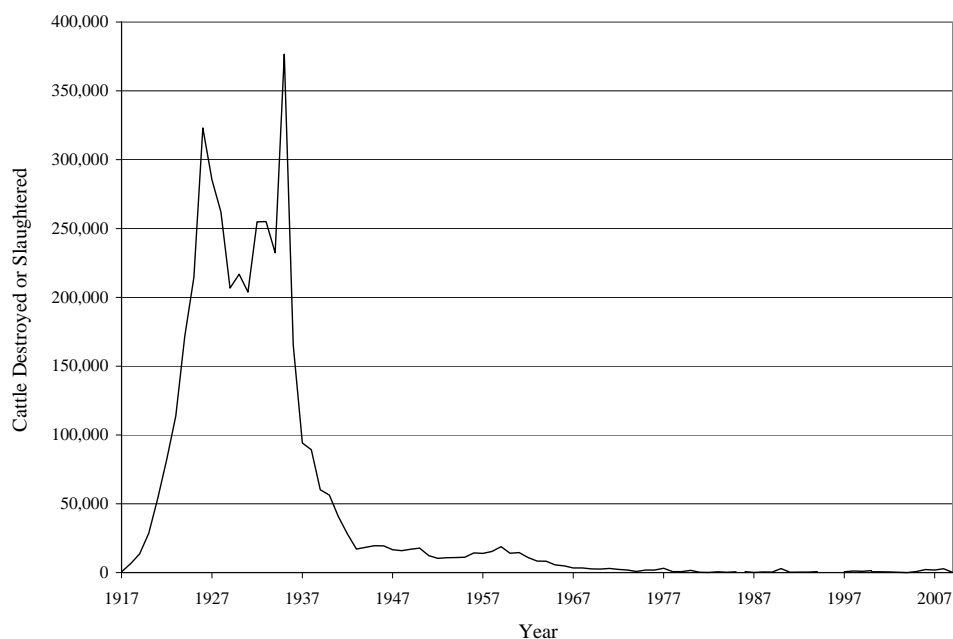
<sup>10</sup> “2005 U.S. Animal Health Report,” United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), accessed April, 2010, [http://www.aphis.usda.gov/publications/animal\\_health/content/printable\\_version/AHR\\_2005B\\_508.pdf](http://www.aphis.usda.gov/publications/animal_health/content/printable_version/AHR_2005B_508.pdf).

<sup>11</sup> Alan L. Olmstead and Paul W. Rhode, “An Impossible Undertaking: The Eradication of Bovine Tuberculosis in the United States,” *Journal of Economic History* 64 (2004), 734-772; accessed May, 2010, [http://www.unc.edu/~prhode/Impossible\\_Undertaking.pdf](http://www.unc.edu/~prhode/Impossible_Undertaking.pdf).

<sup>12</sup> “2007 U.S. Animal Health Report,” United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), pp. 29, accessed September 1, 2010, [http://www.aphis.usda.gov/publications/animal\\_health/content/printable\\_version/ahr2007.pdf](http://www.aphis.usda.gov/publications/animal_health/content/printable_version/ahr2007.pdf).

<sup>13</sup> *Merck Veterinary Manual*, 9th Edition, ed. C. Kahn (Whitehouse Station, NJ: Merck & Co., 2008), accessed April, 2010, <http://www.merckvetmanual.com/mvm/index.jsp>.

## Cattle Destroyed or Slaughtered Due to Tuberculosis (U.S. 1917 to 2009)



Source: Cooperative State-Federal Bovine Tuberculosis Eradication Program Statistical Tables of Fiscal Year 1984 and 1985, 1995-1996 Agricultural Statistics Annual with USAHA reported data in 1990, and OIE HandiSTATUS reports - [http://www.oie.int/hs2/zi\\_pays.asp?c\\_pays=197](http://www.oie.int/hs2/zi_pays.asp?c_pays=197) for years 1996 through 1999 and APHIS reports supplied by Kathy Orloski, D.V.M., and National Bovine Tuberculosis Epidemiologist for years 2000 – 2009.

The principal method for containment used in the United States is herd test and slaughter of the reactor animals. Once a slaughter reactor is traced to the herd of origin, that herd is placed under quarantine and the Caudal Fold Test is applied to every animal, six months of age and older, in the herd. The Comparative Cervical Test and/or Gamma Interferon Test are applied to Caudal Fold responder cattle. Any animal found to be positive during the Comparative Cervical Test and/or Gamma Interferon Test is slaughtered and a thorough post mortem examination is performed. If, during the post mortem, any of the animals are found to be infected with tuberculosis, the herd is classified as affected and classified as the index herd. At this point, those animals identified as Caudal Fold responders are reclassified as reactors and slaughtered. The affected herd is placed on a test and slaughter schedule until the affected herd qualifies for quarantine release under the National Tuberculosis Eradication Program or scheduled for depopulation with agreement from the herd owner and APHIS. The retest schedule timeline interval must be greater than 60 days. Furthermore, any trace-in or trace-out leads associated with the index herd also are subjected to this procedure and/or variants thereof. The Uniform Methods and Rules governing the Tuberculosis procedure may be found at: [http://www.aphis.usda.gov/animal\\_health/animal\\_diseases/tuberculosis/downloads/tb-umr.pdf](http://www.aphis.usda.gov/animal_health/animal_diseases/tuberculosis/downloads/tb-umr.pdf).

Cattle continue to be destroyed for tuberculosis in the United States. Tuberculosis is infectious and can be passed from animal to animal within a herd. Tuberculosis is difficult to detect in the early stages of infection and other bovine diseases may be mistakenly identified as tuberculosis or vice versa, for example Johne's Disease. Tuberculosis occurs regularly in the United States though the number of cases and the number of animals affected have been declining significantly

in beef cattle operations. There have been a few recent cases in areas previously classified by the USDA for multiple years as tuberculosis free. Animal health experts suggest this expansion of affected herd identification in areas previously classified Tuberculosis Free is an effect of improved and increased surveillance of slaughter animals.

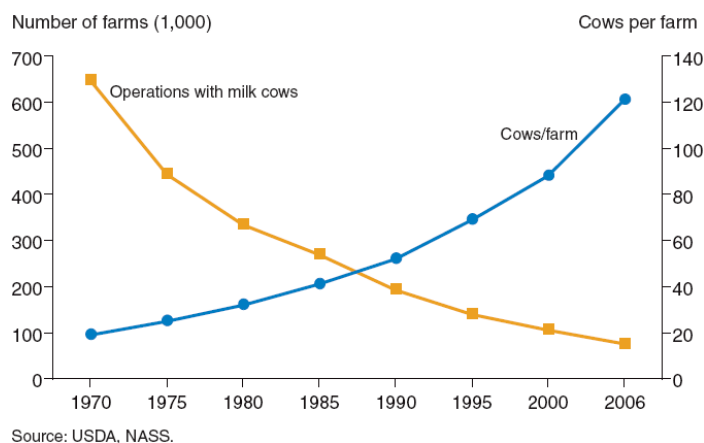
In the 1960's through early 1980's, the USDA was conducting "down the road" animal testing, testing animals at farms proximal to confirmed or suspected cases. In the mid-1980's, emphasis of the surveillance program shifted to incorporate less live animal testing and redirected focus and resources to testing at slaughter. In addition, at around this time the Food Safety Inspection Service (FSIS), the agency charged with surveillance inspections of slaughtered animals, was focusing their resources on salmonella, E. coli, and other food borne pathogens. This focus by the FSIS resulted in the limited inspection resources having less time available to conduct adequate searches for visual indicators for bovine tuberculosis during the slaughter inspection process. Under-reporting of suspicious lesions on carcasses and on tuberculin testing is also identified as possible reasons for the number of infected animals discovered showing dramatic declines during this period. Prior to 1998, 14 of the 40 packing plants in the United States, those that slaughtered 95 percent of the beef cattle in the United States, were under-reporting suspicious carcasses. In 1998, USDA modified their approach to carcass surveillance and placed additional emphasis on inspection of animal carcasses at slaughter. USDA also began an incentive program during this period wherein USDA inspectors were eligible for substantial bonus payments for identifying possible tuberculosis infected carcasses, causing these carcasses to be subjected to additional inspection and retention, and beginning the bacteriological and histopathological process for confirmation of their suspicions. If the carcass was verified to be infected by the laboratory, the inspector who originally identified the carcass is paid a bonus. If the traceback investigation for that carcass results in a new tuberculosis reactor herd being identified, the entire shift receives a substantial bonus to divide between each worker. Additionally, USDA emphasized access to laboratories the late 1990's and early 2000's, resulting in turn around times for laboratory verification being reduced from approximately 10 days (sometimes as long as several weeks) to the investigation veterinarian receiving the laboratory results within 72 hours. These changes in surveillance emphasis resulted in the number of suspicious carcass lesions reported increasing from less than 1,000 per year (on more than 32 million carcasses) to more than 10,000 suspicious carcasses per year in 2008. It should be noted, although there is a general belief that Mexico is a source of tuberculosis infection in the United States, the numbers of tuberculosis cases associated with Mexican cattle were reduced from 400 per year in the early 1990's to just 2 cases in the first eight months of 2010.

The U.S. animal health industry has also implemented training and testing classes for all levels of animal health practitioners and inspectors, supplementing the containment and surveillance protocols. Practitioners are given intense training on medical identifiers for the disease and current medical research relating to identifying the disease in a suspect animal visually. They additionally receive training on the correct procedures for applying the Caudal Fold test and the associated visual indicators which identify a positive reaction to the test as well as the correct procedures for identifying and segregating Caudal Fold reactor animals from the rest of the quarantined herd. State and federal veterinarians receive advance training on the methods and procedures for the use of the Comparative Cervical test, methods and procedures for the use of the Gamma Interferon test, methods and procedures for euthanizing Comparative Cervical and/or

Gamma Interferon reactors, collection of tissue samples, transporting suspect animals to approved laboratories, chain of custody of tissue samples from suspect animals procedures, laboratory testing protocols, confirmation of infection protocols, notification procedures, among others. Inspectors and surveillance personnel within the industry are trained and tested on the visual indicators of the disease on cattle carcasses at the slaughter facility, visual inspection techniques for carcasses, notification procedures for suspect cases of infection, and proper handling and security of the suspect carcass and tissue. Since federal inspectors operate within an incentive payment program, these personnel are also trained on the incentives for identifying a slaughter reactor and the further incentives associated with the confirmation of a slaughter reactor being traced back to a confirmed new reactor herd. Both increased slaughter surveillance and, in the case of dairy animals, increased per farm herd size, has led to the identification of additional tuberculosis-infected animals in the United States.

The trend in the cattle industry overall is toward fewer operations containing larger numbers of cattle. This trend is most dramatic in dairy cattle where between 1970 and 2006 the number of operations fell from 648,000 to 75,000, respectively. The total number of dairy cows during this same time period fell from 12 million to 9.1 million, bringing the average dairy herd size of 19 cows per farm in 1970 up to 120 cows per farm in 2006<sup>14</sup>; a 532 percent increase in the size of dairy operations [(120-19)/19]. Large dairy farms are dominant in California as well as other states in the West and Southwest. Milk production in the Northeast, East, Corn Belt, and Upper Midwest continues to come from smaller dairies, although the trend in these regions is also toward larger dairies. The largest dairy farms have more than 15,000 cows but 1,000 to 5,000 cows is more common.<sup>15</sup> The following figure, taken from “Changes in the Size and Location of U.S. Dairy Farms”, ERS, displays the trend in size and number of dairy operations since 1970.

### Decline in Dairy Farms, Increase in Dairy Size (U.S. 1970 to 2006)



Beef operations are also fewer and contain larger numbers of cattle, although the rate of change is not as dramatic as in the dairy sector. The increase in size in the dairy sector gives rise to significant added concern for tuberculosis. Mega-dairies are characterized by periods of

<sup>14</sup> MacDonald, et al., “Profits, Costs, and the Changing Structure of Dairy Farming,” *USDA Economic Research Report 47* (2007): 2-4, <http://www.ers.usda.gov/publications/err47/err47.pdf>

<sup>15</sup> Ibid

confinement in large populations and often in moist environments. Both proximity and humidity contribute to concerns about the spread and survival of the bacteria. This concern will be further dealt with as the uslp warranty effort for dairy progresses. These concerns are not relevant in the beef production sector where confinement in feedlots is quite different from the confinement in dairy operations.