# Mycobacterial Diseases of Animals

NE-1201 (2012-2017)

## *Mycobacterial Diseases Raise Many Concerns*

Signs of Johne's disease include diarrhea, rapid weight loss, and subsequent milk production dropoff. Typically, affected animals remain bright and alert, without fever, and eating well.

Johne's disease (JD) and the bovine tuberculosis complex (TB) are two of the most prevalent and costly mycobacterial infections of livestock. Both diseases spread easily through saliva, raw milk, and feed and water contaminated with bodily fluids from infected animals. These diseases are difficult to diagnose in a timely manner because of the long incubation period before symptoms appear and the lack of sensitive diagnostic tests. The cattle industry, government agencies, and public health officials are concerned about animal welfare and food safety as well as the economic effects of herd depopulation, quarantines, and trade restrictions used to control the diseases.

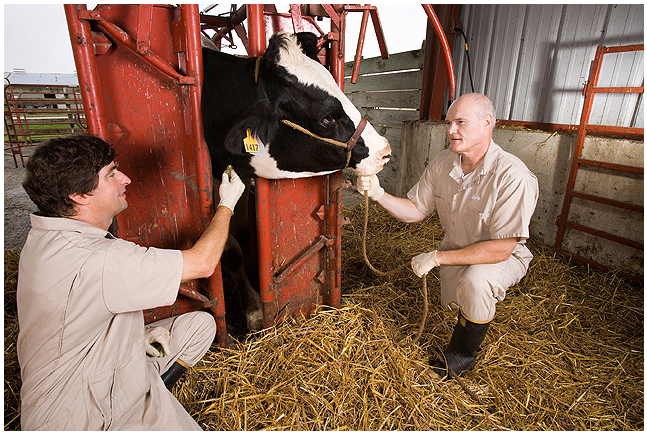
In the US, 68% of all dairy herds—and 95% of those with more than 500 cows—have at least one animal with JD. Each year, the disease, which causes diarrhea, rapid weight loss, and low milk production, results in losses of more than $200 million for the US dairy industry alone. With only one vaccine of limited effectiveness available, producers have very few options for effective prevention. Recent detection of *M. paratuberculosis* (the bacterium that causes JD) in retail milk has heightened concerns about milk quality and food safety.

At the turn of the 20th century, TB reaped greater economic losses to livestock production than all other infectious diseases combined. In later stages of the disease, cattle are lethargic, weak, and have a chronic cough. Prior to required milk pasteurization, TB pathogens in milk caused human suffering as well. Over time, rigorous disease control programs nearly eliminated TB in the US and most developed countries; however, *M. bovis* (a pathogen responsible for TB) can still show up in imported animals and be spread to native stock. Though trade restrictions and testing regulations are in place, current diagnostic tests have low sensitivity, and some infected cattle may not be detected. *M. bovis* was also recently detected in white-tailed deer, which often share habitat with cattle, raising concern about a resurgence of the disease.

## *Multistate Project Forms to Coordinate Research & Strategies to Control Diseases*

In 2012, Multistate Research Project NE-1201 (also known as the Mycobacterial Diseases of Animals multistate initiative) formed to address health impacts and economic losses from JD and TB. Bringing together scientists from across the US to lead dynamic research and development teams, facilitate knowledge and resource sharing, set priorities and protocols for conducting research, and leverage resources from academic, government, and private institutions in the US and internationally. Collaboration and coordination is helping these scientists fill research gaps, develop better diagnostics and vaccines, and create stronger education and outreach programs.

## *Multistate Research Project Mitigates Losses Associated with Diseases*



Veterinary medical officers Ray Waters (left) and Mitch Palmer prepare to collect blood to be used in developing improved tests for tuberculosis in cattle. Tuberculin skin testing of cattle has been effective in reducing the incidence of tuberculosis in US cattle, but more tools are needed for complete eradication. Photo by Peggy Greb.

Through outreach efforts and meetings with USDA leadership, partner organizations, and Congressional staff, awareness of NE-1201 has greatly increased. As a result, NE-1201 is now a sought-after organization for signing on to many initiatives brought before Congress, bringing scientific expertise and research-based recommendations to agriculture and infectious disease policies.

Outreach efforts and widespread use of educational materials developed by NE-1201, such as the online JD veterinary certification program and courses for animal producers and milk processors, have improved knowledge. Accurate, up-to-date, and easy-to-access information has helped veterinarians and producers make smart choices that protect animal health and productivity and cut losses. NE-1201's outreach and education efforts have also increased adoption of recommended tools and practices.

Sampling and testing strategies proposed by NE-1201 were adopted

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by the national voluntary control program for JD and used by the Dairy Herd Information Association.

Implementation of a faster test-and-removal plan recommended by NE-1201 helped control TB in cattle herds in Minnesota and Michigan.

US Department of Agriculture Agricultural Research Service microbiologist Diana Whipple and animal caretaker Katy Lies offer treats to a white-tailed deer being used to study tuberculosis in its wild counterparts. USDA photo by Keith Weller.

Research results enabled scientists to create more accurate predictive models of infection, which help producers prevent disease outbreaks and limit spread.

The well-characterized, easily accessed repository of bovine blood, milk and fecal samples collected by NE-1201 is used by pharmaceutical companies, academic and government scientists, as well as a Canadian regulatory agency to validate new diagnostic tests and vaccines. New generations of diagnostic tests for JD and TB that are more sensitive, rapid, and cost-efficient help identify infected animals before the disease spreads or gets too out of hand.

Adoption of NE-1201's standardized laboratory protocols for culture and molecular diagnostics has further shortened timelines for detecting infected animals.

NE-1201's research, outreach, and teaching have advanced the field of science and supported the professional development of the next generation of researchers and educators, making sure that they are well trained and have the tools needed to tackle ongoing issues.

## Selected Research Activities & Findings

- NE-1201 conducted a national survey to determine the knowledge level and information needs of dairy and beef producers related to JD and TB. Survey results allowed NE-1201 to refine research and outreach priorities.
- The NE-1201 group leveraged the support of USDA-APHIS and overcame logistical challenges to establish a massive, well-characterized repository of over 10,000 bovine blood and tissue samples repository.
- Researchers began to unravel the genetic mechanisms that control susceptibility to infection.
- With significant grant support from the USDA-NIFA and NIH, NE-1201 researchers and industrial partner Advanced Diagnostics Inc. developed a novel diagnostic test that can differentiate the disease-causing pathogen *Mycobacterium avium paratuberculosis* (MAP) from other Mycobacterium species using a newly identified antibody of MAP. Other researchers demonstrated that MAP-infected cows have significantly more T cells than uninfected animals, information which could also be used in diagnostic tests.
- Leveraging significant extramural funding from the highly competitive NIH and NSF emerging infectious diseases program, an NE-1201 research team ran clinical vaccine trials and designed and tested a new approach to modeling vaccine effectiveness in dairy herds.
- NE-1201 developed standard evaluation criteria for testing potential vaccines.
- NE-1201 members hosted three well-attended meetings with workshops, communicated with legislators, met with editors of six major dairy trade publications, gave interviews with two Agricultural Radio networks, presented posters at conferences, and collaborated with colleagues in Italy to develop a user friendly website, *mycobacterialdiseases.org*. Three NE-1201 members were charged by the Bill and Melinda Gates Foundation to develop a special international workshop on developing TB control and eradication strategies to be held in Morocco in December 2015.

## *Want to know more?*

NE-1201was supported, in part, through USDA's National Institute of Food and Agriculture by the Multistate Research Fund established in 1998 by the Agricultural Research, Extension, and Education Reform Act (an amendment to the Hatch Act of 1888) to encourage and enhance multistate, multidisciplinary research on critical issues that have a national or regional priority. For more information, visit *http://nera.umd.edu*.

**Project Website:** *http://mycobacterialdiseases.org/home.html*
**Administrative Advisor:** Gary A. Thompson (gat10@psu.edu)

**Participating Institutions & Researchers:**
Alexandria University, Egypt
University of California, Davis, Department of Population Health and Reproduction, School of Veterinary Medicine
Central Veterinary Institute, The Netherlands
Colorado State University
Cornell University
University of Georgia
Khalid Veterinary Research Institute, Sudan
University of Nebraska-Lincoln
Michigan State University
University of Minnesota
University of Missouri
University of Montreal
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Pennsylvania State University
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Agri-Food and Biosciences Institute
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KEO Consulting, Illinois
Oregon Wheat Commission
VetICE

This Impact Summary was compiled and designed by Sara Delheimer.