Livestock disease surveillance at auction markets

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Livestock disease surveillance programs that include multiple types of surveillance methodology are a pivotal component of disease control and eradication programs worldwide.[1-3] A given program may employ one or more surveillance methodologies. Etiologic surveillance is designed to detect the presence of specific causes of disease, such as an infectious agent. In diagnosis-based surveillance systems, the data of interest are specific clinical diagnoses. Syndromic surveillance is the practice of tracking disease trends in a population through clinical data that precede definitive diagnosis of specific conditions or detection of etiologic agents.[4] In a syndromic surveillance system, clinical signs are grouped into disease syndromes based on common clinical features (e.g., erosive or ulcerative lesions[5]), a common likely cause (e.g., influenza-like illness[6]), or a common organ system (e.g., neurologic dysfunction[5]). In all surveillance systems, response activities are typically triggered when targeted adverse health events occur at a rate that exceeds a predetermined threshold. These responses focus on identifying the etiology, measuring the scale of the event, epidemiologic investigations to identify the source(s) and means of spread, and control measures to attenuate or eradicate the threat.

Livestock disease surveillance systems need to survey relevant sample populations. The 2001 foot-and-mouth disease outbreak in the United Kingdom demonstrated that surveillance systems must be attuned to multiple species as they traverse the production system – consider the role of auction markets, small ruminants, and animal movement in that outbreak.[7] As sites for livestock sales and purchases, auction markets are collection and distribution points for various species of diverse ages, originating from multiple sources. These markets serve as important transaction channels for beef cattle, dairy cattle, sheep, and swine from small enterprises.[8-12] These animals can potentially be relocated into other livestock populations or sent directly to slaughter. Auction markets, therefore, may serve as useful locations for conducting surveillance. In 2005, approximately 1,450 U.S. auction markets were registered with USDA's Grain Inspection, Packers, and Stockyards Administration.[13]

Recent and Ongoing Research

To better characterize the numbers, origin, and destination of animals traversing auction markets, our research team conducted a study in 2006 as part of a cooperative agreement with

APHIS-VS[14] . Data were obtained through an agreement with a commercial company that provides specialized business management and database software for livestock auction markets in the U.S. and Canada. Representatives of this company approached ~150 clients (stratified by number of transactions per year) to solicit participation by anonymously providing electronic records regarding daily cattle transaction data. Data were collected for two 1-year periods: May 2002 – April 2003, a period prior to the discovery of bovine spongiform encephalopathy (BSE) in the United States, and May 2004 – April 2005, a period after the discovery of BSE in the U.S. Twenty-three auction markets elected to participate by providing data. In the 23 markets with complete data for both time periods, over 1.4 million cattle were sold in 2002-2003, and approximately 100,000 fewer cattle were sold in 2004-2005.

Most participating markets were smaller-volume markets located in the eastern United States and Canada. Therefore, these data cannot be assumed to represent the entire auction market system in North America. In 2002-03, on average for each market day, 10 cattle were sold by each seller to 4 different buyers. Each buyer, in turn, purchased an average of ~ 27 head of cattle from 7 sellers (sources) in 11 lots on any given market day. The average numbers of cattle sold, transactions, and sellers per buyer per market day were similar in 2004-05. Therefore, although the participating markets in this study did not likely constitute a representative sample of all North American markets, clearly, substantial mixing of cattle from multiple sources occurred at the participating markets. The potential role that such mixing might play in disseminating a highly contagious infectious disease warrants consideration.

In a related study, our research team developed a prototype syndromic surveillance system for use in auction markets, subsequent to a 30-day study observation period at a Colorado auction market in the fall of 2005.[15] Cattle, sheep, goats, horses, and pigs were observed by a licensed veterinarian. The breed, age, gender, origin, and destination of the observed animals were not recorded. To minimize potential disruption to normal business practices at the market, all observations were made from outside the holding pens, with no restraint or herding of the livestock. The duration of observation for each holding pen was related to the total number of animals in the pen. After all observations were completed, the authors categorized clinical signs into 12 disease syndromes. The frequency of each disease syndrome was expressed as the number of clinical observations related to that syndrome per 10,000 animal observation days. An animal observation day was defined as the observation of a single animal on any study day.

Data were recorded for 29,371 animal observation days during the 30-day study. Cattle had the most animal observation days (24,068 animal observation days [81.9 percent]), followed by sheep (3,898 animal observation days [13.3 percent]), goats (732 animal observation days [2.5 percent]), horses (444 animal observation days [1.5 percent]), and pigs (229 animal observation days [0.8 percent]). When all observations of all species were combined, respiratory tract disease was the most commonly observed disease syndrome (218.9 observations/10,000 animal observations days), followed by thin body condition (80.7 observations / 10,000 animal observation days) and abnormal ambulation or posture (27.2 observations/10,000 animal observation days). These 3 syndromes accounted for nearly 93 percent of all clinical signs observed. Least commonly observed syndromes were injury-related hemorrhage, death, and non-injury related hemorrhage (hemorrhage from orifices); these occurred at a rate of 0.7, 0.3, and 0.0 observations / 10,000 animal observation days, respectively.[15]

In that study, our research team demonstrated that fence line observation could be used to obtain relevant health data on livestock entering an auction market. However, the sensitivity and specificity of such a surveillance system in detecting particular diseases is a necessary focus for further research, as is establishing baseline observation rates for these or other syndromes during different times of year and across multiple auction markets. The composition of clinical signs in the 12 syndromes we developed for this study might reflect a logical framework that is cumbersome or unfamiliar to certain users. Further, before auction markets could be utilized in a national livestock surveillance program, the influences of season, year, and inter-observer variation must be measured so an analyst may account for the effect these variables have on syndromic observation rates. Our team is currently conducting a study to measure the inter-observer variation among laypersons (first-year veterinary students) conducting fence line observation at a Colorado auction market. The Program of Economically Important Infectious Animal Diseases, Colorado State University, is funding this study through a special USDA Cooperative State Research, Education, and Extension Service fund.

Rationale

It could be argued that a syndromic surveillance system based on fence line observations would have limited capacity to detect certain high-priority diseases, such as those characterized by the presence of oral vesicles and erosions. Clearly, restraint of individual animals would be necessary for detection of such lesions. However, we believe that application of certain algorithms to the data could facilitate detection of targeted diseases. For example, if one or

more animals were observed to have signs compatible with both the eyes, ears, nose, and mouth disease syndrome and the abnormal ambulation and posture syndrome, a detailed physical examination animals could be performed to determine whether clinical signs of FMD were present. Conversely, a lack of clinical observations related to relevant syndromes or an incidence of such syndromes less than a predetermined threshold could be used to support a claim of disease-free status for priority diseases. In the era of increased demand for transparency and equivalency in livestock health surveillance data for international trade, an auction market-based surveillance program would be an easy, rapid, and low-cost means of delivering large amounts of live-animal observation data to trading partners. As such, an auction market surveillance system could be used to further document freedom from high-priority diseases, thereby maintaining our nation's unique status in the increasingly competitive global market for livestock products. Further, in the event of a domestic outbreak of a high-priority disease, auction market-based disease surveillance could potentially play a role in recovery, facilitating restoration of animal movement and resumption of business transactions within multiple livestock industries. Our research team is eager to further evaluate this potentially valuable means of enhancing our nation's livestock disease surveillance capacity.

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