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ScienceDirect
Preventive Veterinary Medicine 77 (2006) 96–108
PREVENTIVE VETERINARY MEDICINE
www.elsevier.com/locate/prevetmed

Test characteristics from latent-class models of the California Mastitis Test

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Received 22 November 2005; received in revised form 19 May 2006; accepted 23 June 2006

Abstract

We evaluated (using latent-class models) the ability of the California Mastitis Test (CMT) to identify cows with intramammary infections on the day of dry-off. The positive and negative predictive values of this test to identify cows requiring dry-cow antibiotics (i.e. infected) was also assessed. We used 752 Holstein–Friesian cows from 11 herds for this investigation. Milk samples were collected for bacteriology, and the CMT was performed cow-side, prior to milking on the day of dry-off. At the cow-level, the sensitivity and specificity of the CMT (using the four quarter results interpreted in parallel) for identifying all pathogens were estimated at 70 and 48%, respectively. If only major pathogens were considered the sensitivity of the CMT increased to 86%. The negative predictive value of the CMT was >95% for herds with major-pathogen intramammary-infection prevalence <15%, so that selective dry-cow therapy might be reasonable for such herds if cows were screened with the CMT.

Keywords: California Mastitis Test; Selective dry-cow therapy; Latent-class models; Bayesian

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doi:10.1016/j.prevetmed.2006.06.006

1. Introduction

In North America, one of the cornerstones of mastitis-control programs is the use of dry-cow therapy (DCT) for every quarter of every cow (Eberhart, 1986). This practice has been very effective in the reduction of intramammary infections (IMI) with contagious mastitis organisms and in the prevention of new IMI. However, blanket DCT results in uninfected quarters and cows being treated with dry-cow antibiotics (Dingwell et al., 2003a). Consumers have paid increasing attention to the use of prophylactic antibiotics in food-producing animals. Concern regarding the potential emergence of antibiotic-resistant strains of bacteria (Radostits et al., 1994) is one of the major arguments against continued use of blanket DCT (Berry and Hillerton, 2002b). This concern, coupled with a desire to shift away from antibiotic use, is enticing some producers to consider selective DCT. In addition, with the advent of internal teat sealers (ITS), there is a reasonable alternative to DCT for the prevention of new IMI (Woolford et al., 1998; Berry and Hillerton, 2002a; Huxley et al., 2002; Sanford et al., 2006).

Selective dry-cow strategies have been extensively investigated. In previous studies, untreated quarters consistently had higher rates of IMI and clinical mastitis, both during and after the dry period (Robinson et al., 1983; Browning et al., 1990; Schukken et al., 1993; Browning et al., 1994; Berry and Hillerton, 2002b). Decisions regarding selective DCT should be made at the cow-level, rather than the quarter-level (Browning et al., 1990, 1994; Østerås et al., 1999; Berry et al., 2003); quarters within a cow are not independent in their risk for IMI (Lam et al., 1996; Barkema et al., 1997; Berry et al., 2003). These findings, coupled with previous selective DCT research, further support cow-level DCT decisions on-farm. Guidelines have been proposed for protocols to direct selective DCT programs. Protocols for selective DCT should emphasize simplicity, low cost, and adequate sensitivity (Se) and specificity (Sp) of the diagnostic test(s) used (Poutrel and Rainard, 1981).

There is currently no quick and inexpensive method to reliably identify IMI. Bacteriological culture is often accepted as the gold standard for the identification of IMI. However, culture has logistic and financial problems (Sargeant et al., 2001) and agreement between duplicate quarter-milk samples (albeit good for contagious organisms) is poor for coliform pathogens (Erskine and Eberhart, 1988). Somatic-cell count (SCC) can be useful for detecting IMI and are cheaper than cultures (Sargeant et al., 2001) but the DHI test-date interval is too long to adopt this for identification of quarters or cows for DCT at the time of drying-off (Wallace et al., 2001).

The California Mastitis Test (CMT) was developed in 1957 to detect (quickly and reliably) abnormal milk (Schalm and Noorlander, 1957). The CMT is an inexpensive, fast, cow-side test that can be performed by any individual with minimal training. The CMT reaction is an indirect measure of SCC in milk (Barnum and Newbould, 1961). With increasing SCC or total leukocyte count in milk, the CMT score also increases (Schalm and Noorlander, 1957; Barnum and Newbould, 1961; Dohoo and Meek, 1982). Over the past 50 years, many studies have been conducted in attempts to validate the CMT as a predictor of IMI. The CMT showed some promise as a test to identify *Streptococcus agalactiae*-infected cows (Brookbanks, 1966). However, the CMT could not predict herd infection through the use of bulk-tank samples (Barnum and Newbould, 1961). Positive CMT scores,