

# Salmonella in Dairy Cattle

Chelsea L. Holschbach, DVM<sup>a</sup>, Simon F. Peek, BVSc, PhD<sup>b,\*</sup>

## KEYWORDS

- *Salmonella* • Dairy cattle • *Salmonella* Dublin • Diagnostic tests • Prevention
- Public health

## KEY POINTS

- *Salmonella* Dublin, the host adapted serotype in cattle, has the ability to establish lifelong infection in cattle, characterized by an asymptomatic carrier status with intermittent periods of bacteremia and shedding.
- Enteric, septicemic, and reproductive diseases are all possible manifestations of *Salmonella* infection, with pneumonia being a common manifestation of *Salmonella* Dublin infection in calves.
- Definitive diagnosis is based on detection of the organism through aerobic culture of feces or detection of genetic material from the bacteria via polymerase chain reaction techniques.
- Fluid therapy is the mainstay of treatment for cattle with enteric salmonellosis; antimicrobial therapy remains controversial.
- Larger herd size, crowded husbandry, free stall housing, and purchase of replacement animals contribute to an increased propensity for exposure to contaminated manure, the major source of infection on dairies.

## INTRODUCTION

As an infectious, contagious pathogen *Salmonella* is probably rivalled by only bovine viral diarrhoea virus in its ability to cause such a variety of clinical problems in dairy cattle. Enteric, septicemic, and reproductive diseases are all possible manifestations of *Salmonella* infection and, although reproductive losses are only of concern in sexually mature females, enteric disease can be seen in susceptible cattle at any age from true neonates through adulthood. The increasing prevalence in recent years of the host adapted serotype *Salmonella enterica* serotype Dublin, conventionally referred to by the abbreviated title of *Salmonella* Dublin, has added a new, and highly

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<sup>a</sup> Large Animal Medicine, Department of Medical Sciences, UW-School of Veterinary Medicine, University of Wisconsin-Madison, 2015 Linden Drive West, Madison, WI 53706, USA;

<sup>b</sup> Department of Medical Sciences, UW-School of Veterinary Medicine, University of Wisconsin-Madison, 2015 Linden Drive West, Madison, WI 53706, USA

\* Corresponding author.

E-mail address: [simon.peek@wisc.edu](mailto:simon.peek@wisc.edu)

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challenging, facet to salmonellosis on many modern dairies. The ability to establish lifelong infection, characterized by an asymptomatic carrier status, with intermittent periods of bacteremia and intermittent shedding, challenges control of this serotype. Enteric infection with other non-host-adapted serotypes, particularly in calves, can also be associated with true bacteremia, sepsis, and high mortality rates. No current discussion of bovine salmonellosis could be complete without acknowledging the increasing public health concern regarding its relevance as an important zoonosis, the risk that contaminated dairy and dairy beef products can pose to human health, and, just as important, the reality that increasing antimicrobial resistance among zoonotic enteric pathogens such as *Salmonella* brings the use of antimicrobials by veterinarians and producers under ever stricter scrutiny.

## ETIOLOGY AND TAXONOMY

*Salmonella* is a genus of gram-negative, facultative anaerobic bacteria that belong to the family of Enterobacteriaceae. There are 2 recognized species within the genus: *S enterica* and *Salmonella bongori*. *S enterica* can be further divided into 6 subspecies, *S enterica* subspecies *enterica* being the most relevant in dairy cattle.<sup>1</sup> More than 2500 serovars (serotypes), differentiated by their antigenic composition, have been identified. Serovars are based on the somatic (O), flagellar (H), and capsular (Vi) antigens.<sup>2</sup> Most human and veterinary diagnostic laboratories have phenotypically divided *Salmonella* isolates into serogroups based on detection of the O lipopolysaccharide and H flagellar antigens, historically by agglutination methods.<sup>2,3</sup> Although these traditional serotyping techniques have formed the basis of human and veterinary diagnostic practice for salmonellosis for several decades, they are labor intensive and time consuming, typically taking at least 48 hours.<sup>4</sup>

With the advent of more advanced molecular diagnostic methods, genetic approaches to serotyping are beginning to supercede traditional tests. In general, these methods use 1 of 2 types of targets for serotype determination, the first are indirect targets, which use random surrogate genomic markers known to be associated with certain serotypes, and the second method uses direct targets requiring the use of highly specific genetic determinants of a particular serotype.<sup>5</sup> The latter typically involve the *rfb* gene cluster responsible for O somatic group antigen synthesis<sup>6</sup> and the *fliC* and *fliB* genes encoding the 2 flagellar antigens of *Salmonella*.<sup>7</sup> Genomic sequencing is becoming increasingly common for the identification and serotyping of *Salmonella* isolates.<sup>4,5</sup> The hope is that, with diminishing costs and continued refinement, more rapid, accurate genoserotyping will improve diagnostic and surveillance efforts for both public health and veterinary purposes.<sup>8</sup>

Most commonly, clinical bovine isolates have been divided by their O antigens, and serovars are further grouped into serogroups assigned to an early letter of the alphabet (eg, A, B, C, D, and E).<sup>9</sup> By current convention, *Salmonella* isolates are referred to by their serovar/serogroup classification (eg, *S enterica* subspecies *enterica* serovar Typhimurium, is abbreviated to *Salmonella* Typhimurium). Despite the diversity of serovars, relatively few are of clinical importance among cattle. The majority of cattle isolates are *Salmonella* of types B, C, and E, which are non-host specific, or *Salmonella* Dublin (type D), which is the host-adapted serovar in cattle.<sup>9</sup>

## PREVALENT SEROTYPES IN DAIRY CATTLE

The isolation of *Salmonella* from the feces of dairy cows or calves as well as the environment on dairy farms is increasingly common. As part of the United States Department of Agriculture's National Animal Health Monitoring System (NAHMS) Dairy 2007

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