Environmental Contamination of *Salmonella Enterica*: Where Should We Focus Our Efforts?

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Epidemics of healthcare-associated infections in veterinary teaching hospitals are commonly attributed to *Salmonella enterica* [1]. Although veterinary hospitals employ rigorous personal and environmental hygiene practices into infection control programs, large outbreaks still occur with high case fatality rates and at considerable financial cost [2]. During times of epidemic disease, there is typically widespread environmental contamination and it is not uncommon for patient and environmental isolates to be phenotypically similar (i.e., serotype and antimicrobial susceptibility pattern); a phenomenon that has also been identified during times of endemic disease, suggesting animals to be a likely source for contamination [2-5].

Managing *S. enterica* in equine populations should take into consideration both factors related to the occurrence of epidemic and endemic disease. During times of epidemic disease, environmental hygiene is commonly identified as a contributing factor including ineffective infection control policies and the presence of floor surfaces which allow contamination to accumulate [2; 6; 7]. Contamination of common use equipment (e.g., buckets, nasogastric tubes, and rectal thermometers) is also a common characteristic [6-8]. During the course of an outbreak, horses with severe disease are frequently identified as shedding *Salmonella* and likely contribute to ongoing environmental contamination and transmission among hospitalized patients [6; 8-10].

Historically, *Salmonella* shedding among horses has been associated with a triad of clinical signs – diarrhea, fever and leukopenia – an observation supported in a recent case-control study [11]. However, this triad of clinical signs can occur rather infrequently, accounting for only 2.7% of shedding among a hospital population (the population attributable fraction) [12]. In addition, findings from experimental studies suggest that by the time fever and/or diarrhea are apparent, animals are frequently shedding *Salmonella* in their feces; emphasizing the importance of identifying commonly occurring, easily recognizable factors or groups of factors that would allow for the rapid implementation of prevention strategies [13].

It is generally believed that horses with more severe disease (e.g., gastrointestinal disease, abdominal surgery) and those receiving antimicrobial therapy are more likely to shed detectable quantities of *Salmonella* in their feces. While this seems to make biological sense – it is important to note that over the years this has not been a consistent finding [8; 11; 14-17]. Many of these studies targeted high risk groups and extrapolating findings from studies observing limited patient populations should be done with caution.

Studies focusing on the general patient population found that both patient and hospital factors may be important [12; 17-20]. Patients with systemic illness – regardless of body system affected – and those having any one of the classic triad of clinical signs are more likely to shed *Salmonella*, but shedding is not limited to these particular patients [12]. These clinical signs are specific indicators for identifying shedding, but they are not perfectly sensitive. Additional factors that may affect the likelihood of shedding include patient management factors such as transportation distance, antimicrobial therapy, and duration of hospitalization, as well as species or rearing circumstances (intensively managed cattle being much more likely to shed than horses – an element that should not be overlooked when managing horses in a multi-species hospital) [12; 20]. In addition, reports consistently show a seasonal occurrence to shedding – highest in late summer and early fall, and lowest in the spring [12; 14; 21-23].

The intermittent nature of *Salmonella* shedding, often in the absence of clinical signs, makes it challenging to effectively manage this risk. Patient shedding prevalence can vary from 0.5% up to 7% with horses admitted for elective procedures and those in the general equine population having a lower prevalence; as well those tested on admission typically have a lower prevalence than horses tested throughout hospitalization [18; 19; 21; 23]. A higher shedding prevalence has been reported in horses with gastrointestinal disease or colic ranging from 4.3% up to 13% [14; 16; 19]. Differential management may be warranted for patient subgroups depending upon the likelihood of *Salmonella* shedding on admission or throughout the duration of hospitalization.

Routine surveillance by testing fecal samples may be an effective method to detect *Salmonella* shedding among patients. Consideration should be given to how this may be implemented – test all patients or target a high risk group such as horses with gastrointestinal disease. While research does show that targeted surveillance of horses presenting for acute colic or diarrhea can be an effective method for identifying fecal shedding it also shows that many horses can be shedding *Salmonella* in the absence of clinical signs [3; 11; 24]. An alternative may be to use syndromic surveillance – a method that has been shown to be effective at detecting adverse events in hospitalized horses [25]. Some facilities may choose to conduct surveillance of the hospital environment rather than of patients as environmental contamination is commonly detected near where positive patients are managed [4; 17]. This could be conducted as either routine or periodic surveillance of high-traffic areas. Yet others may choose to conduct both active surveillance of patients and the environment. As complementary techniques, this may allow for earlier detection of endemic shedding among patients and to identify outbreaks early in their time course [3].

Environmental contamination cannot be completely eliminated, therefore the goal is to reduce contamination of the environment to a level that becomes biologically irrelevant. Veterinary hospitals can be frequently contaminated near where positive patients are
managed with floors, floor drains, cracks and crevices being common sights for contamination [4; 24; 26; 27]. To gain meaningful information, environmental testing should be performed regularly to establish a baseline level of environmental contamination to which future findings can be compared. In this way potential environmental reservoirs of Salmonella can be detected and cleaning effectiveness can be continually monitored.

References


