Surveillance for *Salmonella* in horses in Great Britain in the last decade and antimicrobial resistance in *Salmonella* isolates from horses (Part II)

Francesca Martelli, Sue Kidd and Joanna Lawes, Animal and Plant Health Agency

Between 2008 and 2017 the number of incidents (cases reported, excluding repeat reports during 30 days from the same premises) of equine *Salmonella* reported in Great Britain ranged between 30 and 72 per year. *S. Typhimurium* has been the most common *Salmonella* serovar reported from horses in all years from 2008 to 2017 inclusive with the exception of 2013 when it was the second most common; the monophasic strain of *S. Typhimurium*, *S*. 4,12:i:- being the most common.

Monophasic Group B *Salmonella* strains, which lack one of both sets of flagella antigens, can be confirmed as variants of *S. Typhimurium* by obtaining a definitive phage type (DT) for the strain and also by *S. Typhimurium* specific PCRs. PCR methods can also be used to confirm the absence of flagella genes and the presence of a particular genomic island that is characteristic of the recently emerged monophasic *S. Typhimurium* DT193/DT120 variant strains. The first isolate in the UK of these epidemic strains was found in horses in 2006 prior to it being seen in pigs. Reports of the monophasic strains of *Salmonella*, *S*. 4,5,12:i:- and 4,12:i:- have varied in number between 2008 and 2017, peaking during 2013 and 2014 when they comprised 45.1% and 27.8% of total reported *Salmonella* incidents, respectively (Figure 1).

The most commonly reported phage types of *S. Typhimurium* between 2008 and 2017 have been DT8, DT104 and DT193, although phage types DT1, DT12, DT40, DT101 and U302 were all regularly reported. Phage type DT193 was the most commonly reported phage type for the monophasic strains of *S. Typhimurium* during 2009 – 2017 inclusive (Figure 2).

*Salmonella Newport* has been reported every year from 2008 to 2017 and was the second most commonly reported serovar during 2008, 2009, 2010, 2015 and 2016 (Figure 3). All but three of the incidents were fully susceptible to the panel of antimicrobials tested against, and the three that were not (single incidents in 2011, 2013 and 2014), were not multiple-drug resistant, so not related to the US epidemic strains of *S. Newport*. In some parts of the Great Britain, *S. Newport* can be associated with badgers, and is also found in ruminants and turkeys.

*S. Enteritidis* was reported from horses every year from 2008 to 2017 inclusive, although the number of reports was variable, with the fewest in 2008 and 2017 (one report in each year) and the most in 2011 (8 reports) and 2015 (7 reports). The most commonly reported phage type of *S. Enteritidis* over the past 10 years was PT11 which is a hedgehog-associated phage type.

*Salmonella* in horses is reportable under the Zoonoses Order 1989, therefore isolates obtained from horses must be submitted to the Animal and Plant Health Agency for serotyping.
Another serovar reported each year during the period 2008 – 2017, with the exception of 2013, was S. Agama. This serovar is usually associated with badgers and was one of the more common serovars reported from horses during 2009 (10.0% of total Salmonella reports from horses), 2016 (15.6% of total Salmonella reports from horses) and 2017 (16.1% of total Salmonella reports from horses).

S. Oslo was reported from horses during 2010, 2011, 2012, and 2016. Two of the four reports in 2016 were resistant to third generation cephalosporins. All the other reports of S. Oslo were fully susceptible to all the antimicrobials in the panel.

Although reports of Salmonella from horses were received from a wide range of counties in Great Britain during the period 2008 - 2017, Cornwall, Hampshire, Lincolnshire and Suffolk were the counties from which reports were most often received, and together reports from these four areas made up 23% of all Salmonella reports from horses in Great Britain.

Reports of S. Typhimurium were similarly widespread, but again there were four counties from which reports were more commonly received. These were Cornwall, Hampshire, Lincolnshire and North Yorkshire and were responsible for 30% of all S. Typhimurium reports from horses. The monophasic strains of S. Typhimurium, Salmonella 4,5,12:i:- and Salmonella 4,12:i:- were also widespread.

However, the counties from which they were reported differed from S. Typhimurium with Cornwall, Hampshire, Lincolnshire and North Yorkshire being responsible for only 14% of reports of mST in horses. The majority of mST reports in horses (30%) were single incidents reported from 21 different counties.

Antimicrobial resistance in Salmonella isolates from horses
Antimicrobial use in cases is contentious but
reports of antimicrobials typically used alone or in combination for the treatment of salmonellosis in horses include ceftiofur, enrofloxacin, and gentamicin. Multidrug-resistant Salmonella isolates from horses have been frequently reported, particularly among those serovars that are most commonly associated with clinical disease. Antimicrobial-resistant Salmonella isolates limit treatment options and increase the risk for therapeutic failure in veterinary clinical settings (Cummings et al., 2016).

Surveillance programmes on antimicrobial resistance in Salmonella from healthy horses are very limited, and the majority of available information relates to samples submitted for diagnostic purposes from diseased animals, and therefore likely to be skewed (Weese, 2015). In GB, Salmonella isolates received for serological identification at APHA are tested for their in vitro sensitivity to a panel of 16 antimicrobials. The choice of antimicrobials, which is reviewed periodically, comprises a core set which has been used in veterinary practice for many years and also some more recently licensed antimicrobials and some which are not authorised for use in animals in the UK, but which are used in human medicine. All tests are carried out using British Society for Antimicrobial Chemotherapy (BSAC)-recommended disc concentrations. Since 1996, only the first Salmonella isolate from each incident has usually been tested, so that the data are not skewed by testing multiple isolates from the same incident. Of the equine Salmonella samples that were tested for antimicrobial susceptibility between 2008 and 2017, the percentage of samples that were fully susceptible to all the antimicrobials tested against ranged from 55% (in 2013) to 77% (in 2017).

The most commonly reported resistance pattern between 2008 and 2017 was tetracycline, ampicillin, streptomycin and sulphonamide compounds (T, AM, S, Su) which was found in 13% of samples that were tested for antimicrobial susceptibility. In 2016, an extended spectrum beta-lactamase (ESBL)-producing Salmonella Oslo was responsible for an outbreak in an equine hospital. The isolation of ESBL-producing Salmonella from livestock in the UK is a rare occurrence, and incursions are followed up due to the risk they can pose to animal and human health. An advisory visit by APHA was carried out to the premises and ESBL-producing Salmonella and Escherichia coli were isolated from faecal and environmental samples. Although some of the human contacts reported diarrhoeal illness at the time of the outbreak, laboratory investigation of human cases was not performed. The veterinarians at the premises reported that a fourth generation cephalosporin drug was administered to horses undergoing surgery and that ESBL-producing E. coli had previously been isolated from wound infections in some horses. Although the Salmonella Oslo isolated from the outbreak’s index case (a horse admitted to the hospital with diarrhoeal illness) was sensitive to all drugs tested, isolates from subsequent cases were ESBL-producers. This suggested that the sensitive Salmonella Oslo, introduced to the premises by an infected horse, had acquired an ESBL plasmid at the equine hospital from E. coli or other Enterobacteriaceae. ESBL-producing Enterobacteriaceae have frequently been reported as a cause of severe infection in horses, and some studies have reported that as many as 10.7% of horses admitted to equine hospitals are carriers (Walther et al 2018). Transfer and/or selection of resistance genes is likely to occur in vivo in the horse gut microbiome, and Salmonella strains could become resistant through horizontal gene transfer (Sadikalay et al., 2018).

References


Important note
The views expressed in this focus article are the author’s own and should not be interpreted as official statements of APHA, BEVA or the AHT.