Salmonellosis remains an underlying threat in the Irish dairy herd

Salmonellosis has been of long-standing concern within Irish dairy herds, particularly in the south of Ireland. However, with the expansion and intensification of the national dairy herd in recent years, this concern is now spreading across the country, writes Suzanne Naughton MVB, MSD Animal Health veterinary technical advisor

Salmonella is being increasingly identified as a cause of disease on farms throughout Ireland, and in specific regions not previously linked with the bacterial disease. The impact of salmonella infection on the productivity and profitability of cattle is well known and researched. A study conducted in Ireland found that in unvaccinated herds positive for exposure to salmonella, total profits per farm were reduced by €7,731, €9,471, and €11,211 compared with the negative baseline (unvaccinated negative herds) based on milk prices of €0.24, €0.29, and €0.34/L, respectively. In the same study, herds positive for exposure to salmonella were also recorded to have experienced a 316kg reduction in milk yield.[1] It is also important to mention the significant zoonotic potential associated with salmonella infection. This is becoming a growing concern for many producers and veterinary surgeons, particularly from a public health perspective where both animal and human health are now becoming more intrinsically linked in the modern world.

EPIDEMIOLOGY

For identification purposes, the salmonella family is divided into different serotypes or groups based on their distinctive surface structures:

- O antigen – represents the outermost portion of the bacteria surface covering; and
- H antigen – represents the slender threadlike structure that forms part of the flagella.

A substantial amount of diversity exists in these two antigens and, as a result, more than 2,500 serotypes have been identified with regular recognition of new serotypes. The majority of these serotypes are very rare and specific to certain geographical locations throughout the world, with fewer than 100 accounting for most human infections.[2]
In Ireland, the two most commonly identified serotypes encountered in our cattle populations include *Salmonella enterica* serovar *Dublin* and *Salmonella enterica* serovar *Typhimurium*. There are many other serotypes of salmonella which can infect a wide range of species with many animals able to eliminate the infection after a couple of weeks. However, the *Salmonella Dublin* serotype is species-adapted to infect cattle specifically and as such a carrier state exists. Following infection, carrier animals will often harbour the pathogen in lymph nodes and internal organs and periodically shed the bacteria through their faeces or milk, particularly during times of stress, management changes or other infectious/parasitic disease processes. This carrier status forms

an important role in maintaining endemic herd infection. Specific at-risk groups for developing a carrier status include heifers infected between the age of one year and first calving and cows infected around the time of calving. According to research, the risk was higher in the first two quarters of the year (late winter to spring), and when the prevalence of potential shedders in the herd was low. The risk also varied between herds, where herds with the highest risk of carrier development were herds that experienced clinical disease outbreaks.[3]
Salmonella is primarily shed in the faeces of infected cattle. Consequently, transmission of *Salmonella Dublin* usually occurs via the faecal oral route, but rarely, infection may be acquired by the respiratory/conjunctival route or even the aerosol route in confined spaces. After initial infection, shedding of bacteria can start within seven days and can persist for up to two weeks in younger stock, while older stock may shed bacteria within a shorter time frame. However, this time frame for shedding can vary and one study identified that persistent shedding from carrier animals may last in some instances for up to 18 months post infection with no measurable effects on health or production of individual cows.[4] It has also been shown that approximately five per cent of apparently healthy dairy cows may be shedding the organism in their faeces and that approximately 25 per cent of all sick cows on the cull list could shed *Salmonella* spp. This highlights the importance of where these groups are housed in relation to the more susceptible groups such as youngstock and cow's approaching calving on farm.

CLINICAL SIGNS

There are many clinical presentations associated with salmonella infection.

- Diarrhoea is more often associated with *S. Typhimurium* infections. Symptoms can range from mild to severe and affected animals will often show fever, dehydration and inappetence.
- Clinical outbreaks in young calves can often resemble pneumonia. Acute infections can become chronic and may result in poor thrive, jaundice, chronic diarrhoea and terminal dry gangrene. Pre-weaned calves are the most susceptible to infection. However, if infection pressure is high enough, all age groups can be affected.
- Abortion is most commonly associated with *S. Dublin* infection. However, other serotypes can still be implicated in outbreaks. Abortion caused by *S. Dublin* tends to occur in the fifth to eighth month of pregnancy. According to the 2018 All Island Disease Surveillance Report, nine Salmonella spp. serotypes, other than *S. Dublin*, were isolated from aborted foetuses. Eight of these were *S. Typhimurium* and one was *Salmonella Indiana*. [5]

DIAGNOSIS

Culture and serology are two of the most commonly used methods to diagnose salmonella infection. However, both are not without limitations. Bacterial culture can be taken from a number of sample types with faecal culture being the most common. Sensitivity can vary from 60% to 100% in acutely affected animals. However, individual faecal culture for detection of infected animals among cattle not showing overt clinical signs is between 16% to 20%.[6] One reason for the poor sensitivity of faecal culture tests may be intermittent shedding in infected cattle or low concentrations excreted by sub-clinically or re-infected cattle. This can be further compounded by chronically affected carrier animals or post antibiotic treatment. Consequently, the absence of bacteria does not entirely rule out infection. Diagnosis of salmonella infection by post-mortem is considered gold standard whereby a positive culture is obtained from multiple tissue samples or in the case of an aborted foetus from the abomasal contents, brain or placenta.
If the foetus is unavailable for diagnostic purposes, antibody levels can be measured by obtaining a blood sample. A rising titre (one sample taken at clinical phase of disease with another sample taken four weeks later) can be useful for diagnosing salmonella as a cause of diarrhoea. However, blood sampling can be of limited value in diagnosing abortion, as seroconversion has often happened at the time of initial bacteraemia rather than four to six weeks later when the foetus is aborted. The sensitivity of serology can vary from 45% to 94% and specificity 89% to 100%. Best results are achieved in calves from three to 10 months of age.[7] Blood sampling at less than three months of age runs the risk of maternal antibody interference. Bulk milk antibody testing can be a useful surveillance tool for herds although results might not indicate active infection within herd at the time of sampling, monitoring results can give an idea of the level of exposure within the herd and potential trends of infection.

CONTROL

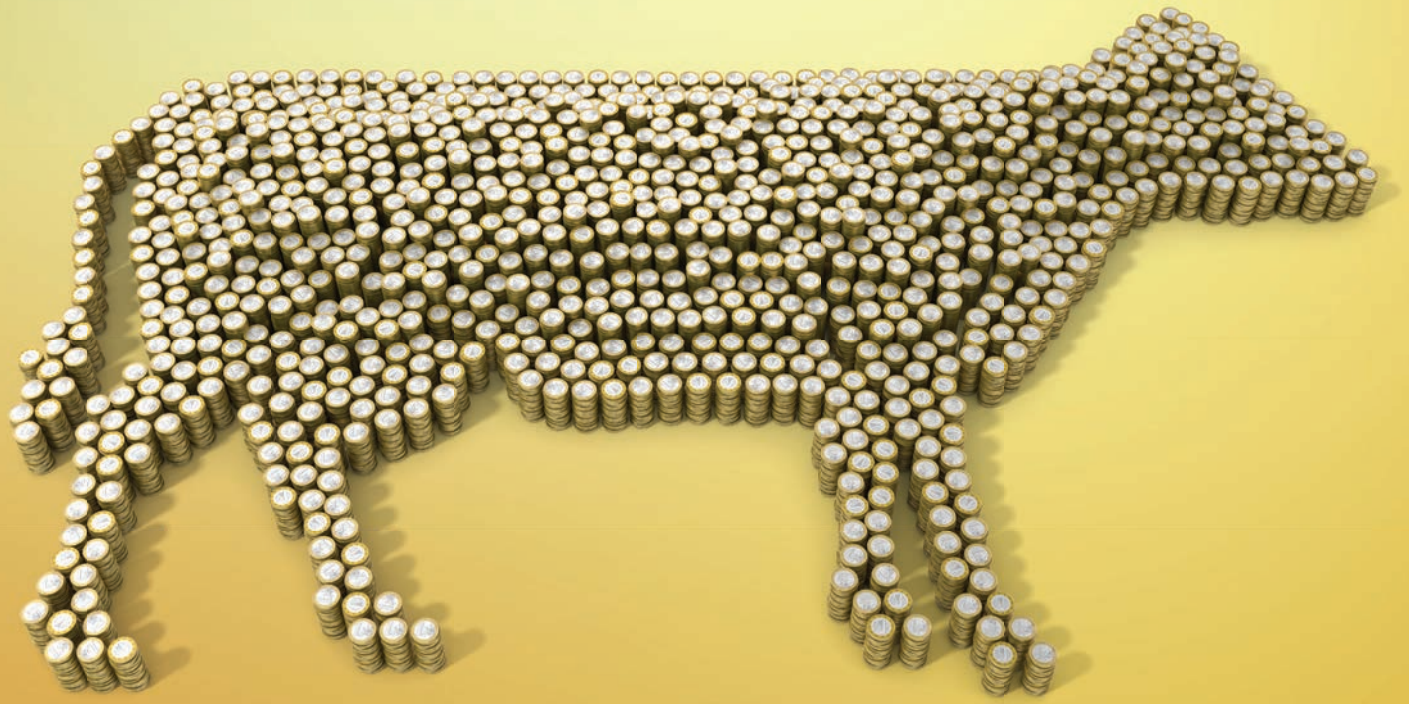
As the disease is difficult to eliminate from farms, vaccination and strict management measures must be implemented to reduce the spread of infection. These can include:

- Maintaining a closed herd/purchase only from herds of known disease status. The main risk of introducing salmonella infection is by buying in infected replacement stock. If buying in, quarantine arrivals for a period of four weeks minimum.
- Strict biosecurity should be particularly maintained around cases of abortion. Dams that have aborted should be isolated from the rest of the herd for a period of one month. Ensure fencing is stock proof to avoid break-in infection from neighbouring herds.
- Consider blood sampling animals on arrival (at start of quarantine) to determine if they have been exposed. It is important to realise, however, that the test has the above reliability concerning sensitivity.

Bovivac® S

Salmonella*

Infection costs Irish Dairy Farmers €112 per cow, per year[1]



Can you afford not to vaccinate with Bovivac S?

The only vaccine for Bovine Salmonellosis

See www.bovilis.ie for more information

*Figures are based on profit reduction in a non-vaccinated dairy herds testing positive for exposure to *Salmonella* at a milk price of €0.34/L
Bovivac S contains inactivated cells of *Salmonella dublin* and *Salmonella typhimurium*.

Use medicines responsibly

Legal category: ROI POM (E) NI POM-V
Withdrawal period - Zero days
Further information is available from your veterinary supplier, the product SPC, or
MSD Animal Health, Red Oak North, South County Business Park, Leopardstown, Dublin 18, Ireland.
Tel: +353 (0)1 2970220 Email: vet-support.ie@merck.com Web: www.msd-animal-health.ie

1. O' Doherty et al., 2014, Effect of exposure to *Neospora caninum, Salmonella* and *Leptospira interrogans* serovar Hardjo on the economic performance of Irish dairy herds, J Dairy Sci, 98: 2789-2800

MSD Animal Health

IE/BVS/0815/0003 August 2015

- Management of slurry – salmonella bacteria can survive for prolonged periods in slurry tanks and for up to 300 days on soil. As a result, faecal material from clinical cases must be prevented from entering the slurry tank.
- Hygiene – disinfection points should be in place for everyone who enters and leaves farm to use and restrict access of livestock to external sources of infection. Hygiene of buildings between batches of animals is also critical. It is important to avoid contamination of young calves who will subsequently become carriers and a source of ongoing infection for other stock.
- Rodent and bird control – as pests can spread disease, especially S. *Typhimurium*, a plan should be in place for rigorous control, especially with regard to access to feed stores.

As discussed previously, management changes and stress can influence carrier animals to re-commence shedding of the bacteria. Maintaining high hygiene standards throughout all production stages are critical in reducing bacterial challenge, particularly around calving while good herd management practices are essential to minimise stress. Practices such as avoiding high stocking levels and maintaining five per cent more cubicles than cows should be standard procedures on all farms.
Regarding vaccination, this author recommends using a product that is licensed for the active immunisation of cattle in order to induce serological and colostral antibody production against *S. Dublin* and *S. Typhimurium* and, in the face of an outbreak, to reduce *S. Typhimurium* infections when used under field conditions as part of an overall herd management programme. Healthy calves from approximately three weeks of age can receive the primary vaccination course of two 2ml injections separated by an interval of 14-21 days. Calves over six months of age and adult cattle should receive two 5ml injections 21 days apart. Depending on the level of infection circulating in the herd, one annual vaccination should maintain a sufficient level of active immunisation. It has been reported that the proportion of *S. Dublin*-positive abortions from vaccinated herds was significantly lower than in herds which were not vaccinating.[8] Abortions due to *S. Dublin* in spring calving dairy herds tend to start in September and peak in October and November. In general, it would be recommended to ensure the primary course or booster is completed two to three weeks prior to the onset of the main risk period. The majority of research has indicated that protection from salmonella vaccination is limited to a single strain or other closely related strains of salmonella contained within the vaccine and so cross-protection against other serotypes is not expected post vaccination.

CONCLUSION

The implications of a salmonella outbreak in cattle can be severe and result in significant financial, production and welfare costs. All farmers and stock people should continually remind themselves of the zoonotic potential of salmonella. In 2018, there were 363 human cases of salmonellosis reported in Ireland. Although more than half of cases were attributable to international travel, *S. Typhimurium* was the most prevalent serotype identified amongst domestic cases, with nine per cent of cases listing contact with farm animals.[9] Not alone is control essential at farm level but also from a public health perspective as mentioned earlier.
Vaccination can form the cornerstone of control. However, it must be used in tandem with excellent herd management procedures, strict hygiene protocols and high biosecurity standards.

REFERENCES

1. O' Doherty E, Sayers R, O'Grady L, Shalloo L. 2015. Effect of exposure to Neospora caninum, Salmonella, and Leptospira interrogans serovar Hardjo on the economic performance of Irish dairy herds. Journal of Dairy Science 98, 2789-2800
2. Centres for disease control and prevention 2020, U.S. Department of Health and Human Services, accessed 01 July 2020 https://www.cdc.gov/salmonella/reportspubs/salmonella-atlas/serotyping-importance.html
3. Nielsen LR, Schukken, YH, Gröhn, YT & Ersb øll AK. 2004b. Salmonella Dublin infection in dairy cattle: risk factors for becoming a carrier. Preventive Veterinary Medicine 65, 47-62
4. Huston C, Wittum TE, Love BC. 2002. Persistent faecal Salmonella shedding in five dairy herds. Journal of the American Veterinary Medical Association 220(5):650-5
5. 2018 All Island Disease Surveillance Report 14 October 2019, DAFM, accessed 01 July 2020, http://www.animalhealthsurveillance.agriculture.gov.ie/media/animalhealthsurveillance/ content/labreports/All_Island_Animal_Disease_Report_Compressed.V.1.1_16102019.pdf
6. Nielsen LR. 2013a. Review of pathogenesis and diagnostic methods of immediate relevance for epidemiology and control of Salmonella Dublin in cattle. Veterinary Microbiology 162, 1-9
7. Nielsen LR, Ersb øll AK. 2004. Age-stratified validation of an indirect Salmonella Dublin enzyme-linked immunosorbent assay for individual diagnosis in cattle. Journal of Veterinary Diagnostic Investigation 16, 212-218
8. Crilly J, Power EP. 2004. Field efficacy of vaccination in the control of bovine abortion. Available at: http://www.teagasc.ie/research/reports/dairyproduction/4992/hyper39vaccination.asp
9. Annual Epidemiological Report Salmonella infection in Ireland 2018, HSE, accessed 01 July 2020.
<https://www.hpsc.ie/az/gastroenteric/salmonellosis/publications/annualreportsonsalmonellosisinireland/Salmonella%202018%20Annual%20report.pdf>