

PATHKINEX UPDATE

Exploring Emerging PathKinex Trends

Together United Animal Health and Microbial Discovery Group are pioneering the investigation of relationships between microbial virulence genes and animal health. Our PathKinex platform and growing database of rectal and intestinal swab samples provide a unique resource for identifying and exploring connections between microorganisms and host or environmental factors, and we are eager to share our key findings with you!

Salmonella on the rise in US dairies

Pathkinex™ Updates are intended to provide you with the latest research insights on emerging pathogen trends and are for your internal use.

In this update, we explore *Salmonella* as an emerging pathogen in US dairy herds, examining prevalence of a specific virulence gene and its association with disease in PathKinex samples from US dairy customers.

Salmonellosis in dairy cattle

Salmonella is a leading cause of clinical disease in dairy cows and other livestock animals. While this enteric pathogen is spread via the fecal-oral route, it is also commonly involved in extraintestinal diseases including septicemia, reproductive losses, and pneumonia because of its ability to invade host tissues and live intracellularly, evading the immune system. Pathkinex surveillance data suggests that *Salmonella* carriage in dairy cows exhibits a trend toward elevation during the warm summer months, in a pattern similar to seasonal fluctuation observed with *E. coli* marker genes.

Since 2013, *Salmonella* Dublin has emerged as the most common *Salmonella* serotype carried on US dairies. As a host-adapted serotype specialized to survive and replicate in cows, *Salmonella* Dublin is commonly transmitted by asymptomatic carriers for many years without signs of acute infection. Subclinical infection contributes to loss of milk production and susceptibility to polymicrobial infections, and acute disease strikes the most vulnerable members of the herd, especially calves, where it manifests as pneumonia.

Other common serotypes found in US dairy herds include *Salmonella* Cerro, Newport, Montevideo, Kentucky, Heidelberg, and Typhimurium. *S. Typhimurium*, Heidelberg, and Newport are involved in severe calf diarrhea, and *S. Cerro* and Kentucky are frequently asymptomatic.

Pathkinex Method: Detect>Quantify>Correlate

Rectal swabs were obtained from 832 cows and heifers between 2018 and 2021 from US commercial dairies and classified as healthy or sick based on records or observations on the day of sampling.

Detect:

- Genomic DNA was extracted from swab samples and tested with a panel of qPCR assays for genus- or species-specific marker and virulence genes unique to bacterial, fungal, and parasitic pathogens of interest including the *invA* gene, a virulence gene carried by all *Salmonella* serotypes.

Quantify:

- Gene data was log-transformed and analyzed via Student's T test to test differences by health status on day of sampling and by one-way ANOVA with Tukey's post-hoc comparisons to assess differences in gene quantity by year. Count data (*invA* positive and negative cows) was analyzed with the chi-square test.

Correlate:

- Data are analyzed to find relationships between factors influencing animal health status, including abundance of specific virulence genes, as well as other factors such as seasonality, geographical region and lactation stage.

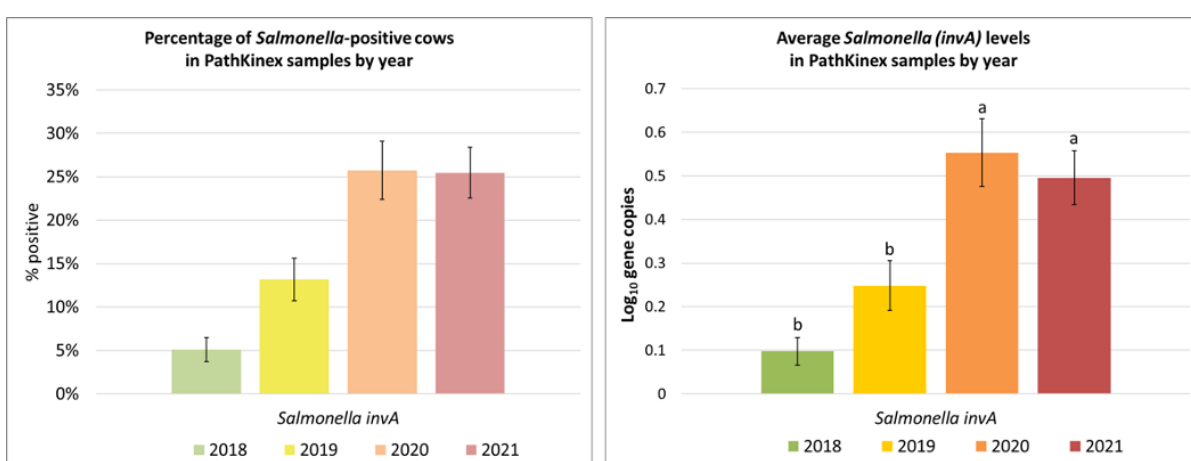
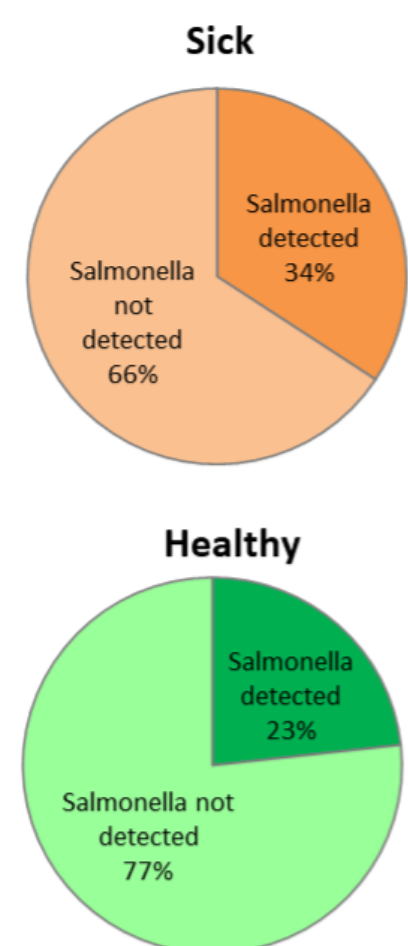


Figure 1. *Salmonella invA* gene prevalence (A) and quantity (B) in rectal swabs from dairy cows in 2018 (n=255), 2019 (n=191), 2020 (n= 162) and 2021 (n=224).

Findings

- Salmonella is increasingly prevalent in US dairy herds**
 - Carriage of *Salmonella* (detected via *invA* gene) has increased between 2018 and 2021 ($P<0.001$).
 - Salmonella* is currently detected in about 25% of cows and heifers tested.
 - Average gene quantity in PathKinex dairy herds has increased significantly by year, with the largest jump between 2019 and 2020. ($P=0.004$)
- Salmonella is significantly associated with sick cows in US PathKinex data**
 - In US dairy survey data from 2020 and 2021, the *invA* marker gene is present more frequently in sick cows and heifers than in healthy cows and heifers ($P=0.030$)
 - Sick cows harbor higher quantities of *Salmonella invA*. ($P=0.004$).

Salmonella detection rate in dairy cows and heifers (2020-2021)



Salmonella levels in dairy cows and heifers (2020-2021)

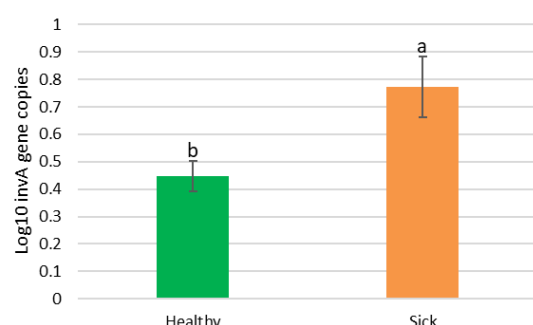


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Actions

These PathKinex™ findings suggest that *Salmonella* is increasing in prevalence on US dairies. Alongside interventions such as updated vaccine strategies, sanitation, and good herd management, direct-fed microbial products can support gut integrity and provide microbial control in the GI tract and the environment, promoting health and performance in herds with *Salmonella* challenges.

Discussion Question

Are your customers concerned about salmonellosis on their farms? Are other novel diseases on their radar this year?

Are you seeing the same trends in the field?

Respond to MDG

Is there a topic you'd like to learn more about in a future newsletter? We enjoy hearing from you! We welcome your questions, comments and suggestions on PathKinex updates. Please contact us at AnimalAg@mdgbio.com



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