

# Research Summaries I & II

"Beef and General"

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## *Salmonella Typhimurium* DT104: An Emerging Salmonella in Livestock and Humans

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In the past four years there has been an increase in the reported prevalence of salmonellosis in dairy cattle in the Pacific Northwest. We have established that *Salmonella typhimurium* DT104 is responsible for much of this increase. *S. typhimurium* DT104 is emerging as a pathogen in the Pacific Northwest and elsewhere in the United States and has importance for animal and human health.

*S. typhimurium* DT104 is a specific epidemic strain. *Salmonella* spp are initially categorized by biochemical, somatic and flagellar antigen characteristics which allows them to be placed into named serovars. Most reports of salmonellosis in animals define isolates to this level. Epidemiological studies require a more finite identification within serovars. Traditionally, phage susceptibility has been used with *S. typhimurium* isolated from cattle combined with further categorization of biotype, antibiotic sensitivity and by the determination of differences in genetic constituents - especially plasmid profiles.<sup>1-5</sup>

The designation DT104 (determinant type 104) is established by phage susceptibility coupled with further categorization by plasmid content and by antibiogram. The epidemic strain has an antibiotic resistance pattern characterized by resistance to ampicillin, chloramphenicol, streptomycin, sulphonamides and tetracycline (R-type ACSSuT) and a plasmid profile char-

acterized by the presence of a single 60 megadalton plasmid.<sup>6,7</sup> R-type ACSSuT antibiograms are uncommon in *S. typhimurium* that are not the epidemic strain and this resistance pattern can be used to make a preliminary identification of an isolate as an epidemic strain pending confirmation by phage typing and plasmid profile. However, this R-type pattern might be missed in routine diagnostic work as chloramphenicol is not commonly included in sensitivity testing of isolates from agricultural animals.

Initial reports of *S. typhimurium* DT104 and its epidemiology in livestock originated from Britain where there is a statutory requirement that all isolates of *Salmonella* spp, regardless of origin, be sent to central reference laboratories for typing and reference purposes. *S. typhimurium* DT104 is currently the cause of an epidemic of salmonella infection in animals and man in Britain.<sup>6-8</sup> Isolation rates of DT104 ACSSuT from cattle in Britain have increased dramatically since 1988 and it is now the most common type of salmonella isolated from cattle.<sup>8</sup> These isolations have been associated with significant illness in cattle herds.

During approximately the same time period as the increase in prevalence of DT104 ACSSuT in cattle, there has been a dramatic increase in the prevalence of infection with DT104 ACSSuT in humans in Britain and this organism is now second only to *Salmonella enteritidis*

phage type 4 as the cause of salmonellosis in humans. There is concern for human health that it is an antibiotic-resistant organism. Also the organism may have increased "infectivity" for humans as farm families and farm workers appear to have a higher risk for infection and illness when herds are infected with DT104 ACSSuT than the risk associated with other salmonella infections in cattle.

In 1994 we observed an apparent increase in the incidence of outbreaks of salmonellosis in dairy cattle in the Pacific Northwest based on an increase in the number of telephone consultations on salmonellosis from veterinary practitioners and from an increase in samples submitted to the Washington Animal Diseases Diagnostic Laboratory (WADDL) for culture for salmonella. An examination of isolates from outbreaks showed a proportion were associated with *S. typhimurium* of R-type ACSSuT. Subsequently we conducted a retrospective examination of isolates of *S. typhimurium* banked in the diagnostic laboratory and found that R-type ACSSuT isolates were absent in 44 cattle isolates obtained prior to 1986, but accounted for 13% of 83 isolates obtained between 1986 and 1991 and for 64% of 51 isolates obtained since 1992. Sixty of these isolates of *S. typhimurium* R-type ACSSuT, all with a 60 megadalton plasmid but 19 with an additional small plasmid, were phage typed courtesy of Dr R Khakhria and Dr W Johnson at Health Canada, Ottawa. Fifty seven were phage type 104. Fifty four of the 57 *S. typhimurium* DT104 R-type ACSSuT isolates share a single pulse field electrophoresis pattern.<sup>9</sup>

In view of reports of the association of contact with cattle and the occurrence of human disease with this strain<sup>10-11</sup> we have examined isolates of *S. typhimurium* from human cases of salmonellosis in this region. Two of 46 *S. typhimurium* isolated from humans in 1989 were R-type ACSSuT compared to 42.5% of 188 isolated in 1994. All ACSSuT *S. typhimurium* typed to date are DT104. Human ACSSuT and non-ACSSuT *S. typhimurium* cases per 100,000 population were examined for possible correlation with the numbers of individual dairy and beef cattle, and the numbers of dairy cattle, beef cattle, poultry, and swine farms on a county-by-county basis for the state of Washington. Statistically significant positive correlations were observed between population-adjusted rates of DT104 salmonellosis and numbers of cattle and cattle farms, while no significant positive correlations were observed for non-DT104 salmonellosis rates.

The clinical disease associated with this infection in cattle is typical of salmonellosis. A risk factor study on DT104 R-type ACSSuT infection in cattle in Britain<sup>8</sup> showed that the incidence was greater in larger herds and that disease was more common in summer than winter. Most outbreaks affected only a single group of

animals, with calves, especially artificially reared calves, being at higher risk than adult animals. There was a higher risk in housed versus pastured animals, for herds with a lack of isolation facilities, for herds with a larger number of feral cats and with a high number of wild birds on the farm. DT104 ACSSuT can be present in the raw milk of infected herds and this presence can result from persistent infection of DT104 ACSSuT in the udder.<sup>12</sup>

A case/control study to examine risk factors for the occurrence of this disease in dairy herds is being conducted in the Pacific Northwest. Preliminary findings show that the majority of isolates have been from dairy cattle herds and have been associated with clinical disease occurring predominantly in cows in the immediate post-calving period and less commonly in young calves on the dairy. Outbreaks of disease associated with this strain have also occurred on premises that purchase calves for rearing and in cow-calf herds and beef cattle feedlots. However, there have been relatively few incidents in beef cow-calf herds and this contrasts with the reported proportional incidence in beef herds in Britain. This difference may be a reflection of the more extensive grazing and greater geographic isolation of beef cattle properties in this region and the lower proportion of herds that purchase animals and that feed purchased feed. We have isolated this strain from sheep and pigs and also from the following host species; horse, goat, emu, cat, dog, elk, mouse, coyote, ground squirrel, raccoon, chipmunk and bird (pigeon, starling, pine siskin). The organism can be readily isolated from the environment of infected farms and there is evidence for contamination of veterinary premises.

Our findings show a temporal increase in the relative occurrence of *S. typhimurium* DT104 in cattle and humans in this region similar to that observed in Great Britain. Infection of cattle is not confined to the Pacific Northwest; an examination of *S. typhimurium* isolates obtained from the collection of the National Animal Disease Center, courtesy of Dr Paula Cray, show that it is present in all regions of the USA.

## References

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## FUTURE MEETINGS

### American Association of Bovine Practitioners

1998	Spokane	September	24-27
1999	Nashville	September	23-26
2000	Rapid City	September	21-24
2001	Vancouver	September	13-16