Antimicrobial susceptibility of *Salmonella*, 2007

A representative sample of 473 non-typhoidal *Salmonella*, chosen from isolates routinely referred to ESR for serotyping in 2007, were tested for antimicrobial susceptibility. The sample comprised 267 human and 206 animal/environmental isolates.

Resistance to each of the 12 antimicrobials tested and multiresistance is shown in Table 1. Antimicrobial resistance among *Salmonella* remains relatively low, with 85.8% fully susceptible to all 12 antimicrobials.

Salmonella from human sources were significantly ($P < 0.05$) more resistant to ampicillin, nalidixic acid and tetracycline than *Salmonella* from other sources (ie, animal and environmental) (Table 1). When the comparison between *Salmonella* from human sources and other sources was confined to just human salmonellosis cases who had no reported recent overseas travel, only ampicillin and nalidixic acid resistance was significantly higher among human isolates.

Table 1. Antimicrobial resistance among non-typhoidal Salmonella, 2007

	Percent resistance			**P value for significance of any difference in resistance between human and other isolates[1]**
Antimicrobial	**All isolates n = 473**	**Human isolates n = 267**	**Animal and environmental isolates n = 206**	
Ampicillin	4.7	6.7	1.9	0.0140
Cephalothin[2]	0.6	0.8	0.5	1.0000
Chloramphenicol	0.9	1.5	0	0.1359
Ciprofloxacin	0	0	0	-
Co-amoxiclav	0.2	0	0.5	0.4355
Co-trimoxazole	1.3	1.5	1.0	0.7011
Gentamicin	0	0	0	-
Nalidixic acid	3.2	5.2	0.5	0.0034
Streptomycin	7.6	8.6	6.3	0.3489
Sulphonamides	7.0	6.4	7.8	0.5535
Tetracycline	6.8	9.0	3.9	0.0284
Trimethoprim	1.3	1.5	1.0	0.6114
Multiresistant to ≥3 antimicrobials[3]	5.5	6.4	4.4	0.3445

[1] Chi-square test or Fisher's Exact test as appropriate.

[2] Cephalothin-resistant isolates were tested for 3rd-generation cephalosporin resistance and production of extended-spectrum β-lactamase (ESBL). No 3rd-generation cephalosporin resistance or ESBL production was detected.

[3] For estimates of multiresistance, co-trimoxazole and trimethoprim resistance was counted as one resistance.

Fluoroquinolone (ciprofloxacin)-susceptible strains of *Salmonella* that are resistant to the older-generation quinolone nalidixic acid may be associated with clinical failure or delayed response when fluoroquinolones are used to treat extra-intestinal salmonella infections. While no isolates in 2007 were ciprofloxacin resistant, 5.2% of

human isolates were nalidixic acid resistant and therefore could fail fluoroquinolone treatment if causing an extra-intestinal infection.

Table 2 shows a comparison of resistance among isolates from salmonellosis cases reported to have travelled overseas with isolates from cases for whom no recent overseas travel was reported. Multiresistance and resistance to nalidixic acid, streptomycin, sulphonamides and tetracycline was significantly higher ($P < 0.05$) among *Salmonella* from cases who had travelled.

Table 2. Antimicrobial resistance among non-typhoidal Salmonella from cases who had travelled overseas compared with non-travellers, 2007

	Percent resistance		**P value for significance of any difference in resistance between travellers and non-travellers[1]**
Antimicrobial	**Cases who had travelled overseas n = 33**	**Cases who had not travelled overseas n = 234**	
Ampicillin	12.1	6.0	0.2537
Cephalothin	0	0.9	1.0000
Chloramphenicol	3.0	1.3	0.4119
Ciprofloxacin	0	0	-
Co-amoxiclav	0	0	-
Co-trimoxazole	3.0	1.3	0.4119
Gentamicin	0	0	-
Nalidixic acid	15.2	3.9	0.0188
Streptomycin	21.2	6.8	0.0134
Sulphonamides	15.2	5.1	0.0440
Tetracycline	24.2	6.8	0.0041
Trimethoprim	3.0	1.3	0.4119
Multiresistant to ≥3 antimicrobials[2]	15.2	5.1	0.0440

[1] Chi-square test or Fisher's Exact test as appropriate.

[2] For estimates of multiresistance, co-trimoxazole and trimethoprim resistance was counted as one resistance.

The incidence of the international multiresistant *S.* Typhimurium DT104 clone continues to be low in New Zealand, with only one case identified in 2007 and a total of 32 isolates in the last 10 years. The 2007 isolate had the typical penta-resistance pattern of ampicillin, chloramphenicol, streptomycin, sulphonamide and tetracycline resistance. There was no information available on where this case acquired the infection.

All *S.* Typhi, *S.* Paratyphi A and *S.* Paratyphi B isolates referred to ESR in 2007 were tested for susceptibility to the same 12 antimicrobials as the non-typhoidal *Salmonella* (Table 3). Based on the travel history information available, there was a clear association between nalidixic acid resistance and *S.* Typhi acquired in the Indian subcontinent and between streptomycin resistance and infection acquired in the Pacific Islands.

Table 3. Antimicrobial resistance among Salmonella Typhi and S. Paratyphi, 2007

	Percent resistance		
Antimicrobial	***S*. Typhi n = 53**	***S*. Paratyphi A n = 16**	***S*. Paratyphi B[1] n = 3**
Ampicillin	1.9	0	0
Cephalothin	0	0	0
Chloramphenicol	1.9	0	0
Ciprofloxacin	0	0	0
Co-amoxiclav	0	0	0
Co-trimoxazole	1.9	0	0
Gentamicin	0	0	0
Nalidixic acid	28.3	75.0	0
Streptomycin	41.5	0	0
Sulphonamides	1.9	0	0
Tetracycline	3.8	0	0
Trimethoprim	1.9	0	0
Multiresistant to ≥3 antimicrobials[2]	3.8	0	0

[1] *S.* Paratyphi B var Java isolates are not included with the other *S.* Paratyphi B isolates, as they are no longer considered to belong to the 'typhoidal' Salmonella.

[2] For estimates of multiresistance, co-trimoxazole and trimethoprim resistance was counted as one resistance.