Antimicrobial susceptibility of *Salmonella*, 2006

A representative sample of 574 non-typhoidal *Salmonella*, chosen from isolates routinely referred to ESR for serotyping in 2006, were tested for antimicrobial susceptibility. The sample comprised 276 human and 298 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 93.4% fully susceptible to all 12 antimicrobials.

Salmonella from human sources were significantly ($P < 0.05$) more multiresistant, and more resistant to ampicillin, chloramphenicol, nalidixic acid, streptomycin, sulphonamides 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, chloramphenicol and nalidixic acid resistance was significantly higher among human isolates.

Table 1. Antimicrobial resistance among non-typhoidal Salmonella, 2006

	Percent resistance			**P value for significance of any difference in resistance between human and other isolates[1]**
Antimicrobial	**All isolates n = 574**	**Human isolates n = 276**	**Animal and environmental isolates n = 298**	
Ampicillin	2.3	4.4	0.3	0.0012
Cephalothin[2]	0.2	0.4	0	0.4808
Chloramphenicol	1.4	2.9	0	0.0027
Ciprofloxacin	0	0	0	-
Co-amoxiclav	0	0	0	-
Co-trimoxazole	1.2	2.2	0.3	0.0596
Gentamicin	0	0	0	-
Nalidixic acid	2.3	4.7	0	0.0002
Streptomycin	3.1	4.7	1.7	0.0373
Sulphonamides	3.3	5.1	1.7	0.0231
Tetracycline	4.0	5.8	2.4	0.0353
Trimethoprim	1.2	2.2	0.3	0.0596
Multiresistant to ≥3 antimicrobials[3]	3.0	4.7	1.3	0.0174

[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 2006 were ciprofloxacin resistant, 4.7% 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. While resistance was generally higher among *Salmonella* from cases who had travelled, the difference was only significant ($P < 0.05$) for nalidixic acid and sulphonamide resistance (Table 2).

Table 2. Antimicrobial resistance among non-typhoidal Salmonella from cases who had travelled overseas compared with non-travellers, 2006

	Percent resistance		**P value for significance of any difference in resistance between travellers and non-travellers[1]**
Antimicrobial	**Cases who had travelled overseas n = 28**	**Cases who had not travelled overseas n = 248**	
Ampicillin	7.1	4.0	0.3486
Cephalothin	0	0.4	1.0000
Chloramphenicol	7.1	2.4	0.1896
Ciprofloxacin	0	0	-
Co-amoxiclav	0	0	-
Co-trimoxazole	7.1	1.6	0.1153
Gentamicin	0	0	-
Nalidixic acid	17.9	3.2	0.0055
Streptomycin	10.7	4.0	0.1338
Sulphonamides	14.3	4.0	0.0417
Tetracycline	14.3	4.8	0.0656
Trimethoprim	7.1	1.6	0.1153
Multiresistant to ≥3 antimicrobials[2]	14.3	3.6	0.0321

[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 three cases identified in 2006 and a total of 34 cases in the last 10 years. The isolates from the three 2006 cases had the typical penta-resistance pattern of ampicillin, chloramphenicol, streptomycin, sulphonamide and tetracycline resistance. There was no information available on where these three cases acquired their infection.

All *S.* Typhi, *S.* Paratyphi A and *S.* Paratyphi B isolates referred to ESR in 2006 were tested for susceptibility to the same 12 antimicrobials as the non-typhoidal *Salmonella* (Table 3). Ten (25.6%) *S.* Typhi isolates were multiresistant, with resistance to ampicillin, chloramphenicol, co-trimoxazole/trimethoprim, streptomycin, sulphonamides and tetracycline. Some of the 10 isolates had additional resistance to cephalothin and/or nalidixic acid. Two of the cases with multiresistant *S.* Typhi had travelled to Africa and another two to India. Several of the other multiresistant cases were household contacts of a case who had travelled to Africa.

Table 3. Antimicrobial resistance among Salmonella Typhi and S. Paratyphi, 2006

	Percent resistance		
Antimicrobial	***S*. Typhi n = 39**	***S*. Paratyphi A n = 10**	***S*. Paratyphi B[1] n = 4**
Ampicillin	25.6	0	0
Cephalothin[2]	7.7	0	0
Chloramphenicol	25.6	0	0
Ciprofloxacin	0	0	0
Co-amoxiclav	0	0	0
Co-trimoxazole	25.6	0	0
Gentamicin	0	0	0
Nalidixic acid	23.1	90	25.0
Streptomycin	46.2	10	0
Sulphonamides	25.6	0	0
Tetracycline	25.6	0	0
Trimethoprim	25.6	0	0
Multiresistant to ≥3 antimicrobials[3]	25.6	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] 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.