Antimicrobial susceptibility of *Salmonella*, 2005

A representative sample of 616 non-typhoidal *Salmonella*, chosen from isolates routinely referred to ESR for serotyping in 2005, were tested for antimicrobial susceptibility. The sample comprised 318 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 92.7% fully susceptible to all 12 antimicrobials.

Salmonella from human sources were significantly ($P < 0.05$) more multiresistant, and more resistant to ampicillin, chloramphenicol and nalidixic acid, than *Salmonella* from other sources (Table 1).

Table 1. Antimicrobial resistance among non-typhoidal Salmonella, 2005

	Percent resistance			**P value for significance of any difference in resistance between human and other isolates[1]**
Antimicrobial	**All isolates n = 616**	**Human isolates n = 318**	**Animal and environmental isolates n = 298**	
Ampicillin	2.3	4.1	0.3	0.0018
Cephalothin[2]	0.3	0.6	0	0.4997
Chloramphenicol	1.0	1.9	0	0.0310
Ciprofloxacin	0.2	0.3	0	1.0000
Co-amoxiclav	0.2	0.3	0	1.0000
Co-trimoxazole	1.1	1.9	0.3	0.1243
Gentamicin	0.5	0.6	0.3	1.0000
Nalidixic acid	2.9	5.7	0	<0.0001
Streptomycin	3.1	3.1	3.0	0.9288
Sulphonamides	2.9	4.1	1.7	0.0759
Tetracycline	3.9	5.0	2.7	0.1325
Trimethoprim	1.1	1.9	0.3	0.1243
Multiresistant to ≥3 antimicrobials[3]	2.8	4.1	1.3	0.0376

[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.

A comparison of resistance among salmonellosis cases reported to have travelled overseas with cases for whom no recent overseas travel was reported, indicates that *Salmonella* acquired outside New Zealand were significantly more resistant to all antibiotics tested except cephalothin, ciprofloxacin and co-amoxiclav (Table 2).

Table 2. Antimicrobial resistance among non-typhoidal Salmonella from cases who had travelled overseas compared with non-travellers, 2005

	Percent resistance		**P value for significance of any difference in resistance between travellers and non-travellers[1]**
Antimicrobial	**Cases who had travelled overseas n = 35**	**Cases who had not travelled overseas n = 283**	
Ampicillin	20.0	2.1	<0.0001
Cephalothin	2.9	0.4	0.2083
Chloramphenicol	11.4	0.7	0.0016
Ciprofloxacin	2.9	0	0.1101
Co-amoxiclav	0	0.4	1.0000
Co-trimoxazole	8.6	1.1	0.0195
Gentamicin	5.7	0	0.0118
Nalidixic acid	25.7	3.2	<0.0001
Streptomycin	11.4	2.1	0.0161
Sulphonamides	17.1	2.5	0.0011
Tetracycline	22.9	2.8	<0.0001
Trimethoprim	8.6	1.1	0.0195
Multiresistant to ≥3 antimicrobials[2]	17.1	2.5	0.0011

[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.

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 only one isolate in 2005 was ciprofloxacin resistant, 5.7% of human isolates were nalidixic acid resistant and therefore could fail fluoroquinolone treatment if causing an extra-intestinal infection.

The ciprofloxacin-resistant isolate was only the second to be identified among *Salmonella* tested at ESR. It was *S.* Kentucky and was isolated from a person who had travelled to India and Nepal. In addition to ciprofloxacin, it was multiresistant to ampicillin, cephalothin, gentamicin, streptomycin, sulphonamides and tetracycline. The first ciprofloxacin-resistant *Salmonella* identified in New Zealand was isolated in 2002. It was a multiresistant *S.* Typhimurium phage type 12a that was acquired in China.

The incidence of the international multiresistant *S.* Typhimurium DT104 clone continues to be low in New Zealand, with only one isolate identified in 2005 and a total of 35 isolates in the last 10 years. There is no information available on where the 2005 case acquired the infection.

All *S.* Typhi, *S.* Paratyphi A and *S.* Paratyphi B isolates referred to ESR in 2005 were tested for susceptibility to the same 12 antimicrobials as the non-typhoidal *Salmonella* (Table 3). Four *S.* Typhi isolates were multiresistant to ampicillin, co-trimoxazole/trimethoprim, streptomycin, sulphonamides and tetracycline. Some of the four isolates had additional resistance to chloramphenicol and/or nalidixic acid. Three of these multiresistant *S.* Typhi were acquired in Cambodia and the fourth was acquired in India.

Table 3. Antimicrobial resistance among Salmonella Typhi and S. Paratyphi, 2005

	Percent resistance		
Antimicrobial	***S.* Typhi n = 28**	***S.* Paratyphi A n = 8**	***S.* Paratyphi B[1] n = 3**
Ampicillin	14.3	0	33.3
Cephalothin	0	0	0
Chloramphenicol	10.7	0	33.3
Ciprofloxacin	0	0	0
Co-amoxiclav	0	0	0
Co-trimoxazole	14.3	0	0
Gentamicin	0	0	0
Nalidixic acid	42.9	50	33.3
Streptomycin	32.1	0	33.3
Sulphonamides	14.3	0	33.3
Tetracycline	14.3	0	33.3
Trimethoprim	14.3	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.