Annual survey of extended-spectrum β-lactamase (ESBL)-producing Enterobacteriaceae, 2012

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Up until 2005, national surveillance of extended-spectrum β-lactamase (ESBL)-producing Enterobacteriaceae (ESBL-E) was based on diagnostic laboratories referring all isolates to ESR for confirmation. This continuous surveillance ceased in 2005 and was replaced with annual surveys.

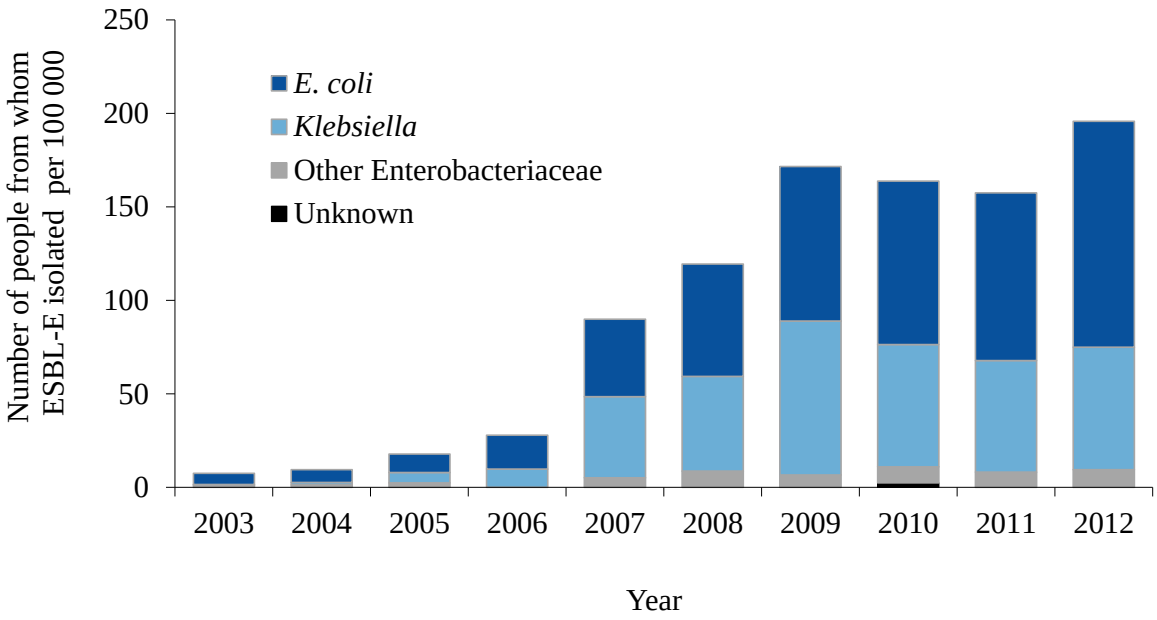
For the 2012 survey, hospital and community microbiology laboratories in New Zealand were asked to refer all ESBL-E isolated during August 2012 to ESR. Laboratories that do not test for ESBL production were asked to refer all Enterobacteriaceae resistant or intermediate to a 3rd-generation cephalosporin. The Microbiology Department, Hawke's Bay Hospital; Medlab Central, Palmerston North; and the Microbiology Laboratory, Nelson Hospital, referred isolates during a 31-day period between mid-August and mid-October 2012. All remaining laboratories, except the Microbiology Department, Middlemore Hospital, and Labtests, Auckland, referred ESBL-E during August 2012.

The Microbiology Department, Middlemore Hospital, and Labtests, Auckland, were requested to send ESBL-E for only a 14-day period due to the large number of ESBL-E these two laboratories isolate. Labtests referred isolates for a 14-day period in August 2012 and the Microbiology Department, Middlemore Hospital, referred ESBL-E for a 14-day period in September 2012. Unless otherwise stated, the analyses in this report have been adjusted for this shorter collection period from these two laboratories so that all data represents a 1-month period.

When referring isolates for the survey, laboratories supplied epidemiological data including patient age, geographic location, hospitalisation status, body site from which the ESBL-E was isolated, whether the ESBL-E was causing infection or from a colonised site, and if the isolate was obtained from a screen or a diagnostic specimen. At ESR, all isolates referred for the survey were confirmed as ESBL positive by the Clinical and Laboratory Standards Institute's (CLSI's) phenotypic confirmatory disc test,[1] or a double-disc synergy test with cefotaxime, ceftazidime, cefpodoxime and cefepime as substrates.[2]

During the period of the 2012 survey, ESBL-E were isolated from an estimated 723 people, which equates to an annualised incidence rate of 195.7 people with ESBL-E per 100 000 population; a 24.3% increase on the 2011 rate of 157.5. Figure 1 shows the annual or annualised incidence of ESBL-E over the 10 years 2003 to 2012, and the distribution of ESBLs among *Escherichia coli*, *Klebsiella* species and other Enterobacteriaceae.

Figure 1. ESBL-producing Enterobacteriaceae incidence rates, 2003-2012



Data for 2003 to 2005 are based on continuous surveillance of all ESBL-E isolations. Data for 2006 to 2012 are annualised and based on 4-week or 1-month surveys conducted in these years. The 2006 survey only included urinary *E. coli* and *Klebsiella*, therefore the data for 2006 is not directly comparable with that for other years. The category 'Unknown' in 2010 represents people identified with an ESBL-E during the survey period but from whom no isolate was referred to ESR and the species was not reported.

The estimated species distribution among the ESBL-E in the 2012 survey was: 446 (61.7%) *E. coli*, 242 (33.5%) *Klebsiella* species, 20 (2.8%) *Enterobacter* species, 7 (1.0%) *Citrobacter* species, 3 (0.4%) *Proteus* species, 2 (0.3%) *Morganella morganii*, and 1 (0.1%) each of *Cronobacter sakazakii*, *Pantoea* species and *Shigella* species.

The patients from whom ESBL-E were isolated were categorised as hospital patients if they were in a healthcare facility (including emergency department, outpatient clinic or residential-care facility) when ESBL-E was isolated or had been in a healthcare facility in the previous three months. All other patients were categorised as community patients. The majority of the ESBL-E (62.7%, 447 of the 713 patients for whom the information was reported or estimated) were isolated from patients categorised as hospital patients. A larger proportion of the ESBL-producing *Klebsiella* than *E. coli* were isolated from patients categorised as hospital patients (84.0% vs 50.1%). These proportions of hospital patients are similar to those recorded in 2011, but lower than those recorded in earlier years: for example in the 2010 survey, 83.1% of all ESBL-E, and 95.4% of ESBL-producing *Klebsiella* were isolated from hospital patients.

55.7% of the patients with ESBL-E were ≥65 years of age, 40.7% were 15-64 years old and 3.6% were ≤14 years old. The annualised incidence rates in these three age groups were 787.0, 120.0 and 35.0 per 100 000, respectively. ESBL-producing *Klebsiella* were more likely to be isolated from older patients than ESBL-producing *E. coli*, with 69.9% of *Klebsiella* isolated from patients ≥65 years of age compared with 49.1% of *E. coli*.

Information on whether the ESBL-E was causing infection or from a colonised site was reported for 91.0% of the patients with ESBL-E, of whom 57.0% were considered to have an ESBL-E infection. Table 1 compares the distribution of species, hospital and community patients, and isolation sites for ESBL-E from infected sites with those from colonised sites. A larger proportion of the ESBL-producing *Klebsiella* (54.6%) than the ESBL-producing *E. coli* (35.5%) were from colonised sites. Also ESBL-E was more likely to be isolated from a colonised site if the patient was a hospital patient (48.3%) than if they were a community patient (34.3%). Many ESBL-E from colonised community patients were actually isolated during screening pre- or on-admission to a healthcare facility. These observations most likely reflect the screening that occurs in hospitals as part of measures to control the transmission of ESBL-E, and the fact that ESBL-producing *Klebsiella* were more likely than ESBL-producing *E. coli* to be associated with hospital patients.

Table 1. Comparison of ESBL-producing Enterobacteriaceae from infected and colonised sites, 2012[1]

	Number (row %)	
	ESBL-E from infected sites (n=375)	**ESBL-E from colonised sites** (n=283)
Species:		
E. coli	263(64.5)	145 (35.5)
Klebsiella species	99 (45.4)	119 (54.6)
other species	13 (40.6)	19 (59.4)
Isolated from:		
hospital patients[2]	210 (51.7)	196 (48.3)
community patients[2]	161 (65.7)	84 (34.3)
Isolation site:[3]		
CSF/blood	10 (100)	0
faeces[4]	1 (0.4)	223 (99.6)
urine	316 (87.1)	47 (12.9)
wound	36 (90.0)	4 (10.0)
other	11 (78.6)	3 (21.4)

1 Data on whether the ESBL-E was isolated from an infected or colonised site was able to be estimated for 658 of the estimated 723 isolates. The remaining 65 isolates are not included in the analyses in this table. Of these 65 isolates, 56 were from urine.

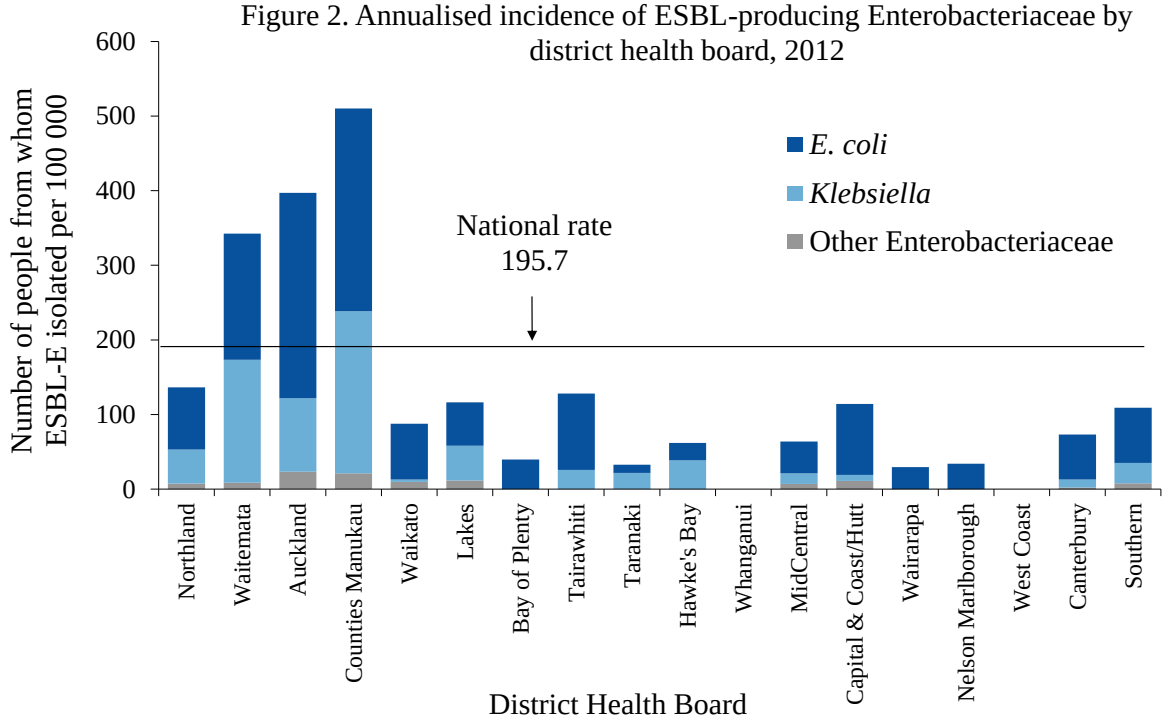
2 Patients were categorised as hospital patients if they were in a healthcare facility (including emergency department, outpatient clinic or residential-care facility) when ESBL-E was isolated or had been in a healthcare facility in the previous three months. All other patients were categorised as community patients. Patient categorisation not known for 4 infected patients and 3 colonised patients.

3 Site not reported for 1 infected site and 6 colonised sites.

4 *Shigella* was isolated from the faecal sample categorised as infected.

Figure 2 shows the incidence of ESBL-E in each district health board (DHB). The highest annualised incidence rates, and rates above the national rate of 195.7 per 100 000 population, occurred in the three DHBs in the greater Auckland area: Counties Manukau (510.1 per 100 000), Auckland (397.2) and Waitemata (342.5) DHBs.

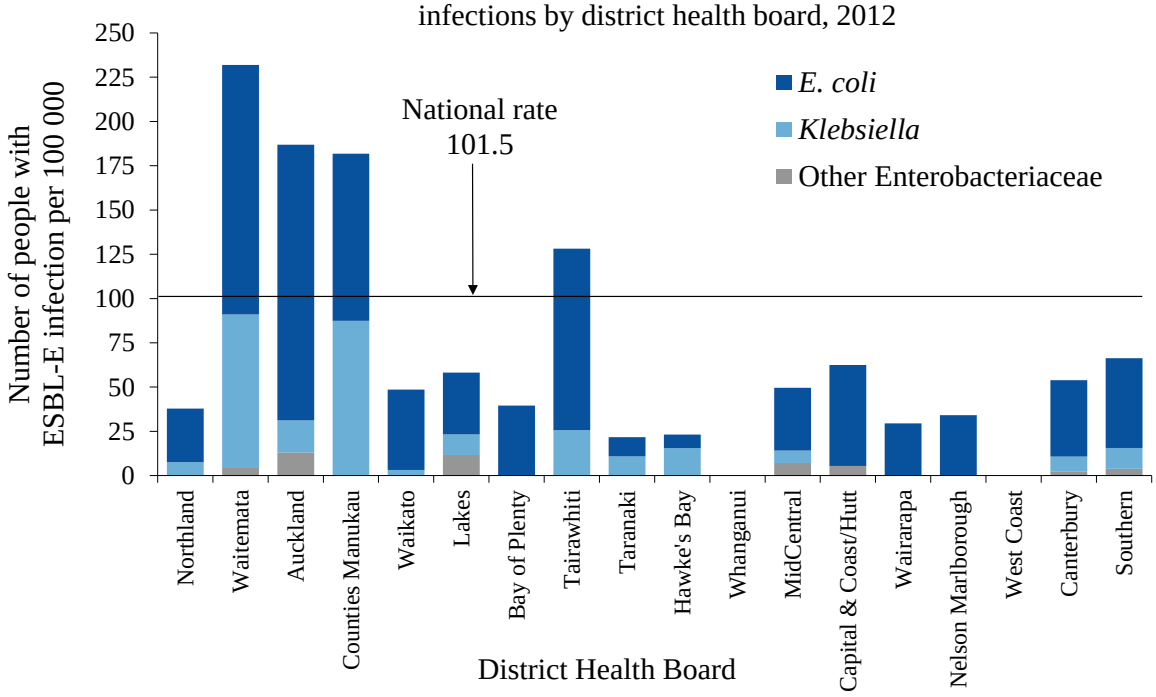
Figure 2. Annualised incidence of ESBL-producing Enterobacteriaceae by district health board, 2012



Data for the Capital & Coast and Hutt District Health Boards (DHBs) is combined as 'Capital & Coast/Hutt', and data for the Canterbury and South Canterbury DHBs is combined as 'Canterbury'.

Some of the apparent differences in ESBL-E rates between DHBs evident in Figure 2 could be due to differences in screening policies between DHBs. Figure 3 shows the annualised DHB incidence rates for ESBL-E that were isolated from infections only. The three DHBs with the highest rates of ESBL-E isolations (Counties Manukau, Auckland and Waitemata, Figure 2) also had the highest rates of ESBL-E infection, although Waitemata (231.9 per 100 000) and Auckland (186.9) DHBs had higher ESBL-E infection rates than Counties Manukau DHB (181.9), which had the highest overall rate of ESBL-E isolations. The fourth DHB with an ESBL-E infection rate above the national average was Tairawhiti, where the ESBL-E isolation and infection rates were identical (128.2 per 100 000).

Figure 3. Annualised incidence of ESBL-producing Enterobacteriaceae infections by district health board, 2012



Data for the Capital & Coast and Hutt District Health Boards (DHBs) is combined as 'Capital & Coast/Hutt', and data for the Canterbury and South Canterbury DHBs is combined as 'Canterbury'.

The proportions of the ESBL-E isolates that would be categorised as ESBL screen positive, cefotaxime resistant and ceftazidime resistant, on the basis of interpreting cefotaxime and ceftazidime zones of inhibition according to the 2012 CLSI standards,[1] are shown in Table 2. 98.3% of the ESBL-producing *E. coli, Klebsiella* and *P. mirabilis* isolates were categorised as cefotaxime resistant, but only 48.1% of these isolates were categorised as ceftazidime resistant, presumably due to CTX-M-type ESBLs being prevalent. Similarly, 86.2% of the species other than *E. coli, Klebsiella* and *P. mirabilis* were categorised as cefotaxime resistant, but only 55.2% were ceftazidime resistant.

The ESBL-producing *E. coli* and *Klebsiella* isolates that were cefoxitin intermediate or resistant were tested for plasmid-mediated AmpC β-lactamases. Four (1.2%) of the 344 ESBL-producing *E. coli* had a plasmid-mediated AmpC β-lactamase: three DHA types and one CIT type. Two (1.1%) of the 187 ESBL-producing *Klebsiella* had a plasmid-mediated AmpC β-lactamase: one CIT type and one DHA type.

Table 2. Cefotaxime and ceftazidime susceptibility of ESBL-producing Enterobacteriaceae, 2012[1]

Species	Number (%) of ESBL-producing Enterobacteriaceae (n=561)							
	Cefotaxime				Ceftazidime			
	S[2]	I[2]	R[2]	Screen positive[3]	S	I	R	Screen positive
E. coli, *Klebsiella* and *P. mirabilis* n=532	5 (0.9)	4 (0.8)	523 (98.3)	528 (99.3)	172 (32.3)	104 (19.6)	256 (48.1)	402 (75.6)
Other species n=29	2 (6.9)	2 (6.9)	25 (86.2)	29 (100.0)	9 (31.0)	4 (13.8)	16 (55.2)	21 (72.4)

1 Data not adjusted for the shorter collection period from the Microbiology Department, Middlemore Hospital, and Labtests, Auckland.

2 S, susceptible; I, intermediate; R, resistant; based on cefotaxime and ceftazidime zone diameters interpreted according to the 2012 CLSI interpretive standards (see reference 1 below).

3 ESBL screen positive according to the 2012 CLSI interpretive standards, that is, cefotaxime zone diameter ≤27 mm, ceftazidime zone diameter ≤22 mm.

References

1 Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing; twenty-second informational supplement. Wayne (PA): CLSI; 2012. CLSI document M100-S22.

2 Jarlier V, Nicolas MH, Fournier G, et al. Extended-broad spectrum ß-lactamases conferring transferable resistance to newer ß-lactam agents in Enterobacteriaceae: hospital prevalence and susceptibility patterns. Rev Infect Dis 1988; 10: 867-78.