Annual survey of extended-spectrum β-lactamase (ESBL)-producing Enterobacteriaceae, 2010

Helen Heffernan and Rosemary Woodhouse

Antibiotic Reference Laboratory, Institute of Environmental Science and Research Limited (ESR)

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 2010 survey, hospital and community microbiology laboratories in New Zealand were asked to refer all ESBL-E isolated during a one-month period to ESR. LabPlus at Auckland City Hospital, the Microbiology Department at Middlemore Hospital and Medlab South at Nelson Hospital referred ESBL-E during October 2010. All remaining laboratories referred ESBL-E during August 2010. In addition, Whangarei Hospital laboratory reported that they isolated ESBL-E from diagnostic specimens from nine patients but they did not refer the isolates to ESR. These nine isolations were included in the analyses of the survey data, except for the analyses relying on the species of the ESBL-E, patient age and the site of isolation as this information was not provided.

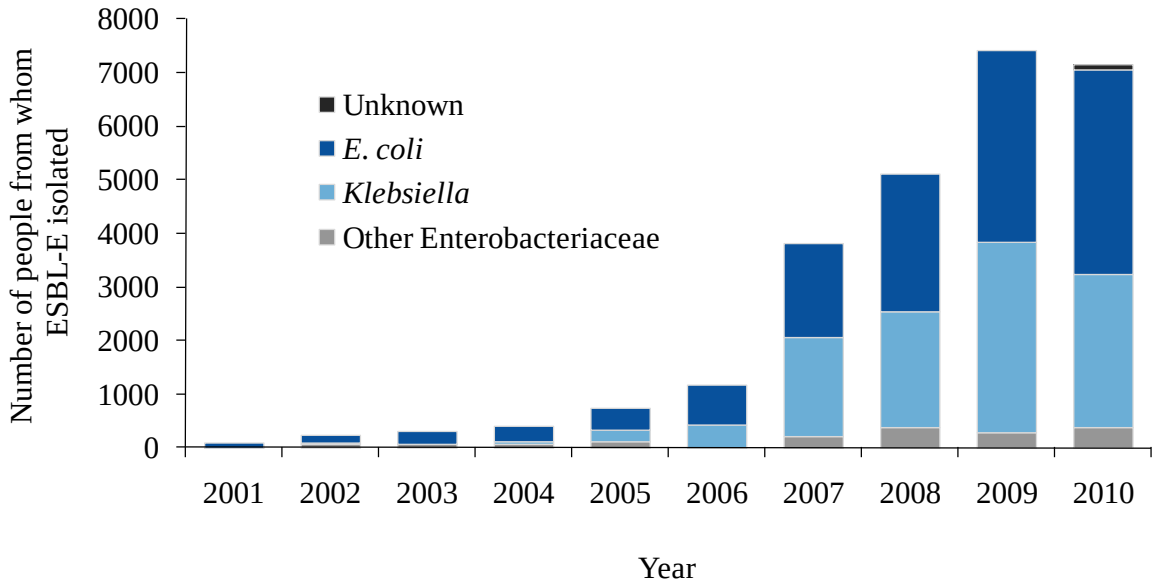
When referring ESBL-E isolates for the survey, laboratories supplied epidemiological data including patient age, geographic location, hospitalisation status, isolation site, infection or colonisation status, and if ESBL-E was obtained from a screen or a diagnostic specimen.

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 2010 survey period, ESBL-E were isolated from a total of 596 people: 587 non-duplicate ESBL-E isolates referred to ESR and confirmed plus the reported isolation by Whangarei Hospital laboratory of ESBL-E from a further nine patients. The total of 596 ESBL-E equates to an annualised incidence rate of 163.7 people with ESBL-E per 100 000 population; a small decrease on the 2009 rate of 171.6. Figure 1 shows the annual or annualised incidence of ESBL-E over the 10 years 2001 to 2010, and the distribution of ESBLs among *Escherichia coli*, *Klebsiella* species and other Enterobacteriaceae.

The 587 ESBL-E isolates referred in 2010 comprised 318 (54.2%) *E. coli;* 238 (40.6%) *Klebsiella* species; 19 (3.2%) *Enterobacter* species; 3 (0.5%) *Citrobacter freundii;* 2 (0.3%) *Morganella morganii;* 2 (0.3%) *Proteus* species; and 1 (0.2%) each of *Kluyvera* species, *Proteus mirabilis*, *Proteus vulgaris*, *Serratia fonticola* and *Shigella sonnei*. Nineteen patients had two different ESBL-producing species.

Figure 1. ESBL-producing Enterobacteriaceae, 2001-2010



Data for 2001 to 2005 are based on continuous surveillance of all ESBL-E isolations. Data for 2006 to 2010 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 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 (83.1%, 495 of 596) were isolated from patients categorised as hospital patients. A larger proportion of the ESBL-producing *Klebsiella* than *E. coli* were from patients categorised as hospital patients (95.4% vs 73.0%).

The majority (58.1%) of the patients with ESBL-E were ≥65 years of age, 39.2% were 15-64 years and 2.7% were ≤14 years old. ESBL-producing *Klebsiella* were more likely to be isolated from older patients than ESBL-producing *E. coli*, with 69.5% of *Klebsiella* isolated from patients ≥65 years of age compared with 51.1% of *E. coli*.

Information on whether the ESBL-E was causing infection or colonising was reported for 533 (89.4%) of the patients with ESBL-E, of whom 222 (41.7%) 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* (73.2%) than the ESBL-producing *E. coli* (50.9%) were from colonised sites. This most likely reflects the screening that occurs in hospitals as part of measures to control the transmission of these organisms, 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, 2010[1]

	Number (row %)	
	ESBL-E from infected sites (n=222)	**ESBL-E from colonised sites** (n=311)
Species [2]		
E. coli	140 (49.1)	145 (50.9)
Klebsiella species	57 (26.8)	156 (73.2)
other species	16 (61.5)	10 (38.5)
Isolated from:		
hospital patients[3]	138 (30.8)	310 (69.2)
community patients[3]	84 (98.8)	1 (1.2)
Isolation site[4]		
CSF/blood	9 (100)	0
faeces	1 (0.4)[5]	276 (99.6)
urine	187 (87.4)	27 (12.6)
wound	11 (91.7)	1 (8.3)
other	3 (50.0)	3 (50.0)

1 Information on whether the ESBL-E was isolated from an infected or colonised site was reported for 533 of the 596 isolates. The remaining 63 isolates are not included in the analyses in this table.

2 Species not known for nine isolates that were not referred to ESR.

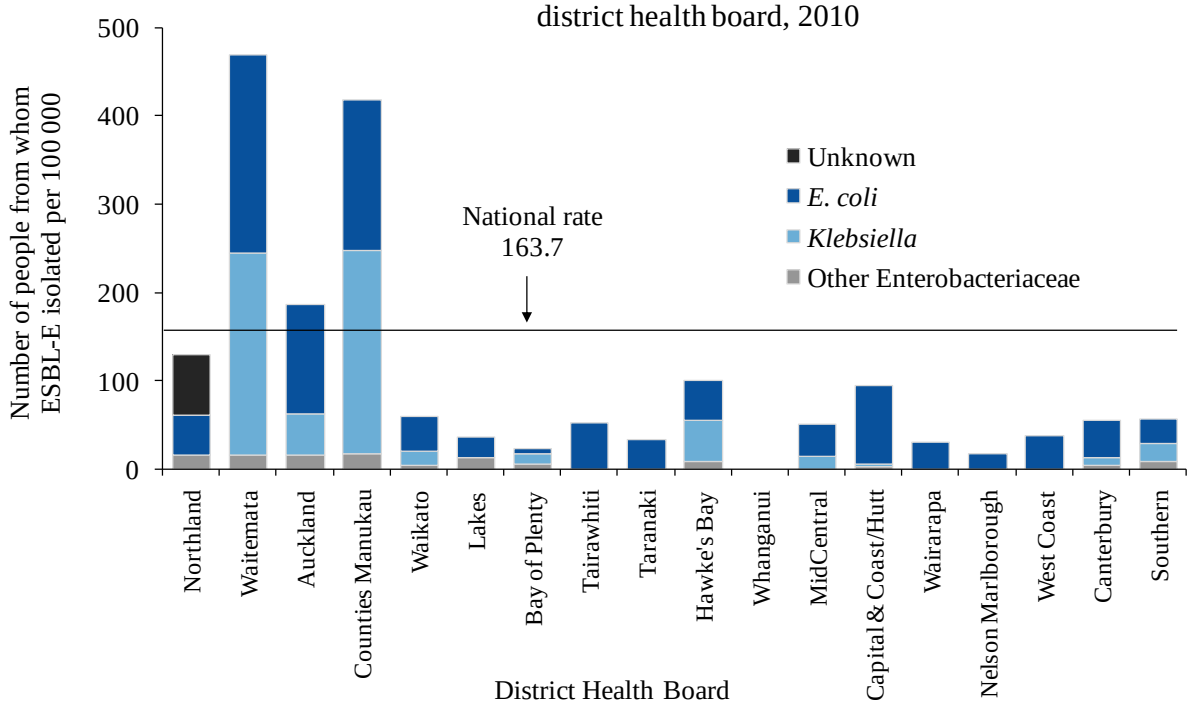
3 Patients were categorised as hospital patients if they were in a healthcare facility (including emergency department, outpatient clinic or residential-care facility) when ESBL-E was isolated or had been in a healthcare facility in the previous three months. All other patients were categorised as community patients.

4 Site not known for 15 isolates.

5 *Shigella sonnei* isolate.

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 163.7 per 100 000 population, occurred in the Waitemata (469.2 per 100 000), Counties Manukau (418.2) and Auckland (186.6) DHBs.

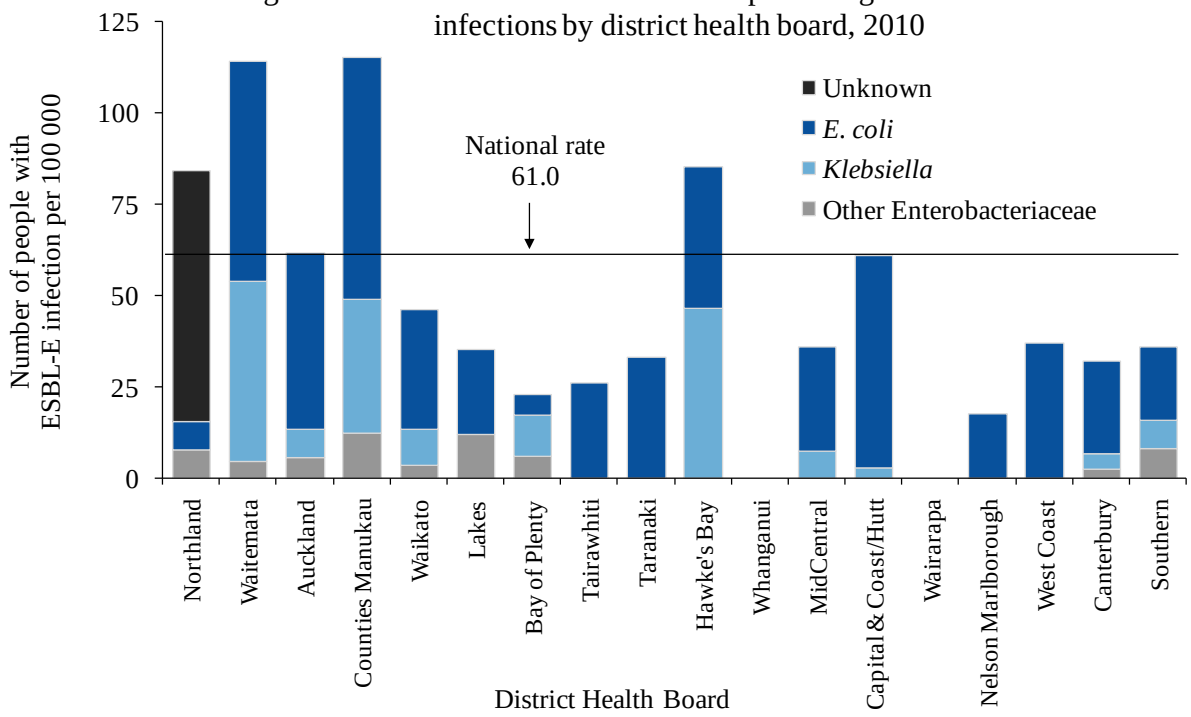
Figure 2. Annualised incidence of ESBL-producing Enterobacteriaceae by district health board, 2010



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 relative rates of ESBL-E infections in the different DHBs were somewhat different to the relative rates of all ESBL-E isolations (Figure 2). Rates of ESBL infections were above the national rate (61.0 ESBL-E infections per 100 000 population) not only in Counties Manukau (114.9 per 100 000) and Waitemata (113.9), but also in Hawke's Bay (85.0) and Northland (83.9) DHBs, while the rate in Auckland DHB (61.3) was very similar to the national average.

Figure 3. Annualised incidence of ESBL-producing Enterobacteriaceae infections by district health board, 2010



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 2010 CLSI standards,[1] are shown in Table 2. 98.9% of the ESBL-producing *E. coli*, *Klebsiella* and *P. mirabilis* isolates were categorised as cefotaxime resistant, but only 47.8% of these isolates were categorised as ceftazidime resistant, presumably due to CTX-M type ESBLs being prevalent.

The ESBL-producing *E. coli*, *Klebsiella* and *P. mirabilis* isolates that were cefoxitin resistant or intermediate were tested for plasmid-mediated AmpC β-lactamases. Seven (2.2%) of the 317 ESBL-producing *E. coli* tested had a plasmid-mediated AmpC β-lactamase: six CIT types and one DHA type. Six (2.5%) of the 238 ESBL-producing *Klebsiella* had a DHA-type plasmid-mediated AmpC β-lactamase.

Table 2. Cefotaxime and ceftazidime susceptibility of ESBL-producing Enterobacteriaceae, 2010

Species	Number (%) of ESBL-producing Enterobacteriaceae (n=586[1])							
	Cefotaxime				Ceftazidime			
	S[2]	I[2]	R[2]	Screen positive[3]	S	I	R	Screen positive[3]
E. coli, *Klebsiella* and *P. mirabilis* n=556	1 (0.2)	5 (0.9)	550 (98.9)	555 (99.8)	160 (28.8)	130 (23.4)	266 (47.8)	432 (77.7)
Other species n=30	0	1 (3.3)	29 (96.7)	30 (100.0)	12 (40.0)	4 (13.3)	14 (46.7)	23 (76.7)

1 One ESBL-E isolate not available for testing.
2 S, susceptible; I, intermediate; R, resistant based on cefotaxime and ceftazidime zone diameters interpreted according to the 2010 CLSI interpretive standards (see reference 1 below).
3 ESBL screen positive according to the 2010 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; twentieth informational supplement. Wayne (PA): CLSI; 2010. CLSI document M100-S20.

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.