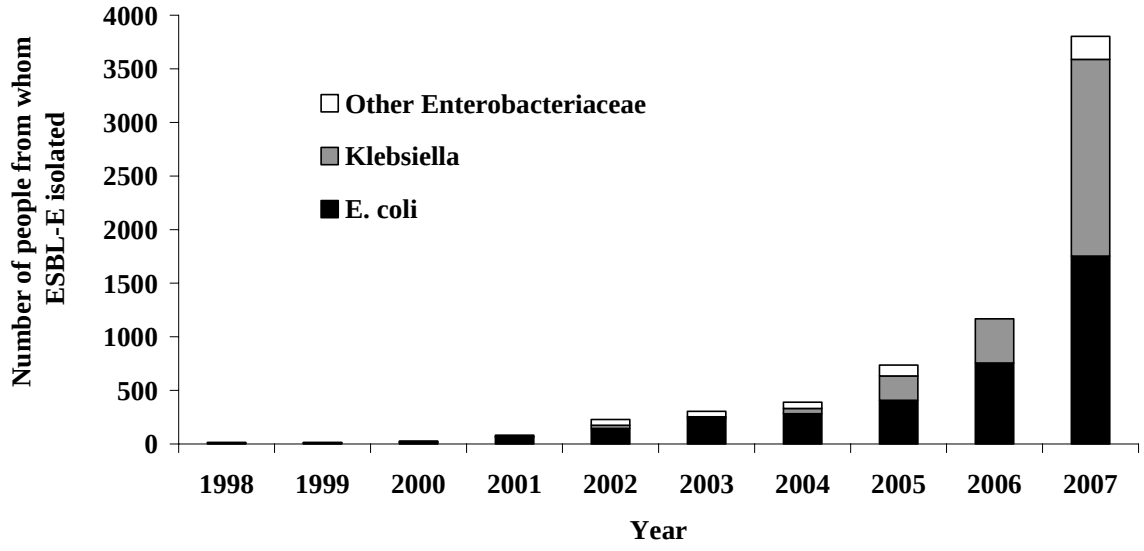
Annual survey of extended-spectrum β-lactamase (ESBL)-producing Enterobacteriaceae, 2007

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

The 2007 survey was conducted in August 2007. Hospital and community microbiology laboratories throughout New Zealand were asked to refer all ESBL-producing Enterobacteriaceae isolated during August to ESR. During the month, 317 ESBL-E isolates were referred. Duplicate isolates of the same species or strain from the same patient are not included in this count. This number of referrals equates to an annualised incidence rate of 90.0 ESBL-E per 100 000 population and a marked increase compared with earlier years (Figure 1).

Figure 1. ESBL-producing Enterobacteriaceae, 1998-2007



Data for 1998 to 2005 are based on continuous surveillance of all ESBL-producing Enterobacteriaceae isolations. Data for 2006 and 2007 are annualised and based, respectively, on 4-week and 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 317 ESBL-E isolates referred in 2007 comprised 153 (48.3%) *Klebsiella* species, 146 (46.1%) *Escherichia coli*, 11 (3.5%) *Enterobacter cloacae*, 6 (1.9%) *Citrobacter* species, and 1 (0.3%) *Morganella morganii*. Thirteen patients had two different ESBL-producing species and one patient had three different species. Another seven patients had ≥2 strains [as identified by pulsed-field gel electrophoresis (PFGE) typing or distinct antimicrobial susceptibility patterns] of the same species. *Klebsiella* formed a much greater proportion of the ESBL-producing isolates in 2007 than in previous years (Figure 1).

The patients from whom ESBL-E were isolated were categorized 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 3 months. All other patients were categorized as community patients. The majority of the ESBL-E (78.9%, 250 of 317) were isolated from patients categorized as hospital patients (Table 1). In particular, the overwhelming majority (91.5%, 140 of 153) of the ESBL-producing *Klebsiella* were from patients categorized as hospital patients. Nearly two-thirds (65.5%) of the patients with an ESBL-E were 65+ years of age.

Information on whether the ESBL-E was causing infection or colonizing was received for 259 (81.7%) of the isolates, of which 131 (50.6%) were categorized as from infections (Table 1). As might be expected, almost all the patients colonised with ESBL-E were hospital patients. This association presumably reflects the screening that occurs in hospitals as part of measures to control the transmission of these organisms.

Among hospital patients, ESBL-E were most commonly isolated from urine or faeces, whereas among community patients ESBL-E was almost exclusively isolated from urine specimens (Table 1). Once again, the frequency of faecal isolates from hospital patients reflects the screening for ESBL-E occurring in hospitals.

Table 1. Distribution of species, infection status and site of isolation among hospital and community patients with ESBL-producing Enterobacteriaceae, 2007

	Number (column %[1])		
	Hospital patients[2]	**Community patients[2]**	**All patients**
	n=250	**n=67**	**n=317**
Species			
E. coli	96 (38.4)	50 (74.6)	146 (46.1)
Klebsiella species	140 (56.0)	13 (19.4)	153 (48.3)
Other species	14 (5.6)	4 (6.0)	18 (5.7)
Isolated from:			
infected site	80 (38.7)	51 (98.1)	131 (50.6)
colonised site	127 (61.3)	1 (1.9)	128 (49.4)
unknown	43	15	58
Isolation site			
blood	4 (1.7)	0	4 (1.3)
faeces	117 (49.0)	0	117 (38.2)
urine	97 (40.6)	65 (97.0)	162 (52.9)
wound[3]	9 (3.8)	1 (1.5)	10 (3.3)
other	12 (5.0)	1 (1.5)	13 (4.3)
not reported	11	0	11

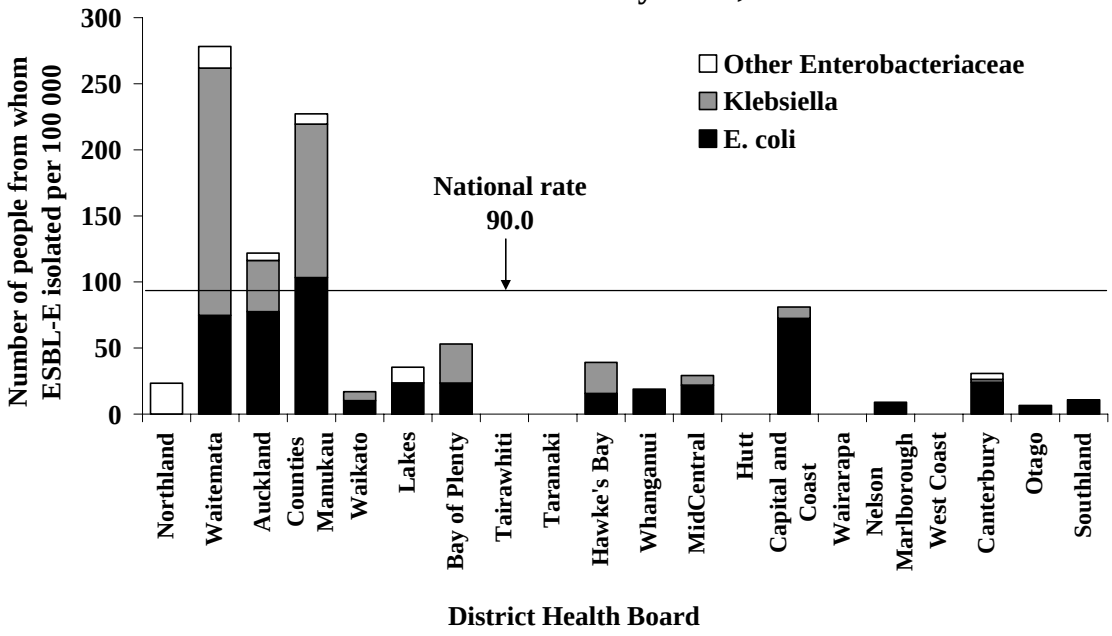
1 The percentage of ESBL-E that were isolated from an infected site vs colonised site, and the percentages for the various isolation sites, were calculated based on ESBL-E isolates for which this information was reported.

2 Patients were categorized 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 3 months. All other patients were categorized as community patients.

3 Includes burns and ulcers.

Figure 2 shows the incidence of ESBL-E in each district health board (DHB) area. The highest annualised incidence rates, and rates above the national rate of 90.0 per 100 000, occurred in the Waitemata (278.2 per 100 000) Counties Manukau (227.2) and Auckland (121.9) DHBs.

Figure 2. Annualised incidence of ESBL-producing Enterobacteriaceae by DHB, 2007



Data for the Canterbury and South Canterbury DHBs are combined.

The ESBL-producing *E. cloacae, Citrobacter* species and *M. morganii* were further investigated to identify the specific ESBL types they produced. The *E. cloacae* and *Citrobacter* isolates were also typed by PFGE to investigate any clonality among them. These investigations were confined to *E. cloacae, Citrobacter* and *M. morganii*, as the ESBL types and clonality among ESBL-producing *E. coli* and *Klebsiella* identified in the 2006 survey was fully investigated and reported (refer to report at http://www.surv.esr.cri.nz/PDF_surveillance/Antimicrobial/ESBLIdentification_2006.pdf).

Table 2. ESBL types among ESBL-producing *E. cloacae, Citrobacter* species and *M. morganii*, 2007

	Number (column %)		
ESBL type	***Citrobacter* species** **n=6**	***Enterobacter cloacae*** **n=11**	***Morganella morganii*** **n=1**
SHV-12	0	9 (81.8)	0
CTX-M-9	5 (83.3)	1 (9.1)	0
CTX-M-15	1 (16.7)	1 (9.1)	1 (100)

The distribution of ESBL types is shown in Table 2. In contrast to the overwhelming predominance of CTX-M ESBLs, particularly CTX-M-15, in the *E. coli* and *Klebsiella* tested in 2006, SHV-12 and CTX-M-9 were the dominant ESBL types in *E. cloacae* and *Citrobacter*, respectively.

Among the 11 *E. cloacae* isolates, three isolates, all with SHV-12 ESBL, from Northland DHB were the same strain (ie, their PFGE banding patterns shared ≥90% similarity) and another two isolates, both with SHV-12, from the Lakes and Auckland DHBs were the same strain. Among the six isolates of *Citrobacter*, the five isolates with CTX-M-9 ESBL (Table 2) were the same strain of *C. freundii* and were referred by the same hospital which had an outbreak at the time.

The antimicrobial susceptibility of the ESBL-E isolates is shown in Table 3. While ESBL-E should be reported as resistant to all cephalosporins, some test as susceptible in routine susceptibility tests. This effect was obvious among the ESBL-E included in this survey, with only 85.8% of the 317 isolates testing as resistant to cefotaxime and 37.2% testing as resistant to ceftazidime. All ESBL-E were susceptible to carbapenems and most remain susceptible to amikacin. The most common pattern of multiresistance (resistance to ≥3 classes of antibiotics – see Table 3 footnote) among ESBL-producing *E. coli* was ciprofloxacin, co-trimoxazole/trimethoprim and gentamicin/tobramycin resistance. This pattern was common to 73.1% of the multiresistant ESBL-producing *E. coli.* The two most common multiresistant patterns among ESBL-producing *Klebsiella* were co-trimoxazole/trimethoprim, gentamicin/tobramycin and nitrofurantoin resistance (36.3% of multiresistant isolates), and ciprofloxacin, co-trimoxazole/trimethoprim, gentamicin/tobramycin and nitrofurantoin resistance (33.3% of multiresistant isolates).

Table 3. Antimicrobial susceptibility among ESBL-producing Enterobacteriaceae, 2007

	Percent resistance			
	E. coli n=146	***Klebsiella* species** n=153	**Other species** n=18	**All isolates** n=317
Cefotaxime	89.0	89.5	27.8	85.8
Ceftazidime	33.6	39.2	50.0	37.2
Cefoxitin	11.0	5.9	88.9	12.9
Co-amoxiclav	39.0	68.6	100	56.8
Piperacillin/tazobactam	9.6	5.9	0	7.3
Ertapenem	0	0	0	0
Imipenem	0	0	0	0
Meropenem	0	0	0	0
Ciprofloxacin	70.6	44.4	5.6	54.3
Gentamicin	60.3	79.7	66.7	70.0
Tobramycin	61.6	86.9	88.9	75.4
Amikacin	2.1	1.3	22.2	2.8
Co-trimoxazole	79.5	90.2	94.4	85.5
Trimethoprim	84.9	94.8	94.4	90.2
Nitrofurantoin	8.2	56.2	22.2	32.2
Multiresistant[1]	53.4	66.7	22.2	58.0

[1] Resistant to ≥3 of the following classes of antibiotics: co-amoxiclav, piperacillin/tazobactam, cefoxitin, carbapenems, ciprofloxacin, aminoglycosides, folate pathway inhibitors and nitrofurantoin