Public Health England

Escherichia coli bacteraemia in England, Wales and Northern Ireland, 2008-2012

Key Points

This report covers voluntary reports of bacteraemia due to *Escherichia coli*, made to Public Health England between 2008 and 2012 from participating laboratories in England, Wales and Northern Ireland. Only *E. coli* bacteraemia isolates identified by culture were included in the analysis. Data were extracted on 15th April 2013 and are provisional as the number of reports for 2012 may increase due to late reporting.

- There has been a year-on-year increase in the number of *E. coli* bacteraemia reports.
- In 2012 there were 30,099 reports for *E. coli*, which was a slight increase (0.8%) compared to 2011 (29,851) (figure 1). In the same period, the total number of bacteraemia reported via LabBase2 only increased marginally from 92,537 in 2011 to 94,048 in 2012 (1.6% increase).
- By 2012 *E. coli* accounted for almost one third (32.0%) of all bacteraemia reports, compared with 25.3% in 2008. However, the proportion of all bacteraemia due to *E. coli* seems to be stabilising being little changed from 2011 (32.5%).
- Between 2008 and 2012 there was a 26% increase in *E. coli* bacteraemia reports compared with 0.5% decrease for all bacteraemia.
- The rates per 100,000 population of *E. coli* bacteraemia were highest in patients aged 65 years and over and in those under 1 year of age (figure 2). In both these groups the rates were generally highest for males. Among those aged 1-14 and 15-44 years, the rates were highest among females.
- The overall population rate of infection of *E. coli* bacteraemia in 2012 was 51.9 per 100,000 population (figure 3).
- There was very little change in the rates of non-susceptibility to 3rd generation cephalosporins and gentamicin from 2008-2012 (table 2).
- The percentages of isolates testing non-susceptible to ciprofloxacin in 2012 remain very similar to 2011, at 19% and 10%, respectively. Non-susceptibility to ciprofloxacin decreased early in the 2008-12 period, but the decline has since levelled off.
- The percentage of isolates testing non-susceptible to the 3rd generation cephalosporins ceftazidime and cefotaxime remains stable at 10-11% for both ceftazidime and cefotaxime in 2011 and 2012.
- Most isolates reported to have been tested with either imipenem or meropenem were found to be susceptible. A small but growing number of *E. coli* resistant to these agents are referred to the Antimicrobial Resistance and Healthcare Associated Infections Reference Unit, but are largely from samples other than blood.

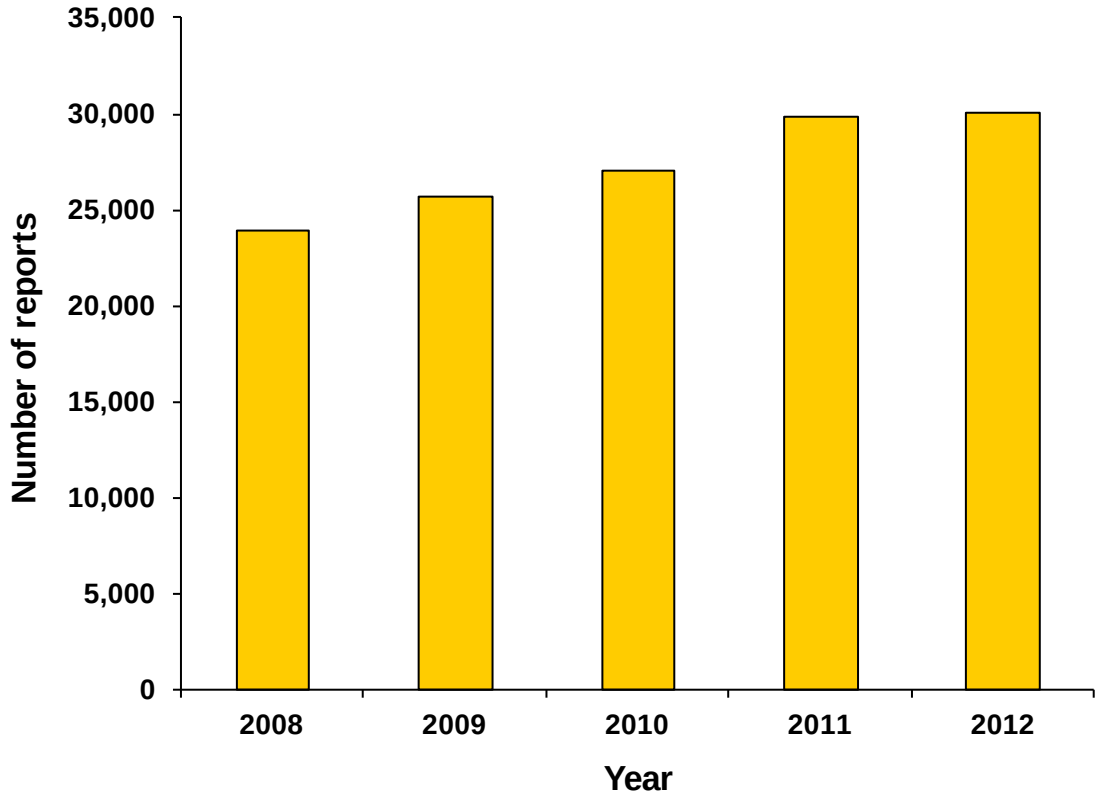
Trends in reports

E. coli has been the most common cause of bacteraemia in England, Wales and Northern Ireland, for most years since 1990, apart from the years 2000 and 2003 when reports of MRSA bacteraemia peaked [see also ref. 1]. Since 1990 the number of reports caused by *E. coli* bacteraemia has continued to increase. In 2012 there were 30,099 voluntary reports to the then Health Protection Agency (figure 1). This is an 0.8% increase compared to 2011 (29,851) and a 11% increase on 2010 (25,045 reports). In comparison, overall numbers of bacteraemia with all bacterial pathogens have decreased by 0.5% over this time period. *E. coli* reports for 2012 are provisional as of 15th April 2013 and the number of reported cases may increase slightly as late reports are received.

Public Health England

Escherichia coli bacteraemia in England, Wales and Northern Ireland, 2008-2012

Figure 1. *E. coli* bacteraemia reports, England, Wales and Northern Ireland: 2008 to 2012*



* Data extracted 15th April 2013

Completeness of laboratory reports

The number of laboratories voluntarily reporting data for *E. coli* bacteraemia has decreased from 183 in 2008 to 171 in 2012 probably due to consolidation into fewer, larger units. In contrast, the percentage of laboratories reporting drug susceptibility data increased from 95% in 2008 to 98% in 2011. In 2012 this decreased slightly to 97%.

Table 1. Laboratories reporting *E. coli* bacteraemia, England, Wales and Northern Ireland: 2008-2012*

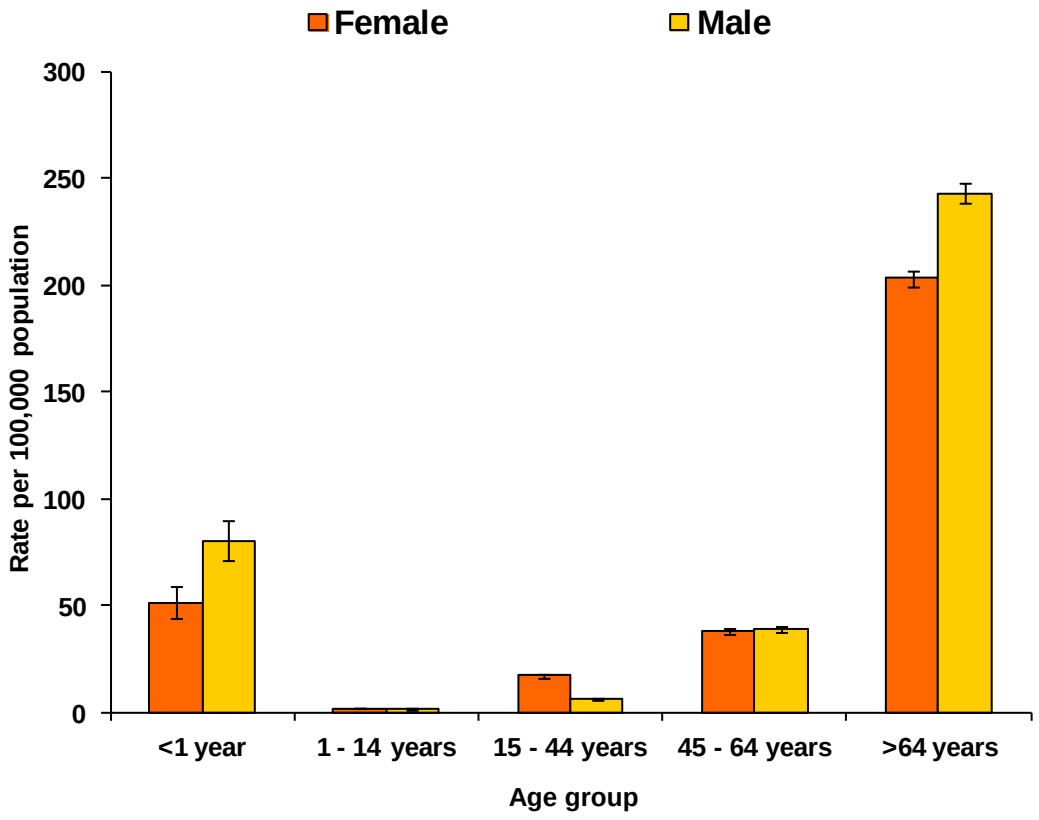
	2008	2009	2010	2011	2012
No of *E. coli* bacteraemia reports	23,950	25,662	27,045	29,851	30,099
Number of reporting laboratories	183	184	180	180	171
Laboratories reporting susceptibility data	95%	98%	98%	98%	97%

* Data extracted 15th April 2013

Age and sex distribution

Figure 2 shows the age and sex distribution for the *E. coli* bacteraemia reported in 2012 as rates per 100,000 population. The distribution between the sexes differs by age group; reports are more frequent for males than females in those aged under one year or aged 64 years and over; while the infection is more frequent among females in the 1-14 and 15-44 years age groups. The rates of bacteraemia for females and males were the same for those aged 45-64 years.
The rate for males aged less than 1 year has decreased from 89.9/100,000 in 2011 to 79.8/100,000 in 2012 whilst the rate for female infants decreased slightly from 54.7/100,000 in 2011 to 51.2/100,000 in 2012. The rate of *E. coli* bacteraemia in females and males aged over 64 remained stable between 2011 and 2012. Only marginal decreases were observed for the other age groups.

Figure 2. *E. coli* bacteraemia reports in 2012, England, Wales and Northern Ireland by age and sex*



Data extracted 15th April 2013

Distribution by region

Figure 3 shows regional distribution of *E. coli* bacteraemia in 2012. Figure 4 is a spatial representation of region-specific bacteraemia rates. The overall rate of *E. coli* bacteraemia in England, Wales and Northern Ireland was 51.9 per 100, 000 population. Regions with high rates of infection include the North East (71.5/100,000) and the North West (59.7/100,000). The country with the highest rate of infection was Northern Ireland (65.4 per 100,000). The region with the lowest incidence was South East (43.5/100,000).

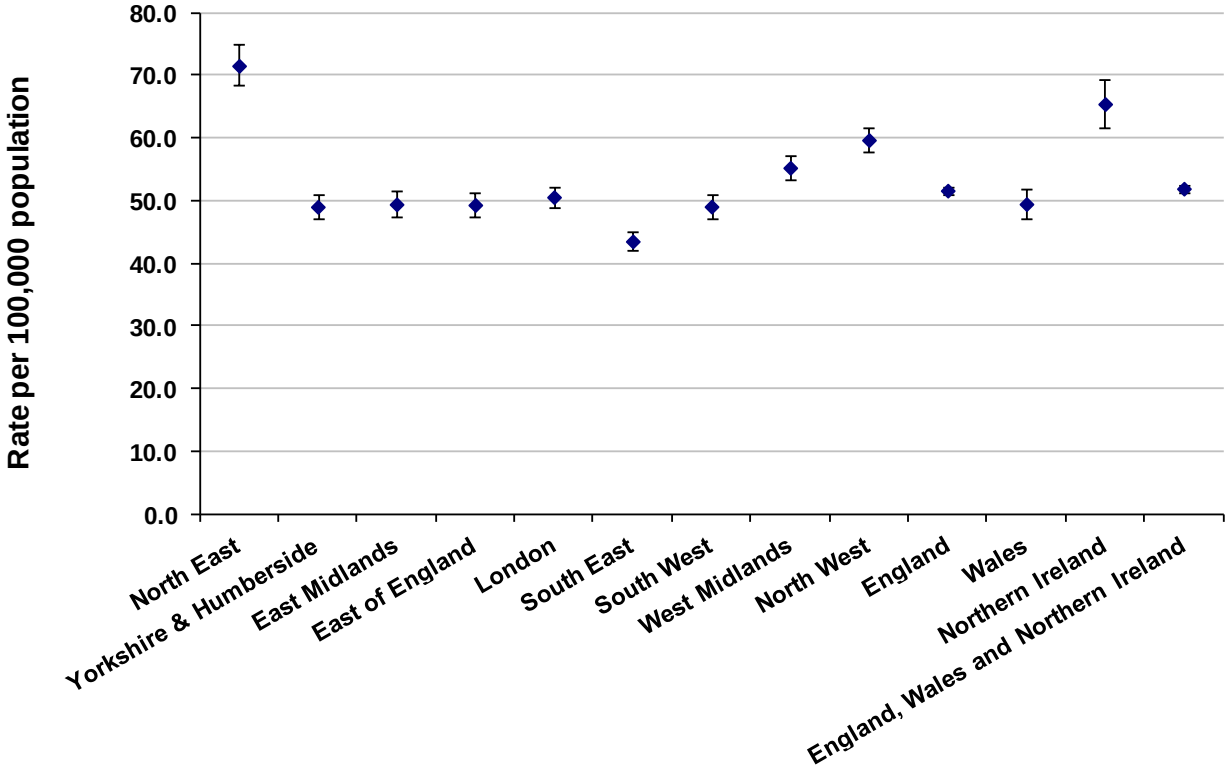
Public Health England

Escherichia coli bacteraemia in England, Wales and Northern Ireland, 2008-2012

The rates of infection have increased in most areas from 2008 to 2012, with the most pronounced increase observed in the North West: from 40.3/100,000 in 2008 to 59.7/100,000 in 2012. The North East had the second highest increase in the rate of *E. coli* bacteraemia (53.8 to 71.5/100,000 in 2008 and 2012, respectively). However, the rate of *E. coli* bacteraemia for the Yorkshire & Humberside remained stable (49.2/100,000 in 2008 to 49.0/100,000 in 2012). England's rate increased from 42.8/100,000 in 2008 to 51.6 in 2012. The rates of infection for Wales and Northern Ireland increased from 40.6/100,000 and 50.8/100,000 in 2008 to 49.5/100,000 and 65.4/100,000 in 2012, respectively. However, the rate for Wales decreased 22% between 2011 (60.4/100,000) and 2012 (49.5/100,000). It is not clear whether this decrease is due to reduced incidence or poor reporting. The overall rate of *E. coli* bacteraemia for England, Wales and Northern Ireland has increased from 42.9/100,000 in 2008 to 51.9/100,000 in 2012. However, none of the rate increases were significant.

As data-collection is based on a voluntary reporting system, it is important to note that regional rates of infection are affected by completeness of regional reporting and may reflect regional differences in reporting rather than genuine differences. However, there is also agreement with mandatory surveillance data.

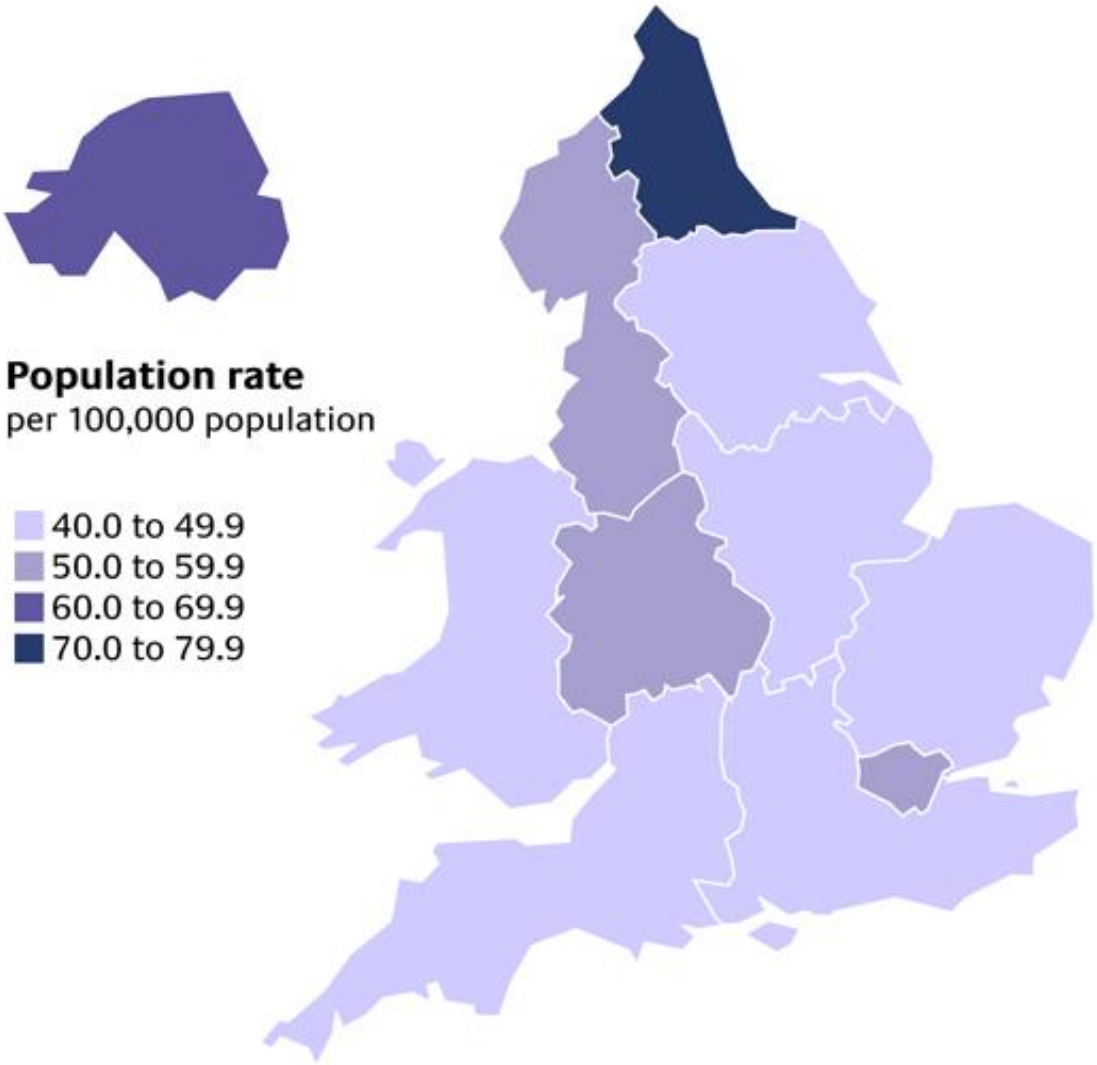
Figure 3: Region-specific rates of *E. coli* bacteraemia: England, Wales and Northern Ireland, 2012*



* Data extracted 15th April 2013

Escherichia coli bacteraemia in England, Wales and Northern Ireland, 2008-2012

Figure 4: Region-specific rates of *E. coli* bacteraemia: England, Wales and Northern Ireland, 2012*



* Data extracted 18th April 2012

Antimicrobial susceptibility

Trends in non-susceptibility to key antimicrobials are presented in table 2. The percentages of *E. coli* isolates showing non-susceptibility to 3rd generation cephalosporins and gentamicin were stable between 2008 and 2012; changes were within 2%. Specifically, for the cephalosporins cefotaxime and ceftazidime non-susceptibility rates were 10-11% in both 2011 and 2012 whereas, for ciprofloxacin rates also remained similar at 19%; for gentamicin, rates were 9-10%.

These stable rates contrast with the significant increases in the number of *E. coli* non-susceptible to cephalosporins from 2001 to 2006 [2], largely reflecting the emergence and spread of strains producing extended-spectrum β-lactamases (ESBLs), particularly **c**efo**t**a**x**ime-**M**unich-β-lactamase enzyme type 15 (CTX-M-15), which has become the dominant ESBL in the species [3, 4]. Ciprofloxacin resistance too increased until 2006 but has since shown a significantly decreasing trend from 21% in 2008 to 19% resistance in 2011 and 2012 (p<0.0001). This trend is in broad agreement with that of the Bacteraemia Surveillance Programme of the British Society for Antimicrobial Chemotherapy (BSAC) data, which has a different sampling scheme to LabBase2 and includes data from Scotland and the Irish Republic (http://www.bsacsurv.org), which showed a decrease in resistance from 26% in 2006 to 15% in 2009 and a partial recovery to 21% in 2011. Susceptibility of isolates tested for 3rd generation cephalosporins (cefotaxime & ceftazidime) show that resistance has remained largely stable between 2008 and 2012 (10-11% of isolates were resistant). BSAC also showed that the resistance to both cephalosporins between 2008 and 2011 remained stable, at 9% for cefotaxime and from 7% to 6% for ceftazidime. The prevalence of CTX-M ESBLs in *E. coli* decreased to 6% in 2010 from 8% in 2007[5]. The BSAC data for 2012 have not been released at the time of publication. Nevertheless the pictures from the two surveillance schemes are broadly consistent.

Most isolates tested for either imipenem or meropenem remained fully susceptible. However, a few *E. coli* samples (and rather more *Klebsiella pneumoniae*) with acquired carbapenemases are now being received by the PHE reference lab. The number of isolates reported resistant to imipenem was 5 out of 5755 and 7 out of 4937 for 2011 and 2012 respectively. Those resistant to meropenem were 19 out of 19,296 and 26 out of 20,825 for 2011 and 2012 respectively. There was a significant increase in meropenem resistant isolates between 2008 and 2012 (p < 0.025). UK microbiologists should be aware of these (many of the *E. coli* have an enzyme called New Delhi Metallo β-lactamase-1 (NDM-1), which is epidemiologically often linked to India and Pakistan [6], though other carbapenemases including Klebsiella Pneumoniae Carbapenemase (KPC) and Verona Imipenemase (VIM) are also circulating, with KPC dominant in *K. pneumoniae*, especially in North West England).

Table 2. Antibiotic susceptibility data for reports of *E. coli* bacteraemia, England, Wales and Northern Ireland: 2008-2012*

E. coli Total reports:		2008 23,950	2009 25,662	2010 27,045	2011 29,851	2012 30,099
Cefotaxime	**% Non-susceptible**	**11%**	**10%**	**10%**	**11%**	**11%**
	Reports with susceptibility data	11,713	12,850	13,487	15,393	16,322
Ceftazidime	**% Non-susceptible**	**11%**	**10%**	**10%**	**11%**	**10%**
	Reports with susceptibility data	15,962	16,507	18,437	20,798	21,200
Ciprofloxacin	**% Non-susceptible**	**21%**	**20%**	**19%**	**19%**	**19%**
	Reports with susceptibility data	19,517	20,063	21,817	24,796	25,505
Gentamicin	**% Non-susceptible**	**8%**	**8%**	**9%**	**9%**	**10%**
	Reports with susceptibility data	21,106	22,106	23,632	26,711	27,402
Imipenem	**% Non-susceptible**	**0%**	**0%**	**0%**	**0%**	**0%**
	Reports with susceptibility data	7,355	7,220	6,456	5,755	4,937
Meropenem	**% Non-susceptible**	**0%**	**0%**	**0%**	**0%**	**0%**
	Reports with susceptibility data	11,715	13,524	15,434	19,296	20,825

* Data extracted 18th April 2012

Concluding remarks

The data presented in this report show that the number of laboratory reports of *E. coli* bacteraemia continues to rise year-on-year [7], with a 26% increase in bacteraemia reports since 2008 and a 0.8% increase from 2011 to 2012. In addition, there are concerns about antimicrobial resistance of this organism [2,3,4]. This 0.8% increase is the smallest year-on-year increase seen since 2003 suggesting that *E. coli* bacteraemia reports have reached a plateau.

Compared to 2011, the rate of *E. coli* bacteraemia laboratory reports per 100,000 population in 2012 have remained stable in England, Wales and Northern Ireland (52.2/100,000 in 2011 to 51.9/100,000 in 2012). The North East had the largest increase in laboratory reports of *E. coli* bacteraemia between 2011 and 2012 (67.2/100,000 in 2011 to 71.5/100,000 in 2012, a 6.4% increase), although this may reflect an increase in reporting rather than an increase in disease incidence although there was no similar increase for all other bacteraemia.

Trends in non-susceptibility to key antimicrobials (3rd generation cephalosporins, quinolones and gentamicin) showed that there was a decrease in *E. coli* resistance to ciprofloxacin (from 21% in 2008 to 19% in 2010 after which it has remained stable for years 2011 and 2012 at 19%) while resistance to 3rd generation cephalosporins and gentamicin remained stable. As shown in table 2, the percentages of *E. coli* resistance to ciprofloxacin, 3rd generation cephalosporins and gentamicin in 2012 were 19%, 10-11% and 10%, respectively. These findings were broadly in agreement with BSAC data which showed stable resistance to 3rd generation cephalosporins but a slight increase in resistance to ciprofloxacin from 18% in 2008 to 21% in

2012 [5]. The increase in the number of laboratory reports across England, Wales and Northern Ireland, coupled with the public health impact of *E. coli* confirms that it should remain a priority. There is also a need for continued surveillance and interventions to prevent the spread of *E. coli* producing ESBLs, particularly CTX-M types and emergent carbapenem-resistant strains (e.g. with NDM-1, VIM, OXA-48 and KPC enzymes) which are frequently associated with multiple antibiotic resistance.

In order to review this in more detail and identify areas for improvement, the Department of Health decided to extend mandatory surveillance (already in place for *Staphylococcus aureus* bacteraemia and *Clostridium difficile* infections to *E. coli* bacteraemia from 1st of June 2011 onwards [8]. The PHE has also initiated a major genetic analysis programme of *E. coli* responsible for bacteraemias using about 2000 isolates from the BSAC collection, seeking to identify population structure, strain type, pathogenicity factors and resistance genes.

References

[1] HPA. Surveillance of Healthcare Associated Infections Report 2008. London: Health Protection Agency, 2008.
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[3] HPA. Investigations into multi-drug resistant ESBL-producing *Escherichia coli* strains causing infections in England: September 2005. London: Health Protection Agency, 2006.
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[5] BSAC, Resistance Surveillance Website (Bacteraemia data). Data downloaded 19/04/2013
[6] HPA. Multi-resistant hospital bacteria linked to India and Pakistan. *Health Protection Report*, 2009; 3(26)
[7] HPA. *Escherichia coli* bacteraemia in England, Wales and Northern Ireland, 2007-2011.
[8] Department of Health. Extension of mandatory surveillance to *E. coli* bloodstream infections- June 2011

Acknowledgements

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