Public Health England

Health Protection Report
weekly report

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News

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Public health in prisons and secure settings: annual report

PHE's recently published *Health and Justice report 2014* [1] is the first comprehensive report on prison health in England and Wales since *Health Protection in Prisons 2009-10*, published by the then Health Protection Agency in 2011 [2].

Since that time legislative and policy changes have significantly expanded the scope of governmental activity relating to the health and welfare of prisoners, detainees and others in contact with the criminal justice system.

In particular, the Health and Social Care Act 2012 gave NHS England new responsibilities for commissioning health services in these settings, while the Care Act 2014 gave local authorities new responsibilities (with effect from April 2015) for assessing and meeting the social care and rehabilitation needs of those groups (when they are resident within their jurisdiction).

The background to, and consequences of, these developments are described in the new report, as is the far broader remit of PHE in this area compared with that of the HPA.

PHE's health and justice team provides guidance and tools to support NHS England in fulfilling its public health commissioning responsibilities, and to other involved agencies, such as the National Offender Management Service (NOMS). The health and justice team, which has specialists located in PHE Centres, is part of the population healthcare division of the health and wellbeing Directorate and will produce reports annually in future about its activities.

A significant component of the new health and justice report comprises national and local data on communicable disease cases and outbreaks in places of detention in England. This includes reports on tuberculosis, BBVs, hepatitis and gastrointestinal infections and also on measures to control substance misuse. The infections data is produced by the Public Health Intelligence in Prisons and Secure Settings Service (PHIPS) that was originally established in 2002 (as the Prison Infection Prevention Team) to monitor the coverage of hepatitis B vaccinations within the prison population. Now part of the national health and justice team, the scope of PHIPS surveillance activity has significantly expanded and includes supplying data to support health needs assessments and recently introduced health performance quality indicators for prisons and young offender institutions (to be followed by separate indicators for other secure settings such as police custody suites and immigration removal centres).

The great majority of infections reported to PHIPS in 2014 were blood-borne viruses (BBVs). Hepatitis C virus in the prison population is significantly higher than in the population as a whole (8% vs 2%) – accounting for by far the greatest proportion of all infections reported to PHIPS.

Improved testing for hepatitis and other BBVs has led to a doubling of the total number of reports of individual cases of infectious disease in the prison population being recorded since 2011 (1268 compared with 549). However, at the same time, evidence of progress being made in identifying and treating BBVs is presented: the first results of the phased implementation of a new policy on BBVs testing in prisons – aimed at better identifying those who would otherwise remain undiagnosed – has led to a significant increase in the numbers being tested. In 2014, 21% of new entrants to prisons were tested for hepatitis C (compared to 11% previously), and 22% for hepatitis B (compared with 12% previously), the new report notes [3].

Further information about the issues covered by the report are available via the Public Health in Prisons and Secure Settings health protection collection webpages.

References

1. PHE (June 2015). *Health and Justice report 2014*.
2. HPA (2011). Health protection in prisons 2009-10 report, *HPR* **5**(11).
3. "Hepatitis cases responsible for 93% of prison disease reports", PHE press release, 15 June 2015.

Mandatory HCAI reports quarterly trends: January to March 2015

PHE's latest quarterly epidemiological commentary on trends in reports of *Staphylococcus aureus* (MRSA and MSSA) and *E. coli* bacteraemia, and of *Clostridium difficile* infections, mandatorily reported by NHS acute Trusts in England up to January-March 2015, has been published on the GOV.UK website [1].

The report, including tabular and graphical information, provides data for the January-March 2015 quarter (updating the previous report published in March 2015). Some key facts are listed below.

MRSA bacteraemia

The total number of MRSA bacteraemia has increased in the current quarter (January to March 2015, n=225) when compared to the same quarter in the previous year (January to March 2014, n=206) and the immediate previous quarter (October to December 2014, n=213). Furthermore, the number of Trust assigned MRSA bacteraemia has decreased 9.4% from 106 in January to

March 2014 to 96 in January to March 2015. However, in the same time period the number of CCG-assigned MRSA bacteraemia increased by 6.0% from 100 to 106.

MSSA bacteraemia

October to December 2014 saw the highest number of MSSA bacteraemia since the inception of the mandatory surveillance programme in January 2011 (n=2,571). The total number of MSSA bacteraemia has increased by 4.6% in the current quarter (January to March 2015, n=2,514) when compared to the same quarter in the previous year (January to March 2014, n=2,404). However when compared to the immediate previous quarter (October to December 2014, n=2,581) it decreased by 2.6%.

E coli bacteraemia

A 1.0% increase has been observed in the rate of *E. coli* bacteraemia reports when comparing the current quarter (January to March 2015) with the same quarter of the previous year (January to March 2014) from 63.09 to 63.75 reports per 100,000 population, with an overall increase of 5.4% since October to December 2011 (from 60.50 to 63.75 reports per 100,000 population).

C. difficile infection (CDI)

From January to March 2014 and January to March 2015 there was a 12.7% increase in the counts of CDI from 3,006 to 3,388. This is now the fourth consecutive observed increase in all reported *C. difficile* infections, when comparing to the same quarters in the previous years.

Reference

1. PHE (11 June 2015). Quarterly Epidemiological Commentary: Mandatory MRSA, MSSA and *E. coli* bacteraemia, and *C. difficile* infection data (up to January-March 2015).

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Infection Reports

HCAI-bacteraemia

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- **Polymicrobial bacteraemia and fungaemia in England, Wales and Northern Ireland, 2014**
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Bacteraemia

Voluntary surveillance of *Klebsiella* spp. bacteraemia in England, Wales and Northern Ireland: 2010-2014

These analyses are based on data relating to diagnoses of *Klebsiella* spp. bloodstream infections during 2010-2014 in England, Wales and Northern Ireland (EWNI) extracted from Public Health England's (PHE) voluntary surveillance database Second Generation Surveillance System (SGSS).

SGSS comprises a communicable disease module (CDR; formerly CoSurv/LabBase2) and an antimicrobial resistance module (AMR; formerly AmSurv). Most analyses presented here are based on data extracted from the CDR module of SGSS data on 5 June 2015, except for the evaluation of multi-drug resistance data from the antimicrobial resistance (AMR) module of SGSS (data extracted 15 June 2015). This module captures more comprehensive antibiogram data allowing more robust evaluation of multi-resistance rates. However these data cannot be used for the trend analysis due to lower laboratory coverage in previous years.

The data presented here will differ in some instances from those in earlier publications partly due to the inclusion of late reports.

Rates of bacteraemia laboratory reports were calculated using mid-year resident population estimates for the respective year and geography, with the exception of 2014 rates, which were based on 2013 population estimates as population estimates for 2014 were not available at the time of producing this report [1,2]. Geographical analyses were based on the residential postcode of the patient if known (otherwise the GP postcode if known or failing that the postcode of the laboratory) with cases in England being assigned to the catchment area of one of 15 local PHE centres (PHECs) formed from administrative local authority boundaries.

This report includes analyses of the trends, patient demographic and geographical distribution as well as antimicrobial susceptibility among these bacteraemia episodes.

Key points

- between 2013 and 2014 the total number of reports of *Klebsiella* spp. bacteraemia in EWNI increased by 0.8% (from 6,453 to 6,507 episodes), an increase in population rate from 10.98 to 11.07 per 100,000
- in 2014, 99% of bacteraemia reports of *Klebsiella* spp. were identified to species level. This represented a continuing improvement in species reporting
- the rate of *Klebsiella* spp. was generally higher in males than females and among older adults (≥65 years) and infants (<1 year)
- at country level, England had the highest rate of *Klebsiella* spp. bacteraemia reports (11.30/100,000) followed by Northern Ireland (9.73) and Wales (7.82)
- within England, Greater Manchester had the highest rate of reports at 14.11/100,000 population, followed by Cumbria and Lancashire at 13.32. The lowest rate was in Thames Valley (6.55)
- antimicrobial susceptibility trends from 2010 to 2014 were examined for five classes of antibiotics
- of the two third-generation cephalosporins examined, there appeared to be marginal increases in resistance to cefotaxime and ceftazidime for *Klebsiella* spp., reaching 10% (12% for *K. pneumonia*) for each antibiotic in 2014
- resistance to the fluroquinolone ciprofloxacin was broadly stable between 2013 and 2014, reported in 9% of *Klebsiella* spp. blood culture isolates
- the five-year trend analysis showed that resistance to the aminoglycoside gentamicin increased significantly at genus level and for *K. pneumoniae*
- further increases in *Klebsiella* spp. resistance to piperacillin/tazobactam were seen, reported in 16% of isolates in 2014 (17% for *K. pneumoniae*). This may reflect the recent switch from CLSI to EUCAST MIC breakpoint from 16 to 8 mg/L for this agent
- resistance to the carbapenems remained uncommon although significant increases were seen from 0.3% (11/4,025) of *Klebsiella* spp. isolates in 2010 to 1.6% (94/5,801) in 2014
- in terms of multi-drug resistance, the most common dual resistance in *K. pneumoniae* was to third generation cephalosporins and ciprofloxacin at 18.3% of these isolates. The lowest dual resistance was for *K. oxytoca* in relation to ciprofloxacin and gentamicin (2.3%).

Trends in the number of reports and rates

Between 2013 and 2014, the total number of *Klebsiella* spp bacteraemia reports in EWNI increased by 0.8% from 6,453 to 6,507 respectively (table 1). The total number of *Klebsiella* spp. reports has been stable since 2011, at around 6,500 *per annum*. In 2014 the majority were reported to species level (99%), representing a continuing improvement over the previous four years (range: 97%-98%).

The predominant *Klebsiella* species causing bacteraemia was *K. pneumoniae*, accounting for 80% of *Klebsiella* spp. bacteraemia reports in 2014, followed by *K. oxytoca* (19%). *K. pneumoniae* bacteraemia reports increased by 1.8% from 2013 to 2014 (from 5,086 to 5,177); over the five-year period the reports for this species increased by 13% (table 1).

Figure 1 shows trends in the rates of bacteraemia laboratory reports for *Klebsiella* species between 2010 and 2014. The annual rate of *Klebsiella* spp. bacteraemia was relatively stable around 11.0 per 100,000 resident population. The rate of bacteraemia due to *K. pneumoniae* showed more variation with an increase by 10.7% from 7.96/100,000 in 2010 to 8.81/100,000 in 2014. The rate increased by 1.8% from 2013 to 2014. The rate for *K. oxytoca* was stable throughout the study period.

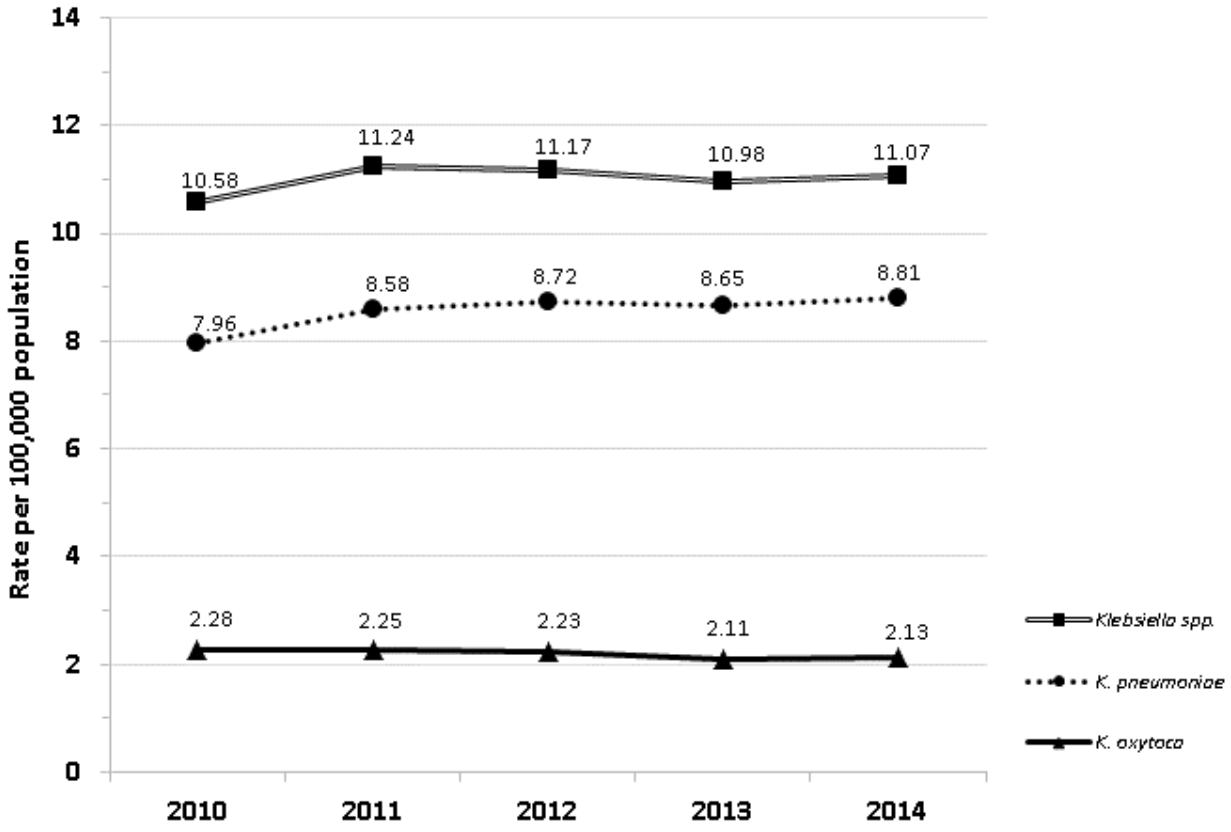
Table 1. Reports of bacteraemia due to *Klebsiella* spp. (England, Wales and Northern Ireland): 2010 to 2014

	2010		2011		2012		2013		2014	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
***Klebsiella* spp.**	**6,083**	100%	**6,518**	100%	**6,525**	100%	**6,453**	100%	**6,507**	100%
Klebsiella pneumoniae	4,574	75.2%	4,976	76.3%	5,091	78.0%	5,086	78.8%	5,177	79.6%
Klebsiella oxytoca	1,313	21.6%	1,307	20%	1,300	19.9%	1,240	19.2%	1,250	19.2%
Klebsiella, other named species	0	<1%	9	<1%	10	<1%	13	<1%	10	<1%
Klebsiella, species not recorded	196	3.2%	226	3.5%	124	1.9%	114	1.8%	70	1.1%

*0% in 2010 due to 0 cases; 0.1% in 2011; 0.2% in 2012; 0.2% in 2013; 0.2% in 2014

Source: PHE, 2015

Figure 1: Rates of laboratory bacteraemia reports of *Klebsiella* spp., *K. pneumoniae* and *K. oxytoca* in England, Wales and Northern Ireland per 100,000 resident population, 2010-2014



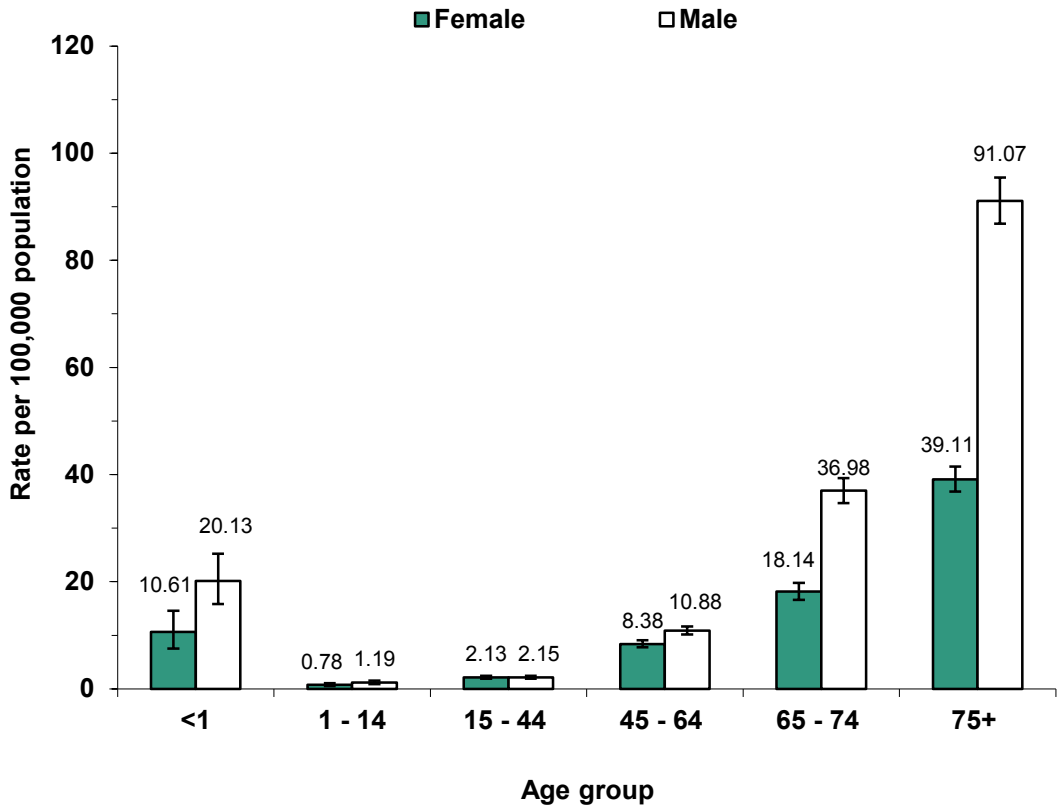
Source: PHE, 2015

Age and sex distribution

Figures 2 to 4 show the age and sex-specific rate of bacteraemia reports in EWNI in 2014 per 100,000 resident population for *Klebsiella* spp. and the two main *Klebsiella* species i.e. *K. pneumoniae* and *K. oxytoca*. In general, the rate was higher in adults over 65 years and in infants (under one year) although the rate in the infant group was based on a relatively smaller sample size (114 *Klebsiella* spp. reports, of which 79 concerned *K. pneumoniae* and 33 *K. oxytoca*) compared to the two oldest age groups . Across all analyses, the highest rate was among patients aged 75 years or more. The rate of bacteraemia was substantially higher among males than females across all age groups except among those aged 15-44 years where the rates were very similar in male and female patients.

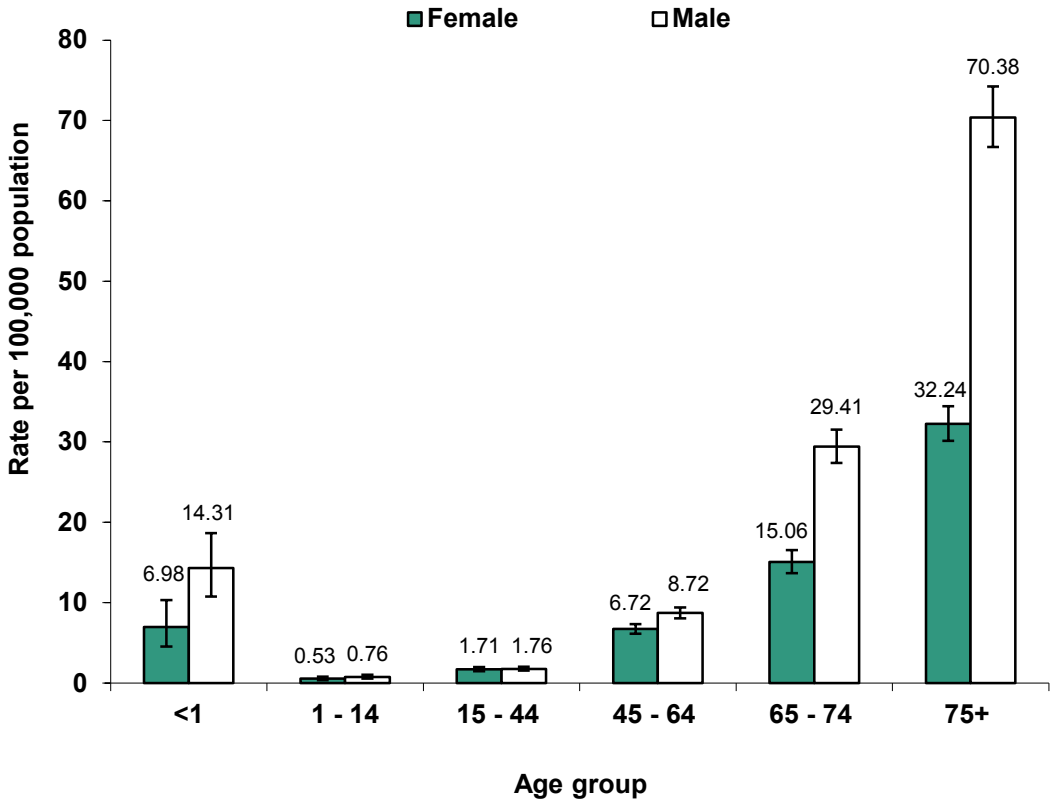
Among the oldest age group (75 years or more), the rate was two to three times higher in males than in females (figures 2-4), with incidence rate ratios of 2.33, 2.18 and 3.10 for *Klebsiella* spp., *K. pneumoniae* and *K. oxytoca* respectively.

Figure 2. Age and sex-specific rates of *Klebsiella* spp. bacteraemia reports per 100,000 population (England, Wales and Northern Ireland): 2014



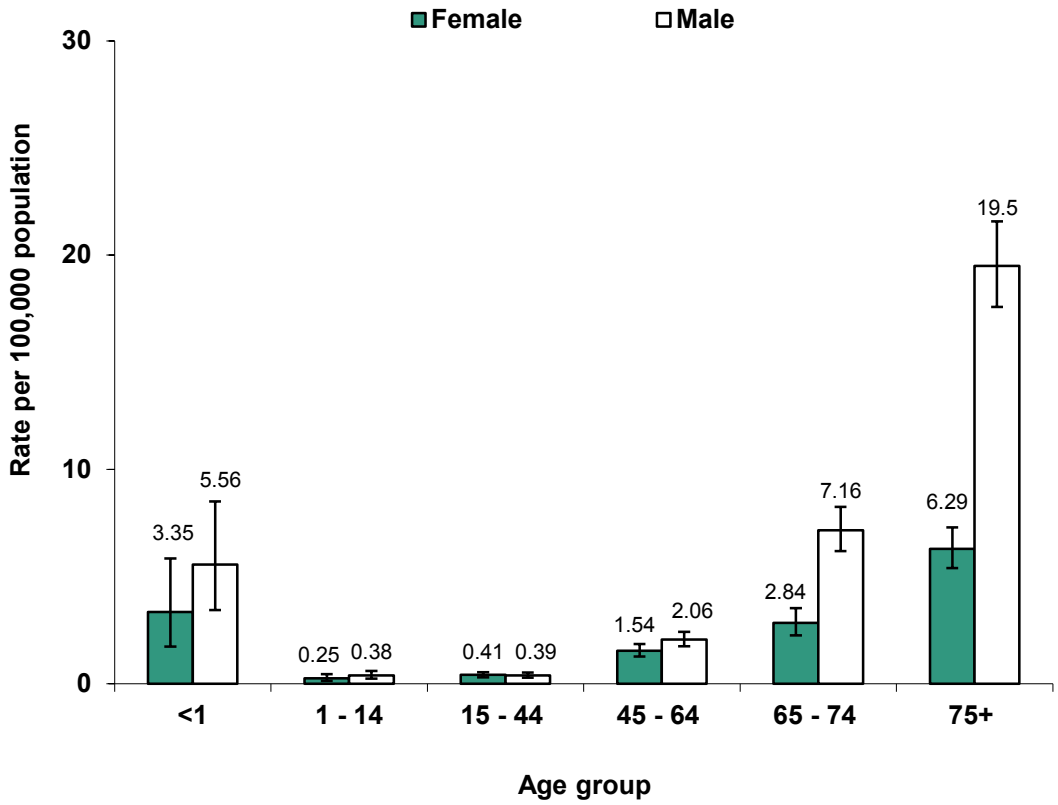
Source: PHE, 2015

Figure 3. Age and sex-specific rates of *K. pneumoniae* bacteraemia reports per 100,000 population (England, Wales and Northern Ireland): 2014



Source: PHE, 2015

Figure 4. Age and sex-specific rates of *K. oxytoca* bacteraemia reports per 100,000 population (England, Wales and Northern Ireland): 2014



Source: PHE, 2015

Geographical distribution

Figure 5 shows the rate of bacteraemia based on *Klebsiella* spp. reports per 100,000 population in 2014 at country level and at English regional level (Public Health England Centres). This analysis is not corrected for variation in reporting between geographical areas.

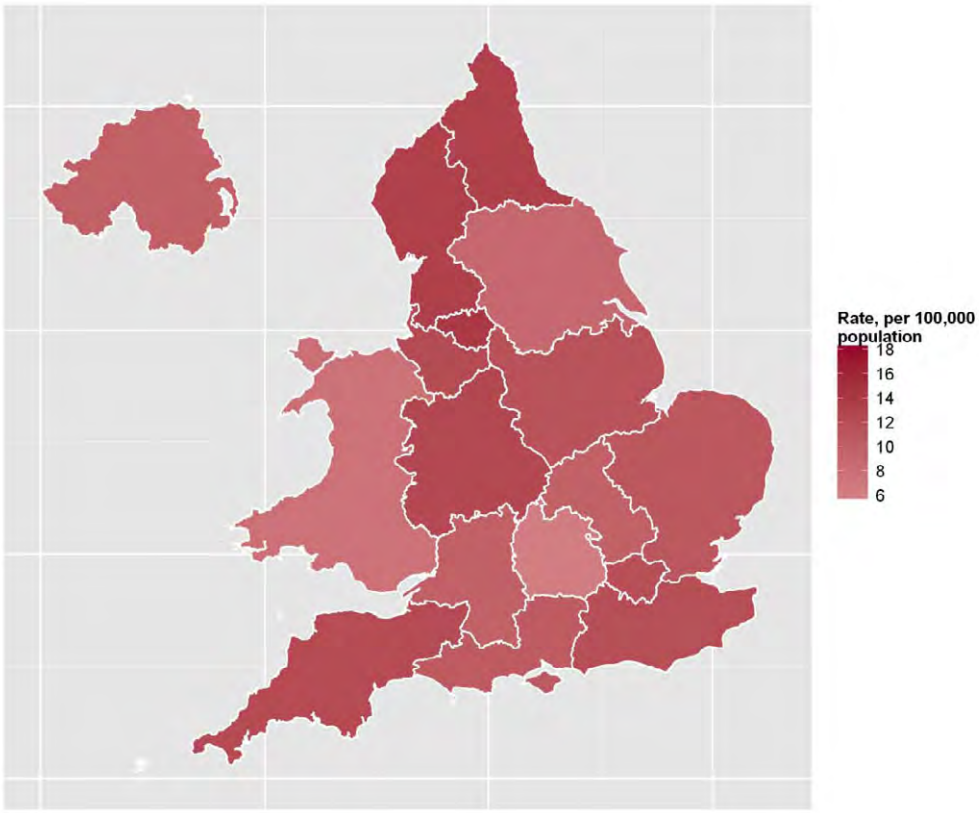
The bacteraemia rate for EWNI as a whole was 11.07/100,000 in 2014. England had the highest rate at 11.30 followed by Northern Ireland at 9.73 then Wales at 7.82.

Within England, variation in the rate between the 15 PHECs was observed. Greater Manchester had the highest rate at 14.11/100,000 population, followed by Cumbria and Lancashire at 13.32/100,000. Greater Manchester is located in the North West, a region observed to have the highest *Klebsiella* spp bacteraemia rate in previous years [3,4,5]. The lowest rate was in Thames Valley at 6.55/100,000.

The geographical variation may be explained by differences in completeness of reporting between PHECs. Local outbreaks, differences in case-mix and variation in the distribution of specialist care units may also influence these rates.

Table 2 shows the five-year trends in the rate by geography. Greater Manchester generally had the highest rates between 2010 and 2014 although the trend has been decreasing from 2011 onwards. The rate decreased between 2013 and 2014 for Cheshire and Merseyside. The lowest rates were consistently observed in Thames Valley over this five year period. Avon, Gloucestershire and Wilshire centre appears to show an increasing trend albeit the increases are small.

Figure 5. Geographical distribution of the rate of *Klebsiella* spp. bacteraemia reports per 100,000 population (England, Wales and Northern Ireland): 2014



Source: PHE, 2015

Table 2: Rate *Klebsiella* spp. bacteraemia reports per 100,000 population by PHE Centre (England, Wales and Northern Ireland): 2010-2014

Region	PHE centre	Rate per 100,000 resident population				
		2010	2011	2012	2013	2014
North of England	Cheshire and Merseyside	13.00	13.99	14.85	14.87	12.27
	Cumbria and Lancashire	9.40	10.71	11.35	10.78	13.32
	Greater Manchester	13.52	15.04	14.91	14.70	14.11
	North East	13.03	11.44	12.26	11.91	13.22
	Yorkshire and Humber	11.02	10.48	10.29	7.83	8.86
Midlands and East of England	Anglia and Essex	10.58	10.37	11.17	10.02	10.84
	East Midlands	12.04	13.97	11.17	12.10	11.36
	South Midlands and Hertfordshire	8.11	8.17	9.97	8.81	9.84
	West Midlands	10.64	11.71	11.47	11.40	12.49
London	London	10.41	12.13	11.72	12.10	11.82
South of England	Avon Gloucestershire and Wiltshire	7.59	8.42	8.86	8.53	9.99
	Devon Cornwall and Somerset	12.69	11.30	11.63	12.19	12.24
	Kent Surrey and Sussex	10.39	10.93	11.45	12.33	11.95
	Thames Valley	7.02	8.39	7.44	6.60	6.55
	Wessex	9.07	9.22	8.74	9.74	10.45
England		10.65	11.28	11.23	10.99	11.30
Northern Ireland		11.64	11.91	11.84	11.97	9.73
Wales		8.75	10.25	9.79	10.19	7.82
England, Wales and Northern Ireland		10.58	11.24	11.17	10.98	11.07

Source: PHE, 2015

Antimicrobial susceptibility data

Tables 3 to 5 present antibiotic susceptibility data for blood culture isolates of *Klebsiella* spp. (all species combined), *K. pneumoniae* and *K. oxytoca*. This analysis examines five classes of antibiotics: third-generation cephalosporins (cefotaxime and/or ceftazidime), carbapenems (imipenem/meropenem or ertapenem only if there was no evidence of testing for imipenem or meropenem), a fluoroquinolone (ciprofloxacin), a penicillin/beta-lactamase inhibitor combination (piperacillin/tazobactam) and an aminoglycoside (gentamicin). Table 6 shows multi-drug resistance in England in 2014 based on a defined combination of antimicrobial drugs using SGSS's AMR data.

Among *Klebsiella* spp. the most common mechanism of resistance to third-generation cephalosporins (cefotaxime or ceftazidime) is plasmid-mediated extended-spectrum β-lactamase (ESBL) production. For *Klebsiella* spp. isolates (all species), there appeared to be

marginal increases in resistance to cefotaxime and to ceftazidime from 8% in 2010 to 10% in 2014 for each agent (table 2). Similarly, for *K. pneumoniae,* marginal increases in resistance to both agents appeared (from 9% in 2010 to 12% in 2014 for each agent). The analysis for *K. oxytoca*, exhibited lower level of resistance to these agents and there did not appear to be a discernable trend based on observed data for this species.

Table 3. Antibiotic susceptibility of *Klebsiella* spp. bacteraemia isolates, England, Wales and Northern Ireland: 2010-2014

	2010		2011		2012		2013		2014	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
Piperacillin/ Tazobactam	4,245	10%	4,743	12%	4,931	12%	4,896	15%	5,512	16%
Imipenem/ Meropenem*†	4,025	<1%	4,484	<1%	4,650	<1%	4,585	<1%	5,801	2%
Cefotaxime	2,793	8%	3,094	8%	3,170	9%	3,029	9%	3,490	10%
Ceftazidime	3,835	8%	4,208	8%	4,237	9%	3,984	9%	4,524	10%
Ciprofloxacin	4,489	8%	4,908	8%	5,047	8%	4,926	9%	5,525	9%
Gentamicin	4,825	5%	5,354	5%	5,420	5%	5,320	6%	5,998	6%
Total *Klebsiella* spp. reports	6,083		6,518		6,525		6,453		6,507	

*0.3% in 2010; 0.6% in 2011; 0.7% in 2012; 0.7% in 2013; 1.6% in 2014

† Ertapenem included only if imipenem or meropenem not tested

Table 4. Antibiotic susceptibility of *K. pneumoniae* bacteraemia isolates, England, Wales and Northern Ireland: 2010-2014

	2010		2011		2012		2013		2014	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
Piperacillin/ Tazobactam	3,172	10%	3,605	12%	3,873	13%	3,832	15%	4,383	17%
Imipenem/ Meropenem*†	3,029	<1%	3,417	<1%	3,641	0.8%	3,592	<1%	4,591	2%
Cefotaxime	2,138	9%	2,410	9%	2,514	10%	2,412	11%	2,765	12%
Ceftazidime	2,889	10%	3,230	10%	3,335	11%	3,161	11%	3,573	12%
Ciprofloxacin	3,366	9%	3,748	9%	3,957	10%	3,866	10%	4,407	11%
Gentamicin	3,633	6%	4,094	6%	4,246	7%	4,167	8%	4,758	8%
Total *K. pneumoniae* reports	4,574		4,976		5,091		5,086		5,177	

*0.3% in 2010; 0.7% in 2011; 0.8% in 2012; 0.7% in 2013; 1.9% in 2014

† Ertapenem included only if imipenem or meropenem not tested

Table 5. Antibiotic susceptibility of *K oxytoca* bacteraemia isolates, England, Wales and Northern Ireland: 2010-2014

	2010		2011		2012		2013		2014	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
Piperacillin/ Tazobactam	933	12%	955	11%	956	11%	959	12%	1,059	13%
Imipenem/ Meropenem*†	859	<1%	901	<1%	925	<1%	902	<1%	1,137	<1%
Cefotaxime	585	4%	603	4%	607	5%	574	5%	673	2%
Ceftazidime	814	2%	820	3%	838	3%	758	3%	896	1%
Ciprofloxacin	974	2%	980	2%	995	2%	962	2%	1,041	2%
Gentamicin	1,035	2%	1,072	1%	1,069	1%	1,049	1%	1,160	2%
Total *K. oxytoca* reports	1,313		1,307		1,300		1,240		1,250	

*0% in 2010 due to 0 cases; 0.1% in 2011; 0.3% in 2012; 0.6% in 2013; 0.4% in 2014

† Ertapenem included only if imipenem or meropenem not tested

Source: PHE, 2015

The proportion of isolates reported resistant to piperacillin/tazobactam increased significantly over the five-year period for *Klebsiella* spp. isolates (from 10% in 2010 to 16% in 2014) ($p<0.0001$). This was similarly reflected in the analysis for *K. pneumoniae*, which also showed a significant increase from 10% in 2009 to 17% in 2014 ($p<0.0001$). These results are likely to reflect laboratories switching from the CLSI to EUCAST MIC breakpoint from 16 to 8 mg/L for this agent in relation to Enterobacteriaceae introduced in 2011. However there was no evidence of change in resistance to this antibiotic among *K. oxytoca* isolates ($p=0.386$).

In terms of susceptibility to ciprofloxacin, the increase in resistance between 2010 and 2014 was not statistically significant at genus level or at species level i.e. *K. pneumoniae* or *K. oxytoca* ($p=0.075$; $p=0.089$ and $p=0.112$ respectively).

Resistance to gentamicin increased significantly at genus level and for *K. pneumoniae* (both $p<0.05$); but there was no evidence of change for *K. oxytoca* ($p=0.941$). The reason for the increase at genus level is due to the increase of *K. pneumoniae* given that this species accounts for the majority of *Klebsiella* spp.

Resistance to the carbapenems remained uncommon in 2014 although increases were observed from 0.3% (11/4,025) of isolates in 2010 to 1.6% (94/5,801) in 2014. Despite the small underlying numbers, the increase was slow but steady at genus level ($p<0.0001$) and for

K. pneumoniae (p<0.0001) over the five-year period. No evidence of a trend was found for *K. oxytoca* reflecting the fact that resistance to carbapenems appears to be far less common in this species. At country level the majority of carbapenem-resistant isolates reported between 2010 and 2014 (n=193) were from England (183/193). At PHE centre level, the majority of these isolates were reported from laboratories in Greater Manchester at 25% (49/193) followed by London at 22% (42/193).

The increasing trend in carbapenem resistance among *Klebsiella* spp. bacteraemia isolates has been reported previously [3,4,5,6]. Although there are small underlying numbers involved, the increase among these bacteraemia isolates is of concern and warrants close vigilance given that this class of antibiotics is a powerful last-line treatment for serious infections caused by Gram-negative bacteria. Moreover these increases are occurring in the context of the emergence of resistance to these antibiotics among Enterobacteriaceae reported internationally in recent years [7,8].

Data based on all isolates referred to PHE's national reference laboratory, the Antimicrobial Resistance and Healthcare Associated Infections (AMRHAI) Reference Unit, indicate an increasing trend in carbapenemase-producing Enterobacteriaceae (CPE) from 2008, although sporadic cases were reported as far back as 2003. A total of 2,794 Enterobacteriaceae, from all specimen types, were identified as carbapenemase producing by AMRHAI between 2003 and 2013. *Klebsiella* spp. accounted for the majority of these isolates (79%), followed by *E. coli* (12%) then *Enterobacter* spp. (7%). Approximately 10% of confirmed carbapenemase producers were isolated from bacteraemia cases. AMRHAI found them variously to produce carbapenemases belonging to the KPC, OXA-48-like, NDM, VIM and IMP families. *Klebsiella* spp. are the commonest hosts of these enzymes. Although carbapenem resistance among Enterobacteriaceae in general (and particularly in *Enterobacter* spp.) may also be mediated by ESBL or AmpC production combined with impermeability (porin loss), the proportion of resistant isolates with carbapenemases is increasing.

In recognition of the importance of carbapenemase-producing Enterobacteriaceae (CPE), PHE issued a toolkit in December 2013 on the identification and management of affected patients in acute healthcare settings [9]. This toolkit includes a risk assessment to identify those individuals who should be screened for colonisation or infection with CPE as part of the routine admission procedure. A toolkit for non-acute settings is to follow.

The SGSS AMR data showed that 97% of total *Klebsiella* spp. blood culture isolates had antimicrobial susceptibility data (4,390/4,521). Multi-drug resistance was based on combinations of two different defined antibiotics (table 6). Generally dual resistance to third generation cephalosporins and ciprofloxacin was most common and combined resistance to both ciprofloxacin and gentamicin the least common. Genus-level data masked variation at species level. *K. pneumoniae* exhibited the highest resistance per combination category and *K. oxytoca* tended to exhibit the lowest resistance levels. Among *K. pneumoniae* bacteraemia isolates, the most common dual resistance was to third generation cephalosporins and ciprofloxacin (18.3%). This result may be due to testing bias as the resistance analysis based on data by individual agent yielded lower resistance rates. The least common dual resistance was for *K. oxytoca* in relation to ciprofloxacin and gentamicin at 2.3% of isolates. Resistance to third generation cephalosporins, ciprofloxacin, gentamicin and meropenem was uncommon (<1%) at genus level (18/3,628) and at species level i.e. *K. pneumoniae* (17/2,853) and *K. oxytoca* (0/730) (data not shown). The low level of combined resistance based on these four agents is likely to reflect the fact that meropenem resistance is uncommon.

Table 6. Multi-drug resistance among isolates of bacteraemia due to *Klebsiella* spp., *K. pneumoniae* or *K. oxytoca*, England, 2014

	3rd-G cephalosporin* and ciprofloxacin		3rd-G cephalosporin* and gentamicin		Ciprofloxacin and gentamicin	
	Total No. isolates tested	% Resistant	Total No. isolates tested	% Resistant	Total No. isolates tested	% Resistant
***Klebsiella* spp.**	3,836	15.6	3,826	13.6	4,221	11.4
K. pneumoniae	3,009	18.3	3,001	15.9	3,343	13.6
K. oxytoca	781	4.5	779	4.6	824	2.3

*cefotaxime or ceftazidime or both

Source: PHE, 2015

For advice on treatment of antibiotic-resistant infections due to these organisms or for reference services including species identification and confirmation of sensitivity testing results, laboratories should contact PHE's AMRHAI Reference Unit in London [10].

Acknowledgements

These reports would not be possible without the weekly contributions from microbiology colleagues in laboratories across England, Wales, and Northern Ireland, without whom there would be no surveillance data. Feedback and specific queries about this report are welcome and can be sent to: mailto:hcai.amrdepartment@phe.gov.uk

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Infection report

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Bacteraemia

Polymicrobial bacteraemia and fungaemia in England, Wales and Northern Ireland, 2014

These analyses are based on data extracted from the Public Health England (PHE) voluntary surveillance database, the Second Generation Surveillance System (SGSS), on 21 May 2015 for the five-year period 2010-2014. To put these analyses in context, the longitudinal trend for the incidence of polymicrobial and monomicrobial bacteraemia incorporates data for the seven-year period 2008-2014, extracted on the same date. The data presented here may differ in some instances from data in earlier publications due to the change in surveillance systems and the inclusion of late reports.

Rates were calculated using 2013 mid-year resident population estimates based on the 2011 census for England, Wales, and Northern Ireland [1]. Geographical analyses were made based on the residential location of the patient with reference PHE Centres.

Episodes of polymicrobial bloodstream infections were defined as the isolation of two or more different organisms (bacterial and/or fungal) from the same blood specimen. Specimen data reported to SGSS are based on each individual organism that has been identified in the specimen. If more than one organism is identified from a single patient specimen, then each organism is given a *different* unique identifying number in SGSS; these records are not linked. Consequently, the identification of patient episodes during which two or more different organisms are present requires identifying specimen records with identical values for the following variables: specimen date, laboratory, patient date of birth, gender, and patient NHS number.

The rates of polymicrobial episodes in this report should be interpreted with caution as the data are derived from voluntary reports. In addition, it is possible that some reports may reflect a contaminant in the specimens rather than a true polymicrobial infection, so the real rates may be lower than reported.

The report includes analyses on the trends, age and sex distribution and geographical distribution of cases of polymicrobial and monomicrobial bloodstream infections.

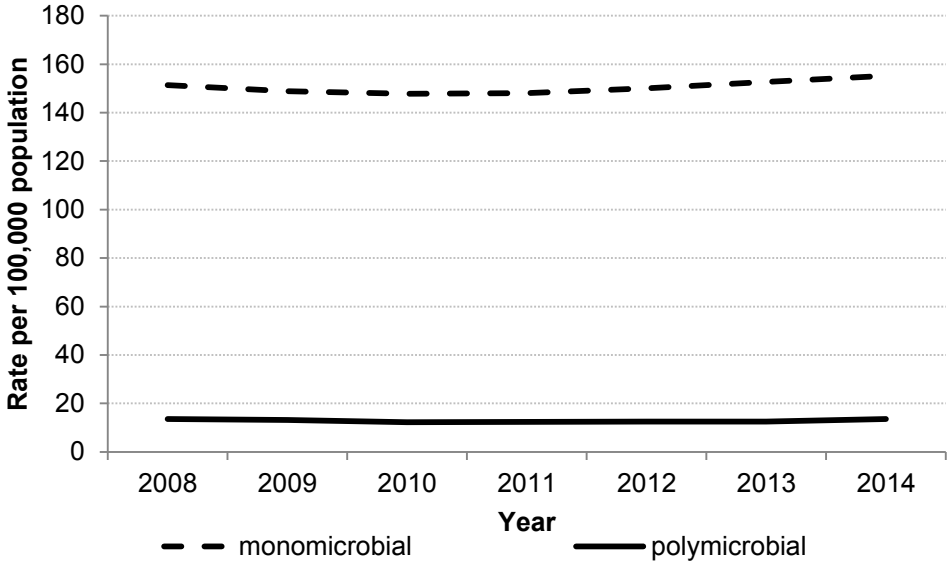
Key points

- overall, the number of patient episodes of bloodstream infections increased by 7.7% between 2010 and 2014 in England, Wales, and Northern Ireland (92,014 episodes in 2010 and 99,191 episodes in 2014)
- the number of polymicrobial patient episodes increased between 2010 and 2014, from 7,025 in 2010 to 8,005 in 2014
- in 2014, 8,005 (8.1%) of the 99,191 patient episodes were identified as polymicrobial and 91,186 (91.9%) monomicrobial infections
- of the 8,005 polymicrobial episodes reported in 2014, a total of 17,052 organisms were isolated, where 7,112 (88.8%) episodes involved two different organisms, 766 (9.6%) episodes involved three different organisms, and 127 (1.6%) episodes involved four or more organisms
- of the 17,052 organisms isolated in the reported polymicrobial episodes, 16,887 (99.0%) were bacterial and 165 (1.0%) were fungal
- the reported national rates (per 100,000 population) of polymicrobial infections were 14.1 for England, 6.7 for Wales and 10.1 for Northern Ireland
- the highest rates were observed in Avon, Gloucestershire and Wiltshire (20.2 per 100,000 population), and Devon, Cornwall and Somerset (18.6 per 100,000 population)
- the highest rate of polymicrobial bloodstream infection was observed for males and females aged 75 years and over (97.1 and 51.4 per 100,000 population respectively), and males and females aged less than one year (37.4 and 28.8 per 100,000 respectively).

Trends in episode numbers and rates

Between 2008 and 2010, the incidence rate of monomicrobial and polymicrobial caused by bloodstream infection and/or fungaemia fell from 151.3 to 147.8 per 100,000 population, and 13.5 to 12.2 per 100,000 population respectively (figure 1). From 2010 onwards, both the rate of monomicrobial and polymicrobial infections has steadily increased from 147.8 to 155.1 per 100,000, and 12.2 to 13.6 per 100,000 respectively. The observed year-on-year increase in reports from 2010 onwards may be due an increase in reporting or increasing *Escherichia coli* bloodstream infections [3, 4].

Figure 1. Trends of monomicrobial and polymicrobial bacteraemia and/or fungaemia patient episodes in England, Wales and Northern Ireland: 2008-2014



In 2014, 99,191 patient episodes involving either bacteraemia and/or fungaemia were identified from reports received from laboratories in England, Wales, and Northern Ireland (table 1). This represented a 5-year increase of 7.7% since 2010 (92,014 episodes).

Based on the positive blood specimens reported in 2014, 8,005 patient episodes (8.1% of all patient episodes) were identified as polymicrobial and 91,186 were identified as monomicrobial. The proportion of polymicrobial patient episodes was highest in 2014, where the proportion between 2010 and 2013 had been steady between 7.6-7.7%.

Table 1. Trends in reports of bacteraemia and fungaemia in England, Wales and Northern Ireland: 2010-2014

	2010	2011	2012	2013	2014
Total reported bacteraemia†	98,352	99,459	101,537	103,808	106,708
Total reported fungaemia†	1,692	1,784	1,704	1,713	1,597
Number of patient episodes	92,014	93,031	94,912	97,122	99,191
Number of polymicrobial patient episodes	7,025	7,192	7,310	7,391	8,005
Percentage of patient episodes that are polymicrobial	7.6%	7.7%	7.7%	7.6%	8.1%

† Total reports can include multiple records for individual patient; i.e. in a polymicrobial infection, there is a separate record for each organism isolated from that patient.

Total reports: 2014

Of the 8,005 polymicrobial patient episodes, 7,112 involved two different organisms, 766 involved three different organisms, and 127 involved four or more organisms (table 2). There were 17,052 organisms isolated from the reported 8,005 polymicrobial episodes, of which 16,887 (99.0%) were bacterial and 165 (1.0%) were fungi.

The most frequently reported organisms involved in polymicrobial infections were *Escherichia* species (39.0%), followed by coagulase-negative staphylococci (28.6%), and Enterococcus species (22.3%; table 3). This is a change to the previous year, when coagulase-negative staphylococci were the most commonly reported pathogen in polymicrobial infections [2]. A total of 146 and 116 different genera were isolated from patients with monomicrobial or polymicrobial infections respectively (table 4).

The most frequently reported organisms in the 91,186 monomicrobial patient episodes (table 3) were *Escherichia* species (30.0%) (of which 99.9% were *Escherichia coli)* followed by coagulase-negative staphylococci (17.4%) and *Staphylococcus aureus* (8.9%).

It should be borne in mind that the incidence of the different genera and lately the less well known genera is the reflection of changing laboratory technology and the widespread use of MALDI-TOF. The incidence of the various genera may be therefore biased by the laboratory methodology used to identify organisms.

Table 2. Number of organisms involved in polymicrobial infectious episodes, 2014

Number of organisms	Episodes	%
Two	7112	88.8%
Three	766	9.6%
Four	109	1.4%
Five	14	0.2%
More than five	4	0.0%

Table 3. The ten most frequently reported genera/organisms in polymicrobial and monomicrobial bloodstream infection episodes: 2014

Rank	Polymicrobial	Rank	Monomicrobial
1	*Escherichia***	1	*Escherichia***
2	*Staphylococcus,* coagulase negative	2	*Staphylococcus,* coagulase negative
3	*Enterococcus*	3	*Staphylococcus aureus*
4	*Klebsiella*	4	*Streptococcus,* non-pyogenic
5	*Streptococcus,* non-pyogenic	5	*Klebsiella*
6	Coliform	6	*Streptococcus,* pyogenic
7	*Staphylococcus aureus*	7	*Enterococcus*
8	*Pseudomonas*	8	*Pseudomonas*
9	*Proteus*	9	*Proteus*
10	*Enterobacter*	10	*Enterobacter*

** *Escherichia coli* in at least 99% of patient episodes

Table 4. Reports of monomicrobial and polymicrobial bacteraemia and fungaemia by genera or species, England, Wales, and Northern Ireland: 2014

	Bloodstream infections					
	Monomicrobial			Polymicrobial		
Organism	n†	%‡	Rank	n†	%‡	Rank
*Escherichia***	27,335	29.96	1	3,128	39.08	1
Staphylococcus, coagulase negative	15,884	17.41	2	2,286	28.56	2
Staphylococcus aureus	8,090	8.87	3	784	9.79	7
Streptococcus, non-pyogenic	7,135	7.82	4	1,325	16.55	5
Klebsiella	5,107	5.60	5	1,623	20.27	4
Streptococcus, pyogenic	4,547	4.98	6	315	3.94	11
Enterococcus	3,818	4.18	7	1,787	22.32	3
Pseudomonas	2,865	3.14	8	654	8.17	8
Proteus	1,951	2.14	9	578	7.22	9
Enterobacter	1,416	1.55	10	436	5.45	10
Candida	1,334	1.46	11	154	1.92	17
Bacteroides	932	1.02	12	212	2.65	14
Micrococcus	932	1.02	12	126	1.57	21
Propionibacterium	824	0.90	13	126	1.57	21
Serratia	688	0.75	14	143	1.79	18
Neisseria	652	0.71	15	45	0.56	25
Clostridium	640	0.70	16	259	3.24	12
Diphtheroids	567	0.62	17	185	2.31	16
Citrobacter	549	0.60	18	216	2.7	13
Haemophilus	521	0.57	19	43	0.54	27
Acinetobacter	519	0.57	20	188	2.35	15
Corynebacterium	464	0.51	21	129	1.61	20
Salmonella	398	0.44	22	15	0.19	38
Bacillus	357	0.39	23	141	1.76	19
Stenotrophomonas	349	0.38	24	141	1.76	19
Coliform	334	0.37	25	1,153	14.4	6
Bordetella	293	0.32	26	1	0.01	51
Morganella	278	0.30	27	123	1.54	22
Moraxella	209	0.23	28	49	0.61	24
Fusobacterium	139	0.15	29	30	0.37	32
Campylobacter	139	0.15	29	7	0.09	45

Organism	Bloodstream infections					
	Monomicrobial			Polymicrobial		
	n†	%‡	Rank	n†	%‡	Rank
Borrelia	131	0.14	30	0	-	-
Mycobacterium	124	0.14	31	6	0.07	46
Listeria	111	0.12	32	5	0.06	47
Pasteurella	76	0.08	33	8	0.1	44
Actinomyces	75	0.08	34	33	0.41	30
Peptostreptococcus	74	0.08	35	23	0.29	35
Aeromonas	72	0.08	36	65	0.81	23
Gemella	71	0.08	37	36	0.45	28
Achromobacter	67	0.07	38	18	0.22	36
Prevotella	65	0.07	39	16	0.2	37
Lactobacillus	64	0.07	40	44	0.55	26
Providencia	58	0.06	41	35	0.44	29
Rothia	55	0.06	42	27	0.34	33
Pantoea	54	0.06	43	31	0.39	31
Raoultella	49	0.05	44	26	0.32	34
Brevundimonas	38	0.04	45	3	0.04	49
Lactococcus	34	0.04	46	18	0.22	36
Veillonella	34	0.04	46	16	0.2	37
Ochrobactrum	34	0.04	46	9	0.11	43
Capnocytophaga	30	0.03	47	2	0.02	50
Brevibacterium	29	0.03	48	10	0.12	42
Granulicatella	26	0.03	49	14	0.17	39
Hafnia	26	0.03	49	11	0.14	41
Eggerthella	26	0.03	49	9	0.11	43
Burkholderia	26	0.03	49	2	0.02	50
Roseomonas	25	0.03	50	3	0.04	49
Bifidobacterium	24	0.03	51	3	0.04	49
Phialophora	24	0.03	51	0	-	-
Chryseobacterium	22	0.02	52	11	0.14	41
Rhizobium	19	0.02	53	10	0.12	42
Cryptococcus	19	0.02	53	0	-	-
Kocuria	17	0.02	54	7	0.09	45
Aspergillus	17	0.02	54	0	-	-
Arcanobacterium	15	0.02	55	9	0.11	43
Kluyvera	15	0.02	55	8	0.1	44
Eikenella	14	0.02	56	4	0.05	48
Peptococcus	14	0.02	56	3	0.04	49
Dermabacter	13	0.01	57	8	0.1	44
Gardnerella	13	0.01	57	3	0.04	49
Kingella	13	0.01	57	1	0.01	51
Rhodococcus	12	0.01	58	6	0.07	46
Leuconostoc	11	0.01	59	12	0.15	40
Anaerococcus	10	0.01	60	0	-	-
Brucella	10	0.01	60	0	-	-
Anaerobiospirillum	8	0.01	61	5	0.06	47
Arthrobacter	8	0.01	61	3	0.04	49
Leptospira	8	0.01	61	2	0.02	50
Yersinia	8	0.01	61	2	0.02	50
Rhodotorula	8	0.01	61	1	0.01	51
Sphingobacterium	8	0.01	61	1	0.01	51
Sphingomonas	8	0.01	61	0	-	-
Pediococcus	7	0.01	62	4	0.05	48
Leclercia	7	0.01	62	1	0.01	51
Alcaligenes	6	0.01	63	9	0.11	43

Organism	Bloodstream infections					
	Monomicrobial			Polymicrobial		
	n†	%‡	Rank	n†	%‡	Rank
Peptoniphilus	6	0.01	63	4	0.05	48
Aggregatibacter	6	0.01	63	1	0.01	51
Collinsella	6	0.01	63	1	0.01	51
Shigella	6	0.01	63	1	0.01	51
Eubacterium	6	0.01	63	0	-	-
Comamonas	5	0.01	64	5	0.06	47
Ralstonia	5	0.01	64	4	0.05	48
Parvimonas	5	0.01	64	3	0.04	49
Leptotrichia	5	0.01	64	1	0.01	51
Epidermophyton	5	0.01	64	0	-	-
Parabacteroides	5	0.01	64	0	-	-
Delftia	4	0.00	65	6	0.07	46
Saccharomyces	4	0.00	65	3	0.04	49
Cardiobacterium	4	0.00	65	1	0.01	51
Finegoldia	4	0.00	65	1	0.01	51
Nocardia	4	0.00	65	1	0.01	51
Paenibacillus	4	0.00	65	0	-	-
Pneumocystis	4	0.00	65	0	-	-
Gordonia	3	0.00	66	2	0.02	50
Microbacterium	3	0.00	66	2	0.02	50
Flavobacterium	3	0.00	66	1	0.01	51
Trichosporon	3	0.00	66	1	0.01	51
Coccidioides	3	0.00	66	0	-	-
Globicatella	2	0.00	67	3	0.04	49
Agrobacterium	2	0.00	67	2	0.02	50
Stomatococcus	2	0.00	67	2	0.02	50
Actinobacillus	2	0.00	67	1	0.01	51
Erysipelothrix	2	0.00	67	1	0.01	51
Geotrichum	2	0.00	67	1	0.01	51
Psychrobacter	2	0.00	67	1	0.01	51
Rahnella	2	0.00	67	1	0.01	51
Actinobaculum	2	0.00	67	0	-	-
Atopobium	2	0.00	67	0	-	-
Fusarium	2	0.00	67	0	-	-
Legionella	2	0.00	67	0	-	-
Oligella	2	0.00	67	0	-	-
Shewanella	2	0.00	67	0	-	-
Alloiococcus	1	0.00	68	1	0.01	51
Malassezia	1	0.00	68	1	0.01	51
Streptobacillus	1	0.00	68	1	0.01	51
Aurantimonas	1	0.00	68	0	-	-
Bilophila	1	0.00	68	0	-	-
Butyribacterium	1	0.00	68	0	-	-
Calymmatobacterium	1	0.00	68	0	-	-
Capnocytophagia	1	0.00	68	0	-	-
Dermacoccus	1	0.00	68	0	-	-
Desulfovibrio	1	0.00	68	0	-	-
Dialister	1	0.00	68	0	-	-
Facklamia	1	0.00	68	0	-	-
Massilia	1	0.00	68	0	-	-
Methylobacterium	1	0.00	68	0	-	-
Mucor	1	0.00	68	0	-	-
Neoscytalidium	1	0.00	68	0	-	-
Paecilomyces	1	0.00	68	0	-	-

Organism	Bloodstream infections					
	Monomicrobial			Polymicrobial		
	n†	%‡	Rank	n†	%‡	Rank
Pandoraea	1	0.00	68	0	-	-
Porphyromonas	1	0.00	68	0	-	-
Rhizomucor	1	0.00	68	0	-	-
Rhizopus	1	0.00	68	0	-	-
Ruminococcus	1	0.00	68	0	-	-
Sneathia	1	0.00	68	0	-	-
Trichophyton	1	0.00	68	0	-	-
Brevibacillus	0	-	-	2	0.02	50
Exophiala	0	-	-	2	0.02	50
Myroides	0	-	-	2	0.02	50
Vibrio	0	-	-	2	0.02	50
Absidia	0	-	-	1	0.01	51
Chryseomonas	0	-	-	1	0.01	51
Empedobacter	0	-	-	1	0.01	51
Herbasprillum	0	-	-	1	0.01	51
Leminorella	0	-	-	1	0.01	51
Paracoccidioides	0	-	-	1	0.01	51
Total	**91,253**	**100**		**8,005**	**100**	

Geographic distribution

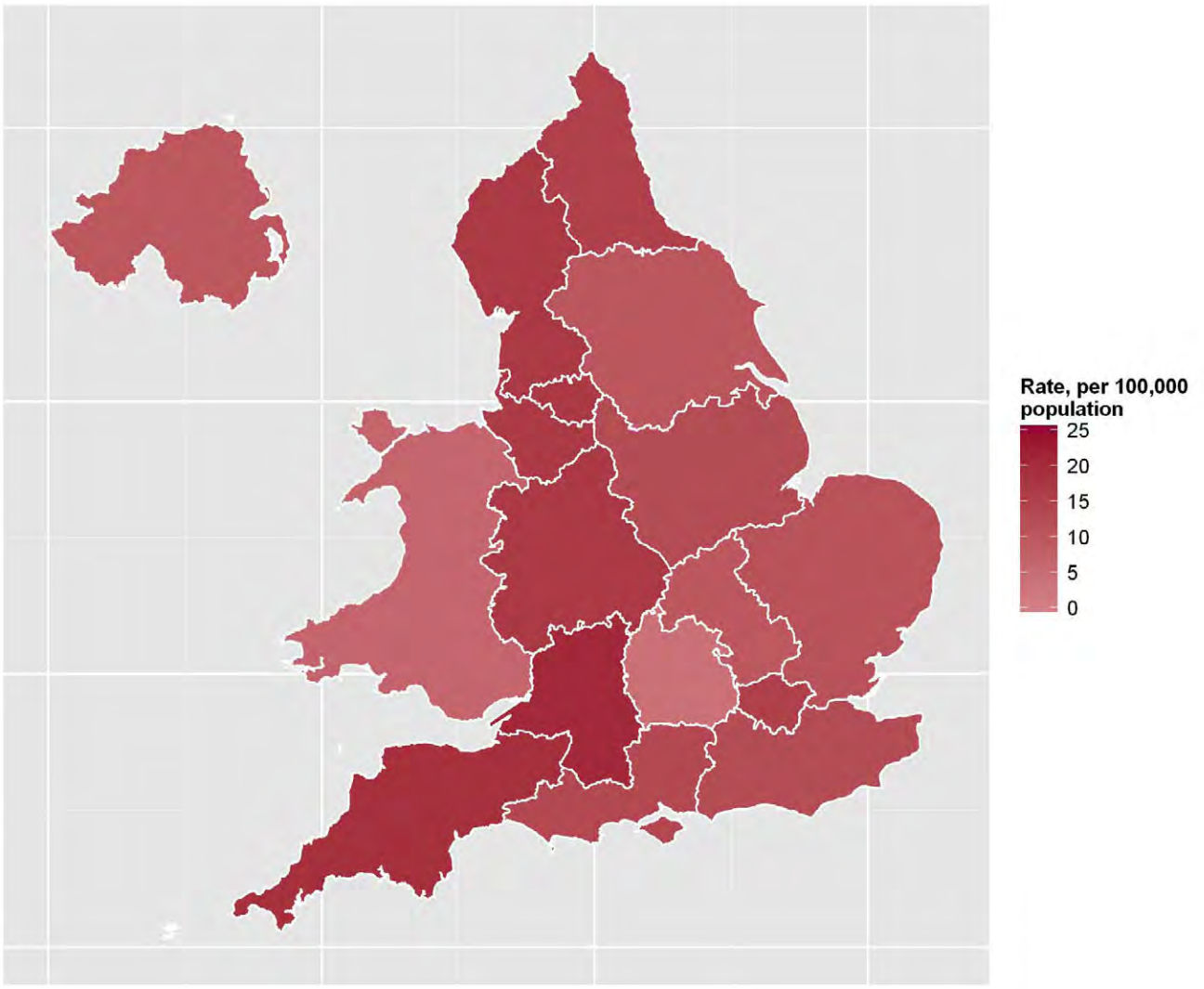
The overall rate of polymicrobial episodes in England, Wales, and Northern Ireland was 13.6 per 100,000 population in 2014 (table 5). By country, the reported rates (per 100,000 population) were 14.1, 6.7 and 10.1 respectively.

Only the English rates increased compared to the previous year (12.9 to 14.1 per 100,000), while the rate decreased in Wales (7.3 to 6.7 per 100,000) and Northern Ireland (12.0 to 10.1 per 100,000). Similar pattern was described in the previous report [2]. Within England in 2014, the lowest rate of polymicrobial episodes was recorded for the Thames Valley (3.9 per 100,000), South Midlands and Hertfordshire (10.0 per 100,000), and Yorkshire and Humber (10.5 per 100,000) (figure 1). The highest rates were observed in Avon, Gloucestershire and Wiltshire (20.2 per 100,000), and Devon, Cornwall and Somerset (18.6 per 100,000). Caution should be taken when comparing these infection rates with those in previous reports due to differences in geographical distribution of reporting laboratories (only concerns PHE centres infection rates).

Table 5. Regional distribution of polymicrobial bacteraemia and/or fungaemia episodes (per 100,000 population) in England, Wales and Northern Ireland: 2010-2014

Region	PHE Centre	Rate, per 100,000 population				
		2010	2011	2012	2013	2014
North of England	Cheshire and Merseyside	15.0	18.1	16.3	16.5	16.6
	Cumbria and Lancashire	10.5	9.7	12.4	14.1	17.1
	Greater Manchester	15.7	14.4	15.2	14.9	17.0
	North East	9.4	9.6	9.2	12.0	15.3
	Yorkshire and Humber	13.4	11.0	10.3	9.8	10.5
Midlands and East of England	South Midlands and Hertfordshire	7.8	9.3	11.2	9.7	10.0
	East Midlands	15.2	13.2	12.3	12.1	13.1
	Anglia and Essex	9.4	10.2	10.2	9.4	11.5
	West Midlands	12.3	12.8	13.4	14.5	17.1
London	London	14.0	14.9	15.2	15.3	15.3
South of England	Avon, Gloucestershire and Wiltshire	11.7	12.8	15.4	15.4	20.2
	Devon, Cornwall and Somerset	16.5	15.3	15.9	17.3	18.6
	Wessex	15.1	15.7	14.9	13.2	13.7
	Kent, Surrey and Sussex	12.8	12.7	13.0	12.7	12.7
	Thames Valley	4.5	6.1	4.8	4.9	3.9
England		12.5	12.6	12.8	12.9	14.1
Wales		8.1	9.9	8.6	7.3	6.7
Northern Ireland		10.2	9.9	10.3	12.0	10.1
England, Wales and Northern Ireland		12.2	12.4	12.5	12.6	13.6

Figure 2. Regional distribution of polymicrobial bacteraemia and/or fungaemia episodes (per 100,000 population) in England, Wales and Northern Ireland: 2014



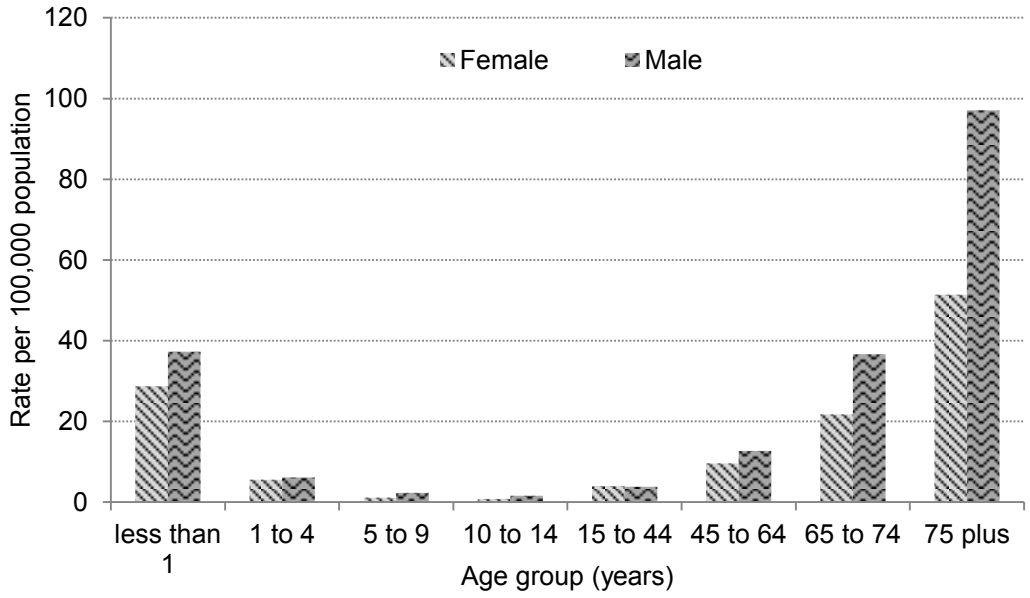
Age and sex distribution

The age distribution of polymicrobial and monomicrobial bacteraemia and/or fungaemia for 2014 is presented in figure 3. The highest rate of polymicrobial bloodstream infection was observed for males and females aged 75 years and over (97.1 and 51.4 per 100,000 respectively), followed by males and females aged less than one year (37.4 and 28.8 per 100,000 respectively). The lowest rate for both sexes was recorded for those aged ten to fourteen years (1.6 and 0.8 per 100,000 respectively). This is similar to the pattern observed previously [2].

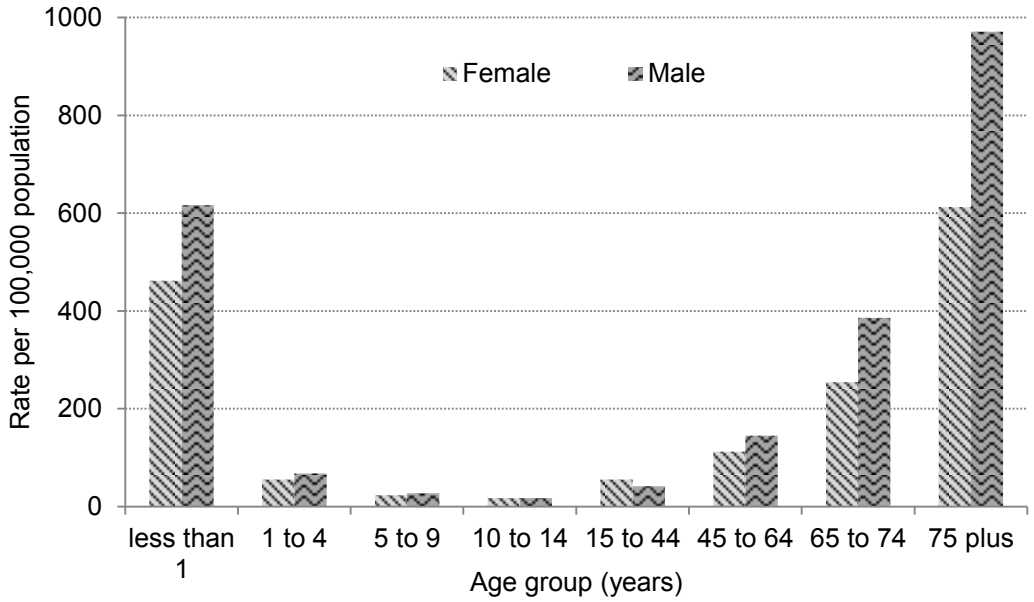
Similarly, rates of monomicrobial bloodstream infections were also highest amongst the oldest and youngest age groups, with those aged 75 and over (male: 971.2 per 100,000; female: 612.5 per 100,000) and those less than one year (male: 616.7 per 100,000; female: 462.2 per 100,000) having the highest rates for both sexes. The lowest rates were recorded for those aged 10 to 14 years (17.7 per 100,000 for both males and females).

Figure 3. Age-specific rates of (a) polymicrobial, and (b) monomicrobial episodes, England, Wales, and Northern Ireland: 2014

(a) Polymicrobial episodes



(b) Monomicrobial episodes



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Bacteraemia

Voluntary surveillance of *Clostridium difficile*, England, Wales and Northern Ireland: 2014

These analyses are based on data extracted from the Public Health England (PHE) voluntary surveillance database, the Second Generation Surveillance System (SGSS), on 21 January and 18 February 2015 for the period 2010-2014. The data presented here differ in some instances from data in earlier publications due to the inclusion of late reports.

The report includes analyses of the trends, age and sex distribution, geographical distribution and level of ascertainment of cases of *Clostridium difficile* (*C.difficile*) in England, Wales and Northern Ireland.

Rates were calculated using 2013 mid-year resident population estimates based on the 2011 census for England, Wales, and Northern Ireland [1,2]. Geographical analyses were made based on the residential location of the patient with reference to the Public Health England Centre areas created in April 2013, when Public Health England was established.

For data from the mandatory surveillance of *C. difficile* in England, see: https://www.gov.uk/government/collections/clostridium-difficile-guidance-data-and-analysis

Key points

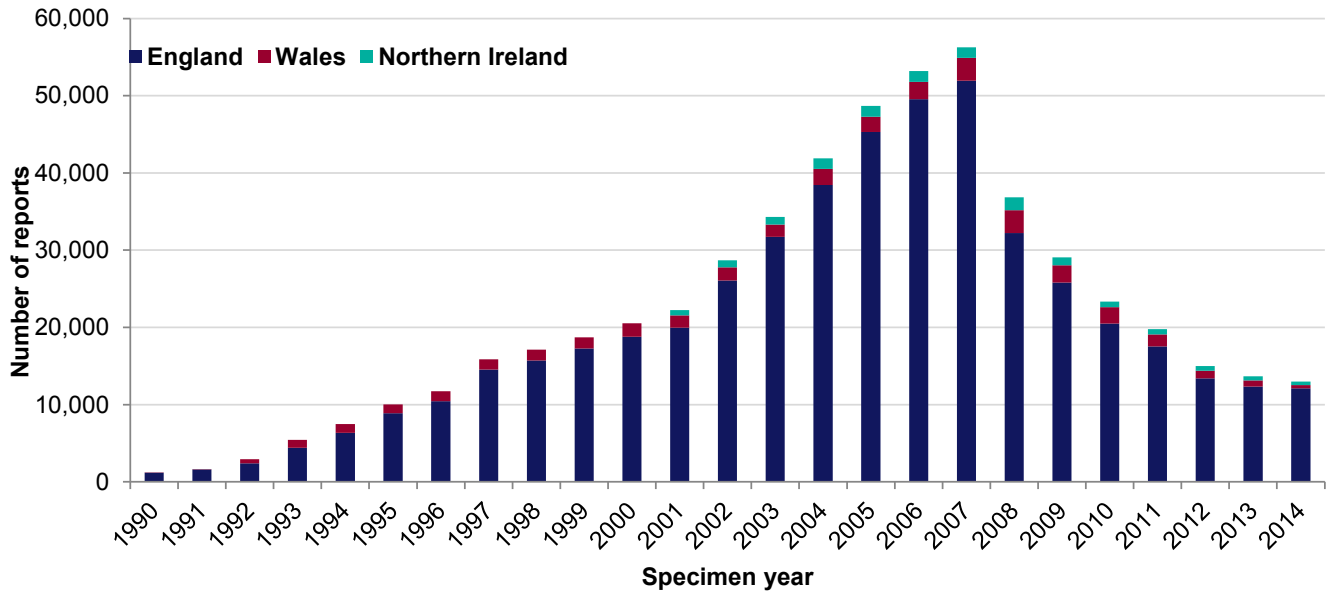
- this report describes laboratory reports of *C. difficile* for the period of January to December 2014 that were submitted on a voluntary basis to PHE from laboratories in England, Wales and Northern Ireland. *C. difficile* infection is usually diagnosed by detection of *Clostridium difficile* toxins from diarrhoeal stool specimens in conjunctions with a first-step/screening method, but cases detected using alternative methods such as culture may also be reported to the voluntary surveillance scheme.
- there were 12,985 reports of *C. difficile* in 2014, comprising 12,120 reports (93.3%) from England, 429 reports (3.3%) from Wales and 436 reports (3.4%) from Northern Ireland. Overall, the total number of reports decreased by 5% in comparison to 2013

- between 2013 and 2014, the reported incidence of *C. difficile* per 100,000 population decreased from 22.9 to 22.5 in England, from 26.1 to 13.9 in Wales and from 28.9 to 23.8 in Northern Ireland
- the majority reported cases (74.1%) were in the 65 years and over age group.
- comparison of voluntary reporting with the mandatory surveillance dataset showed a case ascertainment rate of 87.5% in 2014.

Trends in episode numbers and rates

There were 12,985 reports of *C. difficile*-positive faecal specimens to SGSS (LabBase2 previously) in 2014, a 5% decrease in comparison to 2013 (figure 1, Appendix table 1). The overall total in 2014 comprised 12,120 (93.3%) reports from England, 429 (3.3%) from Wales, and 436 (3.4%) from Northern Ireland; these represented 1.7%, 46.8% and 17.6% decreases since 2013, respectively.

Figure 1. Voluntary laboratory reports of *C. difficile* positive faecal specimens: England, Wales and Northern Ireland* 1990-2014**



* Northern Ireland reports included from 2001
** Data extracted on 21st January and 18th February 2015

There was a decrease in the number of *C. difficile* voluntary reports in England from 12,331 to 12,120 (1.7%) between 2013 and 2014 (table 1). During this time, the percentage change in cases varied by PHE centre. The largest decreases were observed in Thames Valley (27%, 274 to 200), East Midlands (12.2%, 1,393 to 1,209) Kent, Surrey and Sussex (11.6%, 835 to 733)

and Greater Manchester (10.4%, 880 to 778). Conversely, laboratories in Cumbria and Lancashire (24.9%, 482 to 602), Anglia and Essex (19.1%, 841 to 1,002) and London (8.2%, 952 to 1,030) reported the highest year-on-year increase in the number of reports.

In terms of the 5-year trend, the number of *C. difficile* reports decreased in all PHE centres between 2010 and 2014. On average, the total number of reports decreased by 40.8 % in England between 2010 and 2014, and this ranged from 19.6% in Cumbria and Lancashire to 77% in Thames Valley (table 1).

A decreasing trend in the number of positive specimens was also observed in Wales and Northern Ireland with reductions of 80% (2,140 to 429) and 37.3% (695 to 436) between 2010 and 2014, respectively (table 1).

Table 1. Voluntary laboratory reports of *C. difficile*: PHE centres, Wales and Northern Ireland 2010- 2014*

PHE centre	2010	2011	2012	2013	2014
London	1,940	1,466	1,042	952	1,030
South Midlands and Hertfordshire	631	482	435	445	406
East Midlands	1,636	1,583	1,159	1,393	1,209
Anglia and Essex	1,423	1,088	979	841	1,002
West Midlands	2,607	2,244	1,707	1,760	1,846
Cheshire and Merseyside	1,600	994	541	512	553
Cumbria and Lancashire	749	609	519	482	602
Greater Manchester	1,881	1,660	1,149	880	778
North East	944	908	846	747	729
Yorkshire and Humber	2,055	2,000	1,326	1,351	1,274
Avon Gloucestershire and Wiltshire	1,033	950	871	813	739
Devon Cornwall and Somerset	909	1,079	819	613	631
Wessex	805	785	682	433	388
Kent Surrey and Sussex	1,406	953	919	835	733
Thames Valley	869	736	406	274	200
England	20,488	17,537	13,400	12,331	12,120
Northern Ireland	695	689	602	529	436
Wales	2,140	1,564	988	806	429
E, W, NI	23,323	19,790	14,990	13,666	12,985

* Data extracted on 21 January and 18 February 2015

The overall rate of *C. difficile* in England, Wales and Northern Ireland was 22.1 per 100,000 in 2014, a 5% decrease from 23.3 per 100, 000 population in 2013 (table 2).

The rate of *C. difficile* positive samples varied between PHE centres and between England,

Wales and Northern Ireland in 2014 (figure 2). In particular, the rate in England, Wales and Northern Ireland decreased by 1.7%, 46.8% and 17.6% (22.9 vs. 22.5, 26.1 vs. 13.9 and 28.9 vs. 23.8 per 100,000 population, respectively) since 2013. Regionally, the year-on-year percentage change in *C. difficile* ranged from a 24.9% increase in Cumbria and Lancashire (from 24.5 per 100,000 population to 30.6 per 100,000 population) to a 27.0% decrease in Thames Valley (from 13.3 per 100,000 population to 9.7 per 100,000 population).

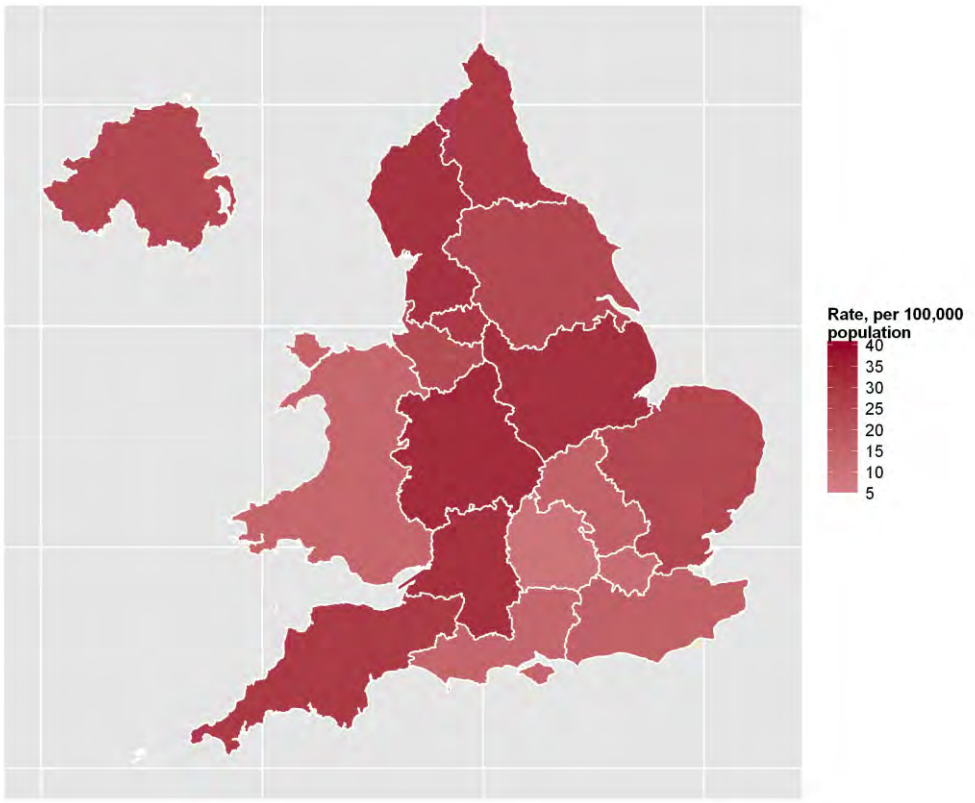
Although the rate per 100,000 population increased in some PHE centres in 2014, the overall 5-year trend still exhibited a decreasing tendency. The overall rate for England, Wales and Northern Ireland decreased by 45.5 % between 2010 and 2014 from 40.6 to 22.1 per 100,000 population, with Wales reporting the largest reduction (80.2%, from 70.2 to 13.9 per 100,000 population, respectively) during this period.

Table 2. Region-specific rates of *Clostridium difficile* in England, Wales and Northern Ireland, 2010-2014, per 100,000 population *

PHE centre	2010	2011	2012	2013	2014
London	24.1	17.9	12.5	11.3	12.2
South Midlands and Hertfordshire	23.8	18.0	16.1	17.0	15.5
East Midlands	42.8	41.2	30.0	35.8	31.1
Anglia and Essex	34.8	26.4	23.6	20.1	24.0
West Midlands	46.8	40.0	30.3	31.0	32.5
Cheshire and Merseyside	66.6	41.3	22.4	21.1	22.8
Cumbria and Lancashire	38.3	31.1	26.4	24.5	30.6
Greater Manchester	70.7	61.8	42.5	32.4	28.7
North East	36.5	35.0	32.5	28.6	27.9
Yorkshire and Humber	39.1	37.8	24.9	25.3	23.9
Avon Gloucestershire and Wiltshire	44.3	40.4	36.7	34.0	30.9
Devon Cornwall and Somerset	41.5	49.0	36.9	27.5	28.3
Wessex	30.7	29.7	25.6	16.2	14.5
Kent Surrey and Sussex	31.7	21.3	20.4	18.3	16.1
Thames Valley	43.3	36.3	19.9	13.3	9.7
England	**38.9**	**33.0**	**25.0**	**22.9**	**22.5**
Northern Ireland	**38.5**	**38.0**	**33.0**	**28.9**	**23.8**
Wales	**70.2**	**51.0**	**32.1**	**26.1**	**13.9**
E, W, NI	**40.6**	**34.1**	**25.7**	**23.3**	**22.1**

* Data extracted on 21st January and 18th February 2015

Figure 2. Geographical distribution of *Clostridium difficile* rates per 100,000 population, England, Wales and Northern Ireland: 2014*

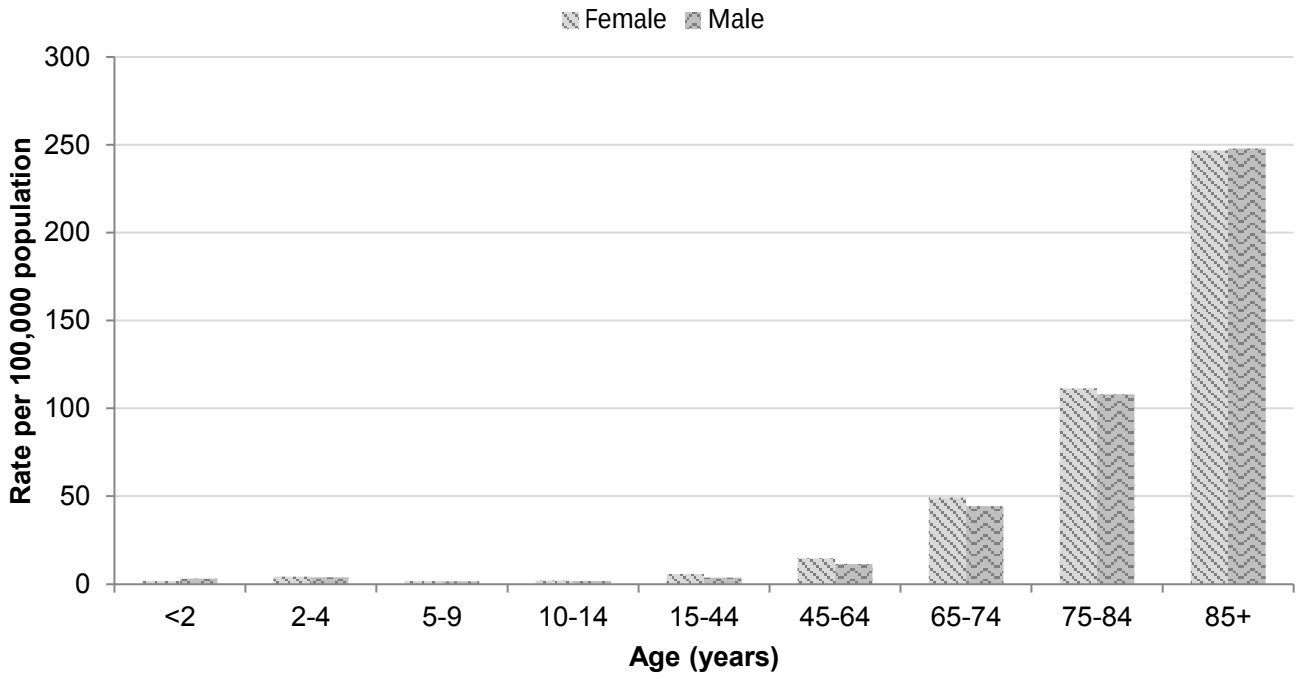


Age and sex-specific rates of *C. difficile*

The age distribution of reports did not change substantially in 2014 in comparison to reports from 2013 [3]. In 2014, the higest age-specific rate of 248.1 per 100,000 population was in 85+ age group, followed by 75-84 and 65-74 age groups (110.5 and 47.1 per 100,000 population, respectively) (figure 3, Appendix table 2). Overall, 74.08 % of *C.difficile* reports were in patients aged 65 years and over.

In 2014, the overall rate of *C. difficile* was higher in females (25.4 per 100,000 population) than males (18.3 per 100,000 population), which was a decrease of 7.6% and 6.6% in comparison to 2013 (27.5 and 19.6 per 100,000 population, respectively).

Figure 3. *Clostridium difficile* age and sex rates† per 100,000 population (England, Wales and Northern Ireland):2014*



† Rates are calculated using 2013 Office for National Statistics mid-year population estimates

* Data extracted on 21 January and 18 February 2015

Ascertainment: Comparison of *C. difficile* positive specimens from the voluntary laboratory reporting scheme versus *C. difficile* infections from the mandatory surveillance scheme in England

The following data compare *C. difficile* positive samples reported to the voluntary laboratory surveillance scheme with *C. difficile* reports to the mandatory surveillance scheme. In order for the data to be comparable, the laboratory reports from the voluntary surveillance scheme have been limited to England and among patients aged ≥2 years.

The number of *C. difficile* reports made to the voluntary surveillance decreased by 1.5% between 2013 and 2014 (12,231 vs. 12,048, respectively) (table 3) compared to the 0.01% increase in the number of reports made to the mandatory surveillance. Overall, the number of reports decreased in both the voluntary and mandatory surveillance by 62.4% and 66.2%, respectively between 2008 and 2014. The case ascertainment of *C. difficile* reported to the voluntary scheme has improved between 2008 (78.8%) and 2014 (87.5%), although the higest ascertainment was obtained in 2011 (91.3%).

Table 3. Ascertainment of *C. difficile* data for the mandatory and voluntary reporting schemes in England for patients aged 2 years and over in 2014

Year	Voluntary reports	Mandatory reports	% Ascertainment
2008	32,071	40,705	78.8
2009	23,672	27,620	85.7
2010	20,334	23,215	87.6
2011	17,476	19,144	91.3
2012	13,308	14,993	88.8
2013	12,231	13,767	88.8
2014	12,048	13,769	87.5

* Data extracted on 21st January and 18th February 2015

Discussion

- voluntary *C. difficile* reports peaked in 2007(figure 1) but have since been decreasing in line with mandatory surveillance reports [4]. The observed trend is likely to reflect the introduction of measures focused on reducing incidence of *C. difficile* infection, such as enhanced infection control procedures with emphasis on hand washing, antibiotic prescribing policies and isolation of infected patients [5, 6], which coincided with the announcement of governmental targets in October 2007.
- the majority of region-specific *C. difficile* rates have decreased since 2010, with Wales showing the largest decrease (80.2%), followed by England (42.2%) and Northern Ireland (38.1%) between 20010 and 2014.
- the recent regional trends in *C. difficile* (2013 vs 2014) were slightly different. Wales still showed the greatest decrease between 2013 and 2014 (46.8%), followed by Northern Ireland (17.6%) and England (1.7%).
- age-specific rates show that *C. difficile* mainly affects older patients with the highest rate in people aged 85 years and older (248.1 per 100,000 population), followed by those aged 75 to 84 years and 65 to 74 years (110.5 and 47.1 per 100,000 population, respectively). Overall, 74.1% of all reports were in those aged 65 years and above. Similar trends were observed in previous years [3].
- the overall rate was higher in females than males (25.4 and 18.3 per 100,000 population, respectively). The reason for this gender disparity requires further investigation.
- case ascertainment has improved by 8.7% between 2008 and 2014 (78.8% to 87.5%); however case ascertainment in 2014 was 1.3% lower than in 2013. This should be interpreted with caution taking into account differences in testing algorithms between the two surveillance systems.

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Acknowledgements

These reports would not be possible without the weekly contributions from microbiology colleagues in laboratories across England, Wales, and Northern Ireland, as well as colleagues in the regional offices of Public Health England.

Appendix

Table 1. Number of voluntary reports of *C. difficile* positive faecal specimens in England, Wales and Northern Ireland* Ireland 1990-2014**

Year	England	Wales	Northern Ireland	England, Wales & Northern Ireland
1990	1,171	22	-	-
1991	1,586	70	-	-
1992	2,419	509	-	-
1993	4,421	1,011	-	-
1994	6,353	1,117	-	-
1995	8,881	1,159	-	-
1996	10,425	1,303	-	-
1997	14,540	1,331	-	-
1998	15,721	1,397	-	-
1999	17,261	1,440	-	-
2000	18,779	1,740	-	-
2001	19,952	1,597	689	22,238
2002	26,059	1,713	928	28,700
2003	31,711	1,593	995	34,299
2004	38,447	2,078	1,380	41,905
2005	45,306	1,990	1,374	48,670
2006	49,570	2,207	1,409	53,186
2007	51,957	2,934	1,379	56,270
2008	32,216	2,954	1,668	36,838
2009	25,793	2,256	1,019	29,068
2010	20,488	2,140	695	23,323
2011	17,537	1,564	689	19,790
2012	13,400	988	602	14,990
2013	12,331	806	529	13,666
2014	12,120	429	436	12,985

* Northern Ireland reports included from 2001. ** Data extracted on 21 January and 18 February 2015

Table 2. Age and sex distribution of voluntary reports of *Clostridium difficile* in England, Wales and Northern Ireland, 2014*

					Rate per 100,000		
Age group (years)	Female	Male	Unknown	Total	Female	Male	Total
<2	14	24	3	41	1.9	3.1	2.7
2-4	46	44	0	90	4.2	3.9	4.1
5-9	32	29	0	61	1.9	1.6	1.8
10-14	31	31	3	65	2.0	1.9	2.0
15-44	666	428	3	1,097	5.7	3.7	4.7
45-64	1,109	841	14	1,964	14.7	11.5	13.2
65-74	1,409	1,181	6	2,596	49.3	44.5	47.1
75-84	2,069	1,591	18	3,678	111.5	108.0	110.5
85+	2,203	1,129	13	3,345	246.7	247.9	248.1
Unknown	2	3	43	48	-	-	-
Total	7,581	5,301	103	12,985	25.4	18.3	22.1

* Data extracted on 21 January and 18 February 2015