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Bacteraemia

Voluntary surveillance of bacteraemia caused by *Klebsiella* spp. in England: 2011-2015

These analyses are based on data relating to diagnoses of bloodstream infections caused by *Klebsiella* spp. between 2011 and 2015 in England, extracted on 20 May 2016 from Public Health England's (PHE) voluntary surveillance database Second Generation Surveillance System (SGSS). Data for Wales and Northern Ireland were extracted separately (DataStore on 10 April and CoSurv on 17 May 2016 resepctively) and are included in the geographical and species analyses only.

SGSS comprises a communicable disease module that includes antimicrobial susceptibility data (CDR; formerly CoSurv/LabBase2) and a separate comprehesive antimicrobial resistance module (AMR; formerly AmSurv). Compared to CDR's antimicrobial susceptibility data, the AMR module captures more comprehensive antibiogram data (involving all antibiotics tested); however, until the launch of SGSS in 2014 there was a lower laboratory coverage to the AMR module. Therefore, antimicrobial non-susceptibility trends cannot currently be undertaken using data from the AMR module but data for 2015 were extracted to assess multi-drug resistance rates.

The data presented here for earlier years 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 2015 rates, which were based on 2014 population estimates as population estimates for 2015 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 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.

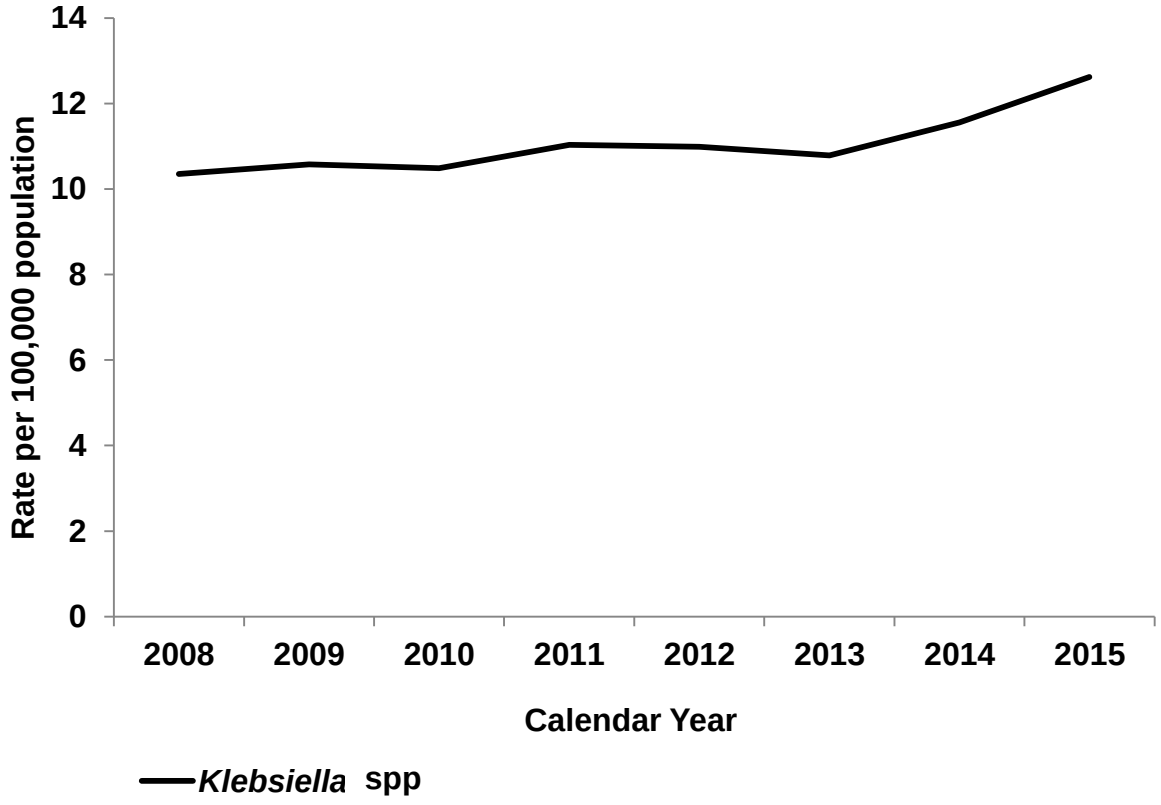
Key points

- between 2014 and 2015 the total number of reports of *Klebsiella* spp. bacteraemia in England increased by 9% (from 6,280 to 6,856 episodes), an increase in population rate from 11.6 to 12.6 per 100,000 population.
- in 2015, 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. bacteraemia reports was generally higher in males than females and among older adults (≥75 years) and infants (<1 year)
- in 2015, Northern Ireland had the highest rate of *Klebsiella* spp. bacteraemia reports (14.8/100,000) followed by Wales (14.1) and England (12.6)
- in England, Devon, Cornwall and Somerset PHE centre had the highest rate of reports at 19.4/100,000 population in 2015, followed by East Midlands at 15.8. The lowest rates were in Wessex (6.0) and Thames Valley (9.4). Trends from 2011 to 2015 showed that the majority of PHE centres had an increase with Devon, Cornwall and Somerset in particular seeing a substantial increase in 2015 over the previous years.
- antimicrobial susceptibility trends from 2011 to 2015 were examined for five classes of antibiotics
    - for the two third-generation cephalosporins examined, there was a marginal increase in resistance to cefotaxime and ceftazidime for *Klebsiella* spp., reaching 10% (12% for *K. pneumoniae*) for each antibiotic in 2015.
    - resistance to the fluoroquinolone ciprofloxacin also increased marginally, reported in 9% of *Klebsiella* spp. (11% for *K. pneumoniae*) in 2015.
    - resistance to the aminoglycoside gentamicin increased marginally from 6% in *2011* to 7% in 2015 *(*9% for *K. pneumoniae* although stable throughout for *K. oxytoca* at 1%).
    - further increases in *Klebsiella* spp. resistance to piperacillin/tazobactam were seen, reported in 17% of isolates in 2015 (19% 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 in 2015 (≤1%) at genus level and species level
- the most common dual resistance was to ciprofloxacin and third-generation cephalosporins among *K. pneumoniae* bacteraemia isolates (11.5%). The least frequent dual resistance was for ciprofloxacin and gentamicin (0.4%) among *K. oxytoca* bacteraemia isolates.

Trends in the number of bacteraemia reports and rates: England

Figure 1a is based on data for England only. This shows the trend in the rates of *Klebsiella* spp. bacteraemia laboratory reports of between 2008 and 2015 per 100,000 resident population. The annual rate was relatively stable around 11.0/100,000 between 2008 and 2013. Increases occurred after this with a 17% increase from 2013 to 2015. Between 2014 and 2015 in particular the rate increased by 9% from 11.6/100,000 to 12.6/100,000 population respectively.

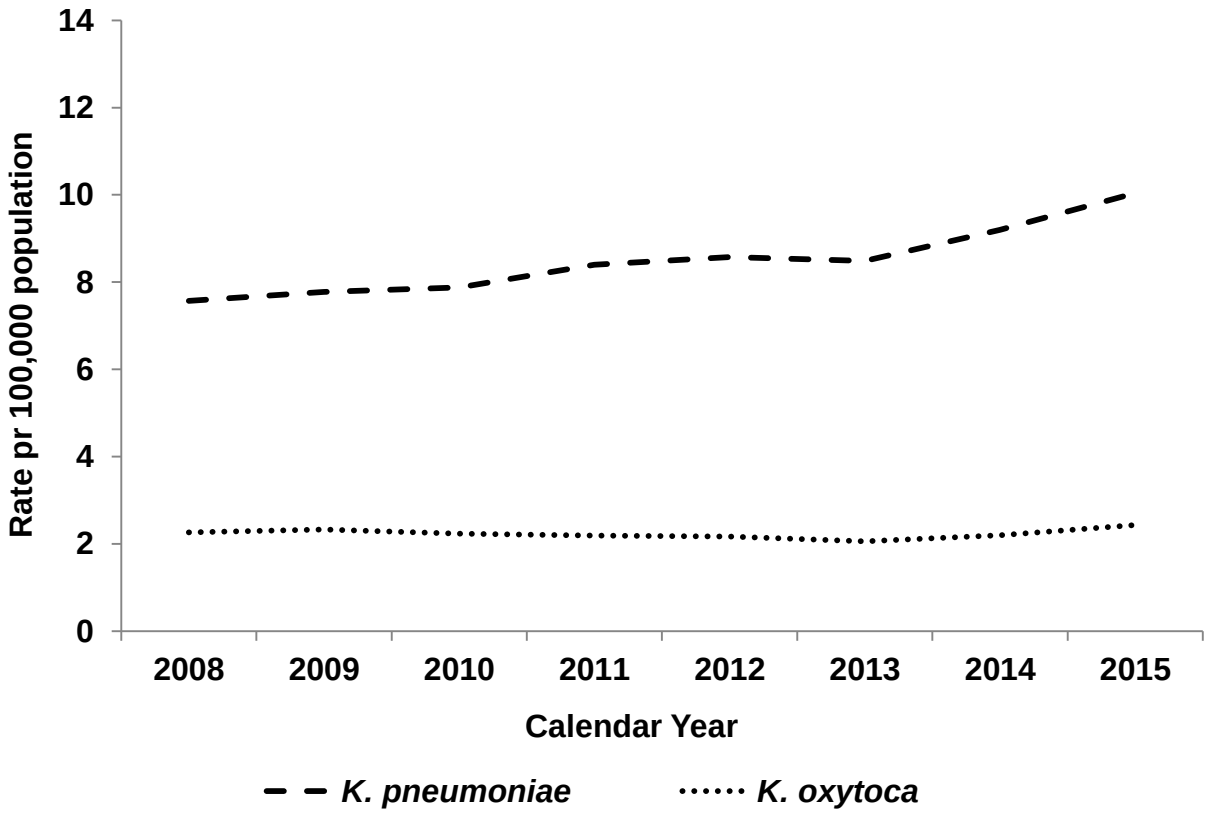
Figure 1a *Klebsiella* spp. bacteraemia rate per 100,000 population, England: 2008- 2015



Source: PHE, 2016

Figure 1b, also based on data for England, shows trends in the rates of bacteraemia laboratory reports between 2008 and 2015 per 100,000 resident population for the two main species. The rates of *K. pneumoniae* bacteraemia the rate was relatively stable at around 8.0/100,000 *per annum* until 2013. The rate increased by 18% from 2013 to 2015. The rate for *K. oxytoca* (figure 1b) was stable throughout the study period at around 2.0/100,000 *per annum*.

Figure 1b Bacteraemia rate per 100,000 population, *K. pneumonaie* and *K. oxytoca*, England: 2008- 2015



Geographical distribution: England, Wales and Northern Ireland

The geographical analyses presented here are not corrected for variation in reporting between geographical areas. Figure 2 is a graphical display of the regional variation in the rates in 2015. Table 2 shows five-year trends by geographical region from 2011 to 2015.

In 2015 the overall rate of laboratory reports of *Klebsiella* spp. bacteraemia for England, Wales and Northern Ireland was 12.8 per 100,000 population. The analysis by country showed that Northern Ireland had the highest rate (14.8) followed by Wales (14.1) then England (12.6).

Within England, there was variation in the rate between the 15 PHE regions (PHECs). In 2015, the highest rates were in Devon, Cornwall and Somerset at 19.4/100,000, East Midlands (15.8) and Cheshire and Merseyside (14.7). The lowest rates were in Wessex (6.0) and Thames Valley (9.4). Although the highest *Klebsiella* spp. bacteraemia rate was in Devon, Cornwall and Somerset, carbapenem-resistant isolates were more frequently reported by laboratories in London and Greater Manchester (described in the antimicrobial susceptibility section of this report).
Although no PHEC experienced a steady year-on-year increase over the five-year period, the majority showed an increase from 2013 (table 1). The analysis for Devon, Cornwall and Somerset in particular showed an increase from its fairly stable rate of around 16.0/100,000 *per annum* to 19.4/100,000 in 2015. The lowest rates were consistently observed in Wessex and Thames Valley over this five-year period.

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.

Figure 2. Geographical distribution of the rate of *Klebsiella* spp. bacteraemia reports per 100,000 population (England, Wales and Northern Ireland): 2015

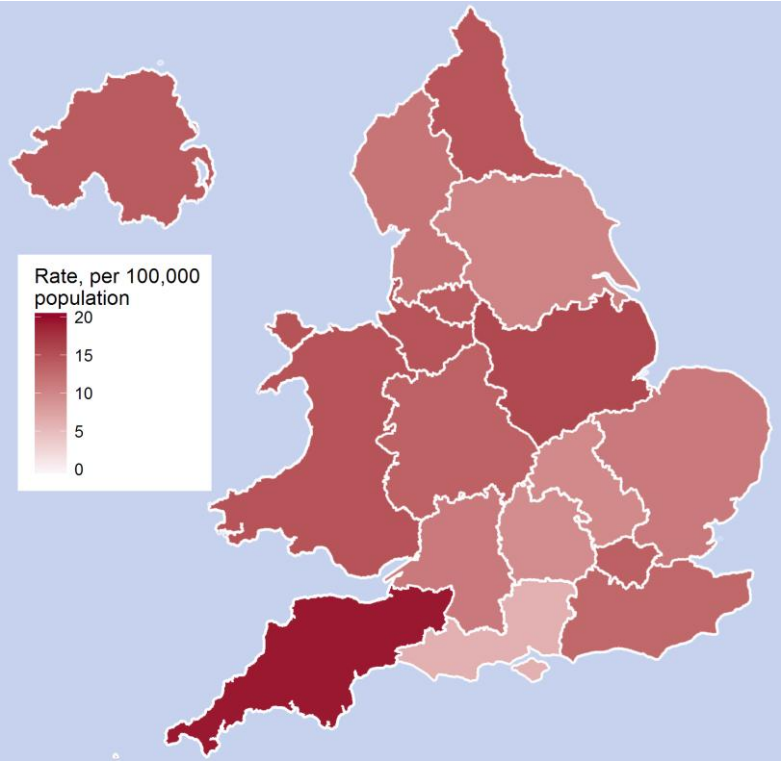


Table 1. Rate of *Klebsiella* spp. bacteraemia reports per 100,000 population by PHE Centre (England, Wales and Northern Ireland): 2011 to 2015

		Rate per 100,000 resident population				
Region	**PHE Centre**	**2011**	**2012**	**2013**	**2014**	**2015**
North of England	Cheshire and Merseyside	13.8	14.5	14.8	12.3	14.7
	Cumbria and Lancashire	10.4	11.2	10.7	13.7	11.7
	Greater Manchester	14.7	14.5	14.1	14.1	13.9
	North East	11.2	12.0	11.7	13.3	14.6
	Yorkshire and Humber	10.3	10.0	7.7	9.0	10.2
Midlands and East of England	Anglia and Essex	10.2	11.2	9.9	10.9	11.3
	East Midlands	14.3	11.6	12.1	12.4	15.8
	South Midlands and Hertfordshire	6.5	8.5	7.2	8.5	9.7
	West Midlands	11.5	11.1	11.1	12.6	13.5
London	London	11.8	11.6	12.2	12.8	13.6
South of England	Avon Gloucestershire and Wiltshire	8.3	8.9	8.5	10.2	11.2
	Devon Cornwall and Somerset	15.2	15.2	15.9	16.4	19.4
	Kent Surrey and Sussex	10.8	11.1	12.1	12.0	12.9
	Thames Valley	8.1	7.1	6.5	6.8	9.4
	Wessex	5.8	5.4	6.0	6.8	6.0
England*		**11.0**	**11.0**	**10.8**	**11.6**	**12.6**
Northern Ireland†		**13.7**	**14.0**	**15.6**	**14.3**	**14.8**
Wales‡		**11.7**	**11.7**	**12.4**	**12.9**	**14.1**
England, Wales and Northern Ireland		**11.2**	**11.2**	**11.1**	**11.7**	**12.8**

* Extracted on 20 May 2016; † extracted on 17 May 2016; ‡ extracted on 10 April 2016. Source: PHE, 2016

Table 2. Reports of bacteraemia due to *Klebsiella spp.* (England, Wales and Northern Ireland): 2011 to 2015

	2011		2012		2013		2014		2015	
	No.	%	No.	%	No.	%	No.	%	No.	%
England										
K. oxytoca	1,161	19.8	1,158	19.7	1,107	19.1	1,194	19.0	1,322	19.3
K. pneumoniae	4,459	76.1	4,585	78.0	4,571	78.7	4,995	79.5	5,455	79.6
Klebsiella spp., other named	9	0.2	10	0.2	13	0.2	10	0.2	11	0.2
Klebsiella spp., sp. not recorded	233	4.0	127	2.2	119	2.0	81	1.3	68	1.0
***Klebsiella* spp.**	**5,862**	100.0	**5,880**	100.0	**5,810**	100.0	**6,280**	100.0	**6,856**	100.0
Wales										
K. oxytoca	98	23.3	97	22.5	101	21.0	80	18.1	80	17.5
K. pneumoniae	313	74.5	320	74.2	373	77.4	336	75.8	340	74.4
Klebsiella spp., other named	8	1.9	10	2.3	6	1.2	3	0.7	0	0.0
Klebsiella spp., sp. not recorded	1	0.2	4	0.9	2	0.4	24	5.4	37	8.1
***Klebsiella* spp.**	**420**	100.0	**431**	100.0	**482**	100.0	**443**	100.0	**457**	100.0
Northern Ireland										
K. oxytoca	63	29.7	57	26.6	57	25.2	58	24.4	67	25.8
K. pneumoniae	146	68.9	154	72.0	163	72.1	179	75.2	192	73.8
Klebsiella spp., other named	1	0.5	3	1.4	6	2.7	1	0.4	0	0.0
Klebsiella spp., sp. not recorded	2	0.9	0	0.0	0	0.0	0	0.0	1	0.4
***Klebsiella* spp.**	**212**	100.0	**214**	100.0	**226**	100.0	**238**	100.0	**260**	100.0

Source: PHE, 2016

Species distribution

In 2015, the majority of *Klebsiella* spp. from blood specimens were identified to species level (99%), a small improvement compared with previous years (table 2). In 2015, as in previous years, the predominant species was *K. pneumoniae* accounting for 79% of reports, followed by *K. oxytoca* (19%). It should be noted that *K. aerogenes* is not a valid species although it continues to be reported with numbers declining substantially in recent years (n<5 in 2015). Also a small number of reports of *K. ornithinolytica* continue to be reported, but these were excluded from all analyses in this report due to the taxonomic change to *Raoultella ornithinolytica* in 2001.

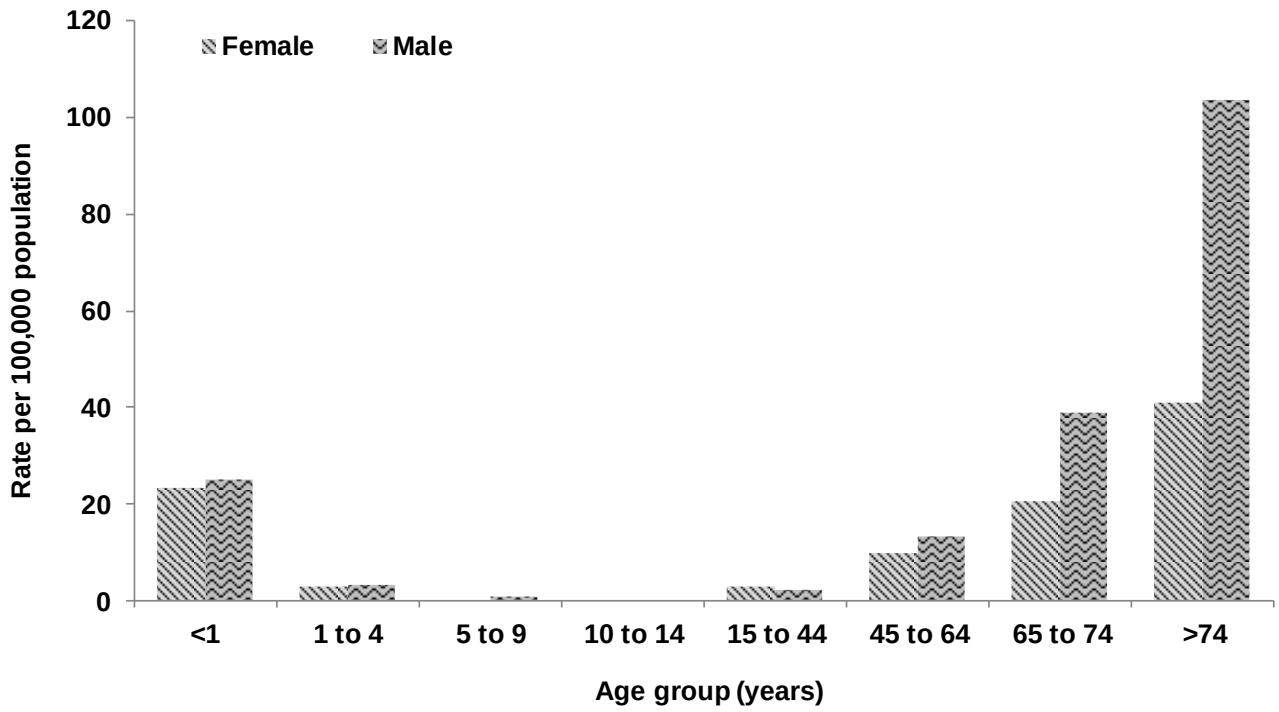
Table 2 shows the number of *Klebsiella* spp. bacteraemia reports based on data from England, Wales and Northern Ireland between 2011 and 2015. Between 2011 and 2013, the total number of *Klebsiella* spp. bacteraemia reports in England was stable at around 5,800 *per annum*; however, between 2013 and 2015, the number of reports increased by 18% for *Klebsiella* spp. (19% for *K. pneumoniae*), with a 9% increase between 2014 and 2015 alone for both *Klebsiella* spp. (from 6,280 to 6,856 episodes) and *K. pneumoniae* (from 4,995 to 5,455 episodes) (table 2). In Wales, although the total number of *Klebsiella* spp. bacteraemia reports increased by 9% from 2014 to 2015, these increases involved small absolute number (table 2). However a small but increasing trend is discernible from 212 episodes in 2011 to 260 in 2015, representing a 23% increase. In Northern Ireland, a 9% increase in *Klebsiella* spp. bacteraemia reports from 2014 to 2015 was also observed (table 2) but again involved small absolute numbers. The number of episodes peaked at 280 in 2013 in Northern Ireland with a subsequent decrease observed afterwards.

Age and sex distribution

Figure 3 shows the age and sex-specific rates of bacteraemia reports in England in 2015 per 100,000 resident population. The rates were higher in adults over 75 years and in infants (under one year). The rate of bacteraemia was higher among males than females across all age groups except for the age group 15 to 44 years where the rate was slightly higher for females.

The incidence rate ratio (IRR) for *Klebsiella* spp. bacteraemia in males and females was highest for 5 to 9 year-olds (IRR=3.3), indicating that the rate for males was more than three times higher than for females. However, in this age group the rate for each sex was <1 per 100,000 population. The second highest IRR was for the oldest age group (≥75 years; IRR=2.5) indicating that the rate was more than twice as high in males than females.

Figure 3. Age and sex-specific rates of *Klebsiella* spp. bacteraemia reports per 100,000 population (England): 2015



Source: PHE, 2016

Antimicrobial susceptibility data

Tables 3-5 present antibiotic susceptibility trends from 2011 to 2015 in England for blood culture isolates using data from the CDR module of SGSS. This analysis examines five classes of antibiotics: third-generation cephalosporins (cefotaxime or ceftazidime), carbapenems (meropenem or ertapenem), a fluoroquinolone (ciprofloxacin), a penicillin/beta-lactamase inhibitor combination (piperacillin/tazobactam), and an aminoglycoside (gentamicin).

Table 6 shows dual resistance in England in 2015 based on a defined combination of antimicrobial drugs based on data from SGSS's AMR module. Trends using data from this module cannot be undertaken at present owing to lower laboratory coverage in previous years.

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. The analysis for *Klebsiella* spp. isolates (all species) showed that resistance to cefotaxime and to ceftazidime increased marginally from 9% in 2011 to 10% in 2015 for each agent (table 3). Similarly, for *K. pneumoniae,* resistance to these agents increased marginally for cefotaxime (from 10% in 2011 to 12% in 2015) and for ceftazidime (from 11% in 2011 to 12% in 2015) (table 4). *K. oxytoca* showed a lower level of resistance to these agents and no trend was observed (table 5).

The proportion of isolates reported resistant to piperacillin/tazobactam increased gradually over the five-year period for *Klebsiella* spp. isolates (from 12% in 2011 to 17% in 2015) (table 3). This was similarly reflected in the analysis for *K. pneumoniae*, which also showed an increase from 13% in 2011 to 19% in 2015 (table 4). These results are likely to reflect laboratories switching from the CLSI MIC breakpoint of 16 mg/L to the EUCAST breakpoint of 8 mg/L for this agent for Enterobacteriaceae introduced in 2011. However among *K. oxytoca* isolates, there was no evidence of change with levels of resistance to this antibiotic fluctuating between 10% and 13% over the five-year period (table 5).

A marginal increase in resistance to ciprofloxacin was observed from 8% in 2011 to 9% in 2015 at genus level (table 3). At species level, although *K. pneumoniae* tended to have a higher resistance rate to this agent than *K. oxytoca*, neither species exhibited a change in resistance level to this antibiotic (tables 4 and 5).

Resistance to gentamicin increased marginally at genus level (from 6% in 2011 to 7% in 2015) (table 3) and for *K. pneumoniae* (from 7% in 2011 to 9% in 2015) (table 4). However resistance to this agent remained low and stable for *K. oxytoca* (being <3% throughout the five-year period) (table 5). The reason for the small increase at genus level is due to the small increase of *K. pneumoniae* given that this species accounts for the majority of *Klebsiella* spp.

Of the two carbapenems, resistance to meropenem remained uncommon between 2011-2015 with 1% or fewer of isolates reported as resistant. At genus level, the marginal increases observed from 0.6% in 2012 to 1.2% 2014 was not sustained in 2015 (table 3). For *K. pneumoniae* marginal increases were also observed (from 0.6% in 2012 to 1.5% in 2014) but this trend was not sustained into 2015 (table 4). Resistance to ertapenem was slightly higher than that for meropenem and although a marginal increase was observed at genus level (from 1.1% in 2012 to 1.7% in 2014) this trend was not sustained in 2015. *K. pneumoniae* was more often resistant to ertapenem than *K. oxytoca* (tables 4 and 5). A small but notable increase in the proportion of isolates that were resistant to this agent was reported for *K. pneumoniae* isolates (from 1.3% in 2012 to 2.1% in 2014) but this trend was not sustained in 2015. Resistance to ertapenem among *K. oxytoca* isolates was much less common and no trend was identified in the five-year period.

It should be noted that EUCAST's clinical breakpoint for determining susceptibility to ertapenem is lower than that for meropenem (0.5 mg/L vs 2 mg/L, respectively). However, ertapenem is more prone to resistance due to ESBL production together with porin deficiency arising via mutation. Meropenem resistance is rarer owing to the higher breakpoint and lower vulnerability

to this combination of mechanisms. Consequently resistance to meropenem is more likely to be due to true carbapenemases, hence of public health concern.

In England, the majority of carbapenem-resistant isolates reported between 2011 and 2015 (n=273) were reported from laboratories in London (n=61) and Greater Manchester (n=48), which combined accounted for 40% (109/273) of total carbapenem-resistant isolates.

Klebsiella spp. organisms are the commonest hosts of carbapenemase enzymes which belong to the KPC, OXA-48-like, NDM, VIM or IMP families; other types of carbapenemase, such as GES enzymes, also occur (both in Enterobacteriaceae and non-fermenters such as *Pseudomonas aeruginosa*) and have caused outbreaks in some UK hospitals. Among Enterobacteriaceae in general, resistance to carbapenems may also be mediated by ESBL or AmpC production combined with impermeability (porin loss). However, data on all Enterobacteriaceae isolates from all specimen types 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 with sporadic cases reported as far back as 2003. Resistance to the carbapenem class warrants close vigilance given that this class of antibiotics is a powerful last-line treatment for serious infections caused by Gram-negative bacteria. The increases in CPE based on all specimen types observed by PHE's ARMHAI are occurring in the context of the emergence of resistance to these antibiotics among Enterobacteriaceae reported internationally in recent years [3,4].

In recognition of the importance of CPE, PHE issued a toolkit in December 2013 on the identification and management of affected patients in acute healthcare settings [5]. 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 was issued in June 2015 [6].

As CPE pose significant treatment and public health challenges, PHE launched an enhanced surveillance of CPE in May 2015 to better understand the epidemiology of these organisms. A web-based electronic reporting system (https://cro.phe.nhs.uk/) has been designed to enable laboratories in NHS Trusts in England to capture specimen, demographic, healthcare setting and risk factor details as part of the core and enhanced dataset [7].

Table 3. Antibiotic susceptibility of *Klebsiella* spp. bacteraemia isolates, England: 2011-2015

	2011		2012		2013		2014		2015	
	No. Tested	% Resistant	No. Tested	% Resistant	No. Tested	% Resistant	No. Tested	% Resistant	No. Tested	% Resistant
Gentamicin	5,230	6%	5,268	6%	5,176	7%	5,414	6%	6,200	7%
Ciprofloxacin	4,798	8%	4,904	8%	4,801	9%	4,991	9%	5,814	9%
Ceftazidime	4,137	9%	4,145	10%	3,907	10%	4,083	10%	4,956	10%
Cefotaxime	2,974	9%	3,023	10%	2,964	10%	3,065	10%	3,371	10%
Meropenem	3,961	1%	4,101	1%	4,222	1%	4,640	1%	5,637	1%
Ertapenem	1,385	2%	1,993	1%	2,392	1%	3,166	2%	4,815	1%
Piperacillin/Tazobactam	4,791	12%	4,984	13%	4,948	16%	5,047	16%	5,853	17%
Total reports	**5,862**		**5,880**		**5,810**		**6,280**		**6,856**	

Source: PHE, 2016

Table 4. Antibiotic susceptibility of *K. pneumoniae* bacteraemia isolates, England: 2011-2015

	2011		2012		2013		2014		2015	
	No. Tested	% Resistant	No. Tested	% Resistant	No. Tested	% Resistant	No. Tested	% Resistant	No. Tested	% Resistant
Gentamicin	3,991	7%	4,133	7%	4,060	8%	4,306	7%	4,936	9%
Ciprofloxacin	3,652	10%	3,852	10%	3,773	11%	3,991	11%	4,613	11%
Ceftazidime	3,163	11%	3,267	11%	3,100	12%	3,243	12%	3,939	12%
Cefotaxime	2,316	10%	2,405	11%	2,366	12%	2,441	12%	2,720	12%
Meropenem	3,018	<1%	3,231	<1%	3,319	<1%	3,699	1%	4,479	1%
Ertapenem	1,081	2%	1,559	1%	1,889	2%	2,534	2%	3,834	1%
Piperacillin/Tazobactam	3,646	13%	3,911	13%	3,876	17%	4,022	17%	4,654	19%
Total reports	**4,459**		**4,585**		**4,571**		**4,995**		**5,455**	

Source: PHE, 2016

Table 5. Antibiotic susceptibility of *K. oxytoca* bacteraemia isolates, England: 2011-2015

	2011		2012		2013		2014		2015	
	No. Tested	% Resistant	No. Tested	% Resistant	No. Tested	% Resistant	No. Tested	% Resistant	No. Tested	% Resistant
Gentamicin	1,025	1%	1,022	1%	1,004	1%	1,026	2%	1,194	1%
Ciprofloxacin	941	2%	949	2%	921	2%	921	1%	1,133	2%
Ceftazidime	792	3%	807	2%	735	3%	786	2%	964	2%
Cefotaxime	567	4%	568	4%	551	5%	572	3%	604	3%
Meropenem	781	0%*	783	<1%	808	<1%	868	<1%	1,094	<1%
Ertapenem	264	<1%	393	<1%	464	<1%	597	<1%	937	<1%
Piperacillin/Tazobactam	935	12%	959	10%	958	13%	951	13%	1,133	11%
Total reports	**1,161**		**1,158**		**1,107**		**1,194**		**1,322**	

* Due to 0 cases

Source: PHE, 2016

The SGSS AMR data for 2015 showed that 99.9% of total blood culture isolates for *Klebsiella* spp. had antimicrobial susceptibility data (6,489/6,496). Multi-drug resistance was based on combinations of two different defined antibiotics (table 6). *K. pneumoniae* exhibited the highest frequency of dual resistance and *K. oxytoca* the least.

Among *K. pneumoniae* bacteraemia isolates, the most common dual resistance was to third generation cephalosporins and ciprofloxacin (11.5%). The least common dual resistance was among *K. oxytoca* isolates to ciprofloxacin and gentamicin at <0.5% of isolates tested. Resistance to third generation cephalosporins, ciprofloxacin, gentamicin and meropenem was uncommon (<1%) among *K. pneumoniae* isolates (14/2,439) and *K. oxytoca* (zero cases in 577 isolates) (data not shown).

While the percentage of all *K. pneumoniae* bacteraemia isolates tested for pair-wise resistance for both a third-generation cephalosporin and either gentamicin or ciprofloxacin were relatively low, of the 539 isolates that were non–susceptible to third-generation cephalosporins, 55% (299/539) were non-susceptible to ciprofloxacin and 53% (287/539) were non-susceptible to gentamicin (data not shown). The corresponding proportions for *K. oxytoca* were 16% (9/55) and 12% (7/55) although this is based on only a small number of bacteraemia isolates that were non-susceptible to third-generation cephalosporins. Resistance to both ciprofloxacin and gentamicin among *K. pneumoniae* isolates resistant to third-generation cephalosporins was 40% (218/539) with the corresponding proportion being 7% (4/55) *for K. oxytoca* (data not shown).

Table 6. Dual resistance among isolates of bacteraemia due to *K. pneumoniae or K. oxytoca*, England, 2015

	Gentamicin and ciprofloxacin		Gentamicin and 3rd-generation cephalosporin*		Ciprofloxacin and 3rd generation cephalosporin*	
	No. tested	% Resistant	No. tested	% Resistant	No. tested	% Resistant
K. pneumoniae	4,899	5.8	2,647	10.8	2,593	11.5
K. oxytoca	1,259	0.4	632	1.1	612	1.5

* Any of cefotaxime, ceftazidime, cefpodoxime or ceftriaxone

Source: PHE, 2016

For advice on treatment of antibiotic-resistant infections due to these organisms or for reference services including species identification and confirmation of susceptibility testing results, laboratories should contact PHE's AMRHAI Reference Unit in London [8].

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: hcai.amrdepartment@phe.gov.uk

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