Public Health England

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Current News

Infection Reports

Bacteraemia/HCAI

News

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JCVI advises continuation of maternal pertussis vaccination programme

PHE has welcomed the Joint Committee on Vaccination and Immunisation's advice to the Department of Health that the pertussis vaccination programme for pregnant women should continue for a further five years [1].

Available data relating to the coverage, effectiveness and safety of the programme, its impact on disease and current epidemiology were considered by the JCVI at its June 2014 meeting and on the basis of these data it has advised that the programme should be extended [2].

An overall decline in pertussis cases since the maternal vaccination programme began in October 2012 is apparent in data on pertussis infections in England to end-May 2014, published in this issue of HPR (see following news report, in which references to newly published safety and effectiveness data are included) [3].

References

1. "Continuation of whooping cough vaccination programme for pregnant women advised as new evidence on effectiveness and safety published", PHE press release, 16 July 2014.

2. Minutes of Joint Committee on Vaccination and Immunisation meetings, 16 July 2014.

3. Laboratory confirmed pertussis in England: data to end-May 2014, *HPR* **8**(28), Advanced Access report published on 16 July 2014.

Laboratory confirmed pertussis in England: data to end-May 2014

With the exception of a small expected seasonal peak in July and August 2013, overall pertussis activity in England continued to fall through to April 2014 but has increased slightly into May and continues to persist at raised levels compared to the years preceding the outbreak in 2012. An increase in laboratory confirmed cases has been observed in adolescents aged 10-14 years from December 2013, in infants <3 months of age from April 2014 and in adults aged 15 years and older in May 2014. There have been five deaths in infants with pertussis diagnosed in 2014 to the end of May. Immunisation of pregnant women continues to be important in the face of these continued raised levels of pertussis and recent infant deaths and with the newly published high effectiveness (>90%) and safety of the pertussis immunisation in pregnancy programme [1,2]. This news report presents current pertussis activity to 31 May 2014, updating the previous report that included data to the end of December 2013 [3].

A level 3 incident was declared in April 2012 to coordinate the response to the ongoing increased pertussis activity observed in the third quarter of 2011 and extending into 2012 (see figure 1) [4]. In response to this ongoing outbreak, the Department of Health announced on 28 September [5,6] that pertussis immunisation would be offered to pregnant women from 1 October 2012 to protect infants from birth whilst disease levels remain high. Available data relating to the coverage, effectiveness and safety of the programme, its impact on disease and current epidemiology were considered by the Joint Committee on Vaccination and Immunisation (JCVI) at its June 2014 meeting and on the basis of these data it has advised that this programme should be extended for a further five years [7].

In infants under 3 months of age low numbers of cases have been sustained since December 2012 with <10 cases per month up to August 2013 and six or fewer cases reported each month between September 2013 and March 2014. Cases increased in April and May 2014, however, with 11 and 14 cases respectively; the highest number of monthly cases since 23 reported in November 2012. The greatest decrease in disease since the peak in 2012 has been in infants under six months of age who are targeted by the maternal pertussis vaccination programme.

Disease incidence has, as expected, continued to be highest in this age group. There have been five deaths reported in young babies (<2 months) diagnosed with pertussis this year. In total eight deaths have been reported in young babies with confirmed pertussis who were born after the introduction of the pregnancy programme on 1 October 2012. Seven of these eight babies were born to mothers who had not been vaccinated against pertussis.

Pertussis activity in infants aged 3-11 months of age remained low with occasional cases reported, almost all in infants who had not received three primary doses of vaccine. Confirmed pertussis also remains low in children aged 1-4 years and, whilst small numbers of cases were confirmed in those aged 5-9 years, these increased slightly to 10-13 cases each month from February 2014 and in the first five months of 2014 exceeded the number of cases in the same time period confirmed each year from 2008.

Pertussis activity in adolescents, teenagers and adults (aged 10-14 and ≥15 years) was lower in January to May 2014 when compared to the equivalent period in 2013 (table 1). Monthly cases in the 10-14 year age group had increased, however, from December 2013. Cases in those aged 15 years and older were relatively stable in the first four months of 2014 but appeared to increase in May. Overall, confirmed cases of pertussis have been lower between January and May 2014 than in the first five months of the two preceding years but cases continue to exceed those confirmed in years prior to 2012. High pertussis activity has been observed across all regions in England with a third of cases in 2014 reported from the South of England (table 2).

The pertussis vaccination in pregnancy programme continues to be important for the prevention of serious disease and death in young babies. To optimise protection of their babies, women should ideally be immunised between 28-32 weeks gestation but may be immunised up to week 38 of pregnancy. Immunisation after week 38 is not ideal as it is unlikely to provide direct passive protection to the infant. Pregnant women who remain unprotected can be offered vaccination after 38 weeks as can new mothers who have not been vaccinated in pregnancy. At this stage of pregnancy, however, vaccination would potentially only directly protect the mother against disease and thereby just reduce the risk of exposure to her infant.

Approximately 60% of all pregnant women in England are currently being vaccinated in pregnancy [8]. This is important because around 75% of all cases of pertussis in babies occur before they can be protected by even the first dose of infant vaccine and when there is a high risk of serious disease. The babies that have died from pertussis in England over recent years all acquired pertussis in the first few weeks of life. Information generated from the pertussis immunisation in pregnancy programme in England has shown high levels of protection against disease in babies born to vaccinated women. Babies born to women vaccinated at least a week

before delivery had a 91% reduction in the risk of disease in their first weeks of life when compared to babies whose mothers had not been vaccinated [1]. In addition, no safety concerns were found relating to pertussis vaccination in pregnancy in a study undertaken by the Medicines and Healthcare Products Regulatory Agency [2].

Figure 1: Provisional number of laboratory confirmed cases of pertussis in England by age group and month: January 2011 to May 2014

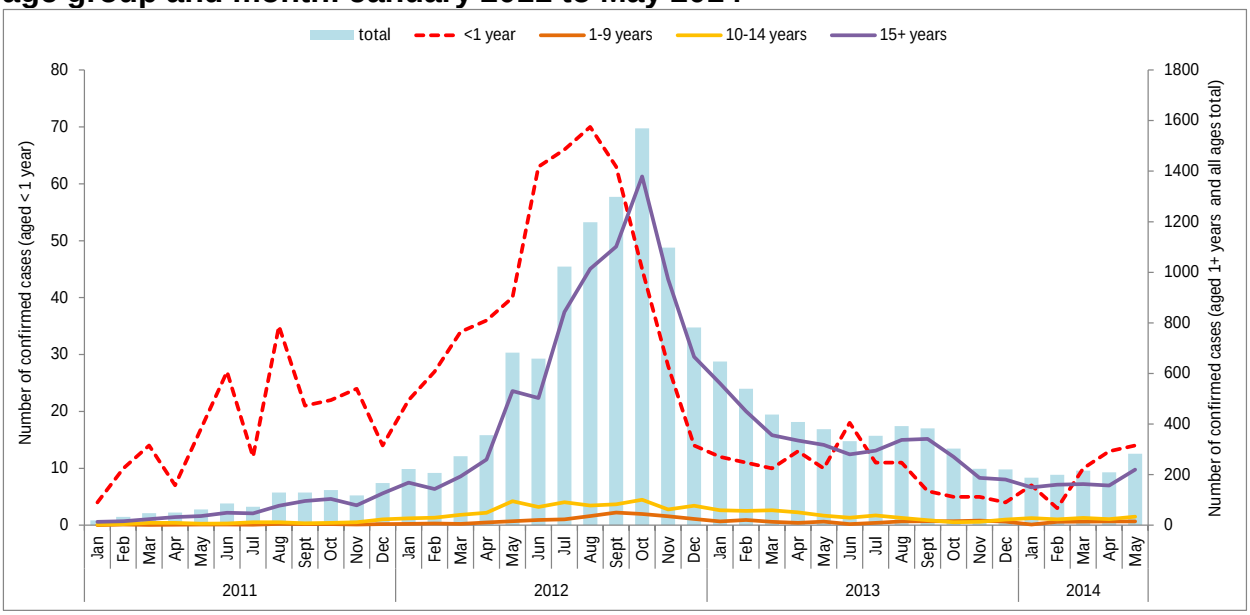

Table 1: Provisional number of laboratory confirmed cases in England, 2008-2014 by age group: January to May

Year	Month	Age group							
		<3 months	3-5 months	6-11 months	1-4 years	5-9 years	10-14 years	15+ years	All ages
2008	January - May	62	13	2	11	8	57	155	308
2009	January - May	45	13	0	9	4	33	137	241
2010	January - May	21	3	0	2	5	22	78	131
2011	January - May	41	9	2	4	5	30	121	212
2012	January - May	136	21	2	7	37	242	1295	1740
2013	January - May	42	13	1	27	45	264	2021	2413
2014	January - May	37	5	5	12	48	138	850	1095

Table 2: Provisional number of laboratory confirmed cases in England, 2008-2014 by PHE Region and PHE Centre: January to May

PHE Region	PHE Centre	2008	2009	2010	2011	2012	2013	2014
		January - May	January - May	January - May	January - May	January - May	January - May	January - May
London	London	33	37	15	26	145	260	183
Midlands and East of England	Anglia and Essex	21	18	8	13	95	197	71
	East Midlands	22	28	4	31	191	282	82
	South Midlands and Hertfordshire	12	5	2	12	64	71	46
	West Midlands	23	18	1	14	98	193	89
	Total	78	69	15	70	448	743	288
North of England	Cheshire and Merseyside	17	9	4	5	34	84	28
	Cumbria and Lancashire	11	14	9	12	31	59	17
	Greater Manchester	5	2	4	7	60	45	22
	North East	19	5	19	19	86	147	36
	Yorkshire and Humber	15	13	15	16	200	266	158
	Total	67	43	51	59	411	601	261
South of England	Avon, Gloucestershire and Wiltshire	41	24	7	18	275	244	53
	Devon, Cornwall and Somerset	15	9	17	7	80	115	45
	Sussex, Surrey and Kent	23	20	8	18	191	306	154
	Thames Valley	36	27	15	11	79	65	45
	Wessex	15	12	3	3	111	79	66
	Total	130	92	50	57	736	809	363
England Total		308	241	131	212	1740	2413	1095

References

1. Amirthalingam G, Andrews N, Campbell H *et al*. "Effectiveness of maternal pertussis vaccination in England: an observational study". *Lancet* (Early Online Publication), 16 July 2014.

2. Donegan K, King B, Bryan P. "The safety of pertussis vaccination in pregnant women in the UK: An observational study". *BMJ* 2014; 349: g4219.

3. Confirmed pertussis cases in England and Wales: update to end-December 2013. *HPR* **8**(6): news, 14 February 2014. http://www.hpa.org.uk/hpr/archives/2014/news0614.htm#prtsss.

4. A level 3 incident is the third of five levels of alert under the HPA's Incident Reporting and Information System (IERP) according to which public health threats are classified and information flow to the relevant outbreak control team is coordinated. A level 3 incident is defined as one where the public health impact is significant across regional boundaries or nationally. An IERP level 3 incident was declared in April 2012 in response to the ongoing increased pertussis activity (*HPR* **6**(15), http://www.hpa.org.uk/hpr/archives/2012/news1512.htm).

5. "Pregnant women to be offered whooping cough vaccination", 28 September 2012. Department of Health website, http://www.dh.gov.uk/health/2012/09/whooping-cough/.

6. "HPA welcomes introduction of whooping cough vaccination for pregnant women as outbreak continues", HPA press release, 28 September 2012, HPA legacy website: http://www.hpa.org.uk/NewsCentre/NationalPressReleases/2012PressReleases/120928whoopvaccforpregwomenwelcome/.

7. Joint committee of Vaccination and Immunisation minutes: https://www.gov.uk/government/groups/joint-committee-on-vaccination-and-immunisation#minutes [*from 0930 hrs. 16 July*].

8. Pertussis Vaccination Programme for Pregnant Women: vaccine coverage estimates in England, October 2012 to March 2014: https://www.gov.uk/government/publications/pertussis-vaccine-uptake-in-pregnant-women-october-2012-to-march-2014.

Impact of chlamydia screening on sexual behaviour of young adults in England

PHE has published *Components of chlamydia screening and the impact of screening on behaviour* [1,2] which presents the results of a National Chlamydia Screening Programme online survey, carried out in January 2014, that examined the impact of chlamydia screening on young adults' sexual health awareness and sexual risk behaviours. It updates data from an earlier survey carried out in 2012.

The survey report analyses the results and evaluates the wider impact of the chlamydia screening programme, over and above its diagnostic and treatment aims. It confirms that the programme provides an effective means of delivering sexual and reproductive health messages to young adults and results in self-reported behaviour change. Ninety percent of respondents said they had received sexual health information at the time of their last test and the majority said that testing had an impact on their knowledge (eg they would know how to avoid chlamydia in future), health seeking (eg they would be more likely to test again in future) and sexual risk behaviour (eg they would use condoms with new partners).

Free access to effective contraception and sexual health services are regarded as an essential component of national programmes for the improvement of young people's sexual health. Coinciding with the publication of the second NCSP web survey report, PHE has published updated guidance for those considering the development, provision or commissioning of free condom distribution schemes, which have proved a successful element of national strategy. Produced in collaboration with Brook, a leading provider of sexual health services and advice to young people, the updated guidance [2,3] incorporates what has been learned by practitioners since the guidance was first published in 2008.

References

1. NCSP. "Components of chlamydia screening and the impact of screening on behaviour: 2014 National Chlamydia Screening Programme web survey report".

2. "Chlamydia screening and condom schemes encourage safer sexual behaviour in young adults", PHE press release, 14 July.

3. *C-Card condom distribution schemes – why, what and how*, available at: www.brook.org.uk/c-card.

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Infection Reports

HCAI / bacteraemia

- ***Staphylococcus aureus*** **(MRSA and MSSA) bacteraemia,** ***Escherichia coli*** **(*E. coli*) bacteraemia and** ***Clostridium difficile*** **infection (CDI) mandatory reports 2013/14)**
- **Voluntary surveillance of bacteraemia caused by** ***Pseudomonas*** **spp.,** ***Stenotrophomonas maltophilia*** **and closely related species, England, Wales and Northern Ireland: 2013**

HCAI

Staphylococcus aureus (MRSA and MSSA) bacteraemia, *Escherichia coli* (*E. coli*) bacteraemia and *Clostridium difficile* infection (CDI) mandatory reports 2013/14

Meticillin-resistant (MRSA) and Meticillin-sensitive *Staphylococcus aureus* (MSSA) bacteraemia, *Escherichia coli* (*E. coli*) bacteraemia and *Clostridium difficile* infection data have been published (10 July, 2014) as part of the Department of Health's mandatory surveillance programme for healthcare-associated infection.

Newly published data include:

- Annual (April 2013 to March 2014) counts and rates of MRSA bacteraemia by acute Trust and Clinical Commissioning Group (CCG).
- Annual (April 2013 to March 2014) counts and rates of MSSA bacteraemia by acute Trust and Clinical Commissioning Group (CCG).
- Annual (April 2013 to March 2014) counts and rates of *Clostridium difficile* infection (CDI) by acute Trust and Clinical Commissioning Group (CCG).
- Annual (April 2013 to March 2014) counts of *Escherichia coli* (*E. coli*) bacteraemia by acute Trust and counts and rates by Clinical Commissioning Group (CCG).

Summary points on MRSA bacteraemia (patients of all ages) [1]

Counts and rates of MRSA bacteraemia continue to fall across the NHS.

Total Reports

A total of 862 cases of MRSA bacteraemia were reported by the English NHS acute Trusts between April 2013 and March 2014 (2013/14). This represents a reduction of 6.7% in the number of cases reported in 2012/13 when 924 cases were reported, and an overall reduction of 80.6% from the number of cases reported in 2007/08 (4,451 cases).

Trust assigned reports ‡

Since 1 April 2013, MRSA bacteraemia has been reported by the assignment outcome of the PIR process, this separates cases into two groups either Trust or CCG assigned. Prior to April 2013 MRSA cases were reported grouped by the Trust apportioning algorithms which groups cases by their time of onset in relation to inpatient admission. Of the 862 cases in 2013/14, 409 MRSA bacteraemias were assigned to an acute Trust (1.2 per 100,000 bed days) while the remaining 453 MRSA bacteraemias were assigned to a CCG, equivalent to 0.8 per 100,000 population.

Summary points on MSSA bacteraemia (patients of all ages) [2]

This is the third annual report to include MSSA bacteraemia.

Total Reports

A total of 9,290 cases of MSSA bacteraemia were reported across the NHS between April 2013 and March 2014 (FY 2013/14). This represents an increase of 5.4% on the number of cases reported in 2012/13 when 8,812 cases were reported and an increase of 6.0% on the number of

cases reported in 2011/12 (8,767 cases).The associated national rate also increased from 16.5 to 17.4 cases per 100,000 population over this time period.

Trust apportioned reports †

Of the 9,290 cases reported in FY 2013/14, 2,696 (29%) were trust apportioned cases. Unlike the number of total reports, this represents a slight reduction (2.7%) in the number of Trust apportioned cases between 2011/12 (n=2,854 cases) and 2013/14. Similarly, the rate of Trust apportioned MSSA bacteraemia has also decreased over time, from 8.2 per 100,000 bed days in 2011/12 to 7.9 per 100,000 bed days in FY 2013/14.

Summary points on Clostridium difficile *infection (patients aged two years and over)* [3]

Counts and rates of *Clostridium difficile* infection (CDI) continue to fall across the NHS.

Total Reports

A total of 13,361 cases of *C. difficile* infection were reported across the NHS between April 2013 and March 2014 (2013/14). This represents a reduction of 9.1% on the number of cases reported in 2012/13 when 14,694 cases were reported and a reduction of 75.9% in the number of cases reported in 2007/08 (55,498 cases). The associated national rate decreased from 108.0 to 25.0 cases per 100,000 population over this time period.

Trust apportioned reports †

There have also been sizable decreases in the number of Trust apportioned cases. Of the 13,361 cases reported in patients aged 2 years and over in FY 2013/14, 5,031 (38%) were Trust apportioned. This represents a 16% reduction on the 5,980 Trust apportioned CDI reports received in FY 2012/13 and a reduction of 85% on the 33,442 Trust apportioned cases reported in FY 2008/09. Between FY 2007/08 and FY 2013/14 the national Trust apportioned rate has decreased from 89.7 to 14.7 cases per 100,000 bed days.

Summary points on E. coli *bacteraemia (patients of all ages)* [4]

This is the second annual report to include *E. coli* bacteraemia. Mandatory surveillance was extended to include *E. coli* bacteraemia in June 2011 because of observed year-on-year increases in *E. coli* bacteraemia reports made to the voluntary surveillance system [5].

Total reports

A total of 34,275 cases of *E. coli* bacteraemia were reported across the NHS between April 2013 and March 2014 (2013/14). This represents an increase of 6.1% on the number of cases reported in 2012/13 when 32,309 cases were reported. The associated national rate also increased from 60.4 to 64.1 cases per 100,000 population over this time period.

Notes

This publication forms part of the range of Official Statistics outputs routinely produced by PHE. Further detailed epidemiological analyses of MRSA bacteraemia, MSSA bacteraemia, *E. coli* bacteraemia and CDI data can be found in both the quarterly epidemiological commentaries [6] and the annual epidemiological commentary, 2013/14 data [6]. The annual report for FY 2013/14 contains additional analyses to previous years, including counts and rates per financial

year by age, sex and region (NHS England Area Team). In addition, trends in time to onset and source of bacteraemias are also reported.

‡ **MRSA Trust assigned reports:** From 1 April 2013, all NHS organisations reporting positive cases of MRSA bacteraemia are required to complete a Post Infection Review (PIR). As a result, MRSA bacteraemia data is now published on the basis of relevant PIR assignment (acute Trust or CCG). This process was introduced to support the delivery of zero tolerance on MRSA bacteraemia, as set out by NHS England in the Planning Guidance *Everyone counts: Planning for Patients 2013/14*. A PIR is undertaken on all MRSA bacteraemias with the purpose of identifying how a case occurred, to identify actions which will prevent a reoccurrence and to identify the organisation best placed to ensure improvements are made, hence the assignment to either a CCG or acute Trust.

† **MSSA Trust apportioned reports**: includes patients who are (i) in-patients, day-patients, emergency assessment patients; AND (ii) have had a specimen taken at an acute Trust; AND (iii) specimen is **3 or more days** after date of admission (admission date is considered day '1').

† **CDI Trust apportioned reports:** include patients who are (i) in-patients, day-patients, emergency assessment patients; AND (ii) have had a specimen taken at an acute Trust; AND (iii) specimen is **4 or more days** after date of admission (admission date is considered day '1').

References

1. Financial year results from the mandatory surveillance of MRSA bacteraemia: July 2014 Legacy HPA website: *Staphylococcus aureus* >Epidemiological Data *Staphylococcus aureus* >Mandatory Surveillance of *Staphylococcus aureus* bacteraemia>Results from the mandatory surveillance of MRSA bacteraemia.

2. Financial year results from the mandatory surveillance of MSSA bacteraemia: July 2014. Legacy HPA website: *Staphylococcus aureus* >Epidemiological Data *Staphylococcus aureus* >Mandatory Surveillance of *Staphylococcus aureus* bacteraemia>Results from the mandatory surveillance of MSSA bacteraemia.

3. Financial year results from the mandatory surveillance of *Clostridium difficile* Infection: July 2014. Legacy HPA website: *Clostridium difficile* > Epidemiological Data *Clostridium difficile* > Mandatory Surveillance of *Clostridium difficile* > Results of the mandatory *Clostridium difficile* reporting scheme.

4. Financial year results from the mandatory surveillance of *Escherichia coli* bacteraemia: July 2014. Legacy HPA website: *Escherichia coli*> Mandatory Surveillance of *Escherichia coli* bacteraemia> Results of the mandatory surveillance of *Escherichia coli*.

5. Extension of mandatory surveillance to *E. coli* bloodstream infections, June 2011: https://www.gov.uk/government/publications/extension-of-mandatory-surveillance-to-e-coli-bloodstream-infections-june-2011.

6. Quarterly Epidemiological Commentaries on MRSA, MSSA and *Escherichia coli* bacteraemia and *Clostridium difficile* infection. Legacy HPA website: *Staphylococcus aureus* >Epidemiological Data *Staphylococcus aureus*> Mandatory Surveillance of *Staphylococcus aureus* bacteraemia >Quarterly Epidemiological Commentaries on MRSA, MSSA, *Escherichia coli* bacteraemia and *C. difficile* infection.

7. Annual Epidemiological Commentary: Mandatory MRSA, MSSA and *E. coli* bacteraemia and *C. difficile infection data, 2013/14*. July 2014. Legacy HPA website: *Staphylococcus aureus*> Epidemiological Data *Staphylococcus aureus*> Mandatory Surveillance of *Staphylococcus aureus* >Results from the mandatory surveillance of MRSA bacteraemia.

Bacteraemia

Voluntary surveillance of bacteraemia caused by *Pseudomonas* spp., *Stenotrophomonas maltophilia* and closely related species, England, Wales and Northern Ireland: 2013

These analyses are based on data extracted from the Public Health England (PHE) voluntary surveillance database, LabBase2, on the 11 April 2014 for the period 2009-2013. The data presented here differ in some instances from data in earlier publications due to the inclusion of late reports.

Rates were calculated using 2012 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 former Government Office Regions.

The report includes analyses on the trends, age and sex distribution, geographical distribution, and the antimicrobial susceptibility data in cases of bacteraemia caused by *Pseudomonas spp., Stenotrophomonas maltophilia* and closely related species.

Key points

- The overall rate of *Pseudomonas* spp. bacteraemia in England, Wales and Northern Ireland was 6.3 per 100,000 population in 2013; the rate of *Pseudomonas aeruginosa* was 5.2 per 100,000 population in 2013. The incidence rate for *Pseudomonas* spp. fell by 11% (7.0 to 6.3 per 100,000) (figure 1). England had the highest reported incidence rate of *Pseudomonas* spp. with 6.4 per 100,000 followed by Northern Ireland (5.0) and Wales (4.5).
- The rate of *S. maltophilia* was 0.8 per 100,000 in 2013. The rate for *S.maltophilia* fell by 16% (0.9 to 0.8 per 100,000) and the rate of other closely related species increased by 37% (0.17 to 0.24 per 100,000).
- Between 2009 and 2013 the total incidence rate of bacteraemia caused by *Pseudomonas* spp*., S. maltophilia* and closely related species fell by 10% from 8.1 to 7.3 per 100,000 population.
- The highest rates of *Pseudomonas* spp. were in children aged <1 year (8.9 per 100,000) and adults aged >64 years (15.4 per 100,000) for both males and females. The highest rate of *S. maltophilia* was 1.1 per 100,000 population for children aged <1 year and adults aged >45 years for both males and females.
- Minimal shifts in the susceptibility of *P. aeruginosa* isolates were observed, of which none were statistically significant; in 2013 the proportion of resistance reported was piperacillin/tazobactam (9%), imipenem (15%), meropenem (8%), ceftazidime (6%), ciprofloxacin (10%) and gentamicin (4%). The proportion of isolates tested for susceptibility to imipenem between 2009 and 2013 has decreased (6%; from 29% to 23%) compared to an increase (19%) in meropenem testing (from 45% to 64%).
- There has been a minimal, non-significant variation in the proportion of *S. maltophilia* that were resistant to co-trimoxazole between 2009 and 2013, from 7% to 6%.
- *Pseudomonas* spp. accounted for 3.5% of monomicrobial bacteraemias in 2013; *S. maltophilia* accounted for 0.4% of monomicrobial bacteraemia [4].

Trends in episode numbers and rates

The overall rate of *Pseudomonas* spp. bacteraemia in England, Wales and Northern Ireland was 6.3 per 100,000 population in 2013; the rate of *Pseudomonas aeruginosa* was 5.2 per 100,000 population in 2013. The incidence rate for *Pseudomonas* spp. fell by 11% (7.0 to 6.3 per 100,000) (figure 1). England had the highest reported incidence rate of *Pseudomonas* spp. with 6.4 per 100,000 followed by Northern Ireland (5.0) and Wales (4.5).

The rate of *S. maltophilia* was 0.8 per 100,000 in 2013. The rate for *S. maltophilia* fell by 16% (0.9 to 0.8 per 100,000) and the rate of other closely related species increased by 37% (0.17 to 0.24 per 100,000). These figures have not been corrected for known under-reporting to the voluntary LabBase2 surveillance system because there is no mandatory reporting of these organisms with which to compare the figures; however the comparison of mandatory and voluntary reporting of *Staphylococcus aureus* to PHE indicates that LabBase2 receives approximately 80% of all *S. aureus* bacteraemia reports.[3]

In 2013, 89% of *Pseudomonas* spp. isolates from blood were identified to species level (table 1). This is an increase since 2009 where 86% included species-level information.

Pseudomonas spp. accounted for 3.5% of monomicrobial bacteraemias in 2013; *S. maltophilia* accounted for 0.4% of monomicrobial bacteraemia.[4]

Of the related genera in 2013, bacteraemia caused by *Burkholderia* spp. (51 reports) and *Brevibacterium* spp. (41 reports) were most frequently reported; both had a slight increase compared with reports in 2012 (46 and 36 respectively).

Figure 1. *Pseudomonas* spp., *Stenotrophomonas maltophilia*, and other closely related species bacteraemia rates per 100,000 population (England, Wales and Northern Ireland): 2009-2013

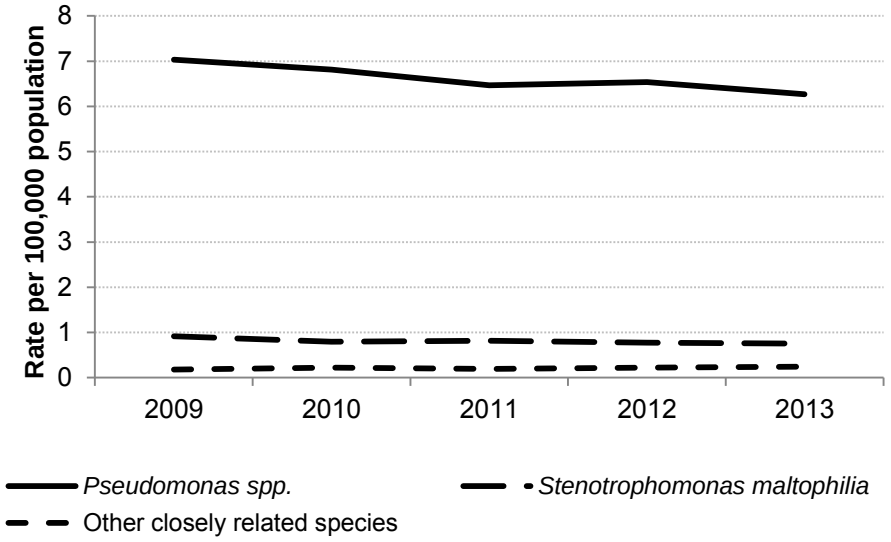


Table 1. Reports of bacteraemia caused by ***Pseudomonas* spp., *Stenotrophomonas maltophilia*, and other closely related species** (England, Wales and Northern Ireland): 2009 to 2013

	2009		2010		2011		2012		2013	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
***Pseudomonas* spp.**	3981	100%	3885	100%	3760	100%	3815	100%	3660	100%
Pseudomonas aeruginosa	3248	82%	3192	82%	3110	83%	3161	83%	3063	84%
Pseudomonas fluorescens	65	2%	64	2%	40	1%	61	2%	52	1%
Pseudomonas putida	56	1%	66	2%	69	2%	68	2%	54	1%
Pseudomonas stutzeri	73	2%	62	2%	81	2%	97	3%	82	2%
Pseudomonas spp., other named	134	3%	126	3%	139	4%	142	4%	149	4%
Pseudomonas spp., species not recorded	405	10%	375	10%	321	9%	286	7%	260	7%
Stenotrophomonas maltophilia	519	100%	453	100%	473	100%	453	100%	439	100%
***Brevibacterium* spp.**	15	100%	21	100%	19	100%	36	100%	41	100%
***Brevundimonas* spp.**	25	100%	28	100%	26	100%	27	100%	30	100%
***Burkholderia* spp.**	35	100%	45	100%	45	100%	46	100%	51	100%
***Comamonas* spp.**	9	100%	10	100%	15	100%	7	100%	6	100%
***Ralstonia* spp.**	8	100%	17	100%	2	100%	6	100%	8	100%
***Shewanella* spp.**	5	100%	2	100%	3	100%	2	100%	4	100%
***Sphingomonas* spp.**	4	100%	2	100%	1	100%	4	100%	3	100%

Age and sex distribution

Rates of *Pseudomonas* spp. bacteraemia reports were higher in males than females across all age groups; this was the same for both *P. aeruginosa* and *Pseudomonas* spp. The highest rates were in adults aged >64 years (15.3 per 100,000) for both male and female, closely followed by infections in children aged <1 year (8.9 per 100,000) and for both males and females (figure 2).

Rates of *S. maltophilia* bacteraemia reports were higher in males than females in children aged 1-14 years and adults aged >45 years. The highest rate was 1.1 per 100,000 population for children aged <1 year and adults aged >45 years although the confidence intervals are quite wide due to the smaller number of total reports (figure 3).

Figure 2. *Pseudomonas* spp. bacteraemia age and sex rates per 100,000 population (England, Wales and Northern Ireland): 2013

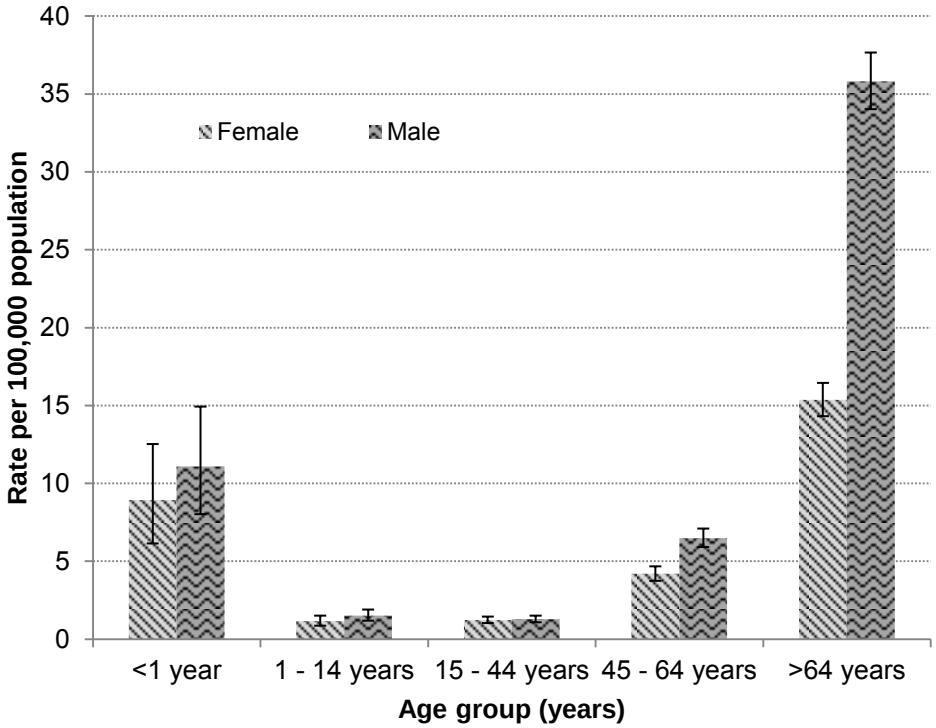
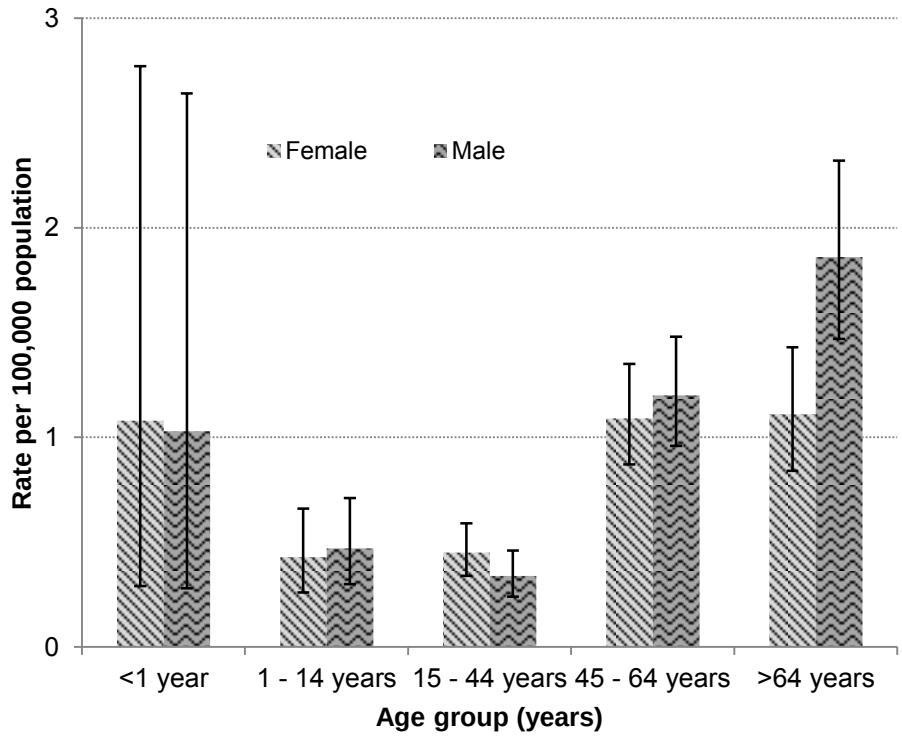


Figure 3. *Stenotrophomonas maltophilia* bacteraemia age and sex rates per 100,000 population (England, Wales and Northern Ireland): 2013



Geographic distribution

The overall rate of *Pseudomonas* spp. bacteraemia in England, Wales and Northern Ireland was 6.3 per 100,000 population in 2013. England had the highest reported incidence rate with 6.4 per 100,000 followed by Northern Ireland (5.0) and Wales (4.5). Since 2009 the rate of *Pseudomonas* spp. bacteraemia reports per 100,000 population has decreased in all countries, with the biggest reduction in England (table 2; figure 4). There was wide variation by PHE centre in 2013 from 4.5 per 100,000 in Greater Manchester to 8.0 per 100,000 in Kent, Surrey and Sussex (figure 4).

Figure 4. Geographic distribution of *Pseudomonas* spp. bacteraemia rates per 100,000 population by PHE centres in England, Wales and Northern Ireland: 2013

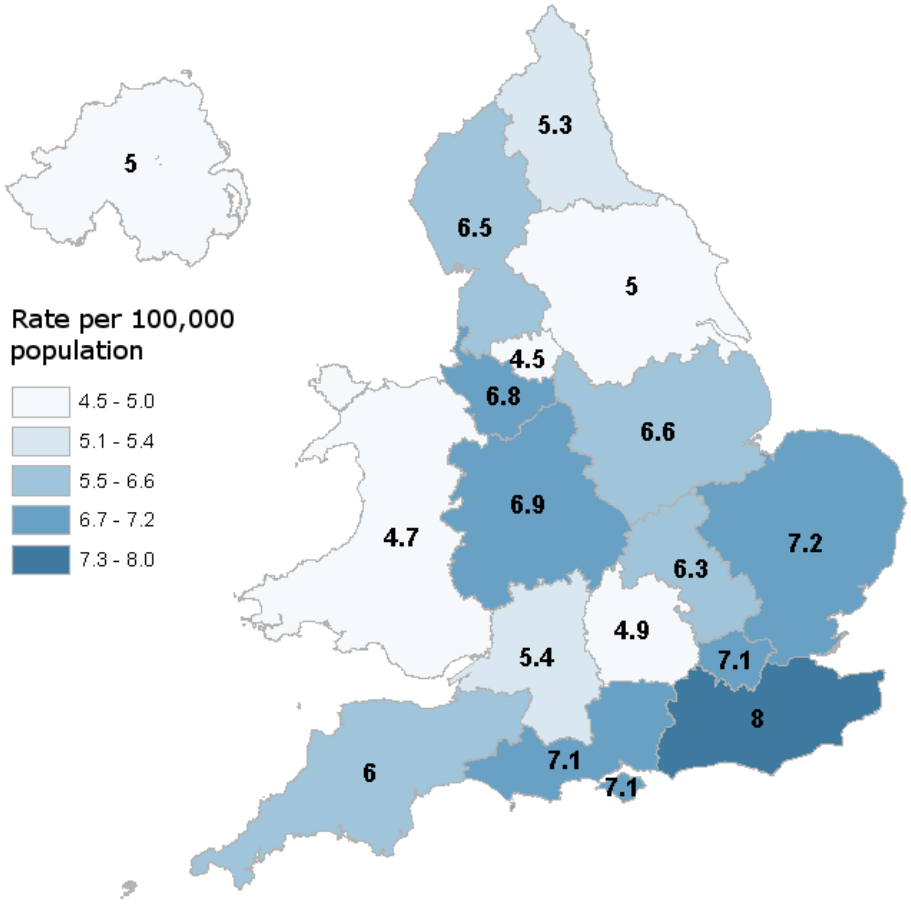


Table 2. Rate of *Pseudomonas* spp. bacteraemia reports per 100,000 population by region: 2009-2013

Region	Rates per 100,000 population				
	2009	2010	2011	2012	2013
East Midlands	7.0	5.9	6.4	6.4	5.1
East of England	6.8	6.8	5.9	6.9	7.5
London	9.6	8.9	8.6	8.7	8.3
North East	6.0	6.0	8.1	6.9	5.7
North West	5.6	6.1	5.8	6.2	5.7
South East	6.6	6.7	6.3	7.2	6.7
South West	5.7	6.7	5.8	5.4	5.2
West Midlands	7.6	7.1	6.7	6.6	6.8
Yorkshire and the Humber	7.8	6.6	5.5	5.2	5.0
England	**7.1**	**6.9**	**6.5**	**6.7**	**6.4**
Wales	**5.0**	**4.9**	**5.4**	**4.9**	**4.5**
Northern Ireland (NI)	**5.4**	**5.2**	**6.2**	**5.0**	**5.0**
England, Wales and NI	**7.0**	**6.8**	**6.5**	**6.5**	**6.3**

The overall rate of *S. maltophilia* bacteraemia in England, Wales and Northern Ireland was 0.8 per 100,000 population in 2013. N. Ireland had the highest reported incidence rate with 1.4 per 100,000 which was significantly different compared to England (0.8) and Wales (0.4). Since 2009 the rate of *S. maltophilia* bacteraemia reports per 100,000 population has decreased in all countries, except for N. Ireland where it has increased by 0.3 per 100,000 (figure 5; table 3). There was small variation by PHE centre in 2013 from 0.3 per 100,000 in the South-Midlands and Hertforshire to 1.6 per 100,000 in Greater Manchester.

Figure 5. Geographic distribution of *Stenotrophomonas maltophilia* bacteraemia rates per 100,000 population by PHE centres in England, Wales and Northern Ireland: 2013

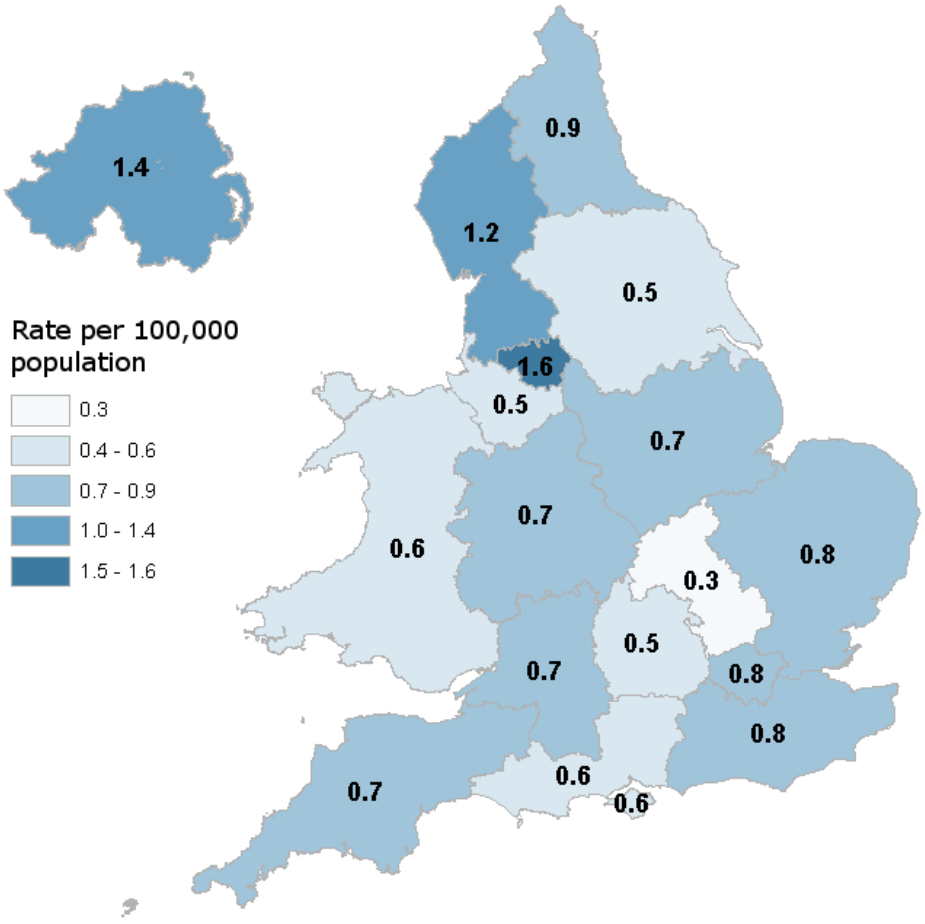


Table 3. Rate of *Stenotrophomonas maltophilia* bacteraemia reports per 100,000 population by region: 2009-2013

Region	Rates per 100,000 population				
	2009	2010	2011	2012	2013
East Midlands	0.6	0.6	0.5	0.4	0.6
East of England	0.8	0.6	0.7	0.8	0.6
London	1.5	0.9	1.3	1.0	1.1
North East	0.9	0.5	1.0	1.1	1.1
North West	1.1	1.1	1.0	0.9	1.1
South East	0.7	0.7	0.7	0.6	0.5
South West	0.9	1.0	0.8	0.6	0.5
West Midlands	0.8	0.7	0.9	1.1	0.7
Yorkshire and the Humber	0.7	0.8	0.6	0.6	0.5
England	**0.9**	**0.8**	**0.8**	**0.8**	**0.8**
Wales	**1.0**	**0.8**	**0.7**	**0.8**	**0.4**
Northern Ireland (NI)	**1.1**	**1.1**	**0.6**	**0.5**	**1.4**
England, Wales and NI	**0.9**	**0.8**	**0.8**	**0.8**	**0.8**

Antimicrobial susceptibility data

Tables 4 and 5 present antibiotic susceptibility data for *P. aeruginosa*, and for *S. maltophilia*, respectively.

The proportion of *P. aeruginosa* isolates with susceptibility test results reported increased for each of the listed antibiotics, especially for meropenem testing (19% increase; from 45% to 64%), with the exception of imipenem for which a 6% decrease in reports was noted, between 2009 and 2013. The proportion of *P. aeruginosa* bacteraemia reports accompanied by susceptibility data for either imipenem or meropenem was 23% and 64%, respectively in 2013.

Minimal shifts in the susceptibility of *P. aeruginosa* isolates were observed of which none were statistically significant; in 2013 the proportion of resistance reported was piperacillin/tazobactam (9%), imipenem (15%), meropenem (8%), ceftazidime (6%), ciprofloxacin (10%) and gentamicin (4%).

Most imipenem-resistant *P. aeruginosa*, have reduced permeability (specifically, via loss of OprD porin), whereas those with meropenem resistance often have a combination of reduced permeability and up-regulated efflux, particularly of the MexAB-OprM pump.

However, the PHE's Antimicrobial Resistance and Healthcare Associated Infections (AMRHAI) Reference Unit receives a steady influx of *P. aeruginosa* and, in smaller numbers, other *Pseudomonas* spp. in which resistance to carbapenems is mediated by carbapenem-hydrolyzing metallo-β-lactamases ('metallo-carbapenemases'; MBLs).

Unlike the mutations that cause porin loss or increased efflux, carbapenemase production involves acquired genes, which may be transferred between strains. From 2009-2013, AMRHAI confirmed 347 *Pseudomonas* isolates with a carbapenemase belonging to one of the 'big 5' families (from any source, not just blood culture); 41 in 2009, 76 in 2010, 37 in 2011, 76 in 2012 and 117 in 2013. These included 318 (89%) *P. aeruginosa* isolates. The big 5 families are KPC, IMP, VIM, NDM and OXA-48-like.

Most of the carbapenemase-producing *P. aeruginosa* had VIM-type MBLs (292 isolates, 92%), though a minority had IMP-types (21 isolates), three produced an NDM carbapenemase, and one had OXA-181 non-metallo-carbapenemase. One further *P. aeruginosa* isolate was confirmed to produce SPM-1 metallo-carbapenemase.

MBL-producing *P. aeruginosa* are a nationally scattered problem although several UK hospitals have had persistent strains causing infections over several years, rather than classic outbreaks. In at least two instances this is suggested to be associated with contamination of plumbing and wastewater systems.[5] The carbapenemase producers are from a variety of clinical settings though none of the isolates has been from cystic fibrosis (CF), where *P. aeruginosa* with complex mixtures of mutational resistances continue to dominate.

Many MBL-producing isolates are resistant to multiple antibiotic classes besides carbapenems, with only colistin remaining active against >90%.

Table 4. Antimicrobial susceptibility for *Pseudomonas aeruginosa* from bacteraemia (England, Wales and Northern Ireland): 2009 to 2013

	2009		2010		2011		2012		2013	
Number of isolates reported	3248		3192		3110		3161		3063	
	No. tested	**(% resistant)**	**No. tested**	**(% resistant)**	**No. tested**	**(% resistant)**	**No. tested**	**(% resistant)**	**No. tested**	**(% resistant)**
Piperacillin/ Tazobactam	2509	8%	2570	7%	2543	7%	2654	9%	2618	9%
Imipenem	1172	13%	1038	12%	926	14%	947	13%	850	15%
Meropenem	1785	11%	2017	9%	2209	9%	2310	9%	2324	8%
Ceftazidime	2461	8%	2530	8%	2525	8%	2595	6%	2488	6%
Ciprofloxacin	2709	11%	2696	10%	2702	11%	2728	9%	2658	10%
Gentamicin	2778	4%	2812	5%	2809	6%	2864	4%	2777	4%

It is difficult to determine the true susceptibility of *S. maltophilia* to aminoglycosides and polymyxins as temperature and medium can influence the results and cause resistant isolates to appear susceptible at 37ºC. However, the favoured treatment option for infections due to this species is co-trimoxazole, which provides more stable results for interpretation when tested [6].

The proportion of *S. maltophilia* isolates with susceptibility test results reported has increased by 23%, from 44% to 67%, for co-trimoxazole between 2009 and 2013. There has been a minimal, non-significant variation in the proportion of *S. maltophilia* that were resistant to co-trimoxazole between 2009 (7%) and 2013) 6%.

Table 5. Antimicrobial susceptibility for *Stenotrophomonas maltophilia* bacteraemia (England, Wales and Northern Ireland): 2009 to 2013

	2009		2010		2011		2012		2013	
Number of isolates reported	519		453		473		453		439	
	No. tested	**(% resistant)**	**No. tested**	**(% resistant)**	**No. tested**	**(% resistant)**	**No. tested**	**(% resistant)**	**No. tested**	**(% resistant)**
Co-trimoxazole	230	7%	248	5%	274	5%	285	4%	296	6%

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