



Infection report

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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

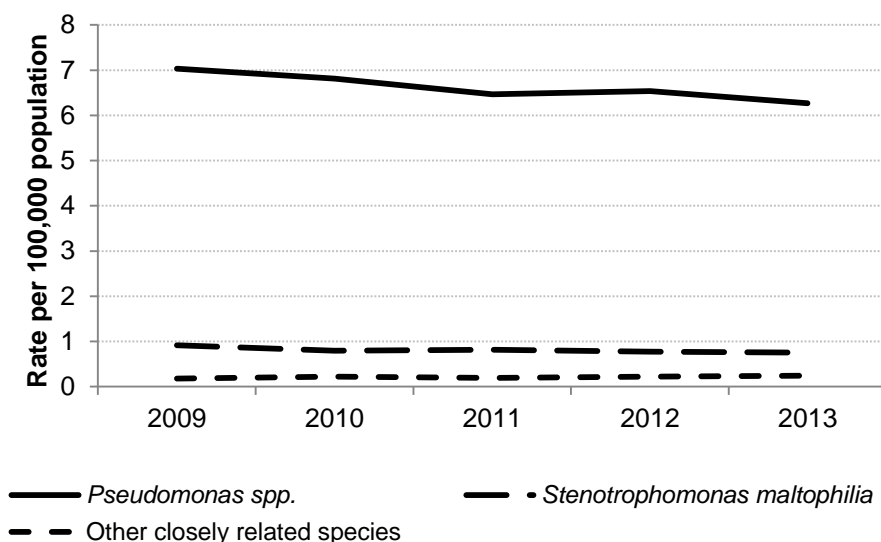


Table 1. Reports of bacteraemia caused by *Pseudomonas* spp., *Stenotrophomonas maltophilia*, and other closely related species (England, Wales and Northern Ireland): 2009 to 2013

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

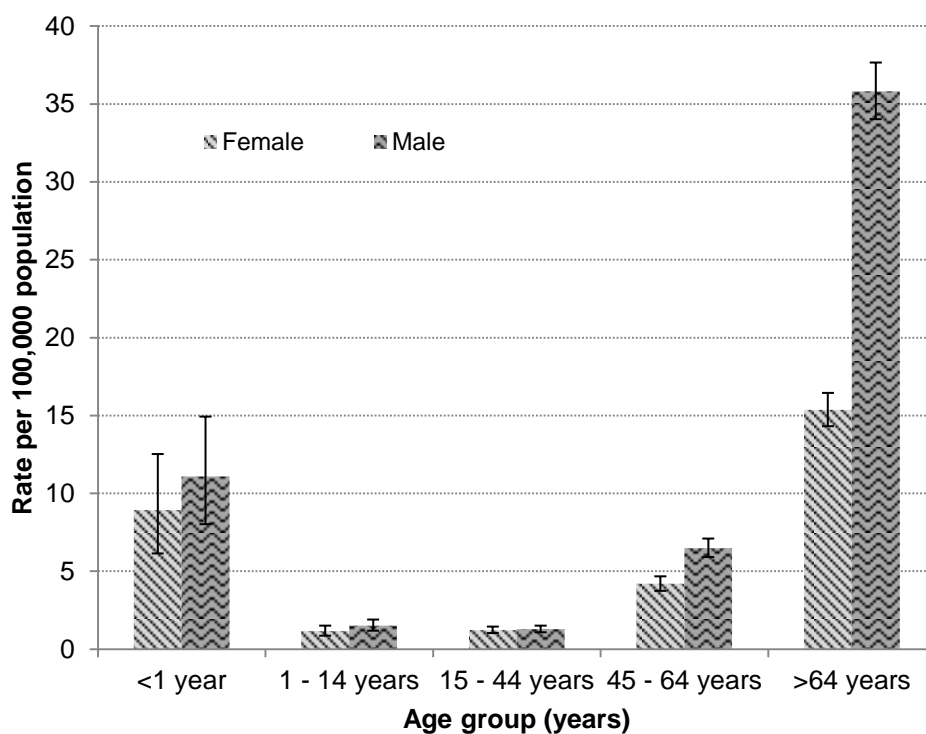
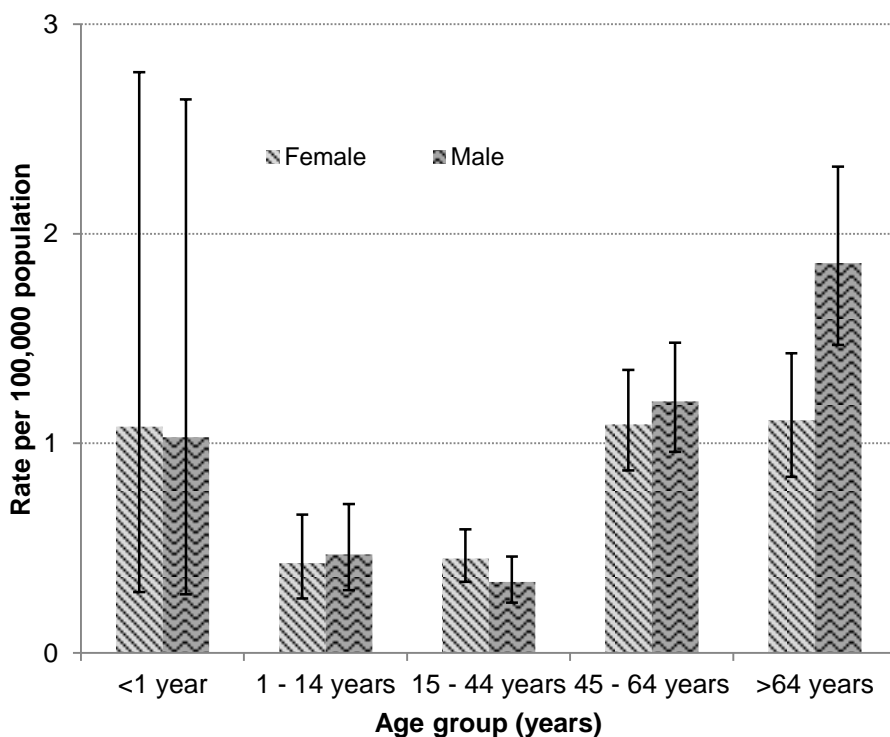


Figure 3. *Stenotrophomonas maltophilia* bacteraemia age and sex rates per 100,000 population (England, Wales and Northern Ireland): 2013



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

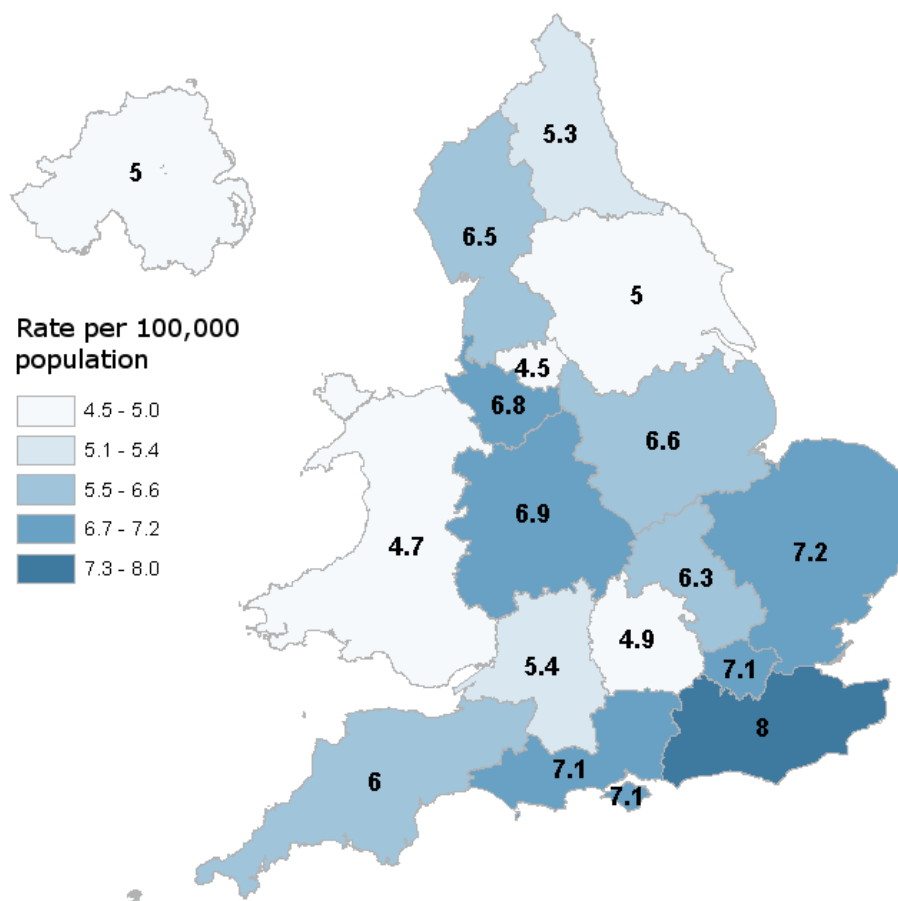


Table 2. Rate of *Pseudomonas* spp. bacteraemia reports per 100,000 population by region: 2009-2013

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 Hertfordshire 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

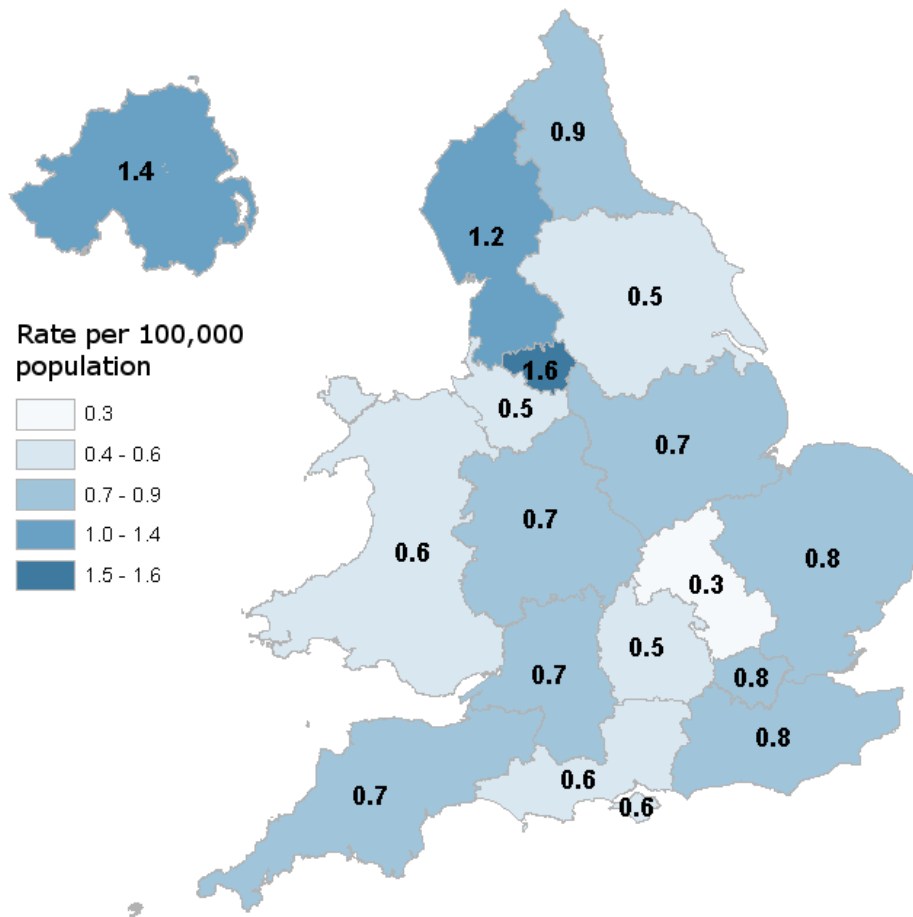


Table 3. Rate of *Stenotrophomonas maltophilia* bacteraemia reports per 100,000 population by region: 2009-2013

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 (AMR/HAI) 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, AMR/HAI 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* spp. from bacteraemia (England, Wales and Northern Ireland): 2009 to 2013

	2009		2010		2011		2012		2013	
Number of isolates reported	3981		3885		3760		3815		3660	
	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 37°C. 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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